Upper Mokelumne River Watershed Authority

EASTERN SAN JOAQUIN COUNTY GBA GROUNDWATER BASIN AUTHORITY

Mokelumne Watershed Interregional Sustainability Evaluation (MokeWISE) Program

FINAL REPORT

June 2015

Upper Mokelumne River Watershed Authority
Eastern San Joaquin Groundwater Basin Authority
RMC Water and Environment

RMC water and environment

TABLE OF CONTENTS

Table of Contents

FIGURES AND TABLES

List of Figures

List of Tables

Acronyms

ACCG	Amador Calaveras Consensus Group
AF	Acre-feet
AFY	Acre-feet per year
AWA	Amador Water Agency
BARDP	Bay Area Regional Desalination Project
BLM	Bureau of Land Management
BMPs	Best Management Practices
CCWD	Calaveras County Water District
CEQA	California Environmental Quality Act
cfs	Cubic feet per second
CHRC	California Hydropower Reform Coalition
CII	Commercial, industrial, and institutional
CPUD	Calaveras Public Utilities District
CUWCC	California Urban Water Conservation Council
CWAP	California Water Action Plan
CWP	California Water Plan
DACs	Disadvantaged communities
DFW	California Department of Fish and Wildlife
DWR	California Department of Water Resources
EBMUD	East Bay Municipal Utility District
EDF	Environmental Defense Fund
ERRK	Earth and rock

ESJ	Eastern San Joaquin
FERC	Federal Energy Regulatory Commission
GBA	North Eastern San Joaquin County Groundwater Basin Authority
GHG	Greenhouse gas
gpcd	Gallons per capita per day
gpd	Gallons per day
GWMP	Groundwater Management Plan
IPCC	International Panel on Climate Change
IRWM	Integrated Regional Water Management
JPA	Joint Powers Authority
JSA	Joint Settlement Agreement
JVID	Jackson Valley Irrigation District
LID	Low impact development
MAC	Mokelumne-Amador-Calaveras
MAF	Million acre-feet
MCG	Mokelumne Collaborative Group
MGD	Million gallons per day
MHI	Median household income
MHSD	Mokelumne Hill Sanitary District
MOCASIM	Mokelumne-Calaveras Simulation Model
MokeWISE	Mokelumne Watershed Interregional Sustainability Evaluation
MOU	Memorandum of Understanding
MRDUA	Mokelumne River Day Use Area

MRF	Mokelumne River Forum
NEPA	National Environmental Policy Act
NGOs	Non-governmental organizations
NMFS	National Marine Fisheries Services
NSJWCD	North San Joaquin Water Conservation District
PG&E	Pacific Gas and Electric
PIPE	Public Interest Profile Enhancement
RMS	Resource Management Strategies
SCWA	Sacramento County Water Agency
SEWD	Stockton East Water District
SJCFCWCD	San Joaquin County Flood Control and Water Conservation District
SWRCB	State Water Resources Control Board
TAF	Thousand acre-feet
UMRWA	Upper Mokelumne River Watershed Authority
UWMP	Urban Water Management Plant
WID	Woodbridge Irrigation District
WTP	Water treatment plant
WWTP	Wastewater treatment plant

Executive Summary

INTRODUCTION

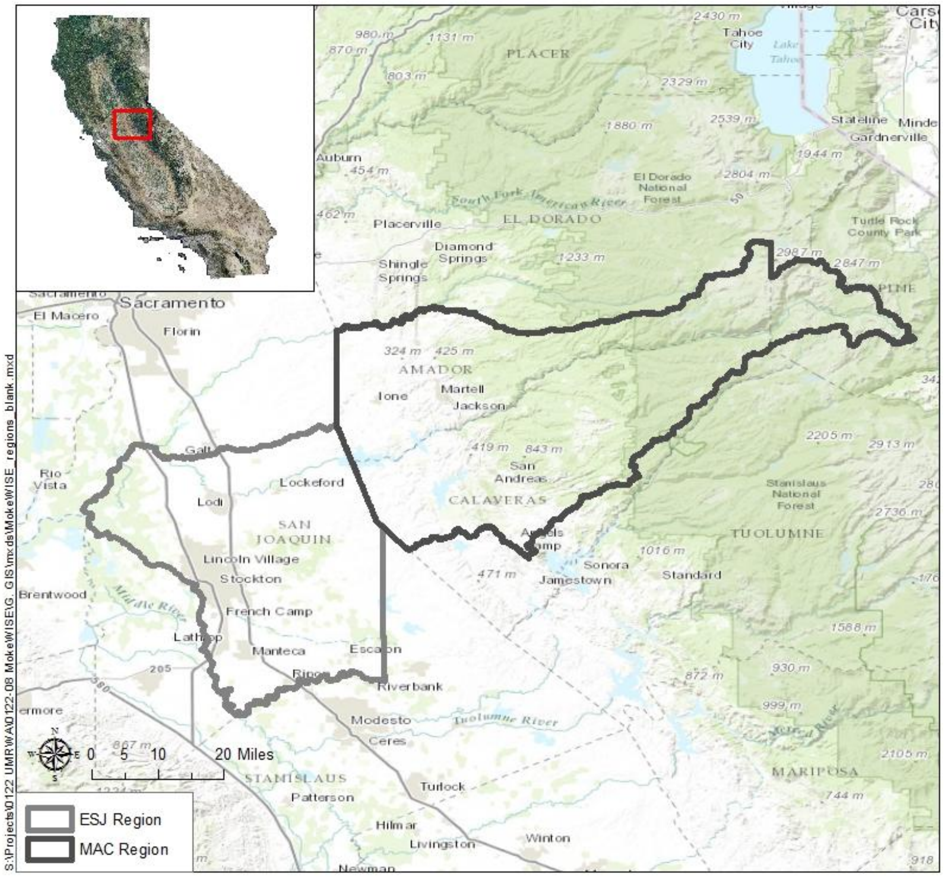
Through the State of California's Integrated Regional Water Management (IRWM) program, the Mokelumne-Amador-Calaveras (MAC) and Eastern San Joaquin (ESJ) IRWM Regions have joined together to create a joint water resources plan for the Mokelumne River watershed. The Mokelumne Watershed Interregional Sustainability Evaluation (MokeWISE) Program was created to develop and evaluate alternatives to optimize water resources management within the upper and lower watersheds of the greater Mokelumne River watershed. The MokeWISE Program offers a bi-regional approach to managing surface and groundwater resources in the watershed to benefit the needs of both regions while maximizing water resource opportunities.

As shown in **Figure ES-1**, the eastern border of the ESJ region is the western border of the MAC region. The two IRWM regions have remained separate because of the differing water supply issues, with the ESJ region predominately focused on groundwater and the MAC region on surface water. Although they are separate IRWM regions, some of the participants of the MAC and ESJ regions have been engaged in regular coordination and communication (through the Mokelumne River Forum and other groups) for many years regarding their common interests and issues, with the goal of evaluating interregional opportunities to enhance integrated water management efforts.

The purpose of the MokeWISE Program is to provide interregional water supply, water quality, and environmental benefits in Amador, Calaveras, and San Joaquin counties, and within the East Bay Municipal Utility District (EBMUD) service area. In developing the MokeWISE Program, the MAC and ESJ Regions have a comprehensive understanding of opportunities and alternatives for enhanced integrated water resource management, which will ultimately strengthen both IRWM Plans. Implementing the MokeWISE Program will demonstrate the success of bi-regional consensus with respect to managing surface water and groundwater resources in the watershed.

The following sections provide an overview of the MokeWISE program process, as well as the project list and implementation plan that evolved out of this effort.

Figure ES-1: MAC and ESJ IRWM Regional Boundaries



STAKEHOLDER AND PUBLIC INVOLVEMENT

The MokeWISE Program is guided by the MokeWISE Planning Committee, comprised of representatives from the grant recipient agencies, including the Upper Mokelumne River Watershed Authority (UMRWA) and the Groundwater Basin Authority (GBA), and technical and facilitation consultants. The MokeWISE Planning Committee conducted outreach and invited a group of water agencies, non-governmental organizations (NGOs), private entities, resource agencies, and local and state agencies with a direct and expressed interest in the Mokelumne River watershed to participate on the Mokelumne Collaborative Group (MCG). The MCG was responsible for guiding the development of the MokeWISE Program and initiating public outreach. Other stakeholder groups were classified into five tiers to target outreach efforts based on their anticipated level of interest and ability to engage in program development. These tiers included Tier 2 stakeholders, interested parties, general public, disadvantaged communities (DACs), and Native American Tribes. The strategy for obtaining input from stakeholder interests and the public is outlined in a Public and Disadvantaged Community Outreach Plan.

PROGRAM OUTCOMES AND MEASURES

The development of the MokeWISE Program was guided by established priorities identified by the MCG. The MokeWISE Program Objectives to be Achieved and Consequences to be Avoided ("Program Objectives") were developed from the MCG's initial collection of thoughts related to benefits and consequences, as well as potential ways of measuring these outcomes, in order to gauge the success of the MokeWISE Program. The Program Outcomes and Measures are summarized in **Table ES-1** and **Table ES-2** below.

TABLE ES-1: MOKEWISE PROGRAM OBJECTIVES TO BE ACHIEVED

CATEGORY	OBJECTIVE	SUMMARY
Water Supply	WS-1: Promote demand-side management strategies	The program should promote projects and policies that support demand-side management strategies including conservation, water use efficiency, peak period rationing and leak detection.
	WS-2: Increase supply reliability	The program should result in increased water supply reliability for water purveyors.
	WS-3: Increase amount of stored water	The program should result in an increase in the amount of water stored within the watershed and consider both ground and surface options.
	WS-4: Promote smart, responsible development	The program should promote projects and policies that ensure that the water needs of new development are met while limiting negative externalities and end use harm.
	WS-5: Reduce reliance on groundwater for irrigation	The program should result in a reduced reliance on groundwater for irrigation and explore surface water alternatives.
	WS-6: Promote a long-term groundwater balance	The program should promote projects and policies that seek to contribute to a positive long-term groundwater balance.
	WS-7: Maximize water resource availability for all beneficial uses	The program should promote projects and policies that allocate water to the full spectrum of beneficial uses based on full analysis of all potential sources of supply.
	WS-8: Decrease the need to import water	The program should seek to implement state legislative goals to improve self-sufficiency and reduce the need to import water
Water Demands	WD-9: Review and understand existing agency demand estimates	The MCG should review and come to a common understanding of water demand estimates described in existing planning documents

TABLE ES-1: MOKEWISE PROGRAM OBJECTIVES TO BE ACHIEVED		
CATEGORY	OBJECTIVE	SUMMARY
	WD-10: To identify water demand issues for timely consideration by the water agencies during their next Urban Water Management Plan (UWMP) update.	The program should identify issues and analyses for water agencies to consider as they prepare demand and population estimates.
Water Quality	WQ-11: Protect and improve surface and groundwater quality	The program should result in improved water quality within the watershed for both surface water and groundwater.
	WQ-12: Match delivered water quality to use	The program should try to avoid wasting high quality water on uses that do not need it.
	WQ-13: Use water purification technology as a tool to maximize beneficial uses	The program should seek to implement the state's legislative goals to use water purification technology as a tool to increase the beneficial uses of water.
Recreation	R-14: Increase access for water-based recreation	The program should result in increased access to the Mokelumne River from Highway 12 to the headwaters.
	R-15: Increase angling and other recreational opportunities	The program should result in increased spawning habitat, designating sections of the river for hatchery and wild species, and designating appropriate environmental flows.
	R-16: Increase angling and other recreational opportunities	The program should result in the stocking of hatchery-raised trout in designated areas on the Upper Mokelumne and designating and managing wild trout sections.
	R-17: Increase angling and other recreational opportunities	The program should result in the reintroduction of salmon in the Upper Mokelumne river.
	R-18: Increase angling and other recreational opportunities	The program should result in increased angling, harvesting, and other recreational opportunities.
Water Rights	WR-19: Resolve existing water rights conflicts in the watershed	The program should seek to resolve existing water rights protests and to achieve a common understanding of the application of relevant water rights law in the watershed.
Flood Management	F-20: Enhance flood protection and management	The program should result in multi-benefit projects which provide flood protection for residents and businesses within the watershed and enhance ecosystem function.

TABLE ES-1: MOKEWISE PROGRAM OBJECTIVES TO BE ACHIEVED

CATEGORY	OBJECTIVE	SUMMARY
Data	D-21: Use sound, agreed-upon data to evaluate program alternatives	The program should produce an agreed-upon hydrology dataset and Water Availability Analysis
	D-22: Use sound, agreed-upon data to evaluate program alternatives	Program components should be described with sufficient detail to allow for evaluation.
	D-23: Promote the contribution of sound scientific data to current body of knowledge	The program should generate and promote projects with monitoring and reporting requirements to increase water resources data
Other Human Values	O-24: Increase investment in forest management	The program should promote forest management that reduces the economic impact of wildfires and other natural disasters, particularly on water supply.
	O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on DACs	The program should seek to design projects and policies to improve socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on DACs.
	O-26: Achieve equity	The program should be designed to achieve equity across regions, cultures, incomes, and time.
Environment	E-27: Protect and enhance natural environment	The program should result in the protection and enhancement of the natural environment of the Mokelumne watershed.
	E-28: Protect and enhance natural environment	The program should include support for wild and scenic designation of the Mokelumne River down to the Pardee High Pool.
	E-29: Protect and restore fisheries	The program should protect, restore, and enhance fisheries in the Mokelumne River downstream of Woodbridge Dam.
Agricultural Benefits	A-30: Enhance or maintain the water supply for beneficial use of agricultural practices	The project should increase the current agricultural water supply

TABLE ES-1: MOKEWISE PROGRAM OBJECTIVES TO BE ACHIEVED

CATEGORY	OBJECTIVE	SUMMARY
Collaboration	C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	The program should foster long-term regional relationships which will promote continued collaboration on water management issues and reduce unnecessary litigation.
	C-32: Promote broadly-supported outcomes that benefit a wide range of interests	The program should promote projects and policies that support outcomes benefiting a wide range of interests within the watershed.
	C-33: Promote broadly-supported outcomes that benefit a wide range of interests	The program should promote the least controversial projects and policies.
	C-34: Promote broadly-supported outcomes that benefit a wide range of interests	The program should result in agreements that reduce conflict.
	C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	The program should facilitate a common understanding of the requirements contained in all existing licenses, permits, and agreements affecting the Mokelumne River and ensure that MCG proposals will not interfere with their implementation.
	C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	The program should adhere to all California Environmental Quality Act and the National Environmental Policy Act (CEQA/NEPA) regulations.

TABLE ES-2: MOKEWISE PROGRAM CONSEQUENCES TO BE AVOIDED

CATEGORY	CONSEQUENCE TO BE AVOIDED	SUMMARY
Data	CA-37: Avoid basing decisions on incomplete or inaccurate information	The program should avoid decision-making based on incomplete or inaccurate information.
Environment	CA-38: Avoid demand for new or larger on-stream dams	The program should avoid demand for new or larger on-stream dams.
	CA-39: Avoid harmful impacts to fisheries and other wildlife	The program should avoid harming fisheries and other aquatic and terrestrial wildlife.
	CA-40: Avoid conversion of agricultural lands to developed uses	The program should avoid urbanization of agricultural lands.
	CA-41: Avoid shifting environmental impacts from one area to another	The program should avoid shifting environmental impacts from one sensitive area to another.
	CA-42: No diminishment of the benefits of existing in-stream flow	The program should protect against any decrease in benefits to public trust resources of existing in-stream flows.
Collaboration	CA-43: Avoid closing the process to the public	The program should avoid closing the process to the public.
Other Human Values	CA-44: Avoid dependency on potentially unreliable supply	The program should support projects and policies that will prevent downstream users from becoming dependent on unreliable supplies
	CA-45: Minimize adverse socio-economic and public health and safety impacts	The program should promote projects and policies that limit or appropriately mitigate adverse socio-economic and public health and safety impacts.
	CA-46: Avoid end use harm	The program should seek to allocate water in ways that do the least end use harm.
	CA-47: Avoid violating procedural or substantive laws.	The program should commit to completing CEQA/NEPA analysis prior to the agencies adopting and implementing the program.
	CA-48: Avoid interregional inequity	The program should provide parity or equity among the regions.

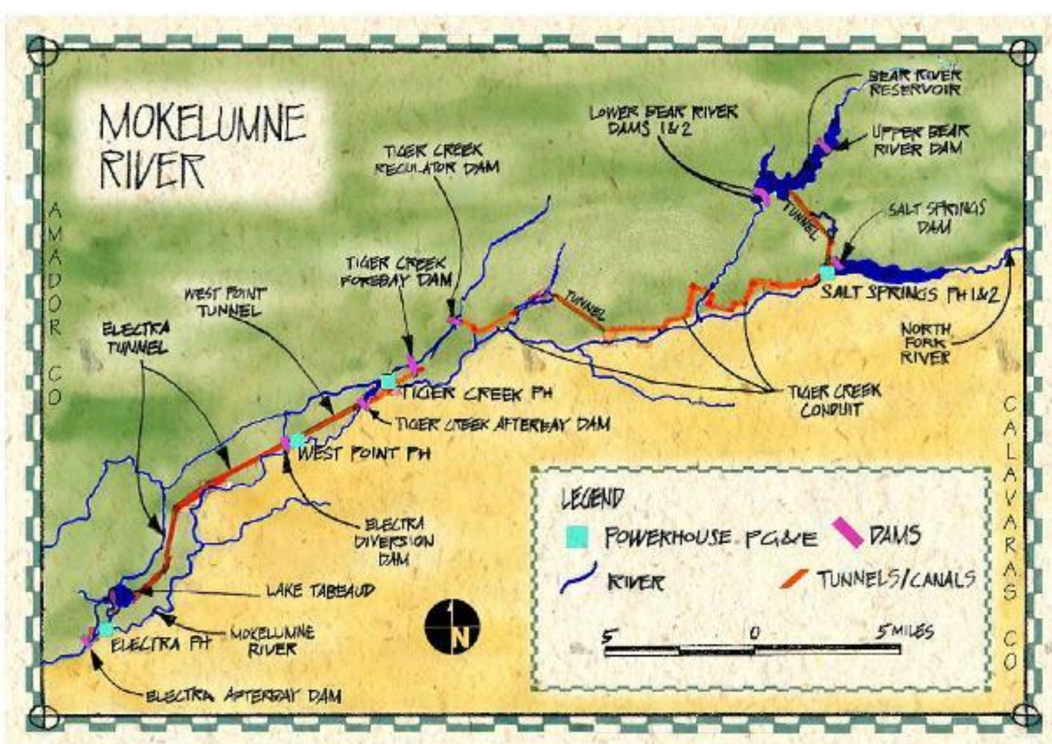
WATERSHED CONDITIONS

Three documents related to the Mokelumne River watershed, its current conditions, and water availability were developed to provide an understanding of baseline conditions through preparation of three documents: the Baseline Environmental Conditions report, the Water Availability Analysis, and the Climate Change Memorandum.

Baseline Environmental Conditions Report

The Baseline Environmental Conditions report provided the MCG with an initial background on watershed environmental conditions, including the geomorphic work and fisheries benefits provided by the watershed and the Mokelumne River. This analysis discusses the physical aspects of the watershed, along with the various facilities and projects that may affect natural flow. There are a number of PG&E hydropower facilities in the upper watershed, as shown below in **Figure ES-2**. Pardee and Camanche Dams, both owned and operated by East Bay Municipal Utility District (EBMUD), serve as the boundary between the upper and lower watersheds. The large dams and reservoir systems diminish flow and sediment between the upper and lower watershed and provide habitat for a number of native and introduced fish species. The Mokelumne River downstream of Camanche Dam supports a diverse assemblage of resident and migratory fish species including fall-run Chinook salmon and steelhead.

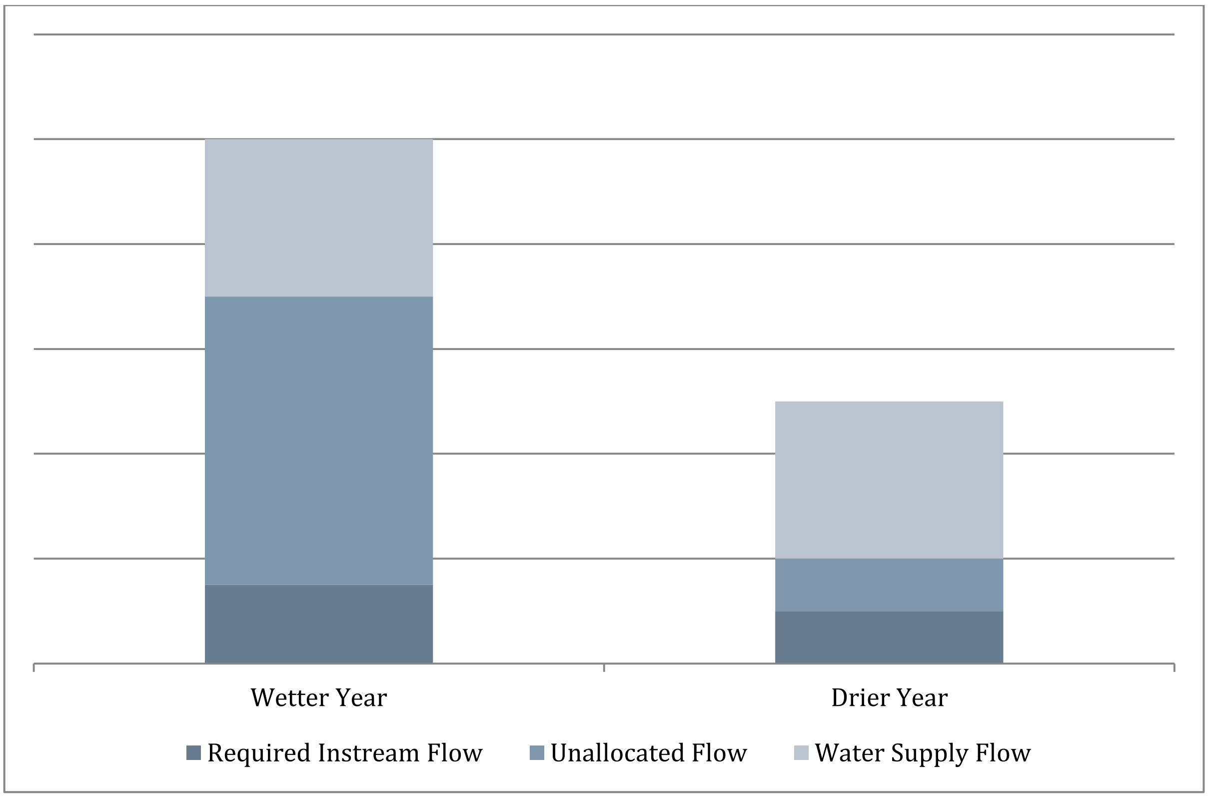
Figure ES-2: PG&E Projects on the Upper Mokelumne River



Water Availability Analysis

The Water Availability Analysis quantified potentially available supply from a variety of sources, including the Mokelumne River, other surface water, groundwater, recycled water, stormwater, agricultural drainage water, desalination, and conservation. This analysis was performed at a feasibility level as part of the MokeWISE Program and was not designed to serve as the basis for a water rights proceeding. **Figure ES-3** shows components of Mokelumne River flow in both wetter and drier years.

Figure ES-3: Mokelumne River Flow Components*



* This figure is provided as an example to show components of Mokelumne River flow and does not represent actual modeling results.

Climate Change Memorandum

The Climate Change Memorandum summarizes information developed by groups in the upper and lower watersheds related to climate change vulnerabilities and strategies for addressing these vulnerabilities. The Mokelumne River watershed was found to be most vulnerable to a combination of the three metrics that were studied: diversions for water supply, diversions for hydropower generation, and disruptions in ecosystems. This result indicates that the Mokelumne River watershed is less resilient to climate change than some of the other Sierra watersheds. As such, a review of climate change information developed by the MAC and ESJ IRWM Regions and related subsequent publications was conducted to determine how climate change may impact the upper and lower watersheds in the future.

PROGRAM DEVELOPMENT

The MCG guided the development of the projects that were ultimately included in the MokeWISE Implementation Plan. The MCG initially brainstormed, revised, and expanded project concepts. To begin developing project concepts, MCG entities identified potential projects and project ideas, referred to as "concepts," that could provide water management, environmental, or other benefits to the region and be included in the MokeWISE program. These concepts were placed on a master list, which were reviewed and refined by a subgroup of the MCG. From this master list, nine categories or project types were created including Ecosystem and Habitat Restoration, Recycled Water, Desalination, Groundwater Management, Water Conservation, Stormwater Management and Flood Control, Surface Water, Local Infrastructure, and Policies and Initiatives. The first eight categories were comprised of project concepts, while the Policies and Initiatives category included supportive policy statements and initiatives for implementation.

Each of the project concepts was further evaluated by undergoing three sequential assessments in order to determine whether or not the concept would be included in the MokeWISE Implementation Plan.

<u>Assessment 1: Preliminary Screening Assessment.</u> The first assessment, Preliminary Screening Assessment, consisted of four screening criteria to determine if the project concepts were feasible, beneficial, attainable, and compatible. This assessment addressed potential concept issues and ultimately removed any concepts which may have been fatally flawed. The concepts were modified such that all concepts, as revised, passed all four screening criteria and were carried forward for further analysis. The MCG-approved Project Assessment Memorandum provides more information about this preliminary screening assessment.

<u>Assessment 2: Fishery and Geomorphic Benefits and Impacts Assessment</u>. The second assessment was based on the potential fishery and geomorphic benefits and impacts the project concepts provided. Each concept was assessed on a scale from 1 to 5, with 1 indicating less potential benefit or greater potential impact and 5 indicating greater potential benefit or less potential impact. Since the Policies and Initiatives are not actual projects and would generally not have quantifiable environmental benefits and/or impacts, they did not undergo this assessment.

Assessment 3: MokeWISE Program Objectives Assessment. The information provided was then incorporated in the third assessment which assessed the project concepts against the objectives and consequences to be avoided. Each project concept was identified as fully addressing, partially addressing, or not addressing each of the MokeWISE program objectives and consequences to be avoided.

Following these three assessments, the MCG reviewed alternative ways of grouping projects for further development and evaluation. Each project concept was evaluated to resolve any conflicts for MCG members and determine whether it would potentially provide a high value to the region. For a number of projects, workgroups consisting of a subset of MCG members were formed to review edits and work through outstanding issues. A Policies and Initiatives Workgroup, a subgroup of the MCG, expanded the descriptions of policies and initiatives. Once the workgroup reached consensus on a policy and initiative, the revised descriptions were reviewed and approved by the full MCG.

The MCG identified a series of 21 projects for inclusion in the MokeWISE implementation plan, based on their potential value to the region and broad support among the MCG member agencies. Implementation of these projects will depend on a variety of factors, including available funding. In addition to identifying broadly-supported projects, the MCG identified a series of Policies and Initiatives with broad support which should be furthered as part of program implementation. The following list includes all projects included in the Implementation Plan; **Figure ES-4** and **Figure ES-5** graphically show these projects. Some of these projects are feasibility studies only and do not have implementation components; these projects are marked with an asterisks.

MokeWISE Projects Included in the Implementation Plan

- 1a: Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir
- 1b: High Country Meadow Restoration Program
- 1c: Mokelumne River Day Use Area Floodplain Habitat Restoration Project
- 1d: Fish Screens for Riparian Diversions in the Lower Mokelumne
- 1f: Riparian Restoration Program – Below Camanche
- 1g: Mokelumne Water Quality, Soil Erosion, & Sedimentation Inventory/Monitoring
- 2a: Municipal Recycled Wastewater Recharge Program
- 2b: Constellation Winery Wastewater Reuse
- 2c: Amador County Regional Reuse
- 4a: Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*
- 4b: Amador and Calaveras Counties Hydrologic Assessment*
- 4d: NSJWCD Infrastructure Improvements
- 5a: Regional Urban Water Conservation Program
- 5b: Regional Agriculture Conservation Program[1]
- 7a: PG&E Storage Recovery*
- 7b: Lower Bear Reservoir Feasibility Update and Preliminary Engineering*
- 7d: Re-operation of Existing Storage*
- 7f: Blue and Twin Lakes Dams Reliability and Replacement Assessment*
- 8b: Rehab of Transmission Main
- 8c: Barney Way Septic System Conversion
- 8d: Lake Camanche Village Recycled Water Project*

MokeWISE Policies and Initiatives Included in the Implementation Plan

- 9a: Land Use Coordination
- 9b: Sustainable Forest - Watershed Management Project
- 9c: Watershed Coordinator
- 9f: MokeWISE Project Public Involvement Initiative

* These projects are studies and do not have implementation components.

[1] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix N.**

Figure ES-4: Upper and Lower Watershed Projects Included in the MokeWISE Implementation Plan

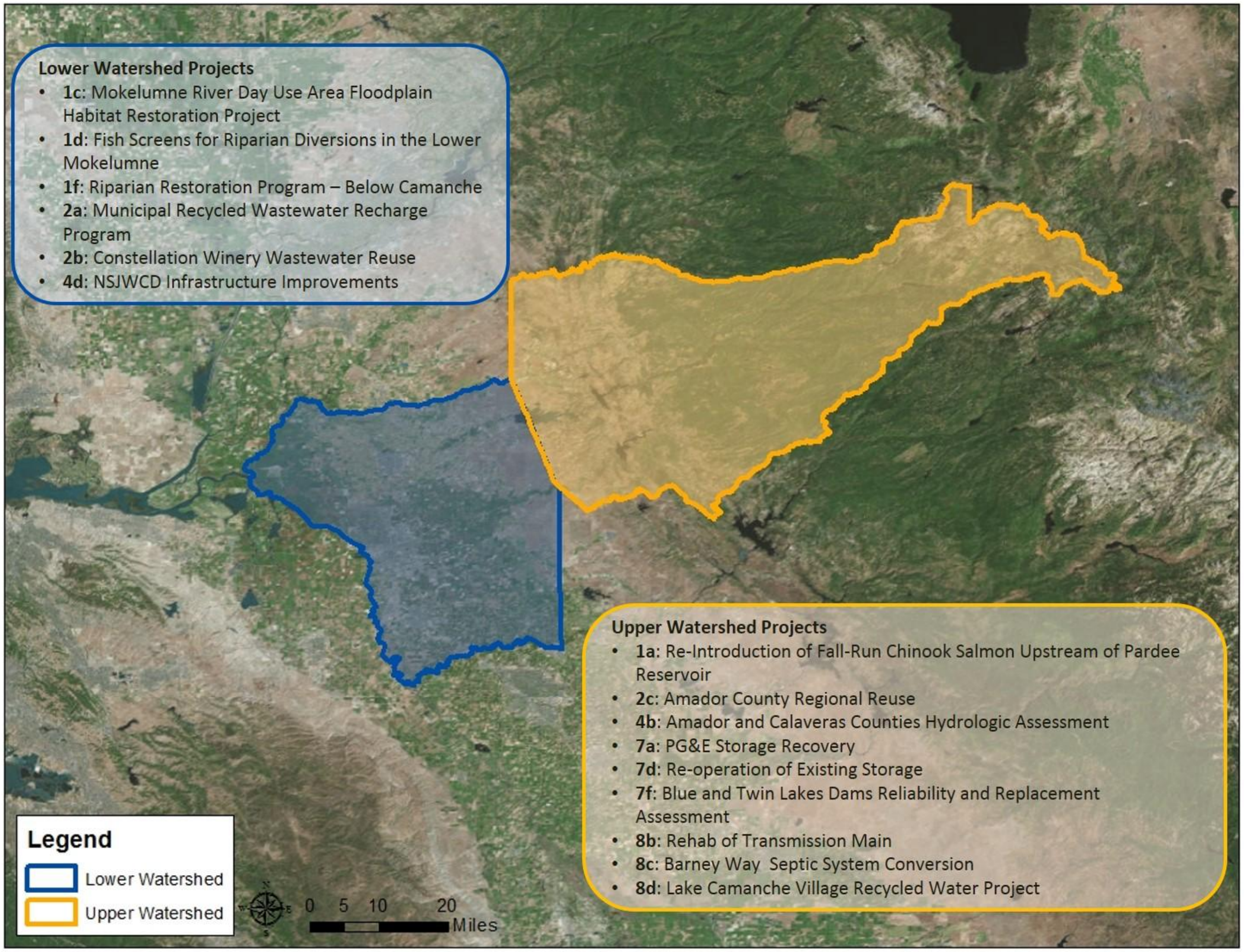
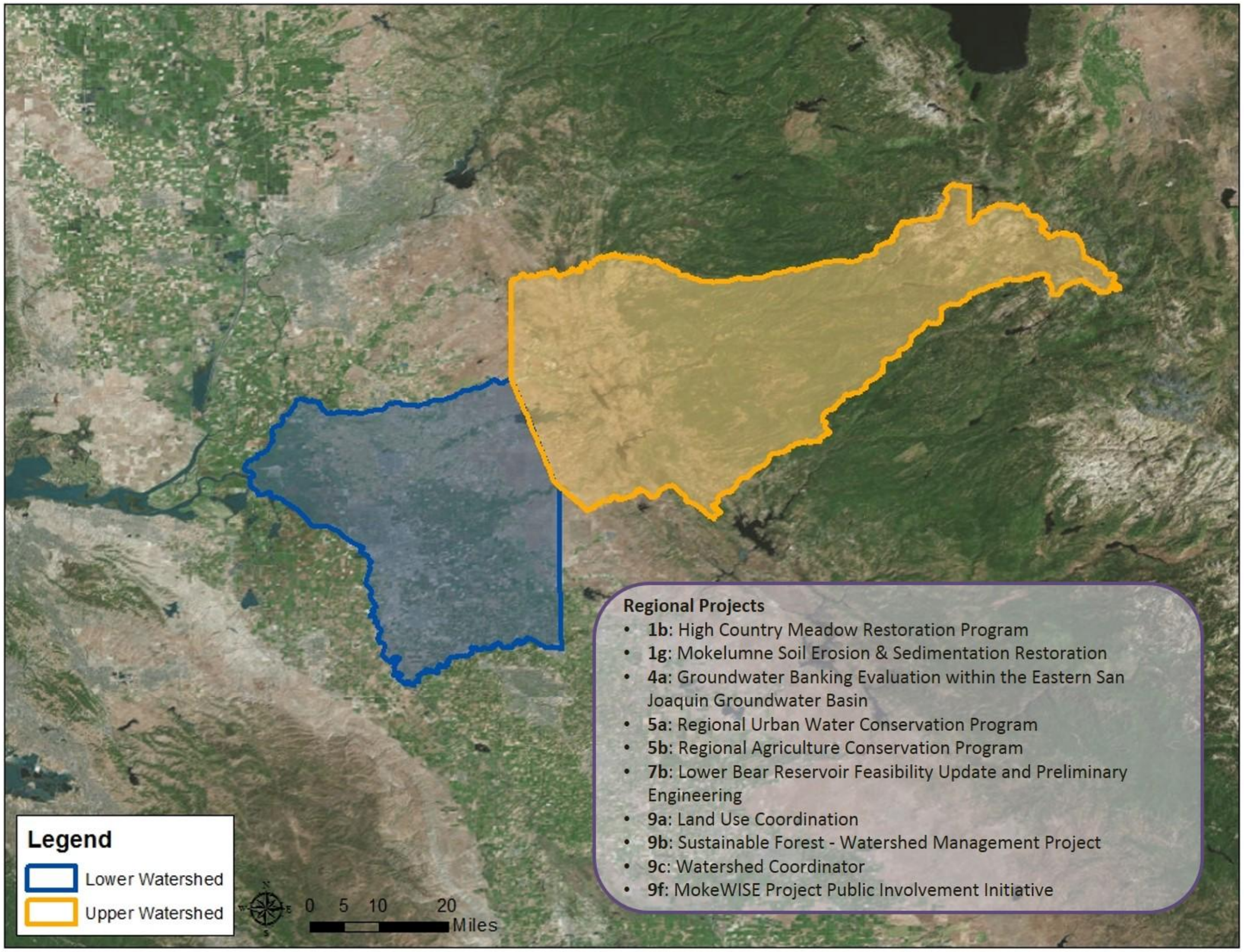


Figure ES-5: Regional Projects Included in the MokeWISE Implementation Plan



IMPLEMENTATION PLAN

As described above, the MCG implemented a multi-step process to identify and develop projects that have the potential to provide a significant range and magnitude of water resources benefits to the upper and lower watersheds. The pathway to implement the MokeWISE Program includes institutional arrangements, which must be identified to further program implementation, and project implementation approach and considerations.

Institutional capacities needed to ensure successful MokeWISE project implementation include:

1. Legal ability to apply for and accept state and other grant funding
2. Authority and administrative capacity to; enter into contracts, account for receipt and expenditure of funds, and implement water resource projects
3. Commitment to ensure continued opportunities for meaningful input from stakeholders and the public

The MCG agreed on an implementation structure to advance project implementation while providing for involvement by key stakeholders and interested parties, including two main tiers of responsibility. The Implementation Tier would be responsible for pursuing funding for and facilitating the implementation of projects and programs. The Stakeholder and Public Involvement Tier would be responsible for providing input and serving in an advisory capacity to the Implementation Tier.

Within the Implementation Tier, a Memorandum of Understanding (MOU) between the GBA and UMRWA would be created specifying them as the lead agencies for soliciting, securing, and administering funding for projects being implemented in each of their regions. If funding were secured by UMRWA or the GBA for a project, a separate contractual agreement would be developed between UMRWA or GBA and the project sponsor, as appropriate, to clearly articulate the funding agreement terms, conditions, and requirements.

The Stakeholder and Public Involvement Tier would be engaged at two levels of MokeWISE implementation, the regional level and the inter-regional level. At the region level, existing committees (the Regional Participants Committee in the MAC Region and the GBA Coordinating Committee in the ESJ Region) would advise the Implementation Tier on what projects to pursue funding for, changing needs for program implementation, within each region. At the inter-regional level, a MCG legacy stakeholder group, which will include current MCG members, potentially other members not currently involved in the process, and the public, will be co-hosted annually by the GBA and UMRWA.

The first step in implementing the institutional arrangement recommended by the MCG involves drafting an MOU outlining the roles and responsibilities of the individual parties.

In order to implement some or all of the implementation projects, several steps must be completed, including: securing funding, preliminary assessment and planning, environmental documentation, design, construction contracting, permitting, land acquisition, construction/project implementation, and post-construction monitoring and reporting to relevant entities as deemed appropriate. **Table ES-3** below indicates, for each of the projects, which of these steps have been and remain to be completed.

The first step for many of these projects will be to secure funding for project implementation. The Implementation Tier will work with the project sponsors and the Stakeholder and Public Involvement Tier to identify appropriate funding mechanisms and projects for funding pursuit. It is anticipated that a high degree of outside funding will be necessary to implement the MokeWISE program, since many areas within the MAC and ESJ Regions are severely disadvantaged as shown in the following figure.

Figure ES-6: Disadvantaged Communities in the MokeWISE Study Area

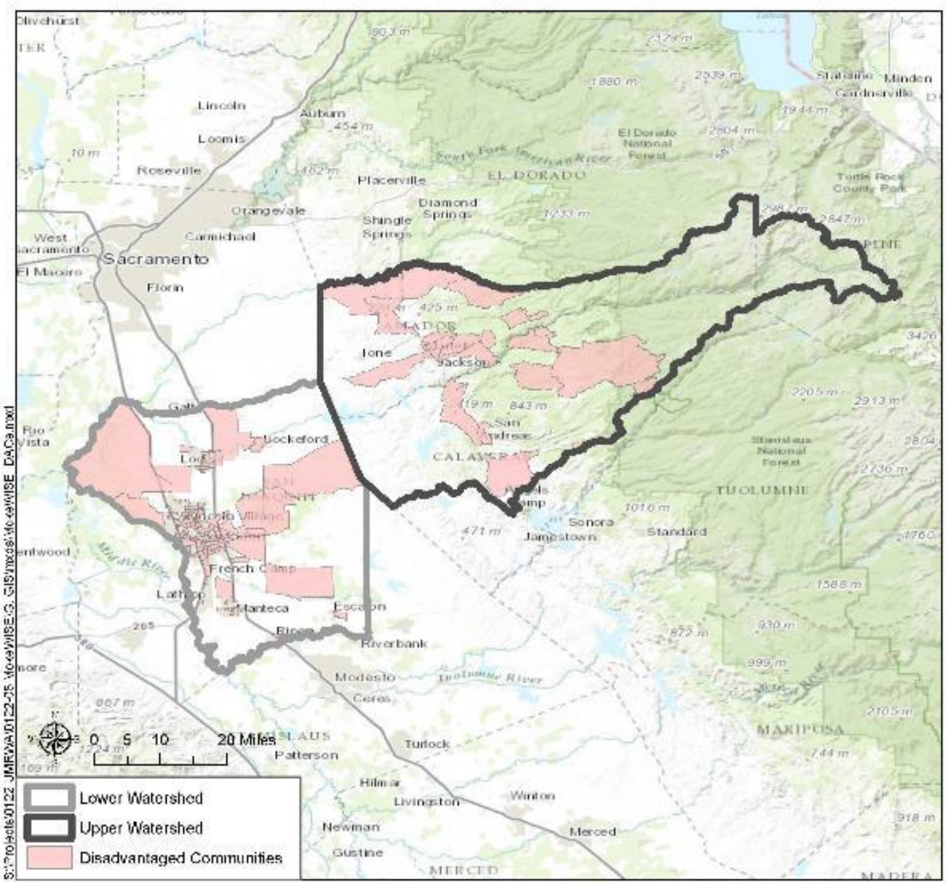


TABLE ES-3: STAGES REMAINING TO COMPLETE MOKEWISE PROJECT IMPLEMENTATION

	PROJECT STAGES COMPLETED							
MOKEWISE IMPLEMENTATION PROJECT	FUNDING	PLANNING	ENVIRONMENTAL DOCUMENTATION	DESIGN	PERMITTING	LAND ACQUISITION	CONSTRUCTION	POST-CONSTRUCTION MONITORING
1a Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir	○	◗	○	○	○	○	○	○
1b High Country Meadow Restoration Program	○	◗	○	○	○	○	○	○
1c Mokelumne River Day Use Area Floodplain Habitat Restoration Project	○	○	○	○	○	○	○	○
1d Fish Screens for Riparian Diversions in the Lower Mokelumne	○	◗	○	○	○	○	○	○
1f Riparian Restoration Program – Below Camanche	○	◗	○	○	○	○	○	○
1g Mokelumne Water Quality, Soil Erosion, & Sedimentation Inventory/Monitoring	○	○	○	○	○	○	○	○
2a Municipal Recycled Wastewater Recharge Program	○	●	○	○	○	○	○	○
2b Constellation Winery Wastewater Reuse	○		○	○	○	○	○	○
2c Amador County Regional Reuse	○	●	○	○	○	○	○	○
4a Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*	○	○	○	○	○	○	○	○
4b Amador and Calaveras Counties Hydrologic Assessment*	○	○	○	○	○	○	○	○
4d NSJWCD Infrastructure Improvements	○	●	●	○	○	○	○	○
5a Regional Urban Water Conservation Program	○	○	○	○	○	○	○	○
5b Regional Agriculture Conservation Program[2]	○	○	○	○	○	○	○	○
7a PG&E Storage Recovery*	○	○	○	○	○	○	○	○
7b Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering*	○	◗	○	○	○	○	○	○
7d Re-operation of Existing Storage*	○	○	○	○	○	○	○	○
7f Blue and Twin Lakes Dams Reliability and Replacement Assessment*	○	○	○	○	○	○	○	○
8b Rehab of Transmission Main	○	●	○	○	○	○	○	○
8c Barney Way Septic System Conversion	○	○	○	○	○	○	○	○
8d Lake Camanche Village Recycled Water Project*	○	○	○	○	○	○	○	○

○ = no/limited work completed
◗ = some degree of work completed
● = project stage completed

* These projects are studies and do not have implementation components.

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[2] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix N.**

It will be necessary for the Implementation Tier to stay informed of the various funding programs available and any specific requirements to receive funding. In particular, the passage of Proposition 1 will result in an influx in State funding to support much-needed water projects statewide. The categories within this funding cover the full range of project types represented in the MokeWISE Program, and the funds could potentially offset a significant portion of the cost to implement the recommended projects.

IRWM PLAN INTEGRATION

The MAC and ESJ IRWM Regions jointly developed this effort to functionally integrate this program into each respective regional effort. The Integration section provides a pathway for integrating MokeWISE into the respective regional plans.

NEXT STEPS

With MokeWISE Program development complete, MCG member entities will introduce the MokeWISE Implementation Plan to their respective Boards and draft a resolution and/or letter of support appropriate for their Board. The Board-approved resolutions will be included in the final MokeWISE plan. In order to ensure MokeWISE projects are implemented in the future, three major next steps are envisioned.

Step 1: Form Structure for Implementation

The initial step in MokeWISE program implementation involves the GBA and UMRWA working together to identify agencies, organizations, and other members of the public that are interested in participating in the Implementation Group. An MOU will be executed between UMRWA and the GBA that will provide guidance for the MokeWISE Program implementation by specifying project sponsors responsible for implementing their respective projects. Project sponsors may also sign the MOU, but this is not a prerequisite for receiving funding.

Step 2: Develop and Formalize Stakeholder Group

The second step involves assembling a stakeholder group (agencies, organizations, and members of the public) tasked with providing guidance during implementation of projects. After this group is assembled, process protocols will be developed to guide the Stakeholder and Public Involvement group.

Step 3: Identify and Secure Funding for Project Implementation

The third and final step includes identifying funding opportunities for each MokeWISE project, compiling funding applications, and securing and administering funding for project implementation. For each MokeWISE project, the Implementation Tier would identify those funding opportunities providing the greatest potential. When appropriate, the GBA and UMRWA, in coordination with project sponsors, the Implementation Tier, and the Stakeholder and Public Involvement Tier, would pursue these funding opportunities.

1 INTRODUCTION

Introduction

Each day, water resource managers are faced with the challenge of balancing competing needs for increasingly precious water supplies between drinking water, environmental needs, recreation, and other uses. Integrated water resource management techniques allow optimization of limited supplies by identifying multi-benefit solutions that incorporate the needs and concerns of a variety of stakeholders.

The Mokelumne Watershed Interregional Sustainability Evaluation (MokeWISE) Program emerged following years of dialogue among a diverse set of stakeholders in the Upper and Lower Mokelumne River watersheds. The Program is intended to develop and evaluate alternatives to optimize water resources management within the Mokelumne River watershed by developing a broadly-supported preferred water resources program that meets the needs of the upper and lower watersheds as well as the needs of regional stakeholders and interest groups.

PROJECT BACKGROUND

Nearly ten years ago, the State of California embarked on a new venture to implement integrated planning at the regional level, known as Integrated Regional Water Management (IRWM) planning. Over time, this program has evolved into a major water resources planning framework implemented statewide, and the California Water Plan cites IRWM as a new paradigm for water planning. Through the IRWM program, the State of California has encouraged collaboration among water supply and wastewater agencies, flood control and stormwater protection districts, resource and regulatory agencies, non-governmental organizations, local governments, and volunteer groups to enhance integration in water management planning – all at the regional level. Through this planning framework, the efforts of individual entities and communities are combined to leverage resources and meet multiple water resource management objectives.

MokeWISE was initiated by two adjacent IRWM Regions: the Mokelumne-Amador-Calaveras (MAC) and Eastern San Joaquin (ESJ) IRWM Regions. Together, these regions applied for and received a grant from the California Department of Water Resources (DWR) through Proposition 84 to develop a joint plan for water resources management in the Mokelumne River watershed.

The objectives of the MokeWISE Program were to develop and evaluate alternatives to optimize water resources management within the MAC and ESJ Regions and to develop a broadly-supported preferred water resources program that meets both regions' needs as well as the needs of regional stakeholders and interest groups.

SETTING AND PROJECT NEEDS

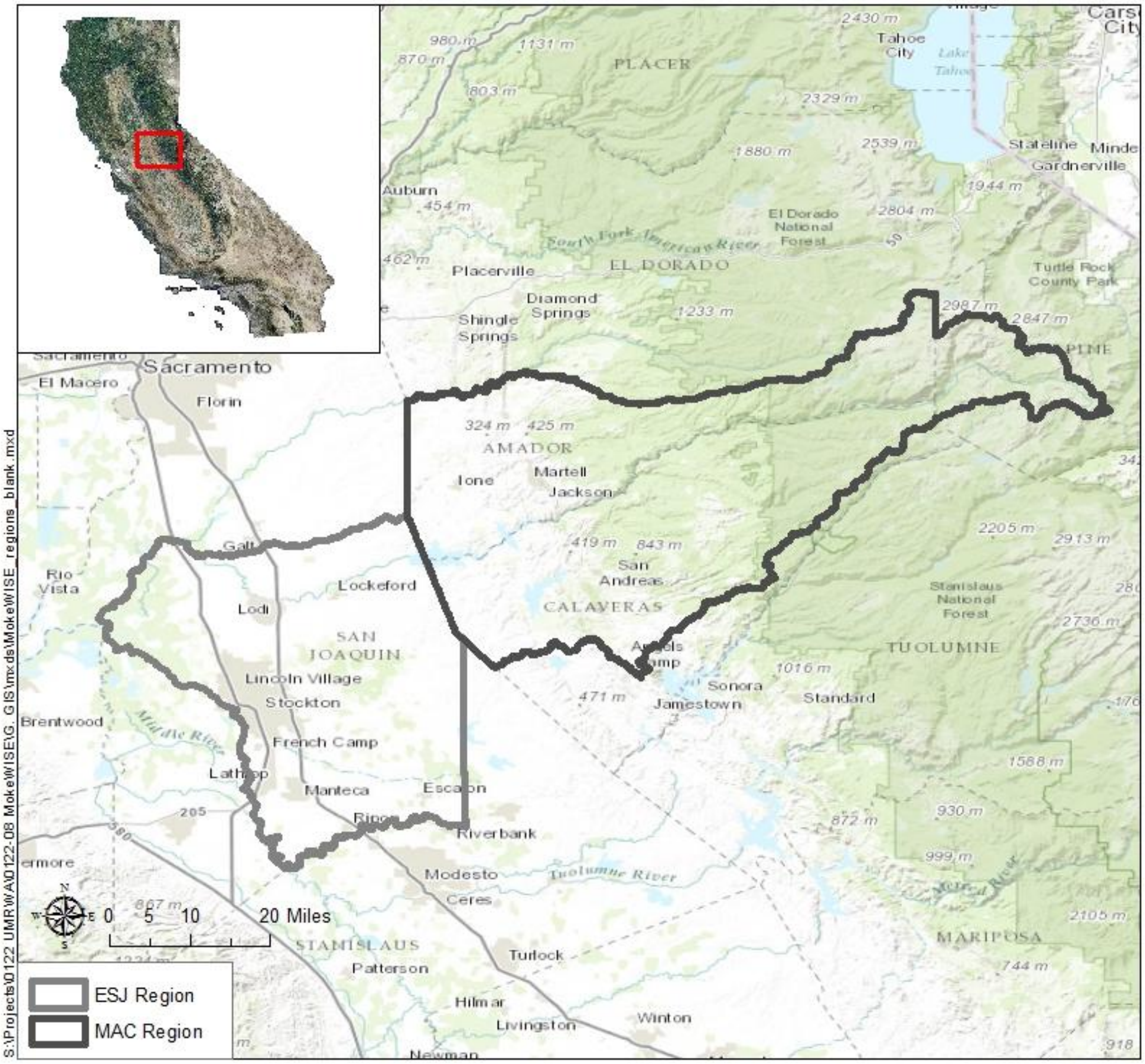
As shown in **Figure 1**, the eastern border of the ESJ region is the western border of the MAC region. The county line between Amador County and San Joaquin County and the county line between Calaveras County, Stanislaus County, and portions of San Joaquin County constitute the interface between the two regions. The two IRWM regions have remained separate because of the differing water supply issues, with the ESJ region predominately focused on groundwater and the MAC region on surface water. In addition, the significant number of agencies and non-governmental organizations interested in water resource issues in both the valley and the foothills and the large physical distance between the outlying areas of the two regions would impede effective stakeholder participation.

Although they are separate IRWM regions, some of the participants of the MAC and ESJ regions have been engaged in regular coordination and communication (through the Mokelumne River Forum and other groups) for many years regarding their common interests and issues, with the goal of evaluating interregional opportunities to enhance integrated water management efforts. Through the regular dialogue that has taken place over this time, the two regions have recognized a need for effective interregional coordination as the basis for evaluating potential opportunities and establishing multi-benefit interregional programs and projects. The two regions realize that working together, rather than independently, is the most promising approach to addressing critical water resource issues spanning the two adjoining regions. They also understand that broad and diverse stakeholder agreement is key to the success of any interregional project.

ESJ and MAC Interregional Conflicts and Synergies

While each of the respective IRWM Plans focuses on meeting needs within the individual region, the different water resource characteristics of the two regions pose a unique opportunity to meet a broader range of needs and provide greater benefits through interregional cooperation. Because the ESJ and MAC IRWM regions are adjacent and share common interests and issues, the two IRWM Plans include a joint chapter regarding interregional projects. The MokeWISE Program represents the culmination of years of collaboration and agreement by a diverse group of stakeholders in the Mokelumne River watershed. The MokeWISE Program provides a scientifically-based and broadly-supported comprehensive and sustainable interregional program with water supply, water quality, and environmental benefits throughout the Mokelumne River Watershed, including Amador, Calaveras, and San Joaquin Counties, and within the East Bay Municipal Utility District (EBMUD) service area.

Figure 1: MAC and ESJ IRWM Regional Boundaries



Mokelumne River Forum

The interregional sections of both the MAC and ESJ IRWM Plans identify the Mokelumne River Forum (MRF) as the appropriate venue for working with stakeholders to develop potential interregional projects that improve water resources management within the two adjacent planning regions. Before MokeWISE, the MRF had been the vehicle for both regions to coordinate beyond IRWM regional boundaries. The MRF provided an opportunity for ongoing coordination and exploration of potential interregional water resource project alternatives, specifically for agencies that rely on the Mokelumne River as a water supply. The MRF aimed to improve water reliability by:

- Developing regionally-supported projects
- Creating long-term, cooperating working relationships among Mokelumne water interests
- Maintaining and improving regional economic health
- Preventing environmental degradation that can affect water quality

The MRF was an open stakeholder process intended to resolve conflicts and improve water supply availability and reliability in the Mokelumne River basin. In April 2005, members of the MRF signed a Memorandum of Understanding (MOU) and agreed to work cooperatively to develop mutually beneficial solutions to meet water supply and related needs of the region that can be widely accepted. MOU signatories included:

- The State of California Department of Water Resources (DWR)
- Alpine County, Amador County
- Amador Water Agency
- Calaveras County Water District
- Calaveras Public Utilities District (CPUD)
- The City of Lodi
- The City of Stockton
- East Bay Municipal Utility District (EBMUD)
- Jackson Valley Irrigation District (JVID)
- North San Joaquin Water Conservation District
- San Joaquin County Flood Control and Water Conservation District (SJCFCWCD)
- Mokelumne River Water and Power Authority
- Stockton East Water District (SEWD)
- Central San Joaquin Water Conservation District
- Woodbridge Irrigation District
- The San Joaquin Farm Bureau Federation

The MRF was also open to other organizations and groups that were not MOU signatories but had a direct interest in the Forum's goals. Prior to the beginning of MokeWISE, a collaborative planning process had been underway in which MRF participants were coordinating various water resources planning efforts across regional boundaries with respect to river hydrology, facilities, infrastructure and institutional arrangements required for the interregional projects. The MRF was very effective in developing improved understanding and expanded purpose among the valley interests (within the ESJ region) and the foothill interests (within the MAC region). Indeed, the MRF was instrumental in brokering a more comprehensive approach to integrated management of the Mokelumne River to extend beyond the confines of a conjunctive use project.

This improved understanding is evidenced by an MOU between the two regions to move forward with this grant application for the Mokelumne WISE Program. Upper Mokelumne River Watershed Authority (UMRWA) and the North Eastern San Joaquin County Groundwater Basin Authority (GBA) entered into an MOU on October 10, 2011 agreeing to prepare and submit a joint Proposition 84 interregional planning grant application to seek funding for investigating interregional opportunities that further the water supply, water quality, and environmental stewardship objectives of each region.

WHERE DO WE GO FROM HERE?

Given the nature of water resources in the MAC and ESJ Regions – with the MAC region largely dependent on surface water and the ESJ region largely dependent on groundwater – evaluating water supply, water quality, and environmental stewardship opportunities within a single region limits each region's ability to optimize water resources for maximum benefit. Developing a program that uses a bi-regional approach helps to build on the strengths of both regions while maximizing water resource, flood management, and environmental stewardship opportunities.

The MokeWISE Program offers this bi-regional approach by bringing together stakeholders from both regions, including water agencies, non-governmental organizations, agricultural interests, and planning organizations. In developing the MokeWISE Program, the MAC and ESJ Regions will have a comprehensive understanding of opportunities and alternatives for enhanced integrated water resource management, which will ultimately strengthen both IRWM Plans. Implementing the MokeWISE Program will further provide a blueprint for achieving bi-regional consensus with respect to managing surface water and groundwater resources in the watershed.

2 STAKEHOLDER AND PUBLIC INVOLVEMENT

Stakeholder and Public Involvement

Stakeholder and public involvement was a foundational component in the MokeWISE program process and outcome. Stakeholder and community input and involvement in the MokeWISE process helped to bring water resource issues of concern to the broader public forward to be addressed by the MokeWISE program. There are two broad components of MokeWISE stakeholder and public involvement, including the Mokelumne Collaborative Group (MCG) and the general public. The MCG was responsible for guiding the development of the MokeWISE program and for initiating public outreach. The following sections highlight the development and role of the MCG, as well as the public outreach process implemented by the MCG.

MOKELUMNE COLLABORATIVE GROUP

During July and August 2013, the MokeWISE Planning Committee, comprised of representatives from the grant recipient agencies (UMRWA and the GBA) and the technical and facilitation consultants, met to identify potential organizations for inclusion in the stakeholder group tasked with guiding the MokeWISE program. Extensive phone outreach was performed to identify which agencies and entities had an interest in participating. Once these interested stakeholders were identified, one-on-one in-person and telephone interviews were conducted by members of the Planning Committee to review stakeholder group member commitment expectations, collect initial thoughts regarding stakeholder group process and organization, and answer any questions. Stakeholders were also asked to identify other potential organizations for outreach and inclusion in the effort. Once all interested organizations had been contacted and interviewed, an initial stakeholder meeting was scheduled.

The MCG is the stakeholder body that was established as a result of this outreach and provided the primary direction in formulating the MokeWISE program. Comprised of organizations with a direct and expressed interest in the Mokelumne River watershed and the MokeWISE program, the MCG provided direction for developing the MokeWISE program. MCG members committed to an intensive work schedule that included monthly group meetings and regular document review for a 22-month period. MCG members included water agencies; non-governmental organizations (NGOs); private entities; resource agencies; and local and state agencies. The MCG member agencies are listed below (refer to **Appendix A**).

- Amador County
- Amador Water Agency
- Calaveras County

- Calaveras County Water District
- Calaveras Planning Coalition
- Calaveras Public Utility District
- California Sportfishing Protection Alliance
- City of Lodi, Public Works
- City of Stockton, Municipal Utilities
- Delta Fly Fishers, Inc.
- East Bay Municipal Utility District
- Foothill Conservancy
- Jackson Valley Irrigation District
- MyValleySprings.com
- North San Joaquin Water Conservation District
- Pacific Gas and Electric
- Restore the Delta
- San Joaquin County
- San Joaquin County Resource Conservation District
- San Joaquin County, Public Works
- San Joaquin Farm Bureau
- Sierra Club California
- Sierra Nevada Conservancy
- Stockton East Water District
- Trout Unlimited (state level)
- Woodbridge Irrigation District

The overall outcome of the MokeWISE program required MCG members to work together in a respectful, collaborative environment, with the diversity of the MCG contributing to a more complete and inclusive program. To begin fostering relationships and developing common understandings, MCG members were asked to draft interest statements that were distributed to the entire MCG. This exercise helped individual MCG member entities clarify for other MCG members their overarching interest in and desired outcomes for the MokeWISE program.

With this initial understanding in place, the MCG established a structure and forum in which they could work together in a respectful, collaborative manner. One early task completed by the MCG involved developing procedures and guidelines by which the MCG would manage its organizational composition, participation, decision-making, documents, and the media. The MCG Charter and Protocols was developed to guide the

MCG process with the intention of developing a broadly-supported preferred water resources program that meets the needs of regional stakeholders and interest groups. The MCG Charter and Protocols can be found in **Appendix B**.

MCG Structure and Organization

MCG meetings began at 9AM on the second Friday of each month and were typically held at the San Joaquin Farm Bureau. Two meetings were held at EBMUD's Pardee Center in the upper watershed. Each meeting was open to the public with a designated public comment period. High level summaries of each meeting were prepared incorporating what was discussed, key factors considered during discussions, and the ultimate decision and rationale. Meeting summaries, once approved by the MCG, were posted onto the public portion of the MokeWISE website. Summaries from each of the MCG meetings can be found in **Appendix C**.

In an effort to foster collaboration and understanding between and among MCG member entities, members were invited to give presentations about their entities to the MCG. These presentations provided an opportunity to share information about each entity with the larger MCG. Presentations often included the history, mission, and current programs of individual member entities of the MCG. With approval from each participating entity, presentations were posted to the protected portion of the website for reference by the MCG.

The MCG decision-making and approval process was built on consensus with an "I/we can live with it" standard. Once a document was approved, it would be posted to the public portion of the website. The MCG approved Protocols Memorandum stated that if the MCG failed to reach consensus on a discrete issue, outstanding concerns or opinions were to be characterized and attached to the document in question. All documents prior to the Implementation Plan were approved without exception. The MCG agreed that when communicating with the media, members would only express their own concerns and interests and would refrain from characterizing the interests, intentions, or motivations of other stakeholders in the process.

All MCG-approved documents developed in support of the effort are included on the project webpage, which is accessible to the public.

PUBLIC OUTREACH AND INVOLVEMENT

To formalize a public outreach and involvement process, the MCG outlined a Public and Disadvantaged Community Outreach Plan. This Plan describes the strategy that was followed to obtain input from stakeholder interests and the public, referred to as stakeholder tiers. The MCG identified five tiers of stakeholders, each requiring varying levels of public outreach. The five tiers included: Tier 2 stakeholders, interested parties, the general public, disadvantaged communities (DACs), and Native American tribes. Through various outreach methods including public workshops, press releases, flyers, website postings, and email notifications, the stakeholder tiers were made aware of the MokeWISE program and progress. The Public and Disadvantaged Community Outreach Plan can be found in **Appendix D**. Additional information on each stakeholder tier and associated outreach efforts is provided in the following sections.

Stakeholder Tiers

Outreach was performed to target the following discrete "tiers" of stakeholders, based on their anticipated level of interest and ability to engage in program development.

- **Tier 2 stakeholders** included state and federal resource agencies, cities or other organizations that, due to budgetary and/or staffing restrictions, were unable to participate in the MCG. While Tier 2 stakeholders had no decision-making authority in the MCG, the MCG solicited feedback from these stakeholders at various program milestones. A Tier 2 stakeholder from the California Department of Fish and Game was part of the Modeling Workgroup and provided insight for that effort (see **Mokelumne River**).
- **Interested parties** included agencies, organizations and individuals that had registered their interest in the MokeWISE program but were neither members of the MCG nor Tier 2 stakeholders.
- **General public** included residents living in the upper and lower watershed and others with a potential and general interest in the MokeWISE program.
- **Disadvantaged communities** (DACs) were defined consistent with the definition established by the State of California as communities with an annual median household income (MHI) that is less than 80 percent of the statewide MHI. Based on current U.S. Census data, a community with an MHI of $48,706 or less is considered a DAC. DAC participation in the MokeWISE program was achieved at two levels: by MCG members and Tier 2 stakeholders who, in conjunction with their official agency duties, represented DAC communities while developing the various milestone MokeWISE program components; and by conducting some of the planned public workshops in DAC communities.
- **Native American** tribes in the region included the Ione and Jackson Rancheria Native American Bands. Direct outreach was performed to gage the interest of these entities in participating in the program. Given the requirements necessary for MCG participation, the Jackson Rancheria Band opted to participate as Tier 2 stakeholders; no response was received from the Ione Band.

Outreach Methods

Public workshops were held at strategic points throughout the MokeWISE program. These meetings were held to keep the general public, including DACs, informed of project status and provide a structured opportunity for the public to offer comments, questions, and concerns. All public meetings were held in communities classified as DACs.

The public outreach meetings were held as follows:

4. February 19, 2014; overview of MokeWISE program and purpose; held at Amador County Board of Supervisors Building in Jackson, CA. There were three members of the public present, in addition to a number of MCG member entities.
5. July 10, 2014; finalized program objectives, finalized baseline environmental conditions, and water availability approach; held at San Joaquin Farm Bureau in Stockton, CA. There were four members of the public in attendance, in addition to several MCG member entities.
6. January 8, 2015; program options and preliminary assessment of options; held at Calaveras County Water District Boardroom in San Andreas, CA. There were 12 members of the public present, in addition to a number of MCG member entities.
7. April 9, 2015; concept development; held at San Joaquin Farm Bureau in Stockton, CA. This meeting was tailored to resource agencies. Personal email invitations and phone calls where appropriate were made to all resource agencies on the Tier 2 stakeholder list. There were four members of the public in attendance, in addition to several MCG member entities. No representatives from resource agencies were present.
8. June 1, 2015; implementation plan and final report; held at San Joaquin Farm Bureau in Stockton, CA. There was one member of the public present, in addition to one MCG member.

Prior to each public outreach meeting, emails were sent to the Tier 2 and Interested Parties lists alerting each stakeholder of the time, date, and location of the public meeting. Additionally, press releases suitable for posting on agency and NGO websites were prepared in advance of each of the five public workshops; these releases were posted to the MokeWISE website and given to MCG members for posting. The press releases were also sent to major newspapers within the watershed, including the Lodi Sentinel, Stockton Record, Calaveras Enterprise, and Amador Dispatch. Flyers for each public outreach meeting were posted to the MokeWISE website and provided to MCG members to send to their constituents. At each of the public meetings, copies of the meeting agenda and PowerPoint slides were provided to attendees. Sign-in sheets were used to collect emails which were then added to the Interested Parties list.

In addition to public meetings, stakeholders were also invited to participate in MCG meetings. Every regularly scheduled MCG meeting was open to the public and included a specified public comment period. This period provided an opportunity for members of the public to speak directly to the MCG and offer comments, questions, suggestions, or other guidance.

The MokeWISE stakeholder involvement process also provided avenues for stakeholder comment on documents. After documents were approved by the MCG and posted on the MokeWISE website, the public and Tier 2 stakeholders were given the opportunity to respond with comments. Email notifications were sent to both Tier 2 and Interested Parties stakeholders when approved deliverables were posted to the website. Tier 2 stakeholders and Interested Parties were given two weeks to provide comments on milestone documents, including the Baseline Environmental Conditions Technical Memorandum and the Water Availability Analysis, which are both discussed in **Section 4**.

3 PROGRAM OUTCOMES AND MEASURES

Program Outcomes and Measures

The MCG established priorities for the MokeWISE program intended to guide development of the MokeWISE program and provide a structure for gauging its success. As discussed in **Section 2**, MCG members were asked to provide interest statements summarizing their general interest in the MokeWISE program. As part of this exercise, MCG members were also asked to include initial thoughts related to potential benefits to be achieved.

After this initial collection of thoughts related to benefits and consequences, members of the MCG were then asked to complete a table further summarizing their entities' desired benefits to be achieved and potential consequences to be avoided by the program, as well as potential ways of measuring these outcomes. The information provided through this exercise was compiled with the goal of identifying areas of common interest, which were used to develop joint program objectives and measures.

The compiled information was ultimately used to formulate the MokeWISE Program Objectives to be Achieved and Consequences to be Avoided ("Program Objectives"), which were modified, revised, and accepted by the MCG. The Program Objectives served as a guide to determine how well the MokeWISE program addressed the priorities and objectives of the MCG. The Program Outcomes and Measures Memorandum, which details the process and includes the interest statements provided by MCG members, can be found in **Appendix E**. **Table 1** presents the MCG approved MokeWISE Program Objectives to be Achieved and **Table 2** presents the MCG approved MokeWISE Program Consequences to be Avoided which together constitute the Program Objectives.

The Program Objectives served as a basis for assessing project concepts developed by the MCG. This is further discussed in **Section 5**.

TABLE 1: MOKEWISE PROGRAM OBJECTIVES TO BE ACHIEVED		
CATEGORY	OBJECTIVE	SUMMARY
Water Supply	WS-1: Promote demand-side management strategies	The program should promote projects and policies that support demand-side management strategies including conservation, water use efficiency, peak period rationing and leak detection.
	WS-2: Increase supply reliability	The program should result in increased water supply reliability for water purveyors.
	WS-3: Increase amount of stored water	The program should result in an increase in the amount of water stored within the watershed and consider both ground and surface options.
	WS-4: Promote smart, responsible development	The program should promote projects and policies that ensure that the water needs of new development are met while limiting negative externalities and end use harm.
	WS-5: Reduce reliance on groundwater for irrigation	The program should result in a reduced reliance on groundwater for irrigation and explore surface water alternatives.
	WS-6: Promote a long-term groundwater balance	The program should promote projects and policies that seek to contribute to a positive long-term groundwater balance.
	WS-7: Maximize water resource availability for all beneficial uses	The program should promote projects and policies that allocate water to the full spectrum of beneficial uses based on full analysis of all potential sources of supply.
	WS-8: Decrease the need to import water	The program should seek to implement state legislative goals to improve self-sufficiency and reduce the need to import water
Water Demands	WD-9: Review and understand existing agency demand estimates	The MCG should review and come to a common understanding of water demand estimates described in existing planning documents
	WD-10: To identify water demand issues for timely consideration by the water agencies during their next Urban Water Management Plan (UWMP) update.	The program should identify issues and analyses for water agencies to consider as they prepare demand and population estimates.
Water Quality	WQ-11: Protect and improve surface and groundwater quality	The program should result in improved water quality within the watershed for both surface water and groundwater.
	WQ-12: Match delivered water quality to use	The program should try to avoid wasting high quality water on uses that do not need it.

TABLE 1: MOKEWISE PROGRAM OBJECTIVES TO BE ACHIEVED		
CATEGORY	OBJECTIVE	SUMMARY
	WQ-13: Use water purification technology as a tool to maximize beneficial uses	The program should seek to implement the state's legislative goals to use water purification technology as a tool to increase the beneficial uses of water.
Recreation	R-14: Increase access for water-based recreation	The program should result in increased access to the Mokelumne River from Highway 12 to the headwaters.
	R-15: Increase angling and other recreational opportunities	The program should result in increased spawning habitat, designating sections of the river for hatchery and wild species, and designating appropriate environmental flows.
	R-16: Increase angling and other recreational opportunities	The program should result in the stocking of hatchery-raised trout in designated areas on the Upper Mokelumne and designating and managing wild trout sections.
	R-17: Increase angling and other recreational opportunities	The program should result in the reintroduction of salmon in the Upper Mokelumne river.
	R-18: Increase angling and other recreational opportunities	The program should result in increased angling, harvesting, and other recreational opportunities.
Water Rights	WR-19: Resolve existing water rights conflicts in the watershed	The program should seek to resolve existing water rights protests and to achieve a common understanding of the application of relevant water rights law in the watershed.
Flood Management	F-20: Enhance flood protection and management	The program should result in multi-benefit projects which provide flood protection for residents and businesses within the watershed and enhance ecosystem function.
Data	D-21: Use sound, agreed-upon data to evaluate program alternatives	The program should produce an agreed-upon hydrology dataset and Water Availability Analysis
	D-22: Use sound, agreed-upon data to evaluate program alternatives	Program components should be described with sufficient detail to allow for evaluation.
	D-23: Promote the contribution of sound scientific data to current body of knowledge	The program should generate and promote projects with monitoring and reporting requirements to increase water resources data

TABLE 1: MOKEWISE PROGRAM OBJECTIVES TO BE ACHIEVED

CATEGORY	OBJECTIVE	SUMMARY
Other Human Values	O-24: Increase investment in forest management	The program should promote forest management that reduces the economic impact of wildfires and other natural disasters, particularly on water supply.
	O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	The program should seek to design projects and policies to improve socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on DACs.
	O-26: Achieve equity	The program should be designed to achieve equity across regions, cultures, incomes, and time.
Environment	E-27: Protect and enhance natural environment	The program should result in the protection and enhancement of the natural environment of the Mokelumne watershed.
	E-28: Protect and enhance natural environment	The program should include support for wild and scenic designation of the Mokelumne River down to the Pardee High Pool.
	E-29: Protect and restore fisheries	The program should protect, restore, and enhance fisheries in the Mokelumne River downstream of Woodbridge Dam.
Agricultural Benefits	A-30: Enhance or maintain the water supply for beneficial use of agricultural practices	The project should increase the current agricultural water supply
Collaboration	C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	The program should foster long-term regional relationships which will promote continued collaboration on water management issues and reduce unnecessary litigation.
	C-32: Promote broadly-supported outcomes that benefit a wide range of interests	The program should promote projects and policies that support outcomes benefiting a wide range of interests within the watershed.
	C-33: Promote broadly-supported outcomes that benefit a wide range of interests	The program should promote the least controversial projects and policies.
	C-34: Promote broadly-supported outcomes that benefit a wide range of interests	The program should result in agreements that reduce conflict.

TABLE 1: MOKEWISE PROGRAM OBJECTIVES TO BE ACHIEVED		
CATEGORY	OBJECTIVE	SUMMARY
	C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	The program should facilitate a common understanding of the requirements contained in all existing licenses, permits, and agreements affecting the Mokelumne River and ensure that MCG proposals will not interfere with their implementation.
	C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	The program should adhere to all California Environmental Quality Act and the National Environmental Policy Act (CEQA/NEPA) regulations.

TABLE 2: MOKEWISE PROGRAM CONSEQUENCES TO BE AVOIDED

CATEGORY	CONSEQUENCE TO BE AVOIDED	SUMMARY
Data	CA-37: Avoid basing decisions on incomplete or inaccurate information	The program should avoid decision-making based on incomplete or inaccurate information.
Environment	CA-38: Avoid demand for new or larger on-stream dams	The program should avoid demand for new or larger on-stream dams.
	CA-39: Avoid harmful impacts to fisheries and other wildlife	The program should avoid harming fisheries and other aquatic and terrestrial wildlife.
	CA-40: Avoid conversion of agricultural lands to developed uses	The program should avoid urbanization of agricultural lands.
	CA-41: Avoid shifting environmental impacts from one area to another	The program should avoid shifting environmental impacts from one sensitive area to another.
	CA-42: No diminishment of the benefits of existing in-stream flow	The program should protect against any decrease in benefits to public trust resources of existing in-stream flows.
Collaboration	CA-43: Avoid closing the process to the public	The program should avoid closing the process to the public.
Other Human Values	CA-44: Avoid dependency on potentially unreliable supply	The program should support projects and policies that will prevent downstream users from becoming dependent on unreliable supplies
	CA-45: Minimize adverse socio-economic and public health and safety impacts	The program should promote projects and policies that limit or appropriately mitigate adverse socio-economic and public health and safety impacts.
	CA-46: Avoid end use harm	The program should seek to allocate water in ways that do the least end use harm.
	CA-47: Avoid violating procedural or substantive laws.	The program should commit to completing CEQA/NEPA analysis prior to the agencies adopting and implementing the program.
	CA-48: Avoid interregional inequity	The program should provide parity or equity among the regions.

4 WATERSHED CONDITIONS

Watershed Conditions

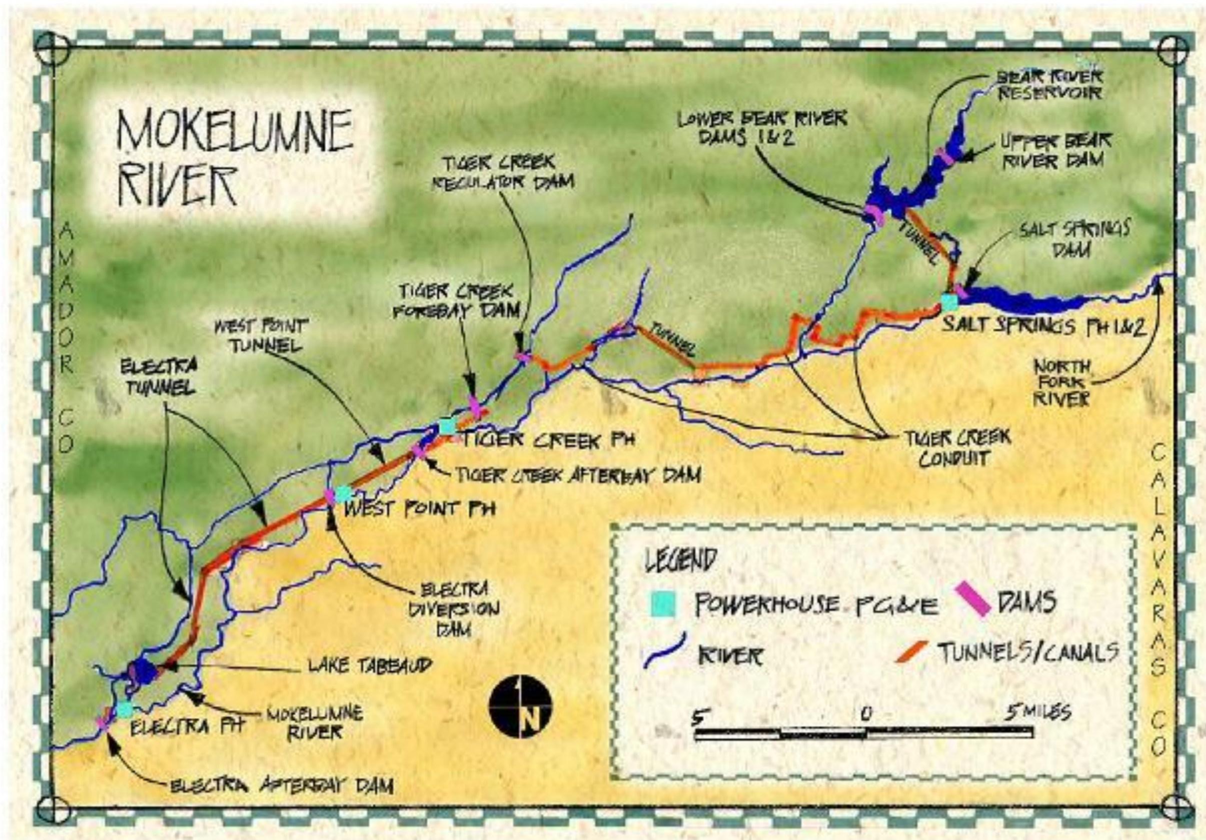
In an effort to establish a common understanding of baseline conditions in the Mokelumne River watershed, the MCG directed development of three documents related to the watershed, its current conditions, and water availability. The Environmental Conditions Overview Technical Memorandum highlights current watershed conditions, explores interactions between flow, sediment, geomorphology, and ecological water needs, and discusses geomorphic and fisheries related opportunities, challenges, and trade-offs. This technical memorandum, included as **Appendix F**, provided the MCG with an initial background on watershed environmental conditions, including the geomorphic work and fisheries benefits provided by the watershed and the Mokelumne River. The Water Availability Analysis, included as **Appendix G**, quantified potentially available supply from a variety of sources, including the Mokelumne River, other surface water, groundwater, recycled water, stormwater, agricultural drainage water, desalination, and conservation. The Climate Change Memorandum summarizes information developed by groups in the upper and lower watersheds related to climate change vulnerabilities and strategies for addressing these vulnerabilities. This memorandum is included as **Appendix H**. Each of these three documents, discussed in further detail below, was approved by the MCG to define baseline conditions as a starting point for identifying opportunities and constraints for water management project concepts in the watershed (see **Section 5** for more information about the project concepts).

BASELINE ENVIRONMENTAL CONDITIONS

The Mokelumne River drains about 627 square miles in the central Sierra Nevada. Mean precipitation in the watershed during 1981-2001 was 48 inches, with a range of 23-65 inches depending on geographic location (Null and others, 2010). In the Mediterranean-montane climate, most precipitation occurs October through May and generally falls as snow above about 3,000 to 5,000 feet in elevation, depending on temperature. As with all other Sierran watersheds, the flow regime of the Mokelumne River is highly dependent on annual snowpack.

The natural flow regime for the Mokelumne River has been highly altered by existing projects, including 13 impoundments that each hold greater than one thousand acre-feet (TAF) of water (Null and others, 2010) (see **Figure 2**). The facilities that support this degree of water management have dramatically altered natural flows. On the other hand, the flow schedule for Pacific Gas and Electric (PG&E) facilities was designed to mimic the natural hydrograph both in seasonal magnitude and in ramping rates, and to provide hydropower and water to around 1.5 million California residents. Other significant alterations to the natural environment include gold mining, gravel extraction, logging, channelization, and conversion of floodplains and riparian corridors to agricultural fields via shallow floodplain lake infill, channel cutoff, and levee building (Kattelmann, 1996).

Figure 2: PG&E Projects on the Upper Mokelumne River



Source: EDF and CHRC, 2000. Modified.

Pardee and Camanche Dams, both owned and operated by EBMUD serve as the boundary between the upper and lower watersheds. The storage volume, landscape position, and dam operations at Pardee and Camanche Dams are highly disruptive to the geomorphic continuity of the Mokelumne River watershed. Functions that are disrupted include flow magnitude, frequency, duration, timing and rate of change, which as a group are defined as flow attenuation features that can alter ecological and geomorphic processes (Poff and others, 1997).

Pardee Dam was completed in 1929. EBMUD has the right to divert 325 million gallons of water per day (mgd) from this facility to Alameda and Contra Costa Counties (EBMUD, 2013). Camanche Dam was completed in 1964 to provide flood control and to help meet downstream water demands. A large proportion of the available water is stored and later released to the Mokelumne River, while larger organic materials (biological sediments) and inorganic sediments are mostly captured within the reservoirs. This watershed-scale discontinuity prevents the natural flow regime from maintaining the geomorphic and ecological integrity of the watershed.

Although the Mokelumne River and its waters provide for consumptive water use, more water is often desired than is available from surface water alone. Agriculture and other developments have come to depend on groundwater as a reliable supplemental water source. Prior to development, groundwater generally infiltrated into the subsurface and moved from uplands areas to lowland areas further downstream. Below Camanche Dam, the Mokelumne River tends to be a losing stream (i.e., one in which surface water infiltrates into the groundwater system through the channel bed rather than groundwater filtering up into the wetted channel).

On the Mokelumne River, all of the dams and reservoirs in the upper and lower watershed create sediment and flow discontinuities within the channel network. The large dams and reservoir systems of Pardee and Camanche Dams diminish flow and sediment between the upper and lower watershed. The watershed issues that arise from the discontinuity of sediments and water are fundamentally linked to the overall geomorphic health of the river-hillslope-floodplain ecosystem.

The Mokelumne River supports a diverse assemblage of resident and migratory fish species. Resident rainbow trout and other native fish inhabit the upper basin watershed. While impoundments such as Camanche and Pardee reservoirs prevent sediment from traveling downstream, they also provide habitat for a number of native and introduced fish species, including largemouth bass that support recreational fisheries. The Mokelumne River downstream of Camanche Dam supports a diverse assemblage of resident and migratory fish species including fall-run Chinook salmon and steelhead, which - prior to construction of the river's dams - continued where they spawned upstream in the upper watershed. Changes in geomorphic function can lead to loss of habitat or populations of fish or amphibians.

Adaptive management of limited water supplies can be and has been used as a management tool for improving habitat conditions (e.g., providing pulse flows in the fall for adult Chinook salmon upstream attraction and migration and flows related to instream conditions for Foothill Yellow-Legged Frogs in the upper watershed). Challenges exist in providing more reliable habitat conditions over a range of hydrologic conditions as well as meeting institutional and regulatory needs for a variety of beneficial uses.

WATER AVAILABILITY

In order to develop effective water resource management projects that could benefit both regions, there is a need to identify and quantify water currently flowing in the Mokelumne River. The Water Availability Analysis determined the quantity of water expected to be present in the river at multiple locations under historical hydrological conditions, as well as water potentially available for use in a MokeWISE project from a variety of sources, including groundwater, agricultural drainage, stormwater, recycled water, conservation, desalination, the Mokelumne River, and other surface water. These sources were investigated over the 30 year planning horizon from 2010 to 2040 for their potential to provide supply to a new project in the upper and/or lower Mokelumne watershed.

The Water Availability Analysis was performed at a feasibility level as part of the MokeWISE Program. It was not designed, nor was it intended to, serve as the basis for a water rights proceeding. Any future water rights application must undergo a separate water availability analysis. The following sections summarize the findings of the Water Availability Analysis, which is provided in **Appendix G**.

Groundwater

Aside from the groundwater currently used and planned for use, groundwater was not considered a viable additional water supply in the upper watershed for a MokeWISE project primarily due to limited potential yield. Based on water age findings, large-scale natural groundwater recharge was found unlikely to be viable in the Calaveras County portion of Eastern San Joaquin subbasin. Total agricultural and municipal groundwater pumping in Eastern San Joaquin County is estimated to have averaged 870,000 AFY since the 1970s, which has contributed to overdraft conditions. The groundwater basin is currently overdrafted at a rate of 70,000 to 80,000 AFY (GBA 2014). Continuing these rates of extraction will further impact groundwater levels, and saline groundwater will continue to migrate east into the basin (GBA 2004). This will continue to impact the availability of groundwater in the future. Conjunctive management strategies (i.e., management of groundwater and surface water resources) and groundwater recharge opportunities may help to mitigate groundwater overdraft conditions.

Agricultural Drainage Water

Agricultural drainage water was assumed to be decreasing. In addition, use of agricultural drainage has the potential to pose challenges for downstream water users. In many cases, downstream users divert agricultural drainage water that was discharged by upstream users. As agricultural efficiencies are realized, this source is naturally decreasing, while potentially increasing the concentrations of contaminants. Capture and reuse of agricultural drainage water was not considered a viable alternative for a MokeWISE project because such use would further decrease this source for downstream users, thereby potentially decreasing the supplies available for downstream water users and groundwater users.

Recycled Water

Potentially available recycled water was determined by quantifying treated wastewater within the watershed and the volume of recycled water that is currently used or planned for future use. The difference between these two amounts, after considering constraints, was considered potentially available for reuse.

Recycled water potentially available for a MokeWISE project was estimated to be 222,500 acre-feet per year (AFY). However, due to constraints and challenges associated with treating and delivering recycled water, the total potentially available supply decreased to approximately 169,400 AFY. This includes an estimated 126,720 AFY in secondary treated recycled water and roughly 42,680 AFY in tertiary treated recycled water available. Future recycled water opportunities within the upper and lower watersheds accounts for roughly 6,500 AFY of the total recycled water potentially available, while the remaining approximately 162,900 AFY is generated in the EBMUD retail service area. It is anticipated that social and economic issues will delay reuse of much of the potentially available supply. There are also sensitivities surrounding the use of recycled water outside the area of origin.

Stormwater

In order to identify the potential supply available from stormwater capture, the amount of stormwater runoff that is not captured or infiltrated was estimated. For residential areas in the upper and lower watersheds, this was estimated by identifying impervious areas and estimating the average annual rainfall and snowmelt in those areas and assuming that some residential homes would participate in a rain barrel program. On a large-scale, stormwater from the municipal systems in Lodi and Stockton was estimated; it was assumed that municipal systems in the upper watershed would not contribute a substantial amount of stormwater for the MokeWISE program. As a final step, large-scale and small-scale stormwater capture programs were evaluated and existing stormwater programs in the MAC and ESJ regions were reviewed.

Total stormwater potentially available for reuse within the region from residential and municipal sources was estimated to be roughly 15,100 AFY. Stormwater that could potentially be captured and reused within residential areas was estimated to be 640 AFY. Stormwater capture from municipal systems was estimated to be 14,920 AFY. Residential areas within the upper watershed could potentially capture up to 90 AFY, while residential areas in the lower watershed could potentially capture 550 AFY, assuming rainwater capture occurs all year long. The cities of Stockton and Lodi discharge approximately

11,370 AFY and 3,550 AFY of stormwater within their municipal systems, respectively. These amounts could potentially be captured and reused.

Conservation and Efficiency

The amount of supply potentially available through conservation was determined by quantifying water that could be conserved through the expansion of conservation programs within the MokeWISE region, after accounting for those measures that are currently being implemented or are planned for implementation. Conservation programs considered included plumbing retrofits, landscape conversions, public outreach programs, and leak detection programs. Two levels of conservation savings were calculated. One assumed that current program levels doubled and the second assumed 85 gallons per capita per day (gpcd). **Table 3** provides a summary of the potential future water savings.

TABLE 3: POTENTIAL ADDITIONAL FUTURE SUPPLY AVAILABLE THROUGH EXPANDED CONSERVATION PROGRAMS*

AGENCY	TOTAL SAVINGS ACHIEVABLE (AFY) UNDER EXPANDED PROGRAM	TOTAL SAVINGS ACHIEVABLE (AFY) UNDER THEORETICAL MAXIMUM (85 GPCD)
AWA	44.9 – 97.2	4,030.7
CCWD	1,385.0 – 1,485.4	5,106.9
CPUD	Not quantified	1,077.1
JVID	212.5	Not quantified
City of Stockton	587.7 – 1,671.3	23,508.2
City of Lodi	301.6 – 603.5	10,945.0
WID	Not quantified	Not quantified
NSJWCD	Not quantified	Not quantified
EBMUD	--	135,263.0
Agricultural	170,826	170,826.0**
Total	173,357.7 – 174,895.9	350,756.9

* The numbers presented do not include Best Management Practices (BMPs) that could not be quantified due to limited available data.

** This figure does not reflect 85 gpcd. It is assumed here that this agricultural program would be implemented in both the expanded program scenario and the theoretical maximum program scenario.

Desalination and Demineralization

Because groundwater within the Eastern San Joaquin Groundwater Basin is considered "critically overdrafted," groundwater demineralization was not considered a viable supply.

While small-scale, local opportunities may exist, additional withdrawal from the groundwater basin would likely exacerbate the groundwater conditions. As such, groundwater demineralization was not anticipated to provide a long-term, regional supply for a new MokeWISE project.

While the Mokelumne River watershed is not located near a source for desalination, desalination exchange could potentially be a viable water supply in the future through a program such as the Bay Area Regional Desalination Program (BARDP). Currently, however, the BARDRP is designed to meet the needs of all current partners; any additional partners would require a modification of the design capacity. As such, desalination exchange was not considered a viable supply alternative.

Mokelumne River

MCG members were tasked with developing a definition of "available water" for Mokelumne River supply. The MCG assembled a Modeling Workgroup (a subset of the MCG), tasked with developing a mutually agreeable definition of available water. Based on recommendations from the Modeling Workgroup, the MCG ultimately decided to quantify "unallocated water" within the Mokelumne River in lieu of defining "available water," because the definition of "available" is heavily dependent on one's perspective and value assigned to various existing uses. Unallocated water, as it is used within MokeWISE, was defined as that quantity of water in the Mokelumne River that is not diverted pursuant to a riparian, pre-1914, or appropriative water right and that is not explicitly required to be in the river pursuant to a prescribed regulatory requirement[3].

Unallocated water was simulated using the Mokelumne-Calaveras Simulation Model (MOCASIM), which simulates in-river flow conditions over the period of record (1953-2010) under specific diversion assumptions representative of the years 2010 and 2040 (referred to as the 2010 and 2040 baselines, respectively). Channel losses and instream flows required by the Federal Energy Regulatory Commission (FERC) requirements for Project 137, Lodi Decrees and Joint Settlement Agreement (JSA) are automatically accounted for by the model logic based on hydrologic and storage conditions. Diversions are included as a primary input to the model. **Figure 3** illustrates the three major components that generally make up Mokelumne River supply.

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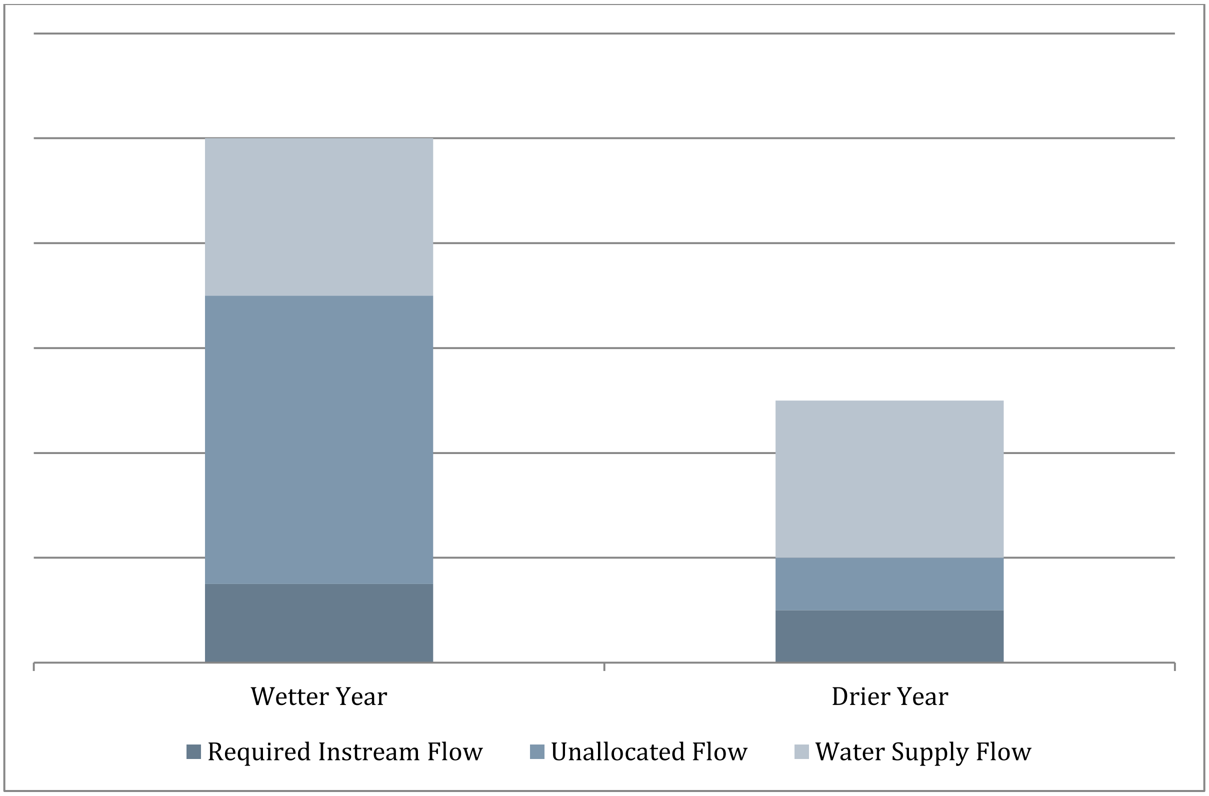
[3] The Modeling Workgroup agreed to look at various ways of defining "available water" in the Mokelumne River in the context of specific projects, particularly projects relating to groundwater recharge in San Joaquin County. However, such recharge projects were not sufficiently defined by the County to allow for this analysis during MokeWISE. The County and interested stakeholders plan to complete this analysis during the implementation of Project 4a ("Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin").

Figure 3: Mokelumne River Flow Components*



* This figure is provided as an example to show components of Mokelumne River flow and does not represent actual modeling results.

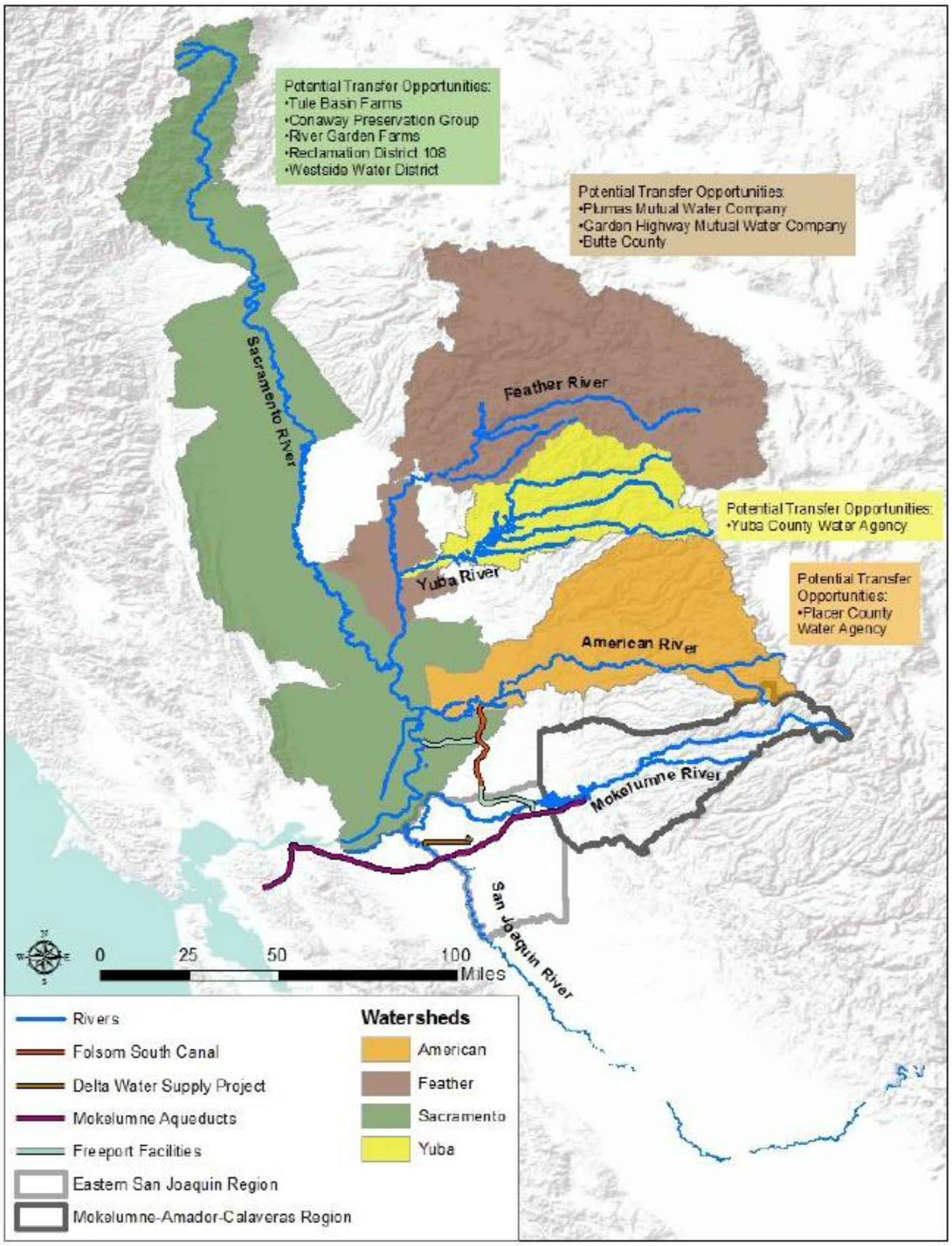
To help facilitate the modeling effort, review preliminary simulation results, and make modeling-related recommendations to the MCG, a Modeling Workgroup was formed. The workgroup consisted of MCG members with a general interest in and understanding of modeling and its principles. The Modeling Workgroup met seven times in person and by telephone to review the MOCASIM model, discuss inputs, and review results. All decisions made by the Modeling Workgroup were brought back to the MCG for approval prior to implementation.

The amount of unallocated Mokelumne River water was found to be highly variable depending on demand/diversion assumptions, location along the River, and simulated hydrologic year type. Generally, there was more unallocated water present in the river further downstream and there was generally more unallocated water in the river in wetter than in drier years. Additionally, under both the 2010 and 2040 base case, more water was being released than is required as part of the JSA. There was also generally less unallocated water under the 2040 baseline condition than in the 2010 baseline condition, due to the assumed increases in diversions in the 2040 baseline condition.

Other Surface Water

Other (non-Mokelumne River) surface water potentially available for use in a MokeWISE project was estimated based on a review of transfers tracked by the State Water Resources Control Board (SWRCB) from 2012 to 2014, combined with information on known, recent water exchanges (**Figure 4**). Of the data reviewed, the greatest quantity of water transfers occurred in 2014, totaling nearly 412,000 acre-feet (AF) in that year.

Figure 4: Examples of Recent Water Transfers in Relation to the MAC and ESJ Regions



In order for the region to utilize a water transfer to supply a MokeWISE project, conveyance infrastructure would be needed to convey the supply to the region. One option for conveying transfer supplies could be the use of EBMUD's Freeport facilities. Freeport facilities can convey roughly 185 MGD, with Sacramento County Water Agency (SCWA) receiving 85 MGD in all years and EBMUD receiving 100 MGD in dry years only (San Joaquin County 2009, ES-1). In normal and wet years, if EBMUD's 100 MGD were used, approximately 112,000 AFY of conveyance capacity would be potentially available for use by a MokeWISE program. As such, the potentially available supply from other surface water was assumed to be limited to the conveyance capacity of Freeport facilities.

Summary of Potentially Available Supply

Estimated quantities of supplies potentially available from each of the sources considered, including groundwater, agricultural drainage water, recycled water, stormwater, conservation, desalination, Mokelumne River, and other surface water, are summarized below and in **Table 4**.

Groundwater

- While currently used in the upper watershed, groundwater is not considered a viable additional source in Amador and Calaveras counties due to low yield, unreliability, age of groundwater, and limited storage opportunities.
- The Eastern San Joaquin Groundwater Basin is considered critically overdrafted.
- Groundwater is not considered a viable additional supply source, although conjunctive use and recharge opportunities may be available.

Agricultural Drainage Water

- While quantities of agricultural drainage water are unknown, it is assumed that they are currently minimal and decreasing due to investments in agricultural irrigation efficiency practices and technologies. As such, this is not considered a viable source.
- Some local, small-scale applications may be viable for capturing agricultural drainage, but it is not expected to provide a viable regional water supply.
- It is generally accepted that there is usually a user that will take agricultural drainage water downstream for use.

Recycled Water

- The total quantity of potentially available recycled water is estimated to be 222,500 AFY; however, that amount is reduced to roughly 169,400 AFY after accounting for challenges and constraints associated with the treatment and distribution of recycled water.

- Potential recycled water available in the future within the upper watershed, lower watershed, and EBMUD service area is estimated to be 3,489 AFY, 3,050 AFY, and 162,857 AFY, respectively. However, full use of this supply is not currently deemed realistic due to costs associated with infrastructure and coordinating with partner agencies. Additionally, the total demand for the recycled water may limit how much can be used.
- Of the up to 169,400 AFY potentially available, an estimated 126,720 AFY of secondary treated and 42,680 AFY of tertiary treated recycled water is available in the future.

Stormwater

- Total potentially available stormwater within the MokeWISE region is between 14,939 AFY and 15,560 AFY. This amount includes the municipal systems in Lodi and Stockton and the residential areas in both the upper and lower watersheds.
- The municipal system in Lodi could potentially yield 3,550 AFY and the system in Stockton could potentially yield 11,370 AFY, totaling 14,920 from municipal systems.
- Residential areas in the MokeWISE region could potentially yield an estimated 20 AFY, with 3 AFY from the upper watershed and 17 AFY from the lower watershed, assuming rainfall capture occurred from April to October. If rainfall capture occurred all year long, the upper watershed could capture 90 AFY and the lower watershed could capture roughly 550 AFY.

Conservation

- Using water savings assumptions from the California Urban Water Conservation Council (CUWCC) and the applicable agencies, the estimated quantity of water that could potentially be available in the future under expanded implementation of BMPs is between 173,000 and 175,000 AFY. This number is assumed to be low, as the savings for several BMPs were unable to be determined due to data gaps.
- Under a theoretical maximum conservation program where agencies could reduce to 85 gpcd, anticipated future savings in 2040 would be roughly 350,000 AFY.
- Agricultural efficiency could potentially conserve roughly 170,000 AFY by 2030.

Desalination

- Groundwater demineralization requires additional withdrawal from the groundwater basin, which could exacerbate the existing overdraft condition.
- While desalination exchange could potentially yield available water in the future, the BARDP as currently sized is designed to meet the needs of all current partners. Additional partners would require a modification of the design capacity.

- At this time, neither groundwater demineralization nor desalination exchange are considered viable supplies.

Mokelumne River

- Supply of unallocated water is highly variable based on year type and River location.
- Generally, there is more unallocated water in wet and above normal years than in below normal, dry, and critically dry years.
- Modeling indicates that under both 2010 and 2040 baselines, more water is being released at both JSA compliance points than is required as part of the JSA.

Other Surface Water

- The total estimated quantity of short-term transfers available is 85,325 AFY, while long-term transfers potentially provide an additional 127,261 AFY. However, more information on availability under various seasonal conditions and year types is needed to refine this estimate.
- Other surface water may include unappropriated flood flows or water that may potentially be available under a new flow regime. These quantities, while variable and difficult to determine, may potentially provide additional available water to the MokeWISE program.

TABLE 4: POTENTIALLY AVAILABLE SUPPLIES

SUPPLY TYPE	TYPE OF SUPPLY AVAILABLE	AMOUNT OF SUPPLY AVAILABLE (AFY)	CHALLENGES	OPPORTUNITIES
Groundwater	N/A	Not quantified	• Availability • Groundwater basin conditions	• Direct/in-lieu banking • Direct injection
Agricultural Drainage Water	N/A	Not quantified	• Downstream impacts • Treatment	• Soil flushing
Recycled Water	Secondary treated Tertiary treated	169,499	• Timing and storage • Economic feasibility • Coordination costs • Infrastructure requirements • Benefit allocation • Market potential • Local considerations • Scalability • Groundwater basin proximity • Downstream impacts	• Non-potable uses • Saline intrusion barrier • Indirect potable reuse/direct potable reuse • Direct injection
Stormwater	Municipal Residential	14,939	• Storage and timing of demand • Downstream impacts • Rain barrel requirements • Treatment and conveyances for large-scale systems • Groundwater recharge	• Large-scale detention basins • Low impact development (LID) • Land purchases • Formal on-site reuse programs • Offset surface water

TABLE 4: POTENTIALLY AVAILABLE SUPPLIES

SUPPLY TYPE	TYPE OF SUPPLY AVAILABLE	AMOUNT OF SUPPLY AVAILABLE (AFY)	CHALLENGES	OPPORTUNITIES
Conservation	Municipal Agricultural	173,357.7 – 350,756.9	• Downstream impacts • Growth impacts • Economic feasibility	• Further implementation of BMPs • Implementation of additional BMPs • Infrastructure improvements • Altering rate structures
Desalination	Groundwater demineralization Desalination exchange	Not quantified	• Institutional challenges • Groundwater basin conditions • Waste stream	• Use of saline supplies • Solar desalination
Mokelumne River	Unallocated water	Variable*	• Balancing competing interests • Variable flow • New diversions • Banking • Infrastructure requirements • Economic feasibility • Ecosystem/wildlife harm	• Supply source for direct/in-lieu banking • Ecosystem/wildlife benefits
Other Surface Water	Short-term transfers Long-term transfers Unappropriated Delta water	212,585**	• Downstream impacts • Growth impacts • Economic feasibility • Infrastructure requirements	• Further implementation of BMPs • Implementation of additional BMPs • Infrastructure improvements • Altering rate structures

* Dependent on year type and location on the Mokelumne River.

** Dependent on flood flows, hydrologic year type, and/or amount of water in Delta.

CLIMATE CHANGE VULNERABILITY

The State of California, along with scientific organizations, including the International Panel on Climate Change (IPCC), have documented changes in both global and local climate over the past 100 years and anticipate even more changes in air temperature, precipitation, and mean sea levels in the coming decades. In California, warming temperatures are expected to raise the snowfall elevation, causing more winter precipitation in the Sierra Nevada to occur as rainfall. As a result of these changes, several million acre-feet (MAF) of natural snowpack storage could be lost annually, reducing available water supply. In addition, the increasing severity of storms and increased runoff could overwhelm existing reservoir flood protection capacity and increase flood risks downstream. Rising sea levels may increase the scope of saltwater intrusion challenges in the Delta.

An analysis using a rainfall-runoff model has been used to better understand how individual watersheds might be affected with changes in runoff quantity and timing due to climate warming (Null et al. 2010). The Mokelumne River watershed was found to be most vulnerable to a combination of the three metrics that were studied: water supply, hydropower generation, and montane ecosystems. This result may indicate that the Mokelumne River watershed is less resilient to climate change than some of the other Sierran watersheds.

Planning for these changes is necessary in order to ensure a reliable water supply, maintain water quality, protect against flooding, and protect and restore ecosystems and habitat. Climate change will likely affect the upper and lower watersheds differently. As such, a review of climate change information developed by the MAC and ESJ IRWM Regions and related subsequent publications was conducted to determine how climate change may impact the upper and lower watersheds. **Table 5** shows the climate change vulnerabilities by region, including those that are shared by both regions.

The MAC Region's highest priority vulnerabilities are water supply, water quality, ecosystem and habitat, increased water demand to fight wildfires, and hydropower. The ESJ Region's highest priority vulnerabilities include water reserve storage and management, water demand uncertainty, water quality and saline intrusion, and flooding and water logging in agricultural areas.

TABLE 5: CLIMATE CHANGE VULNERABILITIES BY IRWM REGION

	VULNERABILITY	MAC REGION	ESJ REGION	BOTH REGIONS
Water Demand	Increased water demand to fight increase in wildfires			✓
	Increased demand for process cooling water for food processing industries with increased surface water temperatures			✓
	Increased domestic demands with increased evapotranspiration			✓
	Increased agricultural demands due to longer growing season, increased temperatures and evapotranspiration, and more frequent/severe drought			✓
	Vulnerability of agricultural products to continued high temperature and changes to chilling hours (e.g., grapes for wine production, cherries)		✓	
	Harm to grapes vines and impacts to harvest due to excessive winter precipitation		✓	
	Increased power demands due to increased cooling needs in buildings		✓	
	Increased power demands at vineyards to use power operated cooling equipment		✓	
Water Supply	Decreased water supply due to decreased snowpack in the Sierra Nevada Mountains and shift in timing of seasonal runoff			✓
	Water table decline due to inadequate recharge		✓	
Water Quality	Reduced water quality due to saline water intrusion from sea-level and from lowered water tables/reduced streamflow		✓	
	Higher concentrations of surface and groundwater contaminants due to lower surface water flows and lower groundwater tables			✓

TABLE 5: CLIMATE CHANGE VULNERABILITIES BY IRWM REGION

	VULNERABILITY	MAC REGION	ESJ REGION	BOTH REGIONS
	Increased pesticide contamination to surface waters due to increased pesticide use (higher temperatures are more conducive to pests)			✓
	Reduced dissolved oxygen content due to increased surface water temperatures			✓
	Increased nutrient load to surface waters due to increase in wildfires			✓
	Increased nutrient loading due to increased urban and agricultural seasonal runoff		✓	
	Degraded surface and groundwater quality due to reduction of meadow area that can provide contaminant reduction	✓		
Flood Management	Increased flooding in low-lying areas due to sea level rise and sea water intrusion into Delta		✓	
	Increased flood inundation due to increased runoff in the winter and potentially fall			✓
	Increased seasonal flooding due to increases in seasonal precipitation during winter and fall			✓
	Increased flooding due to reduction of meadow area which help reduce floods in winter	✓		
Hydro-power	Reduced hydropower generation due to lower reservoir levels caused by increased customer demand and changes in timing of seasonal runoff/flasher storm systems			✓
Ecosystem and Habitat	Impacts to vegetation due to increased temperatures and evapotranspiration, changes in precipitation patterns and distribution, and more frequent/severe droughts and wildfires			✓
	Reduced quality of fish habitat due to reduced water quality, lower flows and warmer water temperatures			✓

TABLE 5: CLIMATE CHANGE VULNERABILITIES BY IRWM REGION				
	VULNERABILITY	MAC REGION	ESJ REGION	BOTH REGIONS
	Hindered upward migration of anadromous fish due to low spring flow			✓
	Shift of freshwater-saltwater habitat due to lower summer stream flows		✓	
Sea Level Rise	Impacts to agricultural land in the Delta's reclaimed regions due to sea level rise		✓	
Sea Level Rise	Exacerbated saline intrusion to surface and groundwater		✓	
Sea Level Rise	Greater risk of levee overtopping or failure due to sea level rise		✓	

Identifying strategies that address the climate change vulnerabilities described above is a key step in adapting to climate change as well as mitigating greenhouse gas emissions. The MAC Region and the ESJ Region each identified Resource Management Strategies (RMS) from the 2009 California Water Plan (CWP) Update that would help them to meet their water resource management objectives, including identifying RMS that could address the Regions' climate change vulnerabilities. In addition, the RMS were evaluated for their ability to potentially reduce greenhouse gas (GHG) emissions and mitigate climate change impacts of the energy needed to treat and distribute water.

Since selection of these strategies, the 2013 CWP Update was published. The following 10 "Essential Actions" are from the California Water Action Plan (CWAP) released by the California Governor in 2014, which align with the CWP. These essential actions are considered priorities for the State of California.

- Make Conservation a California way of life
- Invest in integrated water management and increase regional self-reliance
- Achieve the coequal goals for the Delta
- Protect and restore important ecosystems
- Manage and prepare for dry periods
- Expand water storage capacity and improve groundwater management
- Provide safe drinking water and secure wastewater systems to all communities
- Increase flood protection
- Improve operational and regulatory efficiency
- Identify sustainable and integrated financing

Within these Essential Actions there are 17 objectives:

- Strengthen Integrated Regional Water Management Planning
- Use and Reuse Water More Efficiently
- Expand Conjunctive Management of Multiple Supplies (groundwater & surface storage)
- Protect and Restore Surface Water and Groundwater Quality
- Practice Environmental Stewardship
- Improve Flood Management Using an Integrated Water Management
- Manage the Delta to Achieve the Coequal Goals for California
- Prepare Prevention, Response, and Recovery Plans
- Reduce the Carbon Footprint of Water Systems and Water Uses
- Improve Data, Analysis, and Decision-Support Tools
- Invest in Water Technology and Science

- Strengthen Tribal/State Relations and Natural Resources Management
- Ensure Equitable Distribution of Benefits
- Public Access to Waterways, Lakes, and Beaches
- Strengthen Alignment of Land Use Planning and Integrated Water Management
- Strengthen Alignment of Government Process and Tools
- Improve Integrated Water Management Finance Strategy and Investments

There are more than 300 specific actions in Update 2013, Vol. 1, Ch. 8, "Roadmap for Action" and Vol. 3, "Resource Management Strategies (RMS)." The strategies in the 2013 CWP Update are largely the same as those listed in the 2009 CWP Update, but with some additional strategies added including sediment management, outreach and engagement, and water and culture. The 2013 CWP Update strategies will be considered in detail in the next update of each regions' IRWM Plans.

RMS selected for inclusion in the MAC and ESJ Regions' Plans, the climate change vulnerabilities they help to address, and their contribution to GHG emissions mitigation in the Regions are shown in **Table 6**.

The categories identified in this table correspond to the major areas identified in the CWP Update. Note that these RMS, defined in the 2009 CWP Update, were identified as relevant in the respective IRWM Plans, and reference in the MokeWISE program does not reflect endorsement of the strategies by any or all MCG members.

TABLE 6: RMS THAT ADDRESS CLIMATE CHANGE VULNERABILITIES

	WATER DEMAND	WATER SUPPLY	WATER QUALITY	FLOOD MANAGEMENT	HYDROPOWER	ECOSYSTEM & HABITAT	SEA LEVEL RISE	ENERGY EFFICIENCY	EMISSIONS REDUCTION	CARBON SEQUESTRATION
REDUCE WATER DEMAND										
Agricultural Water Use Efficiency	✓	✓			✓	✓		✓	✓	
Urban Water Use Efficiency	✓	✓			✓	✓		✓	✓	
IMPROVE OPERATIONAL EFFICIENCY AND TRANSFERS										
Conveyance – Regional/Local		✓	✓	✓		✓		✓	✓	
System Reoperation		✓		✓	✓			✓	✓	
Water Transfers		✓						*	*	
INCREASE WATER SUPPLY										
Conjunctive Management and Groundwater Storage		✓	✓	✓		✓		*	*	
Precipitation Enhancement		✓			✓	✓		✓		
Recycled Municipal Water		✓				✓		*	*	
Surface Storage – Regional/Local		✓	✓	✓	✓	✓		*	✓	
IMPROVE WATER QUALITY										
Drinking Water Treatment and Distribution		✓	✓					✓	✓	
Groundwater Remediation/Aquifer Remediation		✓	✓					*	*	
Matching Quality to Use	✓	✓	✓			✓		*	*	
Pollution Prevention		✓	✓			✓			✓	
Salt and Salinity Management		✓	✓			✓			✓	
Urban Runoff Management			✓	✓		✓		✓	✓	

TABLE 6: RMS THAT ADDRESS CLIMATE CHANGE VULNERABILITIES

	WATER DEMAND	WATER SUPPLY	WATER QUALITY	FLOOD MANAGEMENT	HYDROPOWER	ECOSYSTEM & HABITAT	SEA LEVEL RISE	ENERGY EFFICIENCY	EMISSIONS REDUCTION	CARBON SEQUESTRATION
PRACTICE RESOURCE STEWARDSHIP										
Agricultural Lands Stewardship	✓		✓							✓
Economic Incentives	✓	✓	✓		✓		✓	✓	✓	✓
Ecosystem Restoration		✓	✓	✓	✓		✓			✓
Forest Management		✓	✓	✓	✓					✓
Land Use Planning and Management	✓	✓	✓	✓	✓		✓	✓	✓	✓
Recharge Area Protection		✓	✓	✓						✓
Water-dependent Recreation			✓	✓						✓
Watershed Management		✓	✓	✓	✓		✓	✓	✓	✓
IMPROVE FLOOD MANAGEMENT										
Flood Risk Management		✓	✓	✓	✓		✓			✓
OTHER STRATEGIES										
Irrigated Land Retirement	✓	✓	✓		✓			*	*	
Rain-fed Agriculture	✓	✓	✓		✓			✓	✓	

Strategies identified in the 2009 California Water Plan Update (Bulletin 160-09)

Key:

✓ Indicates that, in general, this will provide a beneficial effect

X Indicates that, in general, this will provide an adverse effect

* Indicates that this may provide either beneficial or adverse effects

5 PROGRAM DEVELOPMENT

Program Development

MokeWISE program development was guided by the MCG. Initial project concepts were proposed by individual MCG members. With the aid of the Baseline Environmental Conditions Technical Memorandum (see **Section 4**), the MCG then brainstormed project concepts and revised or expanded these concepts. Concepts were then preliminarily screened, assessed for their environmental benefits and impacts, and assessed against the MokeWISE program objectives and consequences to be avoided (see **Section 3**).

With the aid of the Water Availability Analysis (see **Section 4**), the MCG then determined which of the project concepts would move forward for further analysis. The Climate Change Memorandum (see **Section 4**) was used to confirm the climate change reduction and adaptation benefits of the project concepts. Those project concepts selected underwent scope development and further refinement to better characterize the project concept into an implementable project. Budgets for each project were also developed to support the scope level. From these further analyzed projects, the MCG selected which projects would move forward to be included in the MokeWISE Implementation Plan. The following list includes all projects included in the Implementation Plan; those denoted with an asterisk are studies and do not include implementation components.

MokeWISE Implementation Projects

- 1a: Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir
- 1b: High Country Meadow Restoration Program
- 1c: Mokelumne River Day Use Area Floodplain Habitat Restoration Project
- 1d: Fish Screens for Riparian Diversions in the Lower Mokelumne
- 1f: Riparian Restoration Program – Below Camanche
- 1g: Mokelumne Water Quality, Soil Erosion, & Sedimentation Inventory/Monitoring
- 2a: Municipal Recycled Wastewater Recharge Program
- 2b: Constellation Winery Wastewater Reuse
- 2c: Amador County Regional Reuse
- 4a: Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*
- 4b: Amador and Calaveras Counties Hydrologic Assessment*
- 4d: NSJWCD Infrastructure Improvements
- 5a: Regional Urban Water Conservation Program

- 5b: Regional Agriculture Conservation Program[4]
- 7a: PG&E Storage Recovery*
- 7b: Lower Bear Reservoir Feasibility Update and Preliminary Engineering*
- 7d: Re-operation of Existing Storage*
- 7f: Blue and Twin Lakes Dams Reliability and Replacement Assessment*
- 8b: Rehab of Transmission Main
- 8c: Barney Way Septic System Conversion
- 8d: Lake Camanche Village Recycled Water Project*

MokeWISE Policies and Initiatives

- 9a: Land Use Coordination
- 9b: Sustainable Forest - Watershed Management Project
- 9c: Watershed Coordinator
- 9f: MokeWISE Project Public Involvement Initiative

* These projects are studies and do not have implementation components.

Implementation Plan projects are those that are generally supported by a cross section of Mokelumne River watershed stakeholders and may be more attractive for funding. The institutional structure charged with implementing MokeWISE will focus on seeking funding for projects within the Implementation Plan. The following sections further discuss program development, including how Implementation Plan projects were selected.

PROJECT CONCEPT DEVELOPMENT

To begin developing project concepts, MCG entities identified potential projects and project ideas, referred to as "concepts," that could provide water management, environmental, or other benefits to the region and be included in the MokeWISE program. Submitted project concepts ranged from preliminary thoughts or ideas for new projects to programs or management actions that were currently in planning stages and could move forward independently of the MokeWISE program. Information including a concept name, description, potential partners, and status was collected for each of the 60 concepts submitted. Those submitting concepts were also asked to indicate if the concept would address any of the MokeWISE program objectives or consequences to be avoided (**Section 3**).

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[4] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix N**.

Each submitted concept was added to a master concept list, which established a starting point for MCG discussion. MCG members reviewed concepts on the master list to determine potential synergies. In the subsequent months, a subgroup of the MCG met twice to review the concept list and identify questions or areas of clarification for each concept. Concepts and concept descriptions were further refined by the MCG based on information provided.

As a result of the MCG discussions, the master list was synthesized to 36 projects, which were grouped into 9 categories or project types (**Table 7** and **Figures 5 and 6**). These categories include Ecosystem and Habitat Restoration, Recycled Water, Desalination, Groundwater Management, Water Conservation, Stormwater Management and Flood Control, Surface Water, Local Infrastructure, and Policies and Initiatives. The first eight categories were comprised of project concepts, while the Policies and Initiatives category included supportive policy statements and initiatives for implementation. The concept list, with brief descriptions of each concept, is included in **Appendix I**.

TABLE 7: REVISED MASTER PROJECT CONCEPT LIST
ECOSYSTEM AND HABITAT RESTORATION
Upper Mokelumne Anadromous Fish Restoration
High Country Meadow Restoration Program
Mokelumne River Day Use Area Floodplain Habitat Restoration Project
Fish Screens for Riparian Diversions in the Lower Mokelumne
Riparian Restoration Program – Upstream of Pardee Reservoir
Riparian Restoration Program – Below Camanche Reservoir
RECYCLED WATER
Municipal Recycled Wastewater Recharge Program
Constellation Winery Wastewater Reuse
Amador County Regional Reuse
Mokelumne Hill Sanitary District (MHSD) Reclaimed Wastewater
DESALINATION
Solar-Powered Desalination Study
GROUNDWATER MANAGEMENT
Groundwater Banking within the Eastern San Joaquin Groundwater Basin
Amador and Calaveras Counties Hydrologic Assessment
San Joaquin County Groundwater Banking and Exchange
North San Joaquin Water Conservation District Infrastructure Improvements

TABLE 7: REVISED MASTER PROJECT CONCEPT LIST
WATER CONSERVATION
Regional Urban Water Conservation Program
Amador Canal Conversion to Pipeline
Regional Agriculture Conservation Program
STORMWATER MANAGEMENT AND FLOOD CONTROL
Cosgrove Creek Flood Management Project
Mokelumne Stormwater Capture and Reuse
Mokelumne Floodplain Management Plan – Camanche to Below Woodbridge Dam
SURFACE STORAGE
PG&E Storage Recovery
Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering
Surface Storage Regional Assessment
Re-operation of Existing Storage
LOCAL INFRASTRUCTURE
Jeff Davis Water Treatment Plant Replacement
Rehab of Transmission Main
Barney Water Septic System Conversion
Lake Camanche Village Recycled Water Project
POLICIES & INITIATIVES
Land Use Coordination
State Wild and Scenic River Designation
Sustainable Forest – Watershed Management Project
Watershed Coordinator
Groundwater Management Tools
Mixed-Use Project Concept for Calaveras County Mokelumne Reservation
MokeWISE Public Interest Profile Enhancement (PIPE) Project

Figure 5: Upper and Lower Watershed Project Locations (from Revised Master Project Concept List)

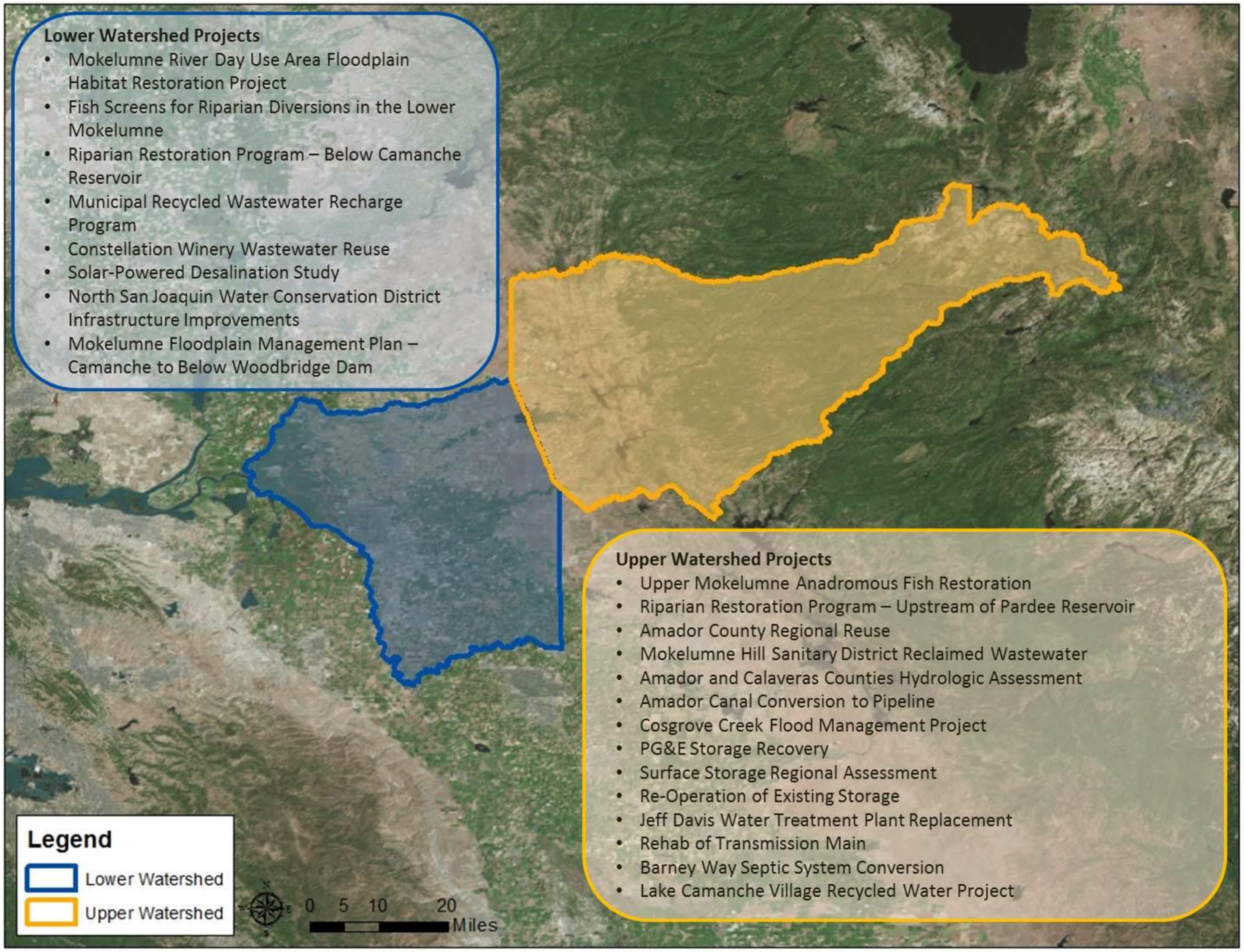
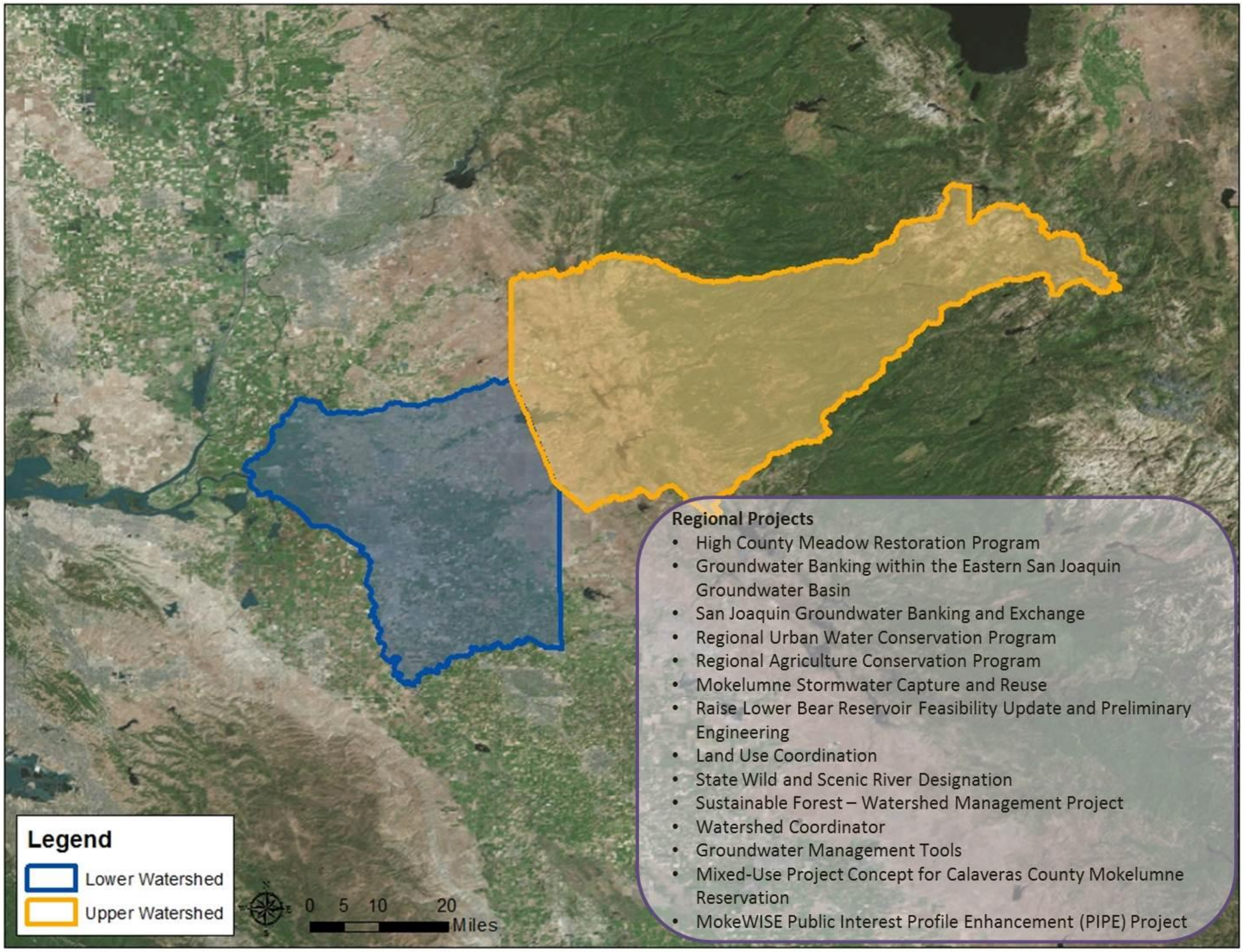


Figure 6: Regional Project Locations (from Revised Master Project Concept List)



A project sponsor was identified as a champion or lead for each project concept. Project sponsors were asked to respond to requests for information, including estimated costs, potential funding sources, project location, and studies completed to-date. Sponsors were requested to provide quantitative information that could be used to assess the concepts and to identify whether and how the projects are consistent with MokeWISE program objectives and consequences to be avoided.

The results from the Water Availability Analysis also provided information used to further refine project concept descriptions. Information including potential yields and project locations was incorporated into relevant project concept descriptions. The information collected during the project development process was used to assess each of the 36 project concepts.

CONCEPT ASSESSMENT

Each project concept underwent three assessments. The assessment information was ultimately used by the MCG to determine whether or not a specific project concept would be included in the MokeWISE Implementation Plan. Project concepts were initially assessed to determine if they were feasible, beneficial, attainable, and compatible. Projects passing all four screens moved forward for further analysis. Those projects that did not were either revised to address the issue and comply with all four screening criteria, or were deemed to have a fatal flaw and were not moved forward. Projects passing this preliminary assessment were assessed based on their potential fishery and geomorphic benefits and impacts. This assessment did not result in any projects being removed from the process, but provided the MCG with information about the environmental merits of each project. The information provided in this environmental assessment was then incorporated into the third assessment. The third and final assessment incorporated the MokeWISE Program objectives and consequences to be avoided by assessing the project concepts against the objectives and consequences to be avoided. This assessment was used to determine the degree to which project concepts fulfilled program objectives and avoided negative consequences. Each of these three assessments is described below in further detail.

Preliminary Screening Assessment

The preliminary screening assessment was designed to identify and address "fatal flaws" associated with preliminary project concepts. Project concepts were qualitatively assessed against four screening criteria: feasible, beneficial, attainable, and compatible. The overarching purpose of this screening process was to address potential concept issues such that concepts which may not have universal support could be modified to be retained in the process longer to allow time and space for creative discussion about these concepts with the goal making changes that would allow broad support. Each criterion is described below.

- **Screen 1, Feasible:** Concepts were determined to pass the preliminary technical feasibility screen if the project concept, or similar projects/concepts, have been demonstrated to be technically feasible and no technical "fatal flaws" have been identified which would suggest the project may not be able to be implemented. The purpose of this screen was to remove concepts which were fatally flawed. This screen was not used to remove concepts which may not have had universal support.
- **Screen 2, Beneficial:** A project was determined to be beneficial if it achieved or helped to achieve one or more of the desired project outcomes established by the MCG (see **Section 3**). If a project or concept achieved one or more of the desired project outcomes and is therefore beneficial, it passed this screen.
- **Screen 3, Attainable:** If a project was reasonably expected based on engineering judgment to provide the benefits it proposed to achieve (Screen 2), it was preliminarily determined to be attainable and therefore passed this screen.
- **Screen 4, Compatible:** A project was determined to be compatible if it had no benefits or impacts that were contrary to the objectives, desired outcomes, and consequences to be avoided set forth by the MCG (see **Section 3**).

MCG members, after reviewing the initial screening assessment, provided comments and revisions were made where necessary and appropriate. Concepts were modified such that all concepts, as revised, passed all four screening criteria and were carried forward for further analysis. **Appendix J**, the MCG approved Preliminary Project Assessment Memorandum, provides more information about this preliminary screening assessment. **Appendix K** includes the MCG approved results of the preliminary screening assessment.

Environmental Assessment

Revised project concepts, after passing the preliminary screening assessment, were assessed for environmental effects, including fishery and geomorphic benefits and impacts. Using the information collected during the project development process and past experience on similar projects, each concept was assessed on a scale from 1 to 5, with 1 indicating less potential benefit or greater potential impact and 5 indicating greater potential benefit or less potential impact. This assessment included a narrative explanation of anticipated feasibility, potential geomorphic benefit/impact, and potential fisheries benefit/impact. **Table 8** presents the general approach to the environmental assessment, including each of the categories against which the concepts were assessed. **Appendix L** includes the MCG approved Environmental Assessment for each of the screened concepts. Since the policies and initiatives are not actual projects and would generally not have quantifiable environmental benefits and/or impacts, they did not undergo this assessment.

TABLE 8: ENVIRONMENTAL ASSESSMENT APPROACH

CONCEPT NAME	FEASIBILITY	GEOMORPHIC BENEFIT	FISHERIES BENEFIT	ENVIRONMENTAL CONSIDERATIONS	GENERAL COMMENTS	POTENTIAL DIRECTION FOR CONCEPT DEVELOPMENT
Name	Benefit assessment (# from 1-5) Explanation of benefit assessment	Benefit assessment (# from 1-5) Explanation of benefit assessment	Benefit assessment (# from 1-5) Explanation of benefit assessment	Qualitative discussion of other environmental considerations of the project concept	General comments regarding the project concept	Discussion of potential areas for concept development, including areas that could help mitigate negative fishery or geomorphic impacts

Objectives Assessment

The objectives assessment involved assessing project concepts against the MokeWISE program objectives and consequences to be avoided (see **Section 3**). Using the information provided by project sponsors and included in the environmental assessment, each project concept was identified as fully addressing, partially addressing, or not addressing each of the MokeWISE program objectives and consequences to be avoided. These assessments were represented as a full moon, half-moon, or no moon, and an explanation was provided for each assessment. **Table 9** presents the general layout of the objectives assessment. **Appendix M** includes the MCG approved Objectives Assessment Project Concept Briefs. Since the policies and initiatives are not actual projects and would generally not provide quantifiable contributions to the program objectives or consequences to be avoided, they did not undergo this assessment.

TABLE 9: OBJECTIVES ASSESSMENT LAYOUT

OBJECTIVE	● ◗ ○	JUSTIFICATION
Objective Name	Moon (indicating degree to which project addresses objective)	Explanation for moon assessment

IDENTIFICATION OF CONCEPTS FOR FURTHER ANALYSIS

Following the various analyses conducted on the concepts, the MCG reviewed alternative ways of grouping projects for further development and evaluation. Initially, the MCG attempted to group projects into "portfolios," or project groupings, to assess opportunities for enhanced benefits through project synergies. However, because many of the project concepts are preliminary and information is qualitative in nature, assessing projects in groupings did not generate additional insights or identify any quantifiable synergistic effects. As such, the MCG opted to discuss and assess each project individually to determine whether or not it should be moved forward for further analysis.

The MCG reviewed each project concept to determine whether it would potentially provide a high value to the region and whether each MCG member could potentially "live with" the project – meaning it may have the potential to be modified to address any apparent issues that might prevent an MCG member entity from allowing it to move forward to implementation.

For each projects identified as potentially providing high value to the region and which each MCG member entity could potentially live with, an expanded project description, or preliminary project scope of work/preliminary engineering, was developed to further refine the project and clarify outstanding questions and issues to enable MCG members to make decisions concerning support for or opposition to each project. Because so many project concepts are conceptual in nature, preliminary engineering could not be completed and the expanded descriptions were developed in lieu of preliminary engineering. In addition, many project concepts were converted into feasibility studies to help answer the outstanding questions critical to future support or opposition to the project itself. The preliminary descriptions were revised at length by the MCG until all outstanding points were clarified and each MCG member was in a position to determine whether or not their respective entity would ultimately be able to support the project or feasibility study. For a number of projects, workgroups consisting of a subset of MCG members were formed to review edits and work through outstanding issues. The MCG approved scopes of work/preliminary engineering are presented in **Appendix N**[5].

The descriptions of policies and initiatives were also expanded by the Policies and Initiatives Workgroup, a subgroup of the larger MCG. This workgroup met and held conference calls several times to discuss each policy and initiative, determine how best to develop or not develop each, and expand upon the preliminary conceptual descriptions. Once the workgroup reached consensus on a policy and initiative, the revised descriptions were reviewed and approved by the full MCG. The MCG-approved policies and initiatives are presented in **Appendix O**.

IMPLEMENTATION PLAN PROJECTS

The MCG identified a series of 21 projects for inclusion in the MokeWISE implementation plan, based on their potential value to the region and broad support among the MCG member agencies. Brief project summaries are provided on the following pages, and expanded project descriptions and scopes of work are included in **Appendix N**. As noted in the Implementation Plan (**Section 6**), implementation of these projects will depend on a variety of factors, including available funding.

In addition to identifying broadly-supported projects, the MCG identified a series of policies and initiatives with broad support which should be furthered as part of program implementation. MokeWISE Policies and Initiatives are described following the project summaries.

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[5] Included at the beginning of the scopes for the majority of the projects is a section titled "Problem Statement and MokeWISE Stakeholder Interests." This section is provided to highlight why the project provides value and characterizes MCG member interests in the project. This "Problem Statement and MokeWISE Stakeholder Interests" section is included as context and is not part of the scope of work for each project.

The following projects and policies and initiatives were identified for inclusion in the MokeWISE Implementation Plan, and are summarized in the following sections and shown in **Figure 7** and **Figure 8**. Those denoted with an asterisk are studies and do not have implementation components.

MokeWISE Implementation Projects

- 1a: Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir
- 1b: High Country Meadow Restoration Program
- 1c: Mokelumne River Day Use Area Floodplain Habitat Restoration Project
- 1d: Fish Screens for Riparian Diversions in the Lower Mokelumne
- 1f: Riparian Restoration Program – Below Camanche
- 1g: Mokelumne Water Quality, Soil Erosion, & Sedimentation Inventory/Monitoring
- 2a: Municipal Recycled Wastewater Recharge Program
- 2b: Constellation Winery Wastewater Reuse
- 2c: Amador County Regional Reuse
- 4a: Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*
- 4b: Amador and Calaveras Counties Hydrologic Assessment*
- 4d: NSJWCD Infrastructure Improvements
- 5a: Regional Urban Water Conservation Program
- 5b: Regional Agriculture Conservation Program[6]
- 7a: PG&E Storage Recovery*
- 7b: Lower Bear Reservoir Feasibility Update and Preliminary Engineering*
- 7d: Re-operation of Existing Storage*
- 7f: Blue and Twin Lakes Dams Reliability and Replacement Assessment*
- 8b: Rehab of Transmission Main
- 8c: Barney Way Septic System Conversion
- 8d: Lake Camanche Village Recycled Water Project*

* These projects are studies and do not have implementation components.

[6] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix N.**

MokeWISE Policies and Initiatives

- 9a: Land Use Coordination
- 9b: Sustainable Forest - Watershed Management Project
- 9c: Watershed Coordinator
- 9f: MokeWISE Project Public Involvement Initiative

Figure 7: Upper and Lower Watershed MokeWISE Implementation Projects

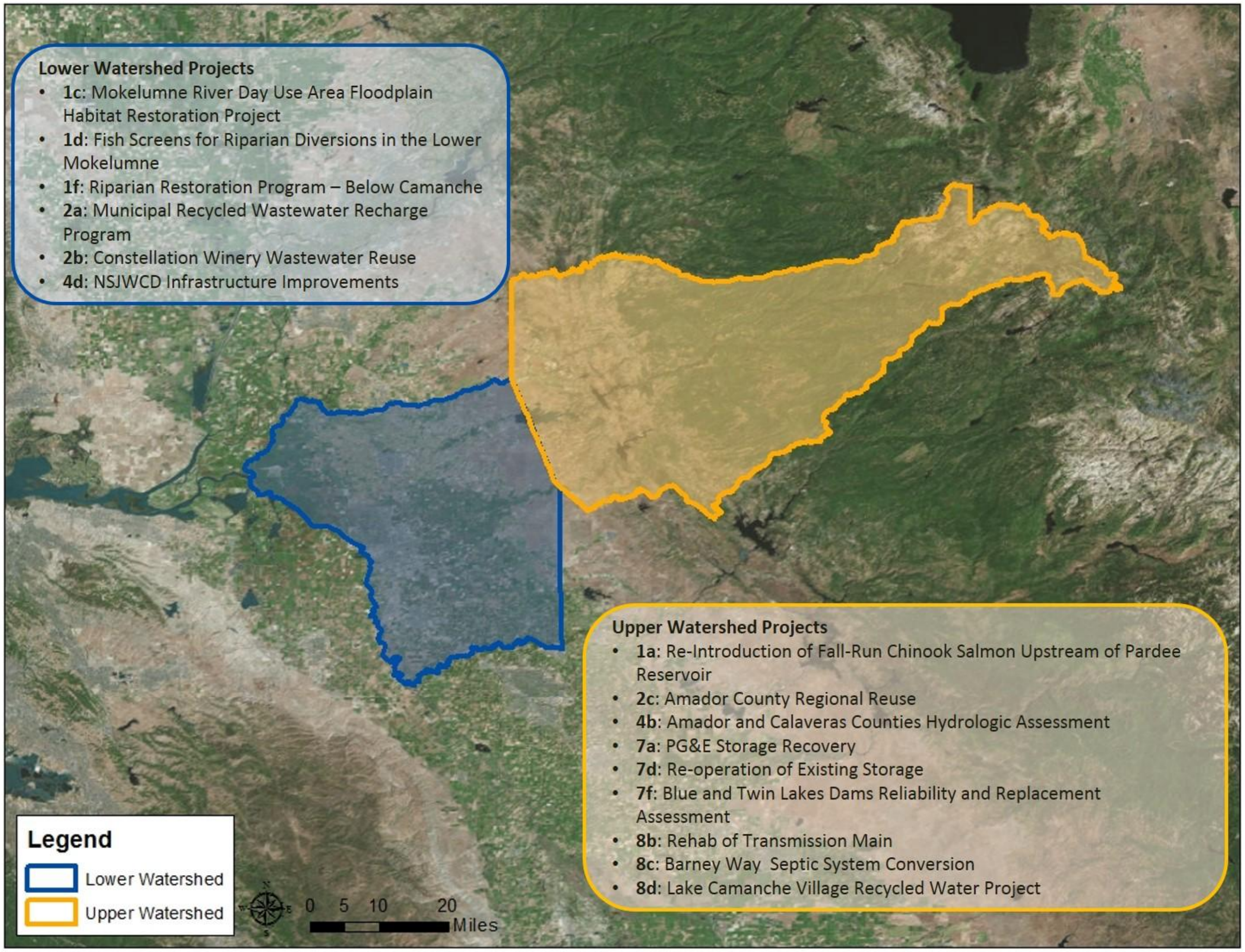
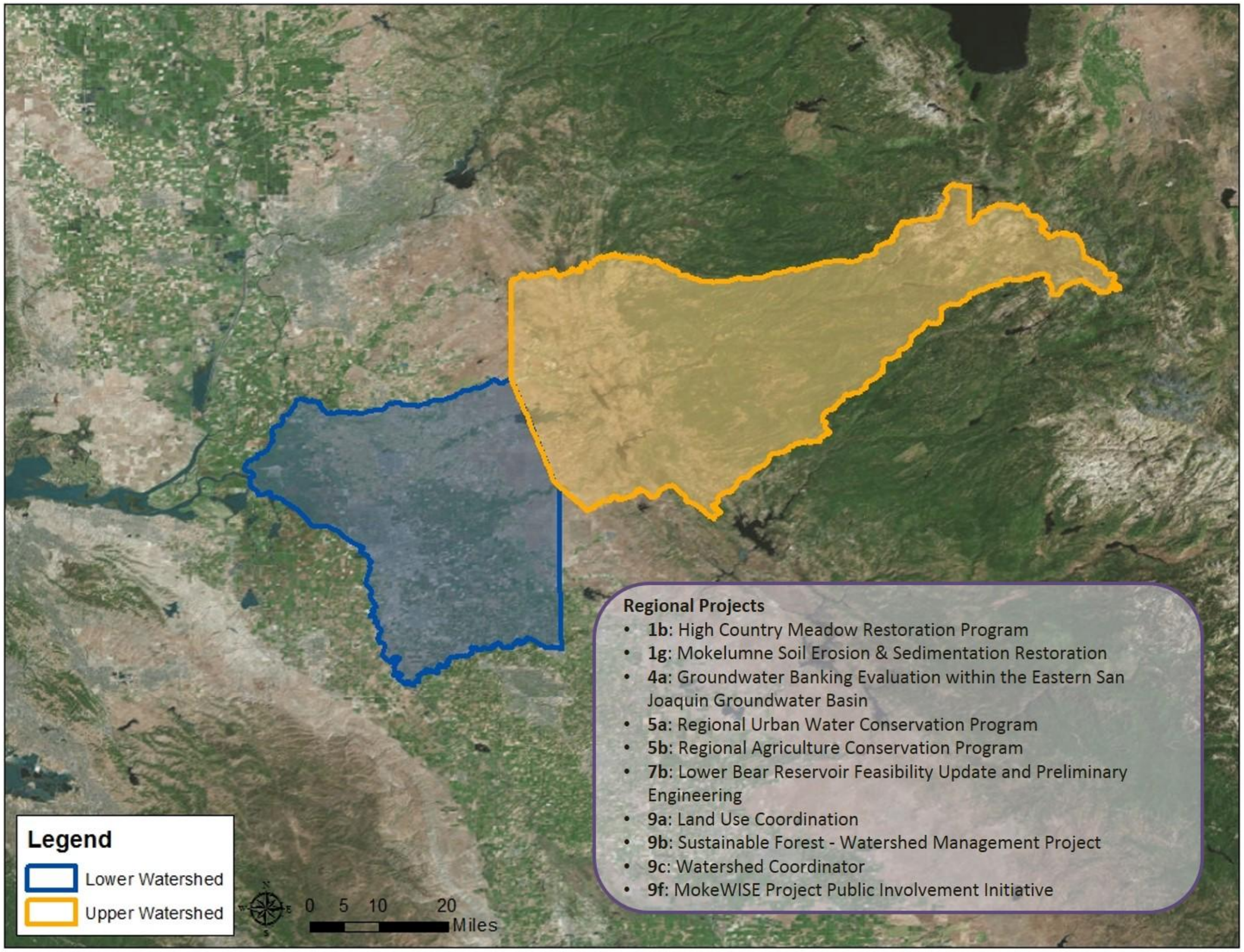


Figure 8: Regional MokeWISE Implementation Projects



PROJECT SPOTLIGHT

1a: Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir

DESCRIPTION:

The Reintroduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir Project will conduct a study to determine the feasibility of transporting adult fall-run Chinook salmon upstream of Pardee reservoir and transporting the juvenile salmon back downstream of Camanche Dam. The study will evaluate the benefits of and clarify the short and long-term operations and any mitigation required to support the proposed project. The study will also seek to identify any potential impacts and constraints of proposed actions on domestic water supply, river flows, technical, political, environmental, economic, legal, and recreational issues. The project includes data collection and analysis, capture and transport system design, as well as an alternatives analysis. Based on the alternatives analysis, a final design will be selected. Implementation of the project includes environmental documentation and permitting, stakeholder outreach and coordination, construction, and monitoring.

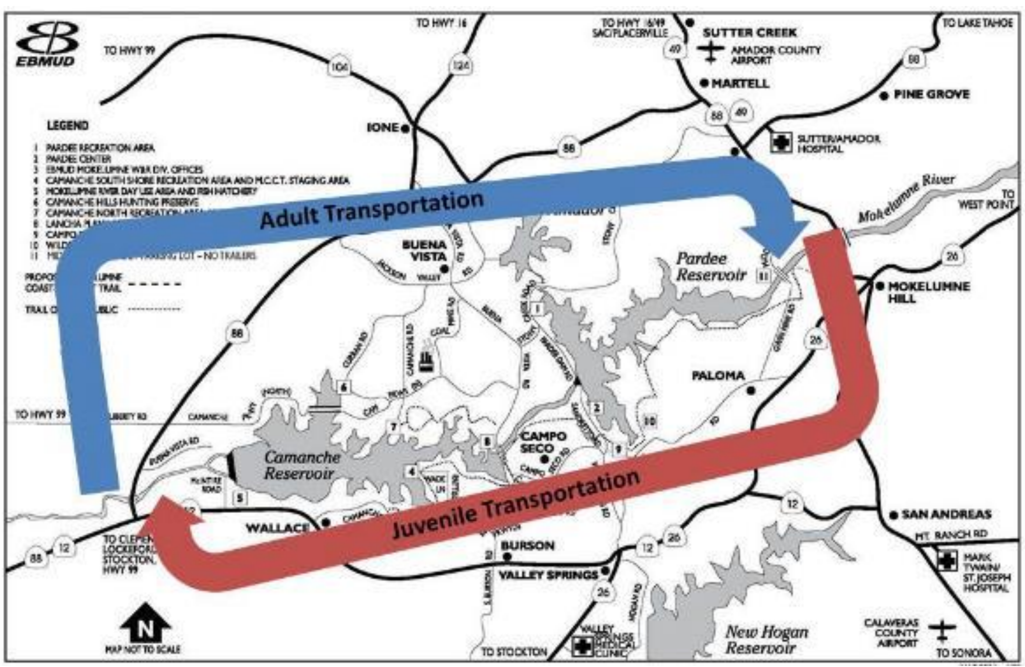
PROJECT:
REINTRODUCTION OF FALL-RUN CHINOOK SALMON UPSTREAM OF PARDEE RESERVOIR

PROJECT TYPE:
ECOSYSTEM/HABITAT PROTECTION

SPONSOR(S):
FOOTHILL CONSERVANCY; CALIFORNIA SPORTFISHING PROTECTION ALLIANCE (CSPA)

ESTIMATED COSTS:
$180,000 (INCLUDES $80,000 FOR PLANNING AND $100,000 FOR IMPLEMENTATION)

LOCATION:



PROJECT SPOTLIGHT

1a: Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Recreation
- Data
- Other Human Values
- Environment
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Recreation
- Nature tourism
- Economic benefits
- Environmental enhancement and habitat restoration

PROJECT SPOTLIGHT

1b: High Country Meadow Restoration

DESCRIPTION:

The High Country Meadow Restoration Project will identify and assess potential meadows for restoration to functioning condition as well as seek funding for the planning phases of identified meadows in the upper Mokelumne River watershed. The project includes involving a stakeholder group and compiling existing data with additional, new meadows identified as in need of restoration in the watershed. Once meadows have been compiled, assessment by a specialist team will be conducted to recommend the type and amount of restoration, and the potential expected benefits to be achieved in each meadow. The collaborative group, potentially the Amador Calaveras Consensus Group (ACCG), will work with the Forest Service, Bureau of Land Management (BLM), and other interested former parties from the MCG, to prioritize the meadows on the list for implementation.

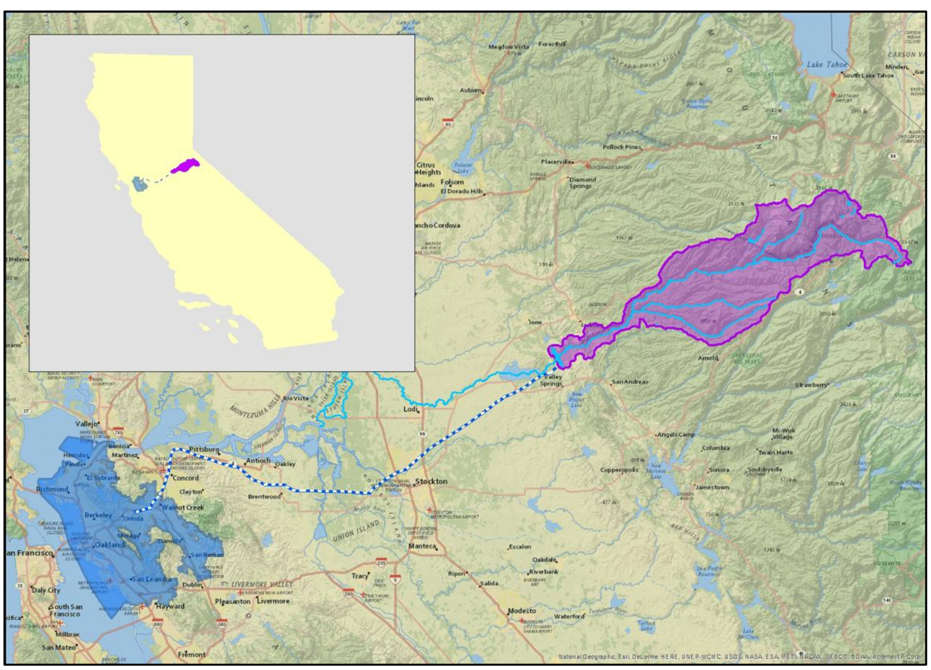
PROJECT:
HIGH COUNTRY MEADOW RESTORATION

PROJECT TYPE:
ECOSYSTEM/HABITAT PROTECTION

SPONSOR(S):
FOOTHILL CONSERVANCY

ESTIMATED COSTS:
$40,000 + $10,000 * NUMBER OF ACRES RESTORED

LOCATION:



Source: Sierra Nevada Conservancy 2014

PROJECT SPOTLIGHT

1b: High Country Meadow Restoration

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Recreation
- Flood Management
- Data
- Other Human Values
- Environment
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Recreation
- Hydropower
- Nature tourism
- Energy costs
- Flood management
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

1c: Mokelumne River Day Use Area Floodplain Habitat Restoration Project

DESCRIPTION:

The juvenile lifestage of both salmon and steelhead/rainbow trout is widely believed by resource managers of the Mokelumne River to be their most vulnerable lifestage. Riparian and channel improvements in the lower Mokelumne River can help improve juvenile survival by providing both cover and edgewater habitat. The Mokelumne River Day Use Area (MRDUA) Floodplain Habitat Restoration Project will reconfigure lands included in the MRDUA to create 1 acre of seasonal floodplain that would also serve as habitat for juvenile salmonids and other native fish species within the lower Mokelumne River. The project would include conducting site excavation and materials screening, which will determine which materials are appropriate for use. Finally, the project will conduct gravel placement and recontouring per work previously conducted by EBMUD.

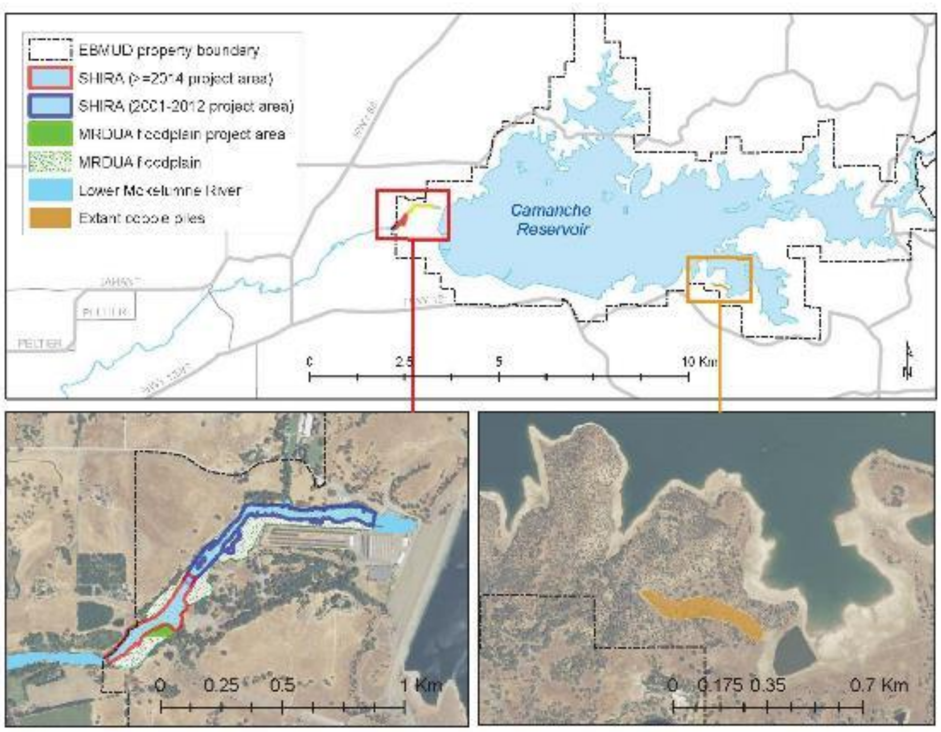
PROJECT:
MOKELUMNE RIVER DAY USE AREA FLOODPLAIN HABITAT RESTORATION PROJECT

PROJECT TYPE:
ECOSYSTEM/HABITAT PROTECTION

SPONSOR(S):
SJCRCD, CSPA (CO-SPONSOR)

ESTIMATED COSTS:
$150,000, INCLUDING $111,000 FOR IMPLEMENTATION AND A 30% CONTINGENCY.

LOCATION:



PROJECT SPOTLIGHT

1c: Mokelumne River Day Use Area Floodplain Habitat Restoration Project

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Recreation
- Flood Management
- Data
- Other Human Values
- Environment
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Recreation
- Nature tourism
- Flood management
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

1d: Fish Screens for Riparian Diversions in the Lower Mokelumne River

DESCRIPTION:

The Fish Screens for Riparian Diversions in the Lower Mokelumne River Project will develop and implement a program to identify and prioritize riparian diversions on the lower Mokelumne River for installation of new fish screens. This includes conducting a diversion assessment and establishing screening design criteria for individual diversions. The project would conduct a funding assessment to determine potential funding sources for screen installation. Working with willing landowners, the project will secure necessary permits, install fish screens, and develop a monitoring strategy.

PROJECT:
FISH SCREENS FOR RIPARIAN DIVERSIONS IN THE LOWER MOKELUMNE RIVER

PROJECT TYPE:
ECOSYSTEM/HABITAT PROTECTION

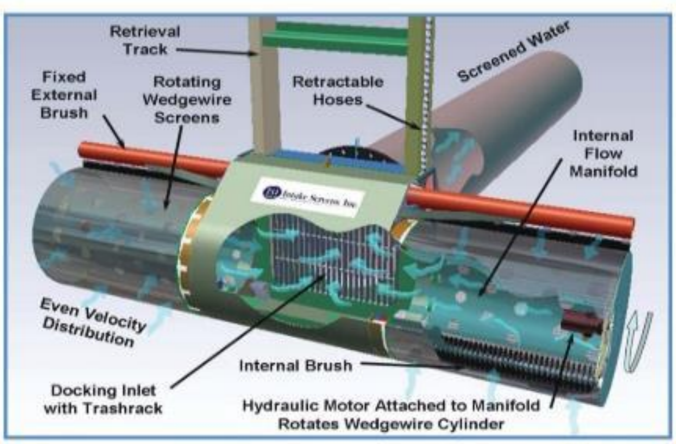
SPONSOR(S):
TROUT UNLIMITED

ESTIMATED COSTS:
$10,000 PER CFS SCREENEDTOTAL PROJECT COSTS ARE ESTIMATED TO BE $300,000 FOR THE PRELIMINARY ASSESSMENT AND PRIORITIZATION AND $10,000 MULTIPLIED BY THE NUMBER OF CFS SCREENED

EXAMPLES OF TYPICAL CYLINDRICAL FISH SCREENS:

Cylindrical Screen Gallery

Cylindrical Screen/Inclined Track



Cut-Away View of Cylindrical Fish Screen

PROJECT SPOTLIGHT

1d: Fish Screens for Riparian Diversions in the Lower Mokelumne River

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Recreation
- Data
- Other Human Values
- Environment
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Recreation
- Nature tourism
- Economic benefits
- Environmental enhancement and habitat restoration

PROJECT SPOTLIGHT

1f: Riparian Restoration Program – Below Camanche Reservoir

DESCRIPTION:

The Riparian Restoration Program below Camanche Reservoir will support the implementation efforts of the Lower Mokelumne Watershed Stewardship Plan, which analyzes and addresses riparian restoration needs. The program will study and evaluate potential areas for restoration below Camanche Reservoir, with a focus on the area from the base of the Camanche Dam to the confluence of the Cosumnes and Mokelumne Rivers.

Using previous efforts as a guide, this project seeks to build on the successful template for ecosystem-based watershed restoration efforts including the continued encouragement and implementation of voluntary restoration and monitoring activities. Implementation could be scaled or conducted in phases depending on funding availability.

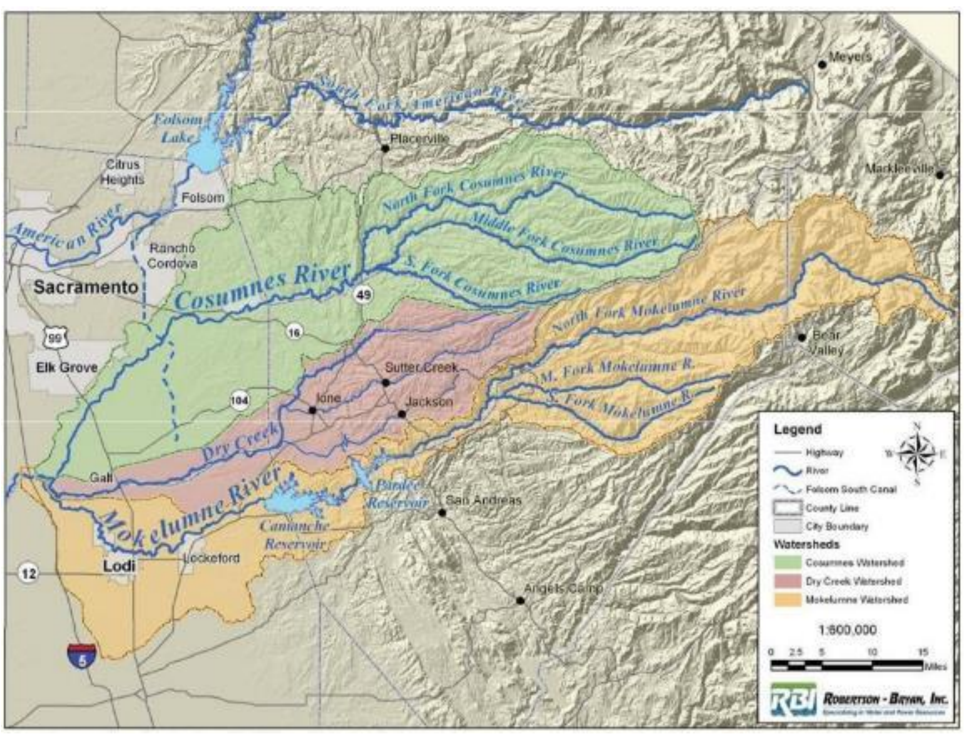
PROJECT:
RIPARIAN RESTORATION PROGRAM BELOW CAMANCHE RESERVOIR

PROJECT TYPE:
ECOSYSTEM/HABITAT PROTECTION

SPONSOR(S):
SJCRCD, FHC (CO-SPONSOR)

ESTIMATED COSTS:
$10,000 FOR RANKING AND EVALUATION OF EACH PROPOSED RESTORATION SITE AND $8,000 PER ACRE RESTORED

LOCATION:



PROJECT SPOTLIGHT

1f: Riparian Restoration Program – Below Camanche Reservoir

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Recreation
- Data
- Other Human Values
- Environment
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Recreation
- Nature tourism
- Flood management
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

1g: Mokelumne Water Quality, Soil Erosion & Sedimentation Inventory/Monitoring

DESCRIPTION:

This project will identify, assess, prioritize, and publish a report on areas of soil erosion-sedimentation reduction in the 368,000 acres of the Mokelumne Watershed above Pardee Reservoir. The project includes establishing and coordinating with a stakeholder group and evaluating existing data and setting priorities for soil erosion and sedimentation reduction or any other source of pollutants entering the river or tributaries. Once sources of soil erosion and delivery to the Mokelumne River or tributaries have been mapped and digitized for analysis and future reference, a method for prioritizing these for restoration will be developed. Sources of restoration work based on the information produced by this project, would be primarily focused on property owners.

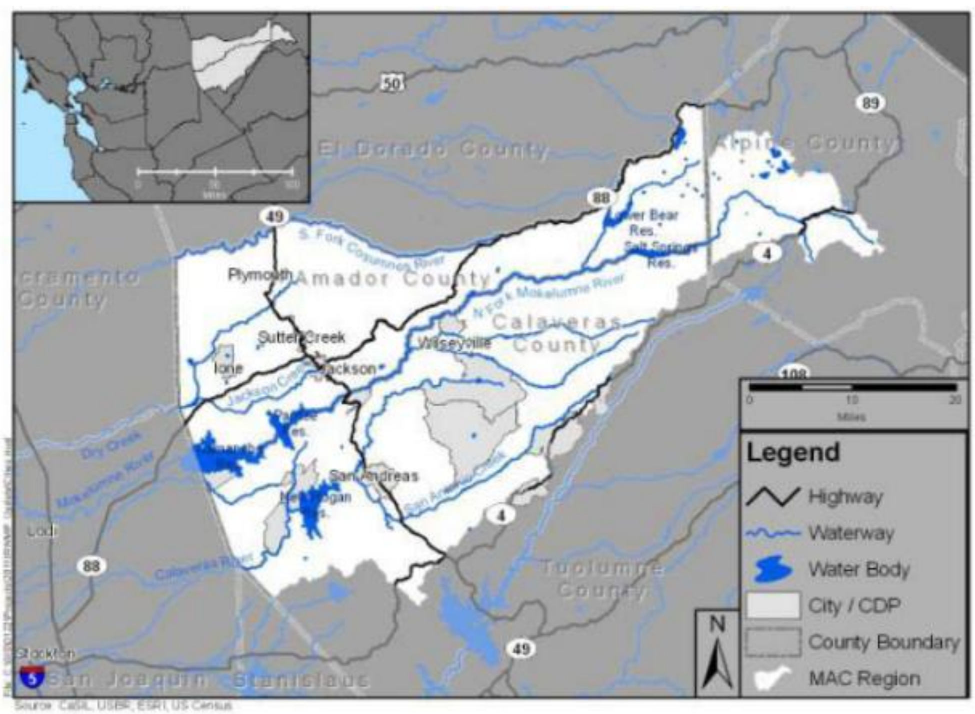
PROJECT:
MOKELUMNE WATER QUALITY, SOIL EROSION & SEDIMENTATION INVENTORY/MONITORING

PROJECT TYPE:
ECOSYSTEM/HABITAT PROTECTION

SPONSOR(S):
AWA

ESTIMATED COSTS:
$1,080,000 FOR OUTREACH, MAPPING, ASSESSING, PRIORITIZING, PUBLISHING RESULTS IN A USEABLE FORMAT, AND SEEKING FOLLOW-UP EROSION-SEDIMENTATION WORK

LOCATION:



PROJECT SPOTLIGHT

1g: Mokelumne Water Quality, Soil Erosion & Sedimentation Inventory/Monitoring

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Recreation
- Flood Management
- Data
- Other Human Values
- Environment
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Recreation
- Hydropower
- Nature tourism
- Energy costs
- Flood management
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

2a: Municipal Recycled Wastewater Recharge Program

PROJECT:
MUNICIPAL RECYCLED WASTEWATER RECHARGE PROGRAM

PROJECT TYPE:
RECYCLED WATER

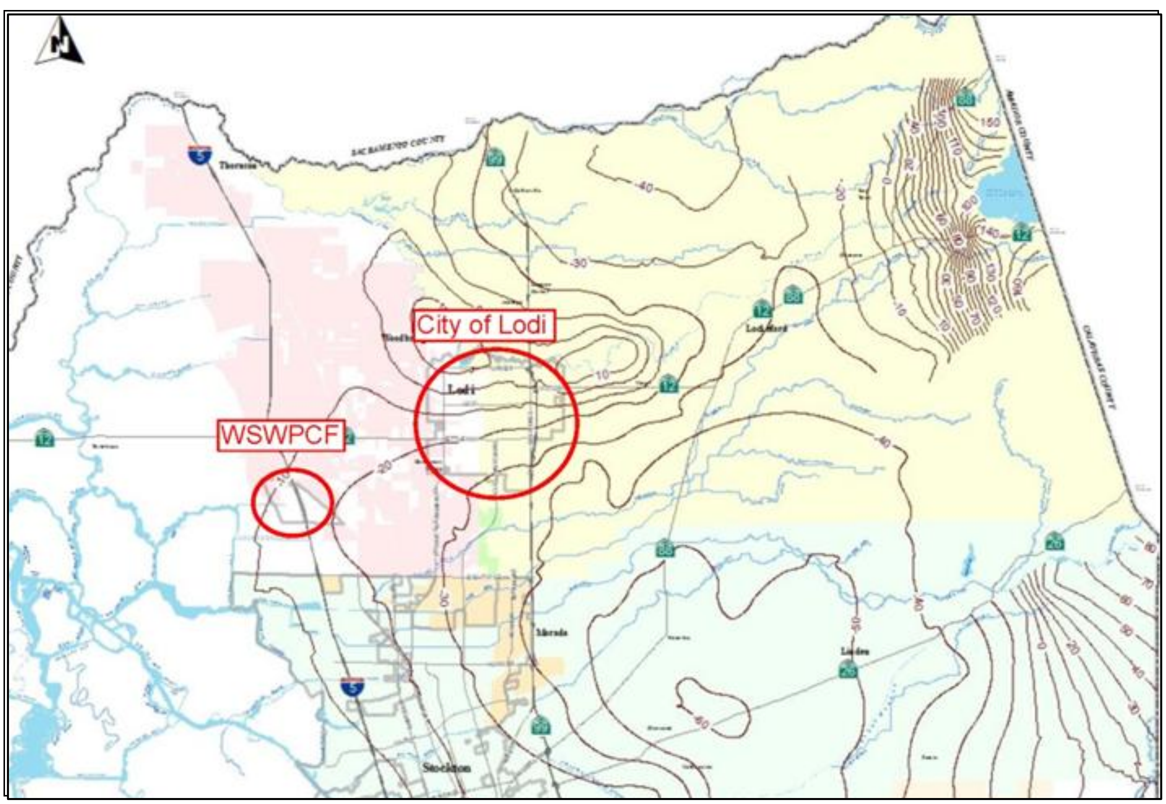
SPONSOR(S):
CITY OF LODI

ESTIMATED COSTS:
$15.15 MILLION (INCLUDES $150,000 FOR THE FEASIBILITY STUDY AND $15 MILLION FOR IMPLEMENTATION)

DESCRIPTION:

The Municipal Recycled Wastewater Recharge Program will investigate the potential for using treated, disinfected wastewater to recharge groundwater aquifers in the valley, either directly or indirectly through in-lieu use of the recycled water. This project includes a feasibility study and implementation of the recommendations outlined in the feasibility study. The feasibility study will include completing a groundwater flow analysis, determining the potential for direct recharge, and developing a recycled water demand analysis. This information will inform the development of project alternatives. The recommended project will be further developed through design work. Implementation will include permitting, site preparation, construction, and testing.

LOCATION:



PROJECT SPOTLIGHT

2a: Municipal Recycled Wastewater Recharge Program

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Data
- Other Human Values
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Economic benefits
- Improved source water quality

PROJECT SPOTLIGHT

2b: Constellation Winery Wastewater Reuse

DESCRIPTION:

The Constellation Winery Wastewater Reuse Project will expand the distribution of treated wastewater from Constellation's Woodbridge Winery to the NSJWCD's distribution system for use by other entities within NSJWCD's service area. Implementing this project would require connecting the NSJWCD's non-potable water conveyance system to Woodbridge Winery's treated wastewater system, and connecting the NSJWCD's 4th diversion point from the Mokelumne River this joint conveyance system for blending. The project would include developing a conceptual design report that would include an assessment of feasibility. Pending feasibility, final design and environmental documentation will be conducted and necessary permits will be secured. Implementation will include site preparation, construction, testing.

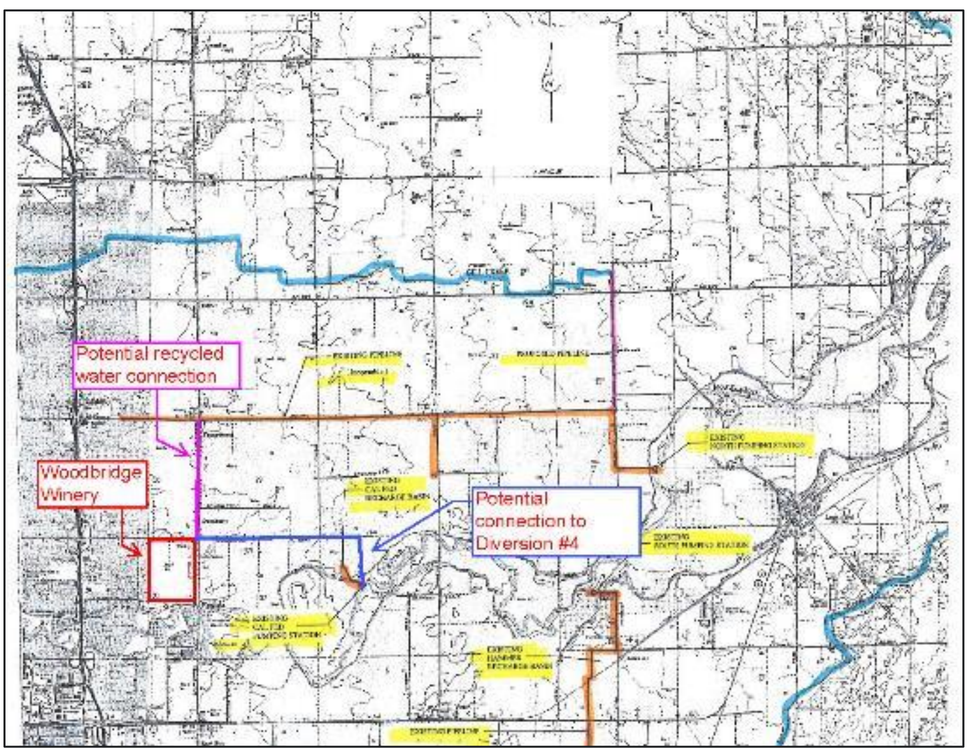
PROJECT:
CONSTELLATION WINERY WASTEWATER REUSE

PROJECT TYPE:
RECYCLED WATER

SPONSOR(S):
CONSTELLATION WINERY

ESTIMATED COSTS:
$16.16 MILLION (INCLUDES $35,000 FOR THE CONCEPTUAL DESIGN REPORT, $100,000 FOR SECURING THE WASTE DISCHARGE REPORT PERMIT, $25,000 FOR SECURING FUNDING, AND $16 MILLION FOR CONSTRUCTION)

LOCATION:



PROJECT SPOTLIGHT

2b: Constellation Winery Wastewater Reuse

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Data
- Other Human Values
- Environment
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

2c: Amador County Reuse

DESCRIPTION:

The Amador County Regional Reuse Project will implement Alternative 3 as developed in the 2013 Regional Approach for Reuse Study by Amador Water Agency. The Study considered the feasibility and options for increasing tertiary-treated recycled water production and use in the region. It was determined that the Alternative 3, the decentralized alternative, is the preferred alternative. This would upgrade the recycled water treatment plant located in the City of Jackson to serve local users and construct a recycled water treatment plant located in the City of Sutter Creek to serve users located in Sutter Creek, Amador City, Martell, and the Gold Rush Ranch Development. The project will conduct a refinement study to develop a more detailed project description for Alternative 3. After the refinement study, the project will undergo design and construction, as well as salt and nutrient management planning, permitting and user agreements, and environmental documentation. A recycled water rules and mandatory use ordinance will be finalized and adopted.

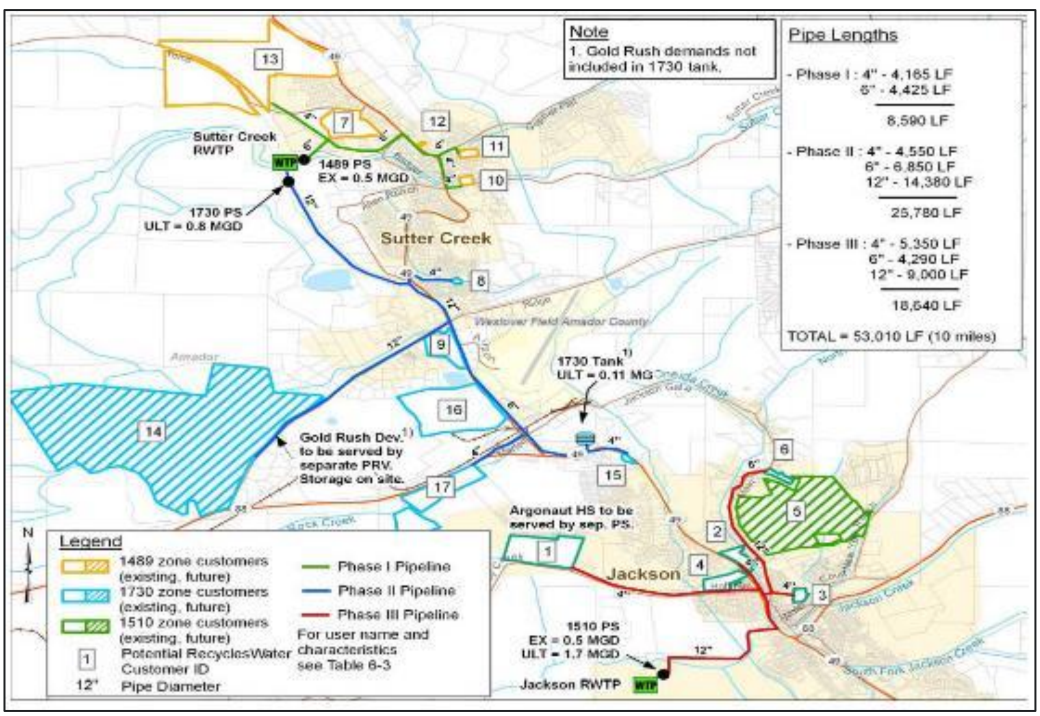
PROJECT:
AMADOR COUNTY REUSE

PROJECT TYPE:
RECYCLED WATER

SPONSOR(S):
AWA

ESTIMATED COSTS:
$21.75 MILLION (INCLUDING $400,000 FOR THE REFINEMENT STUDY AND $21.35 MILLION FOR IMPLEMENTATION)

LOCATION:



MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Data
- Other Human Values
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Hydropower
- Nature tourism
- Energy costs
- Economic benefits
- Improved source water quality

PROJECT SPOTLIGHT

4a: Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin

PROJECT:
GROUNDWATER BANKING EVALUATION WITHIN THE EASTERN SAN JOAQUIN GROUNDWATER BASIN

PROJECT TYPE:
GROUNDWATER

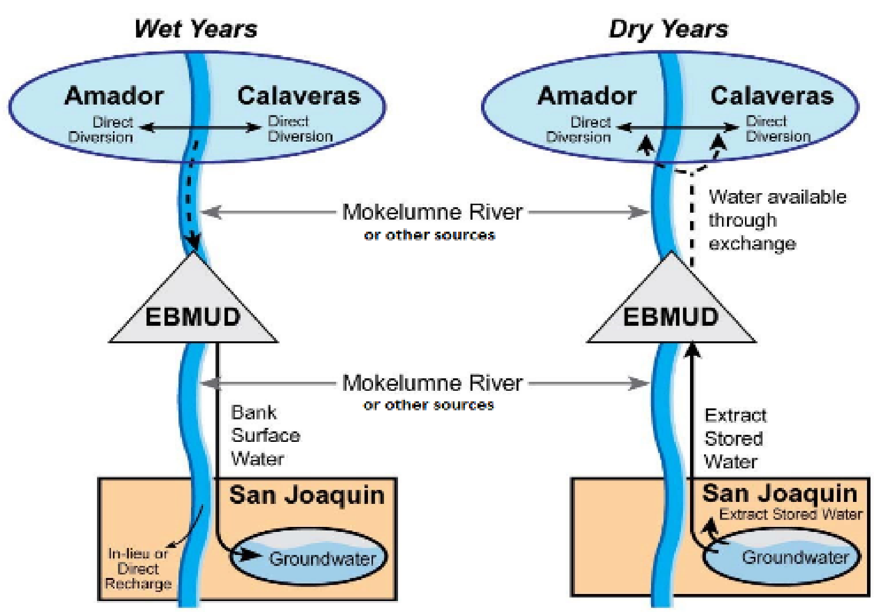
SPONSOR(S):
SJC GBA, CCWD, NSJWCD

ESTIMATED COSTS:
$3,605,000 (INCLUDES FIELD INVESTIGATIONS, STAKEHOLDER COORDINATION, ETC.)

DESCRIPTION:

This study will determine the basis for and feasibility of groundwater banking within the Eastern San Joaquin Groundwater Subbasin with the objective of improving reliable water supplies for not only Eastern San Joaquin County, but also the East Bay Municipal Utility District and the Upper Mokelumne River Watershed region. The desired outcomes of a potential project are improved groundwater levels in the vicinity of the groundwater banking location, the development of a reliable alternative water supply for agencies who rely on Mokelumne River water, and also increased flexibility to provide environmental benefits to the Mokelumne watershed. Consistent with the intent of MokeWISE, the study will also consider impacts and benefits to the environment, conduct an analysis of the feasibility of alternative supplies to the Mokelumne River including stormwater capture, locally-generated recycled water, and conserved water, and identify climate change adaptation. This document summarizes the approach for analyzing and developing the proposed project concept in the form of a feasibility study.

POTENTIAL GROUNDWATER BANKING SCHEMATIC:



PROJECT SPOTLIGHT

4a: Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Flood Management
- Data
- Other Human Values
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Recreation
- Flood management
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

4b: Amador and Calaveras Counties Hydrologic Assessment

PROJECT:
AMADOR AND CALAVERAS COUNTIES HYDROLOGIC ASSESSMENT

PROJECT TYPE:
GROUNDWATER

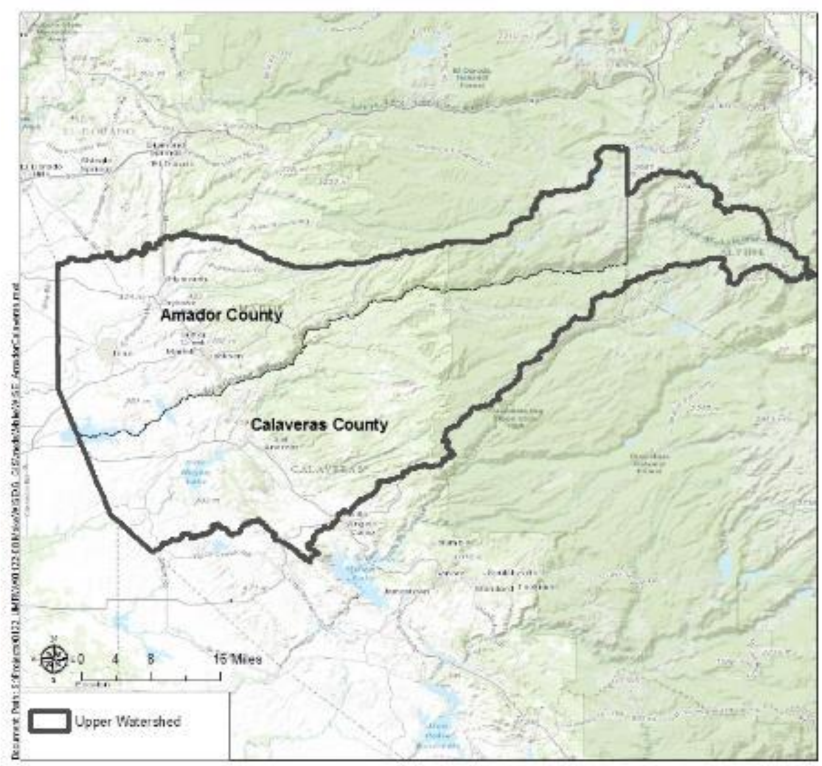
SPONSOR(S):
AWA, CCWD

ESTIMATED COSTS:
$600,000

DESCRIPTION:

Very little quantitative information is available on the carrying capacities of the local groundwater systems within Sierra Nevada foothill areas. Those groundwater systems occur mostly in poorly permeable fractured rock, within which groundwater storage is limited to the small volume represented by the fracture openings. Natural recharge occurs seasonally from the deep percolation of precipitation during the winter. However, the recharge is the small percentage of precipitation remaining after the loss of precipitation to runoff or the consumptive use of vegetation. This characteristic makes the foothill groundwater systems very sensitive to seasonal, year-to-year, and long-term changes in precipitation. This study seeks to answer questions regarding groundwater recharge in Amador and Calaveras Counties so that sustainable groundwater evaluations can be determined to guide land use decisions and provide direction to water agencies to meet planned water needs.

LOCATION:



PROJECT SPOTLIGHT

4b: Amador and Calaveras Counties Hydrologic Assessment

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Data
- Other Human Values
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Recreation
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

4d: North San Joaquin Water Conservation District Infrastructure Improvements

PROJECT:
NORTH SAN JOAQUIN WATER CONSERVATION DISTRICT INFRASTRUCTURE IMPROVEMENTS

PROJECT TYPE:
GROUNDWATER

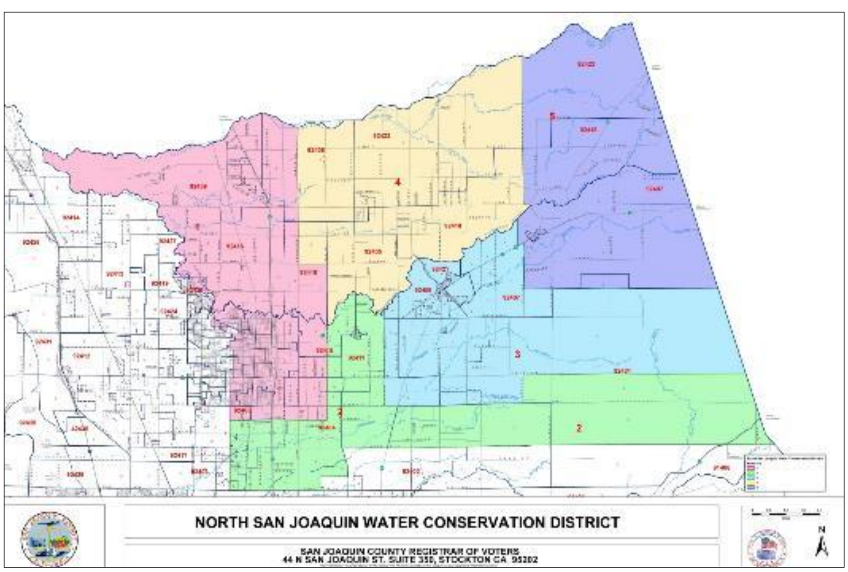
SPONSOR(S):
NSJWCD

ESTIMATED COSTS:
$20,000,000 ($2.2 MILLION TO IMPLEMENT INFRASTRUCTURE IMPROVEMENTS AND $10-18 MILLION FOR THE DISTRIBUTION SYSTEM REHABILITATION)

DESCRIPTION:

North San Joaquin Water Conservation District's (NSJWCD's) existing surface water source is Permit 10477, which allows the district to extract water from the Mokelumne River in years when water surplus to the needs of EBMUD and other prior right holders is available. Rehabilitation of the South Pump and Distribution System will help enable NSJWCD to put the water available under Permit 10477 to beneficial use. This Project could also allow NSJWCD to leverage its improved distribution system for groundwater banking. Groundwater banking projects would involve the delivery of additional surface water into the NSJWCD service area, from another source (such as EBMUD). NSJWCD would require that some of the banked water be left in the NSJWCD service area and not extracted, as a condition, in order to obtain local benefits from the banking and assist in correcting overdraft. Such an arrangement would bring additional surface water into the NSJWCD region to help reduce groundwater demand, and would allow NSJWCD to spread the costs of its distribution system and operations among additional users, thereby making the use of the system by local farmers more economical.

LOCATION:



PROJECT SPOTLIGHT

4d: North San Joaquin Water Conservation District Infrastructure Improvements

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Data
- Other Human Values
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Agricultural water supply
- Economic benefits
- Improved source water quality

PROJECT SPOTLIGHT

5a: Regional Urban Water Conservation Program

DESCRIPTION:

The Regional Urban Water Conservation Program will develop a program to reduce demand through implementation of efficient urban water use practices. The program will evaluate existing conservation measures and programs being implemented in the region and identify opportunities for further water efficiency gains. The program will develop a regional conservation plan to pursue funding opportunities, which would then be distributed among participating agencies to fund municipal conservation plan implementation.

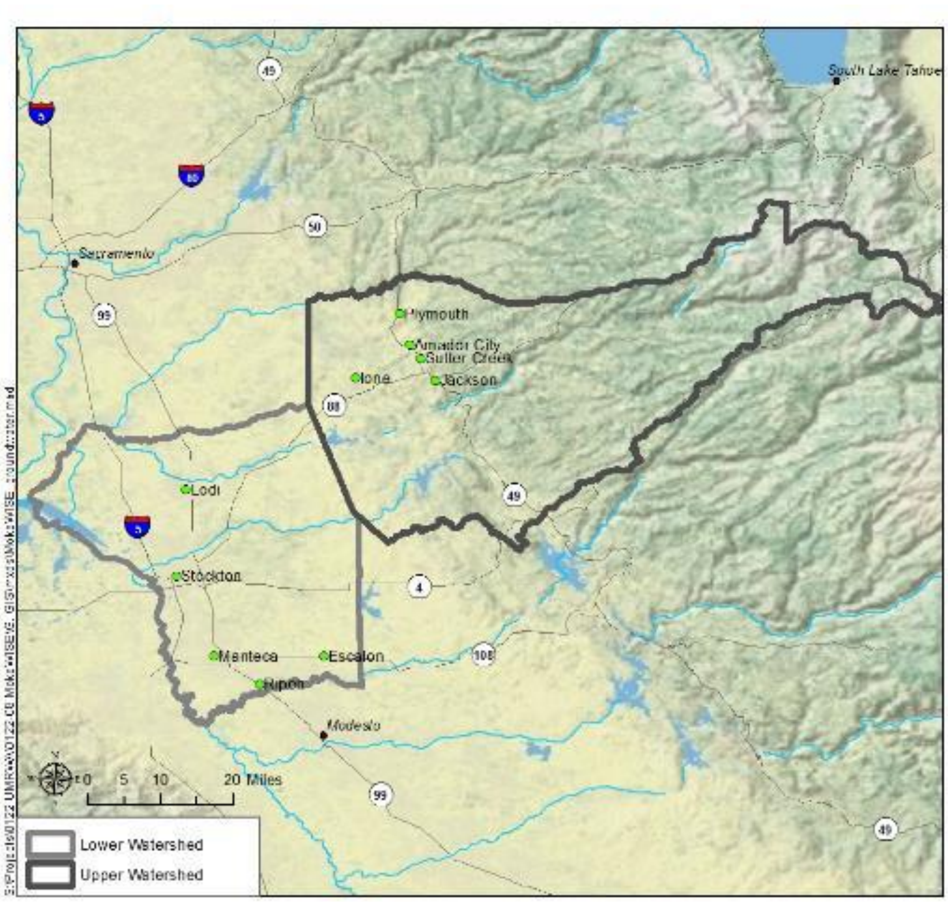
PROJECT:
REGIONAL URBAN WATER CONSERVATION PROGRAM

PROJECT TYPE:
WATER CONSERVATION

SPONSOR(S):
UMRWA, SJC GBA, CITY OF STOCKTON, CITY OF LODI

ESTIMATED COSTS:
$80,000 ($60,000 FOR PLANNING AND $20,000 TO A FUNDING APPLICATION)

LOCATION:



PROJECT SPOTLIGHT

5a: Regional Urban Water Conservation Program

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Data
- Other Human Values
- Environment
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Hydropower
- Nature tourism
- Energy costs
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

5b: Regional Agricultural Water Conservation Program

DESCRIPTION:

The Regional Agriculture Conservation Program will develop a program to reduce agricultural water use through evaluation and testing of agricultural management practices for irrigation water management efficiency. The program will evaluate existing conservation measures and programs already being implemented in the region and identify opportunities for further water efficiency gains. Based on identified opportunities, the program would develop a regional agricultural water conservation plan to implement the identified strategies that would enhance irrigation efficiency. The plan would be used as the basis for pursuing funding opportunities, which would be distributed among participating members to fund program agricultural water conservation project implementation.

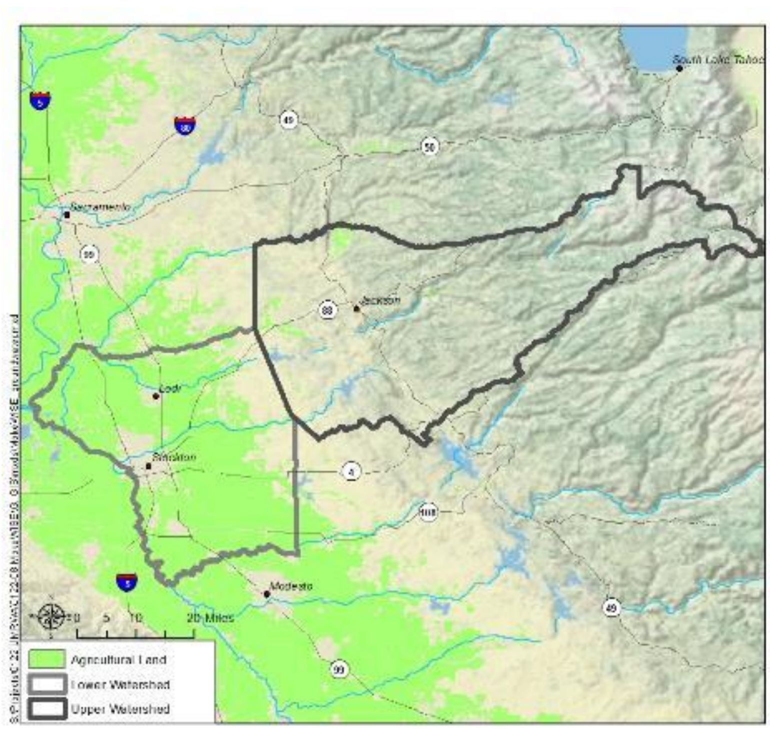
PROJECT:
REGIONAL AGRICULTURAL WATER CONSERVATION PROGRAM

PROJECT TYPE:
WATER CONSERVATION

SPONSOR(S):
SJCRCD

ESTIMATED COSTS:
$100,000 ($80,000 FOR PLANNING AND $20,000 TO A FUNDING APPLICATION)

LOCATION:



* This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix N**.

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Data
- Other Human Values
- Environment
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Hydropower
- Nature tourism
- Energy costs
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

7a: PG&E Reservoir Storage Recovery

DESCRIPTION:

Amador Water Agency uses some of PG&E's hydroelectric reservoirs and related facilities for the Agency's water supply. Unfortunately, erosion, and sedimentation in the Mokelumne watershed has, to varying degrees, gradually filled PG&E reservoirs with sediment. This project will assess the feasibility of and potential environmental effects of removing sediment from seven PG&E reservoirs in the upper Mokelumne watershed.

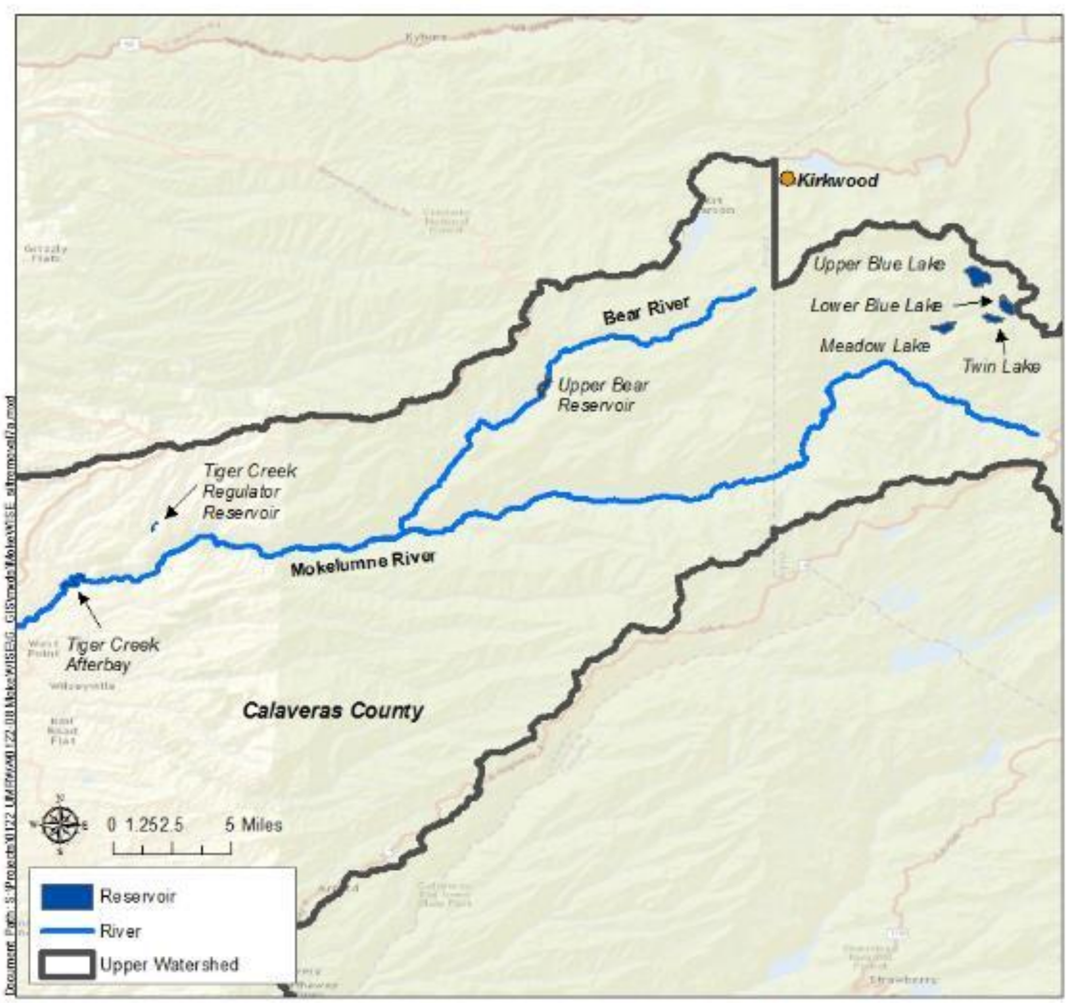
PROJECT:
PG&E RESERVOIR STORAGE RECOVERY

PROJECT TYPE:
STORAGE

SPONSOR(S):
AWA

ESTIMATED COSTS:
$350,000 TO COMPLETE THE STUDY

LOCATION:



PROJECT SPOTLIGHT

7a: PG&E Reservoir Storage Recovery

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Flood Management
- Data
- Other Human Values
- Environment
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Hydropower
- Nature tourism
- Energy costs
- Flood management
- Economic benefits
- Environmental enhancement and habitat restoration

PROJECT SPOTLIGHT

7b: Raise Lower Bear Feasibility Study

DESCRIPTION:

The study will evaluate the feasibility of enlarging Lower Bear Reservoir by raising the existing dam (embankment) by up to 32 feet to increase surface water storage capacity within the upper Mokelumne River watershed and operating the enlarged reservoir to protect the Mokelumne River and its resources consistent with the existing licenses, permits, legal agreements, legal decisions, and operating regimes that currently protect the river's water quality, cultural and historical resources, recreational uses, scenic values. In addition to modifications to the dam itself, the study will evaluate construction of an updated intake structure and spillway, and relocation of adjacent roads and existing recreation facilities. This feasibility study will be a continuation of previous studies and serve to address previously unanswered questions and unresolved issues.

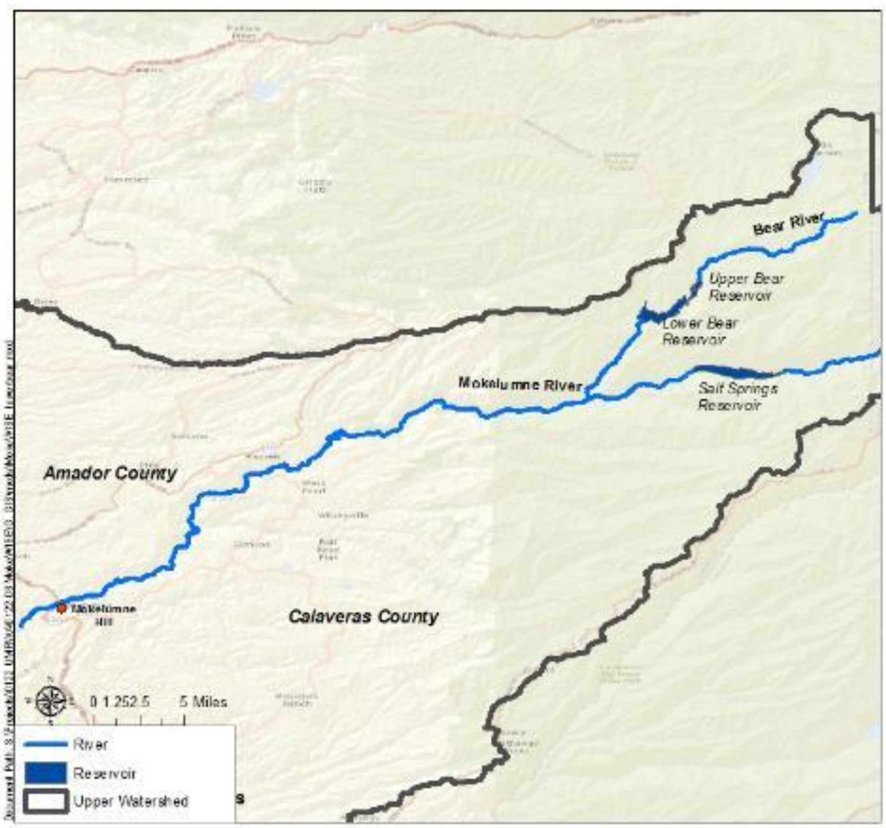
PROJECT:
RAISE LOWER BEAR FEASIBILITY STUDY

PROJECT TYPE:
STORAGE

SPONSOR(S):
AWA, JVID, CCWD, CPUD

ESTIMATED COSTS:
$750,000 TO COMPLETE THE STUDY

LOCATION:



PROJECT SPOTLIGHT

7b: Raise Lower Bear Feasibility Study

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Recreation
- Water Rights
- Flood Management
- Data
- Other Human Values
- Environment
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Recreation
- Hydropower
- Nature tourism
- Energy costs
- Flood management
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

7d: Re-operation of Existing Storage

DESCRIPTION:

The study will evaluate opportunities for re-operating and diversifying existing storage in PG&E's Mokelumne River Project (FERC No. 137) and in East Bay Municipal Utility District's two large storage reservoirs further downstream, consistent with the existing licenses, permits, legal agreements, legal decisions, and operating regimes that currently protect the river's water quality, cultural and historical resources, recreational uses, scenic values.

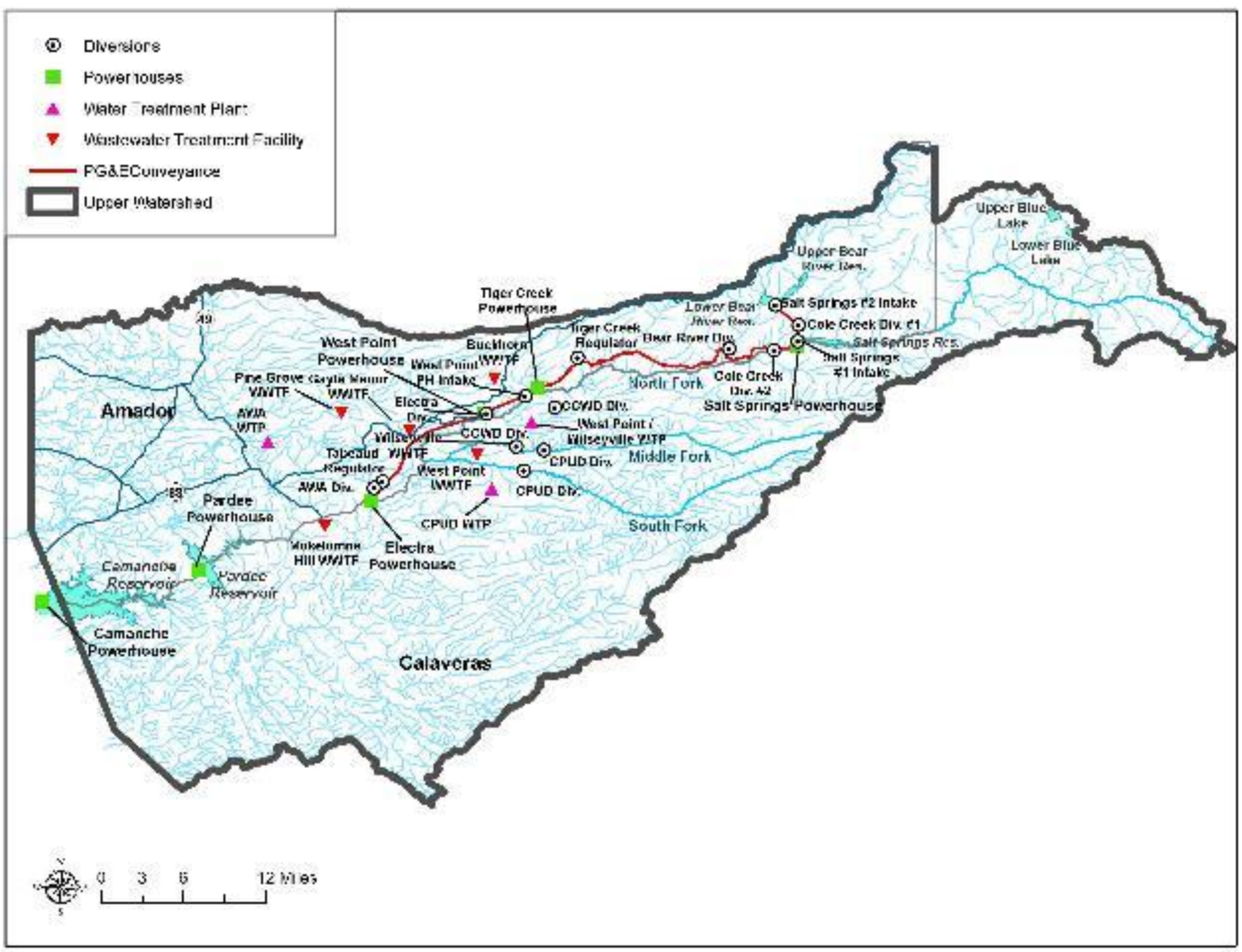
PROJECT:
RE-OPERATION OF EXISTING STORAGE

PROJECT TYPE:
STORAGE

SPONSOR(S):
UMRWA, CSPA (CO-SPONSOR)

ESTIMATED COSTS:
$750,000 TO COMPLETE THE STUDY

LOCATION:



PROJECT SPOTLIGHT

7d: Re-operation of Existing Storage

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Flood Management
- Data
- Other Human Values
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Hydropower
- Nature tourism
- Energy costs
- Flood management
- Economic benefits
- Environmental enhancement and habitat restoration

PROJECT SPOTLIGHT

7f: Reliability and Replacement Assessment for Dams at Blue and Twin Lakes

DESCRIPTION:

Pacific Gas & Electric (PG&E) owns and operates Upper and Lower Blue and Twin Lakes Reservoirs. Total storage capacity of these three reservoirs is 13,176 AF. At present, PG&E nearly empties these reservoirs in the fall because of safety issues in the winter. In addition, all three of the dams on these lakes are classified as an ERRK (earth and rock) type by the California Division of Dam Safety, and could be at risk of failure during a seismic event. This study will evaluate potential to replace these old dams to achieve increased stability during an earthquake and to improve local water supply reliability by providing "carry-over" storage water through the winter.

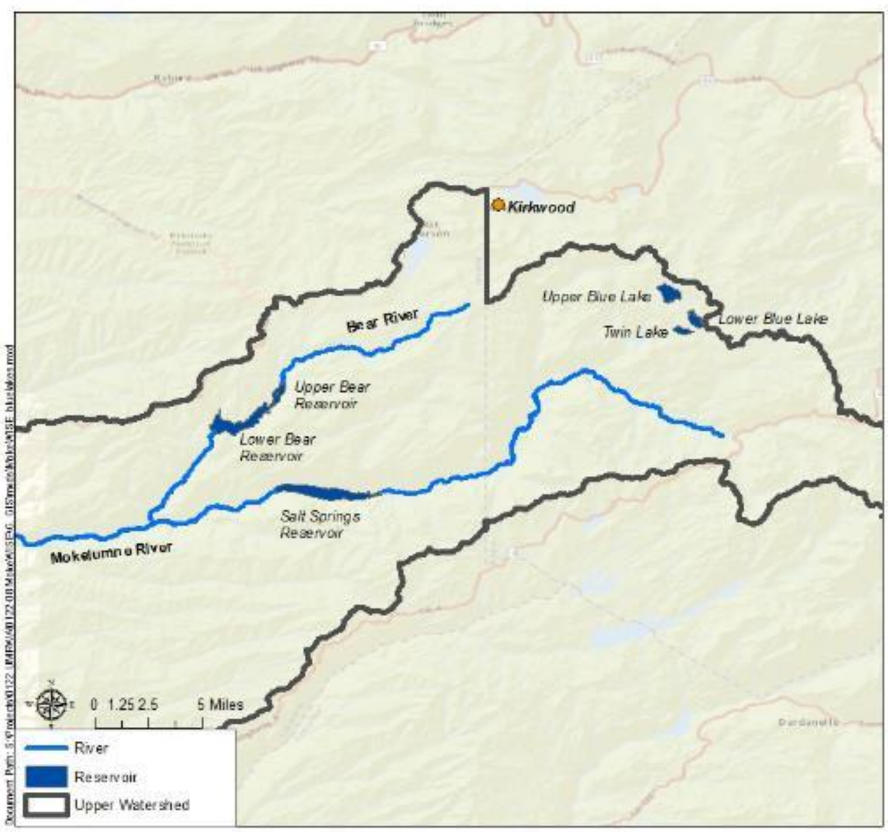
PROJECT:
RELIABILITY AND REPLACEMENT ASSESSMENT FOR DAMS AT BLUE AND TWIN LAKES

PROJECT TYPE:
STORAGE

SPONSOR(S):
AWA

ESTIMATED COSTS:
$2,500,000 TO COMPLETE THE STUDY

LOCATION:



PROJECT SPOTLIGHT

7f: Reliability and Replacement Assessment for Dams at Blue and Twin Lakes

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Flood Management
- Data
- Other Human Values
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Hydropower
- Nature tourism
- Energy costs
- Flood management
- Economic benefits
- Environmental enhancement and habitat restoration

PROJECT SPOTLIGHT

8b: Rehabilitation of Transmission Main

DESCRIPTION:

The Rehabilitation of Transmission Main Project will conduct a study to determine the benefits of replacing all or a portion of the transmission main that conveys treated water from the Jeff Davis Water Treatment Plant (WTP) to Mokelumne Hill, Paloma, and San Andreas. The study will include assessment of areas that are reaching life expectancy, areas of water loss, and recommendations for rehabilitation. Upon completion of the study, the project includes replacing or lining the recommended portions of the current transmission main.

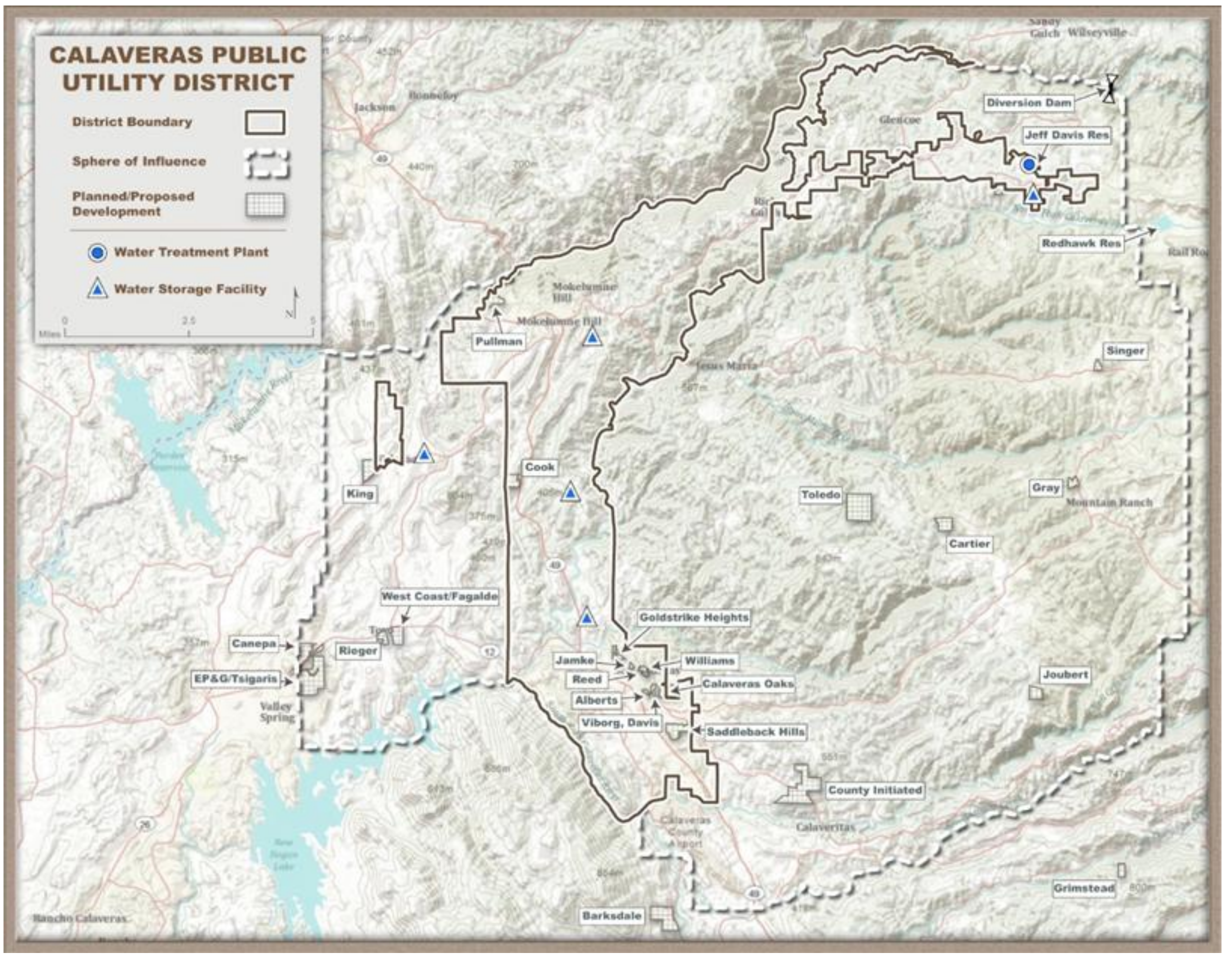
PROJECT:
REHABILITATION OF TRANSMISSION MAIN

PROJECT TYPE:
LOCAL INFRASTRUTURE

SPONSOR(S):
CPUD

ESTIMATED COSTS:
$1.03 MILLION (INCLDUES $30,000 FOR THE STUDY AND $1 MILLION FOR IMPLEMENTATION)

LOCATION:



PROJECT SPOTLIGHT

8b: Rehabilitation of Transmission Main

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Data
- Other Human Values
- Environment
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Hydropower
- Nature tourism
- Energy costs
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

8c: Barney Way Septic System Conversion

DESCRIPTION:

The Barney Way Septic System Conversion Project will convert 40 residences along Barney Way from individual septic systems either to a sanitary sewer, which would convey wastewater to the West Point treatment facility, or to a new community septic system. This would result in the decommissioning or abandoning of existing septic systems. The project includes conducting a preliminary evaluation to determine feasibility, engaging in public outreach, design, permitting, and construction.

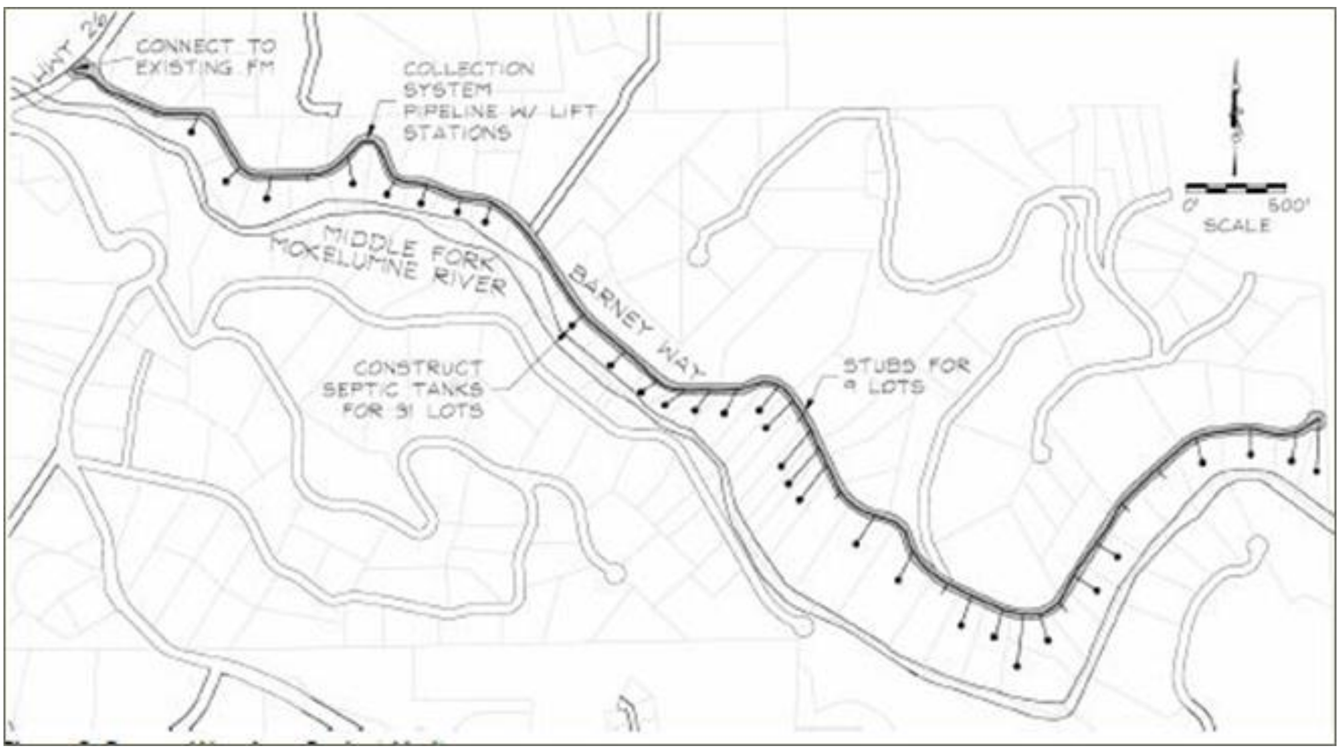
PROJECT:
BARNEY WAY SEPTIC SYSTEM CONVERSION

PROJECT TYPE:
LOCAL INFRASTRUTURE

SPONSOR(S):
CCWD

ESTIMATED COSTS:
$4.3 MILLION (INCLUDES PLANNING, ENGINEERING, CONSTRUCTION, AND A 10% CONTINGENCY)

LOCATION:



PROJECT SPOTLIGHT

8c: Barney Way Septic System Conversion

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Quality
- Data
- Other Human Values
- Environment
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Nature tourism
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT

8d: Lake Camanche Village Recycled Water Project

DESCRIPTION:

The Lake Camanche Village Recycled Water project will develop a study to explore the feasibility of upgrading the Lake Camanche Wastewater Treatment Plant (WWTP) to tertiary treatment and providing recycled water for local use. The feasibility study will include a treatment plant update assessment and demand assessment. The study would also identify project alternatives and conduct an alternatives assessment in order to select a preferred alternative.

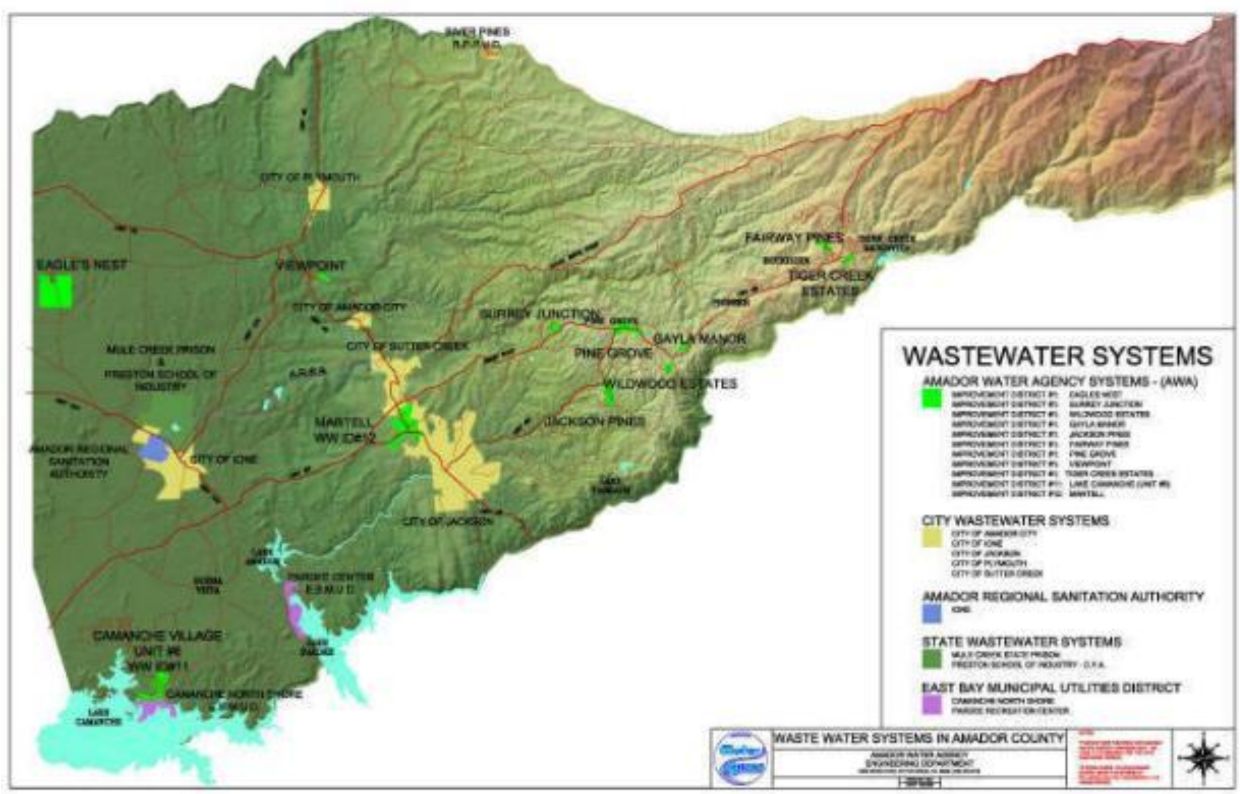
PROJECT:
LAKE CAMANCHE VILLAGE RECYCLED WATER PROJECT

PROJECT TYPE:
LOCAL INFRASTRUCTURE

SPONSOR(S):
AWA

ESTIMATED COSTS:
$150,000 FOR PLANNING

LOCATION:



PROJECT SPOTLIGHT

8d: Lake Camanche Village Recycled Water Project

MOKEWISE PROGRAM OBJECTIVES POTENTIALLY ACHIEVED BY THE PROJECT:

- Water Supply/Water Resources
- Water Quality
- Data
- Other Human Values
- Environment
- Agricultural Benefits
- Collaboration
- Avoids Consequences

BENEFITS POTENTIALLY ACHIEVED BY THE PROJECT:

- Municipal and industrial water supply
- Agricultural water supply
- Hydropower
- Nature tourism
- Energy costs
- Economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

PROJECT SPOTLIGHT
Policies and Initiatives

POLICY 9A: LAND USE COORDINATION

Sponsors: CPC, MyValleySprings.com

Description: MokeWISE Stakeholders support a more defined and transparent approach to improving the coordination between willing water agencies and local land use agencies to ensure that there is adequate water supply to serve existing and future needs and the public interest.

POLICY 9B: SUSTAINABLE FOREST - WATERSHED MANAGEMENT PROJECT

Sponsor: none identified

Description: MokeWISE Stakeholders support the development and implementation of sustainable forestry practices within the upper portion(s) of the Mokelumne River Watershed. MokeWISE Stakeholders support the Amador-Calaveras Consensus Group's Principles and Policies to Guide Operation as adopted on August 18, 2010.

POLICY 9C: WATERSHED COORDINATOR

Sponsor: SJCRCD and UMRWA

Description: MokeWISE Stakeholders support funding efforts to retain one or more watershed coordinators to work under the direction of the San Joaquin County Resource Conservation District (lower watershed) and/or UMRWA (upper watershed) to facilitate collaborative interregional efforts to improve and sustain the health of the Mokelumne Watershed.

POLICY 9F: MOKEWISE PROJECT PUBLIC INVOLVEMENT INITIATIVE

Sponsor: UMRWA and the GBA

Description: MokeWISE stakeholders support ongoing participation of interested stakeholders and members of the public to oversee MokeWISE implementation and track implementation of individual MokeWISE projects. Continuing engagement with former Mokelumne Collaborative Group (MCG) members and the public on a regular basis constitutes an important element needed for success of MokeWISE projects.

PROGRAM COSTS AND ANTICIPATED BENEFITS

As discussed previously, MokeWISE projects and initiatives were identified for implementation in the MokeWISE program based on their ability to provide significant value to the Region. The projects, together, would achieve program objectives developed by the MCG and discussed in **Section 3** of this document.

The implementation projects that included implementation elements and had a well-defined project area underwent a preliminary cultural assessment. These projects included Project 1a (Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir), Project 1c (Mokelumne River Day Use Area Floodplain Habitat Restoration Project), and Project 8b (Rehabilitation of Transmission Main).

A records search was performed on 8,400 acres and found that 34 cultural resource studies have been performed, which cover 37% of the 8,400 acre area. Results of the cultural assessment identify 24 archeological resources within this area. Of these, 17 are historic-era, four are pre-historic, and three contain both historic and prehistoric components. Most of the historic-era sites are related to mining activities and associated settlements along the Mokelumne River. In addition, the historic-era resources include a rock foundation, a bridge, a highway culvert, and historic landscaping. The prehistoric resources are primarily food production sites, with at least one site having a small habitation area. The three resources with both historic and prehistoric archeological deposits and features include remains from historic settlements, homesteads, and mining camp operations, built in area containing other prehistoric bedrock milling sites.

CEQA Guidelines require that the significance of potential project impacts to these cultural resources needs to be considered. Public agencies must avoid damaging effects on these cultural resources whenever feasible. If avoidance is not feasible, the significance of the resource shall be evaluated to determine impacts and develop mitigation measures.

In total, full implementation of the MokeWISE program would be expected to cost more than $100,000,000. Benefits of program implementation would be expected to include:

- Enhanced municipal and industrial water supply
- Enhanced agricultural water supply
- Improved recreation
- Increased hydropower generation
- Increased opportunities for nature tourism
- Reduced energy costs
- Improved flood management

- Local economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

Table 10 summarizes anticipated project costs, type and extent of potential project benefits. Additional project information and analysis would be required to determine the extent and magnitude of benefits. Those projects with an asterisk are studies and do not have implementation components. For these projects, the benefits are estimated and assume implementation of study outcomes.

TABLE 10: ESTIMATED MOKEWISE PROJECT COSTS AND POTENTIAL BENEFITS

PROJECT	ESTIMATED PROJECT COST	MUNICIPAL AND INDUSTRIAL WATER SUPPLY	AGRICULTURAL WATER SUPPLY	RECREATION	HYDROPOWER	NATURE TOURISM	ENERGY COST	FLOOD MGMT	ECONOMIC BENEFITS	ENVIRONMENTAL ENHANCEMENT AND HABITAT RESTORATION	IMPROVED SOURCE WATER QUALITY
1a Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir	$180,000 (includes $80,000 for planning and $100,000 for implementation)			✓		✓			✓	✓	
		The project would provide recreation benefits by increasing angling opportunities in the upper watershed. This could also create additional nature tourism opportunities. Increased tourism could provide economic benefits. The project will contribute to increased fish habitat in the upper watershed.									
1b High Country Meadow Restoration Program	$40,000 for assessment plus $10,000 per acre restored	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		The project would provide water supply benefits to municipal and agricultural customers by mitigating flood flows and increasing the portion of flood water able to be stored for later use. Increasing water in the system could provide hydropower benefits, which could lead to reduced energy costs. Reducing flood peaks could provide flood management benefits. Creation of new meadows could increase recreation and nature tourism opportunities. Increased tourism could provide economic benefits. The project would enhance the environment and habitat in the upper watershed by creating/restoring meadows. Water quality could be enhanced by greater natural filtration.									
1c Mokelumne River Day Use Area Floodplain Habitat Restoration Project	$150,000 (including $111,000 for implementation and 30% contingency)			✓		✓		✓	✓	✓	✓
		The project would restore floodplain downstream of Camanche Reservoir, thereby mitigating flood flows. Reducing flood peaks could provide flood management benefits. Creation of new meadows could increase recreation and nature tourism opportunities. Increased tourism could provide economic benefits. The project would enhance the environment and habitat in the upper watershed by restoring the floodplain. Water quality could be enhanced by greater natural filtration.									
1d Fish Screens for Riparian Diversions in the Lower Mokelumne	$300,000 for the preliminary assessment and prioritization plus $10,000 per cubic feet per second (cfs) of diversions screened	✓	✓	✓		✓			✓	✓	
		The project would increase supply reliability by assuring diverters that their use of the diversion would not be restricted due to potential impacts to fish. Implementing fish screens on currently unscreened lower Mokelumne River diversions would reduce entrapment and entrainment, leading to enhanced fish populations and associated recreation and nature tourism benefits. Increased tourism could provide economic benefits. By reducing entrapment and entrainment issues, the project would provide enhanced fish habitat.									
1f Riparian Restoration Program – Below Camanche	$10,000 for ranking and evaluation of proposed restoration sites plus $8,000 per acre restored	✓	✓	✓		✓		✓	✓	✓	✓
		The project provide groundwater recharge opportunities which would help water supply for municipal, industrial, and agricultural uses. The project would restore riparian habitat downstream of Camanche Reservoir, providing environmental restoration and potential flood management benefits. This could result in enhanced recreational opportunities associated with improved habitat and environmental conditions, and an associated increase in nature tourism. Increased tourism could provide economic benefits. Water quality could be enhanced by greater natural filtration.									
1g Mokelumne Water Quality, Soil Erosion, & Sedimentation Inventory/Monitoring	$1,080,000 for planning, inventory, mapping, assessment of erosion-sedimentation reduction options, prioritization, stakeholder coordination, publishing the results, and outreach	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		The project would improve water quality by addressing erosion and reduce sediment loading to the Mokelumne River. This could provide supply, flood management, and hydropower benefits by reducing reservoir siltation and reducing cost of filtering water for domestic use. Hydropower benefits could in turn lead to reduced energy costs. Improved water quality resulting from reduced sediment loading could result in improved habitat and associated nature tourism, as well as related recreational opportunities. Increased tourism could provide economic benefits.									
2a Municipal Recycled Wastewater Recharge Program	$150,000 for the feasibility study and $15 million for implementation	✓	✓						✓		✓
		Using recycled water provides a supply benefit by increasing overall supply availability. Recycled water can help reduce utility rates, which would provide an economic benefit. The project improves water quality by recharging the groundwater basin, which would dilute harmful constituents.									

TABLE 10: ESTIMATED MOKEWISE PROJECT COSTS AND POTENTIAL BENEFITS

PROJECT	ESTIMATED PROJECT COST	MUNICIPAL AND INDUSTRIAL WATER SUPPLY	AGRICULTURAL WATER SUPPLY	RECREATION	HYDROPOWER	NATURE TOURISM	ENERGY COST	FLOOD MGMT	ECONOMIC BENEFITS	ENVIRONMENTAL ENHANCEMENT AND HABITAT RESTORATION	IMPROVED SOURCE WATER QUALITY
2b Constellation Winery Wastewater Reuse	$35,000 for the conceptual design report, $100,000 for securing the Waste Discharge Report permit, $25,000 for securing funding, and $16 million for construction	✓	✓						✓	✓	✓
		Using recycled water provides a supply benefit by increasing overall supply availability. If recycled water use offsets Mokelumne River supplies, leaving additional supply in the river, the project could provide a recreational benefit associated with improving instream habitat. Increased recreation can provide an economic benefit. If the project reduces withdrawals from the Mokelumne River, there would be an environmental impact associated with greater instream flows. Greater instream flows would provide a water quality benefit.									
2c Amador County Regional Reuse	$400,000 for the refinement study and $21.35 million for implementation	✓	✓		✓		✓		✓		✓
		Using recycled water in the upper watershed provides a supply benefit by increasing overall supply availability and could provide hydropower benefits if the recycled water supply is used in lieu of Mokelumne River supply. If there is a hydropower benefit, this could result in reduced energy costs. Reduced energy costs can provide an economic benefit. If the project reduces withdrawals from the Mokelumne River, there could be a water quality benefit to the River associated with greater instream flows.									
4a Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*	$3,605,000 for study preparation	✓	✓	✓				✓	✓	✓	✓
		Implementing groundwater recharge could provide a supply benefit by increasing overall ability to store available supplies for use when needed. Having improved supply reliability provides a recreation benefit (and associated economic benefit) by potentially leaving additional supply in the Mokelumne River when being conveyed for groundwater storage. Increased groundwater levels can result in enhanced environmental conditions, which generates a recreation and nature tourism benefit. Managing flood flows for recharge could provide a flood management benefit. If the project reduces withdrawals from the Mokelumne River during certain year types, there could be a water quality benefit to the River associated with greater instream flows.									
4b Amador and Calaveras Counties Hydrologic Assessment*	$600,000 for study preparation	✓	✓	✓					✓	✓	✓
		Completing the hydrologic assessment could enable expanded groundwater use and/or groundwater banking in the upper watershed. Implementing groundwater recharge could provide a supply benefit by increasing overall ability to store available supplies for use when needed. Having improved supply reliability provides a recreation benefit (and associated economic benefit) by potentially leaving additional supply in the Mokelumne River when being conveyed for groundwater storage. Increased groundwater levels can result in enhanced environmental conditions, which generates a recreation and nature tourism benefit. If the project reduces withdrawals from the Mokelumne River during certain year types, there could be a water quality benefit to the River associated with greater instream flows.									
4d NSJWCD Infrastructure Improvements	$20,000,000 for implementation		✓						✓		✓
		The project would enable NSJWCD to use surface water in lieu of groundwater when it is available. This could provide a supply benefit by increasing overall ability offset groundwater pumping, which has associated economic benefits of reduced pumping. Increased groundwater levels can dilute constituents, which can result in increased water quality.									
5a Regional Urban Water Conservation Program	$80,000 (includes $60,000 for planning and $20,000 to prepare materials for a funding application)	✓			✓	✓	✓		✓	✓	✓
		Conserving water can reduce withdrawals from the Mokelumne River, providing a supply benefit by increasing overall supply availability and a potential hydropower benefit by reducing withdrawals from the Mokelumne River. If there is a hydropower benefit, this could result in reduced energy costs. Reducing River withdrawals could result in improved water quality associated with increased in stream flow and associated environmental and habitat improvement. Improved habitat could provide an increase in nature tourism and associated economic benefit.									
5b Regional Agriculture Conservation Program[7]	$100,000 (includes $80,000 for planning and $20,000 to prepare materials for a funding application)		✓		✓	✓	✓		✓	✓	✓
		Conserving water can reduce withdrawals from the Mokelumne River, providing a supply benefit by increasing overall supply availability and a potential hydropower benefit by reducing withdrawals from the Mokelumne River. If there is a hydropower benefit, this could result in reduced energy costs. Reducing River withdrawals could result in improved water quality associated with increased in stream flow and associated environmental and habitat improvement. Improved habitat could provide an increase in nature tourism and associated economic benefit.									

[7] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix N**.

TABLE 10: ESTIMATED MOKEWISE PROJECT COSTS AND POTENTIAL BENEFITS

PROJECT	ESTIMATED PROJECT COST	MUNICIPAL AND INDUSTRIAL WATER SUPPLY	AGRICULTURAL WATER SUPPLY	RECREATION	HYDROPOWER	NATURE TOURISM	ENERGY COST	FLOOD MGMT	ECONOMIC BENEFITS	ENVIRONMENTAL ENHANCEMENT AND HABITAT RESTORATION	IMPROVED SOURCE WATER QUALITY
7a PG&E Storage Recovery*	$350,000 for study preparation	✓	✓		✓	✓	✓	✓	✓	✓	
		Increasing existing storage by desilting reservoirs would provide a supply benefit by increasing available storage. Capturing additional supply could provide increased instream flows for fisheries and environmental purposes when needed. Improved environmental conditions could result in increased nature tourism. Ability to capture and manage flood flows would be enhanced with greater storage capability. In addition, hydropower operations could be enhanced, resulting in a potential decrease in energy costs, which could yield economic benefits.									
7b Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering*	$750,000 for study preparation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Increasing existing storage by raising Lower Bear Reservoir could provide a supply benefit by increasing available storage. Capturing additional supply could provide a recreational benefit by providing increased instream flows for fisheries and environmental purposes when needed. Improved environmental conditions could result in increased nature tourism. Increased instream flows could provide enhanced recreational opportunities and associated economic benefits. Ability to capture and manage flood flows would be enhanced with greater storage capability. In addition, hydropower operations could be enhanced, resulting in a potential decrease in energy costs.									
7d Re-operation of Existing Storage*	$750,000 for study preparation	✓	✓		✓	✓	✓	✓	✓	✓	
		Optimizing existing storage through reoperation of existing reservoirs could provide a supply benefit by increasing/optimizing available storage capacity. Capturing additional supply could provide a recreational benefit by providing increased instream flows for fisheries and environmental purposes when needed. Improved environmental conditions could result in increased nature tourism. Increased instream flows could provide enhanced recreational opportunities and associated economic benefits. Ability to capture and manage flood flows would be enhanced with greater storage capability. In addition, hydropower operations could be enhanced, resulting in a potential decrease in energy costs.									
7f Blue and Twin Lakes Dams Reliability and Replacement Assessment*	$2,500,000 for study preparation	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		This project would reduce the possible earthquake risk associated with one or more of these dams and allow carryover storage, increasing supply reliability and available storage for the entire Mokelumne River system. This could provide a supply benefit by increasing available storage capacity. Capturing additional supply could increase instream flows for fisheries and environmental purposes when needed. Improved environmental conditions could result in increased nature tourism, recreation, and associated economic benefits. Ability to capture and manage flood flows would be enhanced with greater storage capability. In addition, hydropower operations could be enhanced, resulting in a potential decrease in energy costs.									
8b Rehab of Transmission Main	$1,030,000 ((includes $30,000 for planning and $1 million for implementation)	✓	✓		✓	✓	✓		✓	✓	✓
		Rehab of this transmission main would provide a water conservation benefit. Conserving water can reduce withdrawals from the Mokelumne River, providing a supply benefit by increasing overall supply availability and a potential hydropower benefit by reducing withdrawals from the Mokelumne River. If there is a hydropower benefit, this could result in reduced energy costs. Reducing River withdrawals could result in improved water quality associated with increased in stream flow and associated environmental and habitat improvement. Improved habitat could provide greater recreational opportunities and an increase in nature tourism and associated economic benefit.									
8c Barney Way Septic System Conversion	$4.3 million (includes planning, engineering, construction, and a 10% contingency)					✓			✓	✓	✓
		Reducing pollution to the Mokelumne River associated with failing onsite septic systems could provide a water quality benefit, which could in turn provide environmental and habitat improvements. These improvements could generate increased recreational and nature tourism opportunities and an associated economic benefit.									
8d Lake Camanche Village Recycled Water Project*	$150,000 for study preparation	✓	✓		✓	✓	✓		✓	✓	✓
		Using recycled water in the upper watershed provides a supply benefit by increasing overall supply availability and could provide hydropower benefits if the recycled water supply is used in lieu of Mokelumne River supply. If there is a hydropower benefit, this could result in reduced energy costs. If the recycled water offsets Mokelumne River supplies, leaving additional supply in the river, the project could increase recreation and provide an economic benefit. If the project reduces withdrawals from the Mokelumne River, there could be a water quality benefit to the River associated with greater instream flows.									

* These projects are studies and do not have implementation components.

The benefits of implementing the MokeWISE program would be expected to accrue to a wide variety of parties, including the following.

- Amador Water Agency
- Calaveras County Water District
- Calaveras Public Utility District
- East Bay Municipal Utility District
- City of Lodi
- Jackson Valley Irrigation District
- North San Joaquin Water Conservation District
- City of Stockton
- Stockton East Water District
- Woodbridge Irrigation District
- San Joaquin County
- General public in the upper watershed
- General public in the lower watershed
- Natural environment in the upper watershed
- Natural environment in the lower watershed

Table 11 identifies which beneficiaries would be expected to receive the benefits identified above; those denoted with an asterisk are studies and do not include implementation components.

TABLE 11: POTENTIAL MOKEWISE PROJECT BENEFICIARIES

MOKEWISE PROJECT	POTENTIAL PROJECT BENEFICIARIES													
	AWA	CCWD	CPUD	EBMUD	CITY OF LODI	JVID	NSJ WCD	CITY OF STOCKTON	SEWD	WID	GENERAL PUBLIC IN THE UPPER WATERSHED	GENERAL PUBLIC IN THE LOWER WATERSHED	NATURAL ENVIRONMENT IN THE UPPER WATERSHED	NATURAL ENVIRONMENT IN THE LOWER WATERSHED
1a Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir											✓	✓	✓	✓
1b High Country Meadow Restoration Program	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1c Mokelumne River Day Use Area Floodplain Habitat Restoration Project					✓		✓	✓	✓	✓		✓		✓
1d Fish Screens for Riparian Diversions in the Lower Mokelumne												✓		✓
1f Riparian Restoration Program – Below Camanche												✓		✓
1g Mokelumne Water Quality, Soil Erosion, & Sedimentation Inventory/Monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2a Municipal Recycled Wastewater Recharge Program					✓					✓		✓		✓
2b Constellation Winery Wastewater Reuse												✓		✓
2c Amador County Regional Reuse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4a Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4b Amador and Calaveras Counties Hydrologic Assessment*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4d NSJWCD Infrastructure Improvements							✓	✓	✓	✓		✓		✓
5a Regional Urban Water Conservation Program	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5b Regional Agriculture Conservation Program[8]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7a PG&E Storage Recovery*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7b Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7d Re-operation of Existing Storage*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7f Blue and Twin Lakes Dams Reliability and Replacement Assessment*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8b Rehab of Transmission Main	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8c Barney Way Septic System Conversion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8d Lake Camanche Village Recycled Water Project*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

[8] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix N.**

CLIMATE CHANGE BENEFITS

In addition to the benefits identified above, the implementation projects would be expected to provide significant climate change adaptation and mitigation benefits to the regions. **Table 12** summarizes potential climate change adaptation and mitigation benefits projected to be generated through program implementation.

TABLE 12: POTENTIAL CLIMATE CHANGE BENEFITS

PROJECT	RELATED VULNERABILITIES	RMS IMPLEMENTED	GHG MITIGATION EFFECTS
1a. Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir	• Impacted ecosystem and habitat	• Ecosystem Restoration • Water-Dependent Recreation	• None
1b. High Country Meadow Restoration Program	• Degraded surface water and groundwater quality Impacted ecosystems and habitat	• Ecosystem Restoration • Recharge Area Protection • Watershed Management • Flood Risk Management	• Carbon Sequestration
1c. Mokelumne River Day Use Area Floodplain Habitat Restoration Project	• Increased flooding • Impacted ecosystem and habitat	• Ecosystem Restoration • Recharge Area Protection • Watershed Management • Flood Risk Management	• Carbon Sequestration
1d. Fish Screens for Riparian Diversions in the Lower Mokelumne River	• Impacted ecosystems and habitat	• Ecosystem Restoration • Watershed Management	• None
1f. Riparian Restoration Program – Below Camanche River	• Degraded surface water and groundwater quality Increased flooding • Impacted ecosystems and habitat	• Ecosystem Restoration • Recharge Area Protection • Watershed Management • Flood Risk Management	• Carbon Sequestration
1g. Mokelumne Water Quality, Soil Erosion & Sedimentation Inventory/ Monitoring	• Decreased surface water quality	• Sediment Management • Watershed Management	• None

TABLE 12: POTENTIAL CLIMATE CHANGE BENEFITS

PROJECT	RELATED VULNERABILITIES	RMS IMPLEMENTED	GHG MITIGATION EFFECTS
2a. Municipal Recycled Wastewater Recharge Program	• Decreased water supply/Water table decline • Degraded surface water and groundwater quality	• Conjunctive Management and Groundwater Storage • Recycled Municipal Water • Matching Quality to Use • Pollution Prevention	• Energy Efficiency • Emissions Reduction
2b.Woodbridge Winery Wastewater Reuse	• Decreased water supply • Degraded surface water and groundwater quality	• Conjunctive Management and Groundwater Storage • Recycled Municipal Water • Matching Quality to Use • Pollution Prevention	• Energy Efficiency • Emissions Reduction
2c. Amador County Reuse	• Decreased water supply • Degraded surface water and groundwater quality	• Recycled Municipal Water • Matching Quality to Use • Pollution Prevention	• Energy Efficiency • Emissions Reduction
4a. Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*	• Decreased water supply/Water table decline • Degraded surface water and groundwater quality	• Water Transfers • Conjunctive Management and Groundwater Storage • Recharge Area Protection	• Energy Efficiency • Emissions Reduction
4b. Amador and Calaveras Counties Hydrologic Assessment*	• Decreased water supply/Water table decline • Degraded surface and groundwater quality	• Water Transfers • Conjunctive Management and Groundwater Storage • Flood Risk Management	• Energy Efficiency • Emissions Reduction

TABLE 12: POTENTIAL CLIMATE CHANGE BENEFITS

PROJECT	RELATED VULNERABILITIES	RMS IMPLEMENTED	GHG MITIGATION EFFECTS
4d. NSJWCD Infrastructure Improvements	• Decreased water supply/Decreased water supply/Water table decline	• Conveyance – Regional/Local • Conjunctive Management and Groundwater Storage • Recharge Area Protection	• Energy Efficiency • Emissions Reduction
5a. Regional Urban Water Conservation Program	• Increased domestic/urban and commercial, industrial and institutional (CII) demands • Degraded surface water and groundwater quality	• Urban Water Use Efficiency • Matching Quality to Use • Pollution Prevention • Urban Runoff Management • Economic Incentives	• Energy Efficiency • Emissions Reduction
5b. Regional Agriculture Conservation Program[9]	• Increased agricultural demands • Degraded surface water and groundwater quality	• Agricultural Water Use Efficiency	• Energy Efficiency • Emissions Reduction • Carbon Sequestration
7a. PG&E Storage Recovery*	• Decreased water supply • Increased seasonal flooding	• Surface Storage – Regional/Local • Flood Risk Management	• Energy Efficiency • Emissions Reduction
7b. Raise Lower Bear Feasibility Study*	• Decreased water supply • Increased seasonal flooding	• System Reoperation • Water Transfers • Conjunctive Management and Groundwater Storage • Surface Storage – Regional/Local • Watershed Management • Flood Risk Management	• Energy Efficiency • Emissions Reduction •

[9] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix N**.

TABLE 12: POTENTIAL CLIMATE CHANGE BENEFITS

PROJECT	RELATED VULNERABILITIES	RMS IMPLEMENTED	GHG MITIGATION EFFECTS
7d. Re-operation of Existing Storage*	• Increased seasonal flooding • Reduced hydropower generation	• System Reoperation • Surface Storage – Regional/Local • Flood Risk Management	• Energy Efficiency • Emissions Reduction
7f. Blue & Twin Lakes Dams Reliability & Replacement Assessment*	• Decreased water supply • Increased seasonal floods	• Surface Storage – Regional/Local • Flood Risk Management	• Energy Efficiency • Emissions Reduction
8b. Rehabilitation of Transmission Main	• Decreased water supply	• Urban Water Use Efficiency • Conveyance – Regional/Local	• Energy Efficiency • Emissions Reduction
8c. Barney Way Septic System Conversion	• Decreased water supply • Degraded surface water and groundwater quality	• Pollution Prevention • Recharge Area Protection	• None
8d. Camanche Village Recycled Water Project*	• Decreased water supply • Degraded surface water and groundwater quality	• Recycled Municipal Water • Matching Quality to Use • Pollution Prevention	• Energy Efficiency • Emissions Reduction

* These projects are studies and do not have implementation components.

6 IMPLEMENTATION PLAN

Implementation Plan

As discussed in **Section 5**, the MCG implemented a multi-step process over a series of months to identify and develop projects that, together, have the potential to provide a significant range and magnitude of water resources benefits to the upper and lower watersheds. This section identifies the pathway to implement the MokeWISE Program. Key components of the implementation plan include:

- **Institutional Arrangements**. Following completion of the MokeWISE program development process, new institutional arrangements must be identified and implemented to oversee and further program implementation. This section provides an overview of the recommended institutional arrangements for program implementation as well as initial steps needed to implement the recommended arrangements.
- **Project Implementation Approach and Considerations.** Each project is currently at a different state of development and carries with it a unique set of requirements and considerations for implementation. This section identifies potential considerations for implementing the projects identified in the MokeWISE Program.

INSTITUTIONAL ARRANGEMENTS

To achieve MokeWISE Program implementation, it is necessary to establish an institutional arrangement capable of securing funding, and facilitating and overseeing project implementation. The institutional arrangement must have the following attributes:

9. Legal ability to apply for and accept state and other grant funding
10. Authority and administrative capacity to; enter into contracts, account for receipt and expenditure of funds, and implement water resource projects
11. Commitment to ensure continued opportunities for meaningful input from stakeholders and the public

The MCG considered six potential arrangement options for project implementation, including three inter-regional approaches and three bi-regional approaches centered on either a Joint Powers Authority (JPA) or MOU structure. The MCG formed a workgroup to recommend a preferred approach. Based on the workgroup's recommendations and subsequent discussion, the MCG identified that implementation structure which would potentially be most beneficial for project implementation while providing an appropriate level of involvement by key stakeholders and interested parties.

The MCG determined that the preferred approach would involve two main tiers of responsibility. One tier would be responsible for pursuing funding for and facilitating the implementation of projects and programs (Implementation Tier), and the other tier would be responsible for providing input and serving in an advisory capacity to the implementation tier (Stakeholder and Public Involvement Tier). These tiers would be organized as follows.

Implementation Tier

The Implementation Tier of the proposed institutional arrangement would be achieved through an MOU between the GBA and UMRWA. The MOU would specify that the GBA and UMRWA would act as the lead agencies for soliciting, securing, and administering funding for projects being implemented in each of their regions, respectively. The MOU would characterize the roles and responsibilities of all the MOU signatories and would specify that project sponsors would be ultimately responsible for implementing their respective projects. Project sponsors and other governmental and non-governmental stakeholders would also be able to sign on to the MOU but would not be required to do so.

If funding were secured by UMRWA or the GBA for a project, a separate contractual agreement would be developed between UMRWA or GBA and the project sponsor, as appropriate, to clearly articulate the funding agreement terms, conditions, and requirements. It should be noted that being included in the MokeWISE implementation plan does not mean that a project cannot be initiated by a project sponsor independently from this process. It simply means that the project is a high priority for the region and that the institutional group, charged with implementing MokeWISE will lead or assist in pursuing funding for the project, as appropriate and in coordination with the project sponsor.

Stakeholder and Public Involvement Tier

The Stakeholder and Public Involvement Tier of the proposed institutional arrangement would engage at two levels of MokeWISE implementation.

At the region level, existing committees (the Regional Participants Committee in the MAC Region and the GBA Coordinating Committee in the ESJ Region) would advise the Implementation Tier on what projects to pursue funding for, changing needs for program implementation, etc. within each region.

At the inter-regional level, a MCG legacy stakeholder group will be co-hosted annually by the GBA and UMRWA. This MCG legacy stakeholder group would presumably include current MCG members and potentially other members not currently involved in the process, including individual members of the public. The legacy stakeholder group would adopt or adapt the MCG's protocols for decision-making and organization, and would meet at least annually to review MokeWISE implementation. Recommendations made by the legacy stakeholder group would be brought back to and considered by both the existing committees within each region and the Implementation Tier. As determined appropriate by the MCG legacy stakeholder group, public workshops may be held to provide status updates and solicit input from the public on the projects being implemented, similar to those being held under the current structure used by the MCG.

The first step in implementing the institutional arrangement recommended by the MCG involves drafting an MOU outlining the roles and responsibilities of the individual parties. **Table 13** summarizes roles and responsibilities of each party involved in the institutional structure. Sample MOUs for several Regional Water Management Groups have been provided in **Appendix P** for use as a basis when developing an MOU for MokeWISE implementation.

TABLE 13: INSTITUTIONAL ARRANGEMENTS ROLES AND RESPONSIBILITIES

MEMBER	ROLE/REPONSIBILITIES
IMPLEMENTATION TIER	
UMRWA	• Enters into MOU with GBA to administer MokeWISE program implementation for upper watershed projects • Solicits input from stakeholders and public related to upper watershed MokeWISE implementation projects for grant funding • Pursues and administers grant funding for upper watershed MokeWISE implementation projects • Contracts with project sponsors to provide funding for implementation of upper watershed MokeWISE implementation projects • Reports to DWR on project implementation status for upper watershed projects on behalf of the project sponsors • Works with GBA to convene annual MCG legacy stakeholder group meetings
GBA	• Enters into MOU with UMRWA to administer MokeWISE program implementation for lower watershed projects • Solicits input from stakeholders and public related to lower watershed MokeWISE implementation projects for grant funding • Pursues and administers grant funding for lower watershed MokeWISE implementation projects • Contracts with project sponsors to provide funding for implementation of lower watershed MokeWISE implementation projects • Reports to DWR on project implementation status for lower watershed projects on behalf of the project sponsors • Works with UMRWA to convene annual MCG legacy stakeholder group meetings
Project Sponsors	• May sign onto MOU with UMRWA and GBA (optional) • Contract with UMRWA or GBA as appropriate to accept funding for implementation own project(s) • Implement projects for which funding has been secured

TABLE 13: INSTITUTIONAL ARRANGEMENTS ROLES AND RESPONSIBILITIES

MEMBER	ROLE/REPONSIBILITIES
Other Entities	• May sign onto MOU with UMRWA and GBA (optional)
STAKEHOLDER/PUBLIC OUTREACH TIER	
Stakeholder Organizations	• Participate on GBA and UMRWA region IRWM stakeholder committees and attend periodic stakeholder meetings and public workshops • Participate on the MCG legacy stakeholder group • Use internal networks to disseminate program-related information • Provide input related to implementation projects for grant funding
Members of the Public	• Participate on GBA and UMRWA region IRWM stakeholder committees and attend periodic stakeholder meetings (optional) • Participate on the MCG legacy stakeholder group • Attend public workshops • Use internal networks to disseminate program-related information • Provide input related to implementation projects for grant funding

It is recommended that UMRWA and the GBA undertake the following actions following completion of MokeWISE Program development to implement the institutional structure and continue program implementation (see **Table 14**).

TABLE 14: NEXT STEPS FOR INSTITUTIONAL ARRANGEMENT IMPLEMENTATION

ACTION	RESPONSIBLE PARTY(IES)	TARGET COMPLETION DATE
Meet to initiate MOU development	UMRWA and GBA	July 9, 2015
Draft MOU complete	UMRWA and GBA	August 9, 2015
Outreach to other potential signatories	UMRWA and GBA	September 9, 2015
UMRWA, GBA, and other signatories sign MOU	UMRWA, GBA, other signatories	December 31, 2015
Convene first annual MCG legacy stakeholder group meeting	UMRWA, GBA	June 2016

Implementing the actions identified above will establish the basis for continuing the MokeWISE Program beyond program development and into implementation.

PROJECT IMPLEMENTATION APPROACH AND CONSIDERATIONS

Section 6 identifies a suite of projects for implementation, which, taken together, constitute implementation of the MokeWISE Program. It is recognized that funding will be necessary to enable some or all of the implementation projects to move forward, and the main charge of the Implementation Tier will be to work with the project sponsors and the Stakeholder and Public Involvement Tier to identify candidate projects for outside funding and to pursue funding to assist project sponsors in implementing those projects. There are several steps that must be completed for each planning and implementation project prior to moving forward. These are summarized below.

Funding Pursuit

As discussed previously, many of the projects identified in the MokeWISE Program require funding assistance to enable project implementation. The first step for these projects may be to secure funding for project implementation (or for project planning to proceed). Depending upon the type of funding programs open at any given time, the specific preferences of those funding programs, eligible project types, and quantities of funding available, some projects may be better aligned than others. The Implementation Tier will work with the project sponsors and the Stakeholder and Public Involvement Tier to identify appropriate funding mechanisms and projects for funding pursuit.

Planning and Assessment

Each project, prior to moving forward into design and preparing environmental documentation, requires preliminary assessment and planning. Preliminary assessment and planning provide the basis for determining whether a project is feasible for future implementation, and provides guidelines and basic information on how a project may proceed. Many of the projects included in the MokeWISE Program have some or no preliminary planning completed. Planning and assessment is a critical first step to determine how a project might proceed to provide benefits, and this must be completed prior to determining whether the project should be fully implemented.

Environmental Documentation

Some projects included in the implementation plan have environmental documentation in place, meeting the requirements of the CEQA/NEPA, and are ready to proceed. However, the majority of projects will require environmental documentation to be completed prior to implementing construction. Depending upon the project type (planning or implementation) and the funding source, environmental documentation may be required prior to becoming eligible for grant funding.

Design

Project design typically involves furthering assessment and planning work to develop detailed plans and specifications for how a project would be constructed. Design is often completed in increments such as 10 percent, 30 percent, 60 percent, and 90 percent, prior to completing final design and preparing bid documents suitable for contractors to bid on the work.

Construction Contracting

Following preparation of bid document, construction contracting involves entering into an agreement with the selected contractor to perform the work. This may also include resident engineering, in which an engineer is present on site during construction, overseeing and reviewing construction activities, and construction materials testing.

Permitting

In addition to environmental documentation, a variety of project-specific permits may be required prior to implementing construction. Examples permits from State and Federal agencies that may be required, depending upon the project in question are listed in **Table 15**. It should be noted that this is not an exhaustive list, but is intended to provide an overview of the type of permits that may be needed, depending upon the project being implemented.

TABLE 15: EXAMPLE STATE AND FEDERAL PERMITS POTENTIALLY REQUIRED

PERMITTING AUTHORITY	POTENTIAL PERMITS NEEDED
SWRCB	• Petition for Water Rights Transfer • Waste Discharge Requirements
Central Valley RWQCB	• General construction stormwater discharge permit • Permit under Section 401 of the Clean Water Act
California Department of Fish and Wildlife (DFW)	• Streambed Alteration Agreement under Fish and Wildlife Code Section 1602
Division of Drinking Water	• Treatment plant operating permit
Caltrans	• Encroachment Permit, if required
Army Corps of Engineers	• Permit under Section 404 of the Clean Water Act, if jurisdictional waters or wetlands affected • Permit under Section 10 of the Rivers and Harbors Act, if jurisdictional waters affected
US Fish and Wildlife Service	• Approval of incidental take permit under Section 10 of the federal ESA, if potential for effect on listed wildlife species • Consultation under Section 7 of the federal ESA, if Corps permit required and potential for effect on listed species
National Marine Fisheries Service (NMFS)	• Approval of incidental take permit under Section 10 (a)(1)(B) of the ESA, if potential for effect on listed marine life species
State Historic Preservation Office (SHPO)	• Possible compliance with Section 106 of the National Historic Preservation Act, if Corps permit required and potential for effect on cultural resources

Land Acquisition

Some projects may require purchase or acquisition of land for construction of facilities, maintenance easements, etc. Depending upon the location and purpose, land acquisition may be required prior to beginning construction.

Construction/Project Implementation

Assuming the project has environmental documentation and permits in place (as appropriate) and has funding available implementation, the next major step for project implementation is construction (or implementation if a planning project). Construction results in delivery of the completed project, including as-built drawings, completed facilities, and an inspection report. The general steps for construction implementation include:

<u>Mobilization and Site Preparation:</u> this step involves mobilization of the contractor's forces and equipment necessary for performing the work required to complete construction. It includes all activities for transportation of contractor's personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary general facilities for the contractor's operations at the site. Site preparation includes completing work that is necessary to provide access to the site including, but not limited to, grading, temporary culverts, and clearing.

<u>Project Construction:</u> Construction includes implementing the building tasks necessary to install the project structures and features.

<u>Performance Testing and Demobilization:</u> Following construction and prior to startup of the completed project, performance testing may be necessary to demonstrate that the project was constructed and operates according to specifications. Following performance testing and acceptance, demobilization will be implemented. Demobilization involves demobilization of the contractor's forces and equipment once construction has been completed and accepted. It includes all activities for transportation of contractor's personnel, equipment, and operating supplies from the site.

Post-Construction Monitoring and Reporting

Depending upon the project and funding source, post-construction monitoring and periodic reporting may be required to demonstrate continued operation of the project consistent with planned operations, and to document that the claimed project benefits were, in fact, achieved. The type and extent of monitoring required will depend upon the type of project and specific funding source. Some DWR funding sources require 10 years of post-construction monitoring and reporting.

Table 16 lists the MokeWISE implementation plan projects and identifies remaining tasks that would need to be completed before the projects can be fully implemented.

TABLE 16: STAGES REMAINING TO COMPLETE MOKEWISE PROJECT IMPLEMENTATION

MOKEWISE IMPLEMENTATION PROJECT	PROJECT STAGES COMPLETED							
	FUNDING	PLANNING	ENVIRONMENTAL DOCUMENTATION	DESIGN	PERMITTING	LAND ACQUISITION	CONSTRUCTION	POST-CONSTRUCTION MONITORING
1a Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir	○	◗	○	○	○	○	○	○
1b High Country Meadow Restoration Program	○	◗	○	○	○	○	○	○
1c Mokelumne River Day Use Area Floodplain Habitat Restoration Project	○	○	○	○	○	○	○	○
1d Fish Screens for Riparian Diversions in the Lower Mokelumne	○	◗	○	○	○	○	○	○
1f Riparian Restoration Program – Below Camanche	○	◗	○	○	○	○	○	○
1g Mokelumne Water Quality, Soil Erosion, & Sedimentation Inventory/Monitoring	○	○	○	○	○	○	○	○
2a Municipal Recycled Wastewater Recharge Program	○	●	○	○	○	○	○	○
2b Constellation Winery Wastewater Reuse	○		○	○	○	○	○	○
2c Amador County Regional Reuse	○	●	○	○	○	○	○	○
4a Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*	○	○	○	○	○	○	○	○
4b Amador and Calaveras Counties Hydrologic Assessment*	○	○	○	○	○	○	○	○
4d NSJWCD Infrastructure Improvements	○	●	●	○	○	○	○	○
5a Regional Urban Water Conservation Program	○	○	○	○	○	○	○	○
5b Regional Agriculture Conservation Program[10]	○	○	○	○	○	○	○	○
7a PG&E Storage Recovery*	○	○	○	○	○	○	○	○
7b Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering*	○	◗	○	○	○	○	○	○
7d Re-operation of Existing Storage*	○	○	○	○	○	○	○	○
7f Blue and Twin Lakes Dams Reliability and Replacement Assessment*	○	○	○	○	○	○	○	○
8b Rehab of Transmission Main	○	●	○	○	○	○	○	○
8c Barney Way Septic System Conversion	○	○	○	○	○	○	○	○
8d Lake Camanche Village Recycled Water Project*	○	○	○	○	○	○	○	○

*** These projects are studies and do not have implementation components.**

○ = no/limited work completed

◗ = some degree of work completed

● = project stage completed

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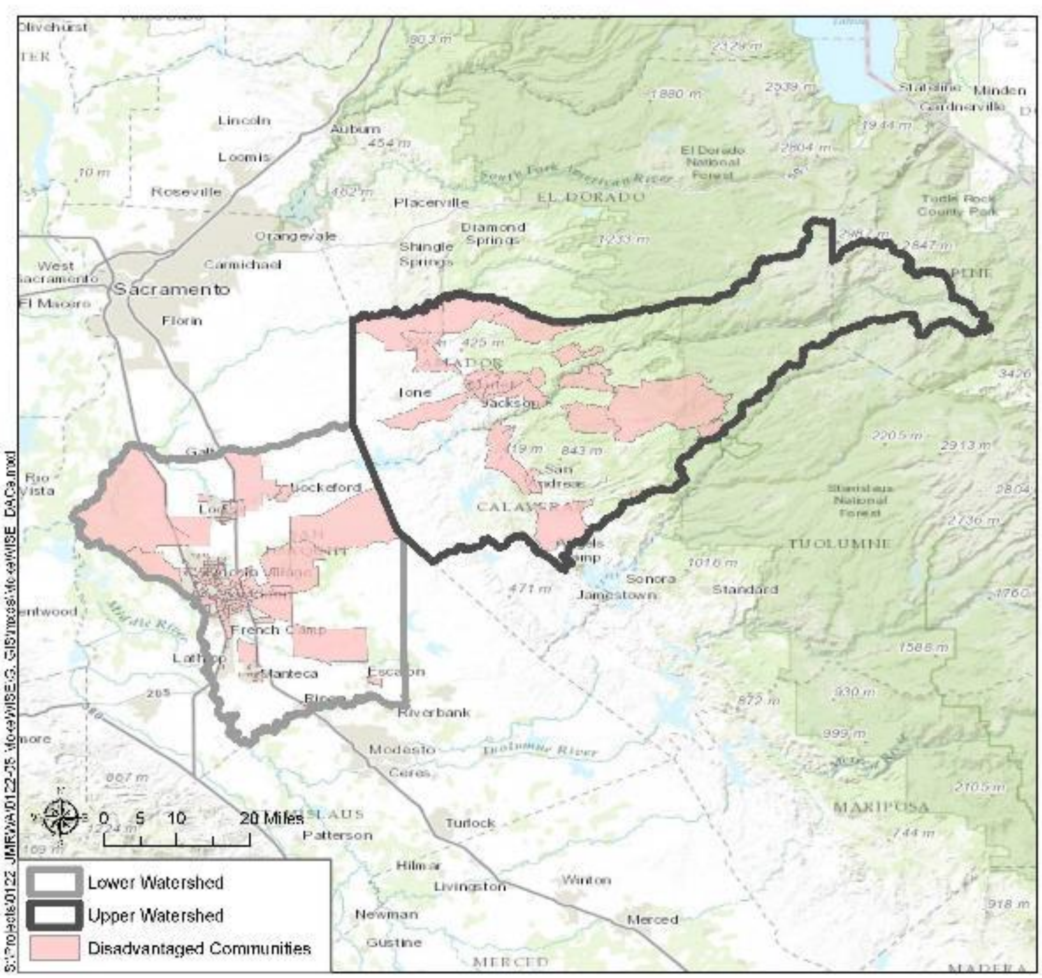
[10] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix N.**

FUNDING AND FINANCING STRATEGY

Conceptual-level estimates of capital costs were developed for the projects included in the MokeWISE Program. For some projects, operations and maintenance costs were also developed. These costs, together, are expected to total more than $100,000,000. In many cases, these costs reflect only the cost to complete the planning or feasibility study; as such, the actual cost to implement all of the identified projects and therefore realize all of the potential program benefits would be significantly greater than this estimate. Some projects may be able to be partially funded from existing revenue sources. However, some projects are expected to require additional or alternate funding sources for all project costs. Further, while some projects may funded in part by existing revenue sources, many areas within the MAC and ESJ Regions are severely disadvantaged, and any incremental increase in utility rates due to implementation of new projects or programs could constitute an economic hardship (see **Figure 9**). As such, it is expected that a high degree of outside funding will be necessary to implement the MokeWISE program.

Figure 9: Disadvantaged Communities in the MokeWISE Study Area



Funding and Financing Approach

As discussed previously, the Implementation Tier will be tasked with working with project sponsors and the Stakeholder and Public Involvement Tier to identify potential projects for funding. In order to do this effectively, the Implementation Tier will need to stay abreast of the various funding programs available to implement different project types.

At the State level, the November 2014 passage of Proposition 1 will result in an influx in State funding to support much-needed water projects statewide. Proposition 1 authorizes $7.54B for implementation of water projects, including $7.12B in new funds, combined with $420M repurposed from existing bonds (84, 50, 13, 204, 44, and 1E). The $7.54 B in funding is allocated to the following general project categories:

- Storage: $2,700 M
- Statewide Flood Management: $395 M
- Watershed Protection/Ecosystems: $1,495 M
- Groundwater Sustainability: $900 M
- Water Recycling: $725 M
- Safe Drinking Water: $520 M
- Regional Water Reliability: $810 M

These categories cover the full range of projects types represented in the MokeWISE Program, and the funds could potentially offset a significant portion of the cost to implement the recommended projects.

In order to track and pursue funding through Proposition 1 for project implementation, it must be recognized that Proposition 1 funding is being administered by a host of state agencies, departments, board, councils, and conservancies along a series of different timelines, with different requirements for each funding opportunity. **Table 17**, adapted from the Governor's Bond Accountability webpage, identifies the various implementing entities and the respective implementation schedules. This table also identifies the general category of project types anticipated to be funded by each opportunity.

TABLE 17: PROPOSITION 1 2015 PROGRAM DEVELOPMENT TIMELINE AND POTENTIAL MOKEWISE PROJECT ELIGIBILITY

ADMINISTERING ENTITY	NAME OF PROGRAM	POTENTIALLY ELIGIBLE MOKEWISE PROJECT TYPES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SWRCB	Small Community Wastewater	Recycled Water Local Infrastructure		Draft GLs. Released	Public Workshops			Final GLs.; Grant Solicitation Ongoing						
SWRCB	Clean, Safe and Reliable Drinking Water	Recycled Water Desalination Groundwater Conservation Surface Water Local Infrastructure				Draft GLs. Released	Public Work-shops			Final GLs. Solicit. Ongoing				
Baldwin Hills Conservancy	Ballona Creek/ Baldwin Hills Watershed Program	-		Draft GLs. to Board (2/27)		Public Workshops Final GLs. Review by CNRA	Board Adoption (5/22)							
Tahoe Conservancy	Ecosystem and Watershed Protection and Restoration Program in the Lake Tahoe Basin	-	Draft to GLs. Board		Public Work-shops	Final GLs. Rev. by CNRA; Board Update/ Adoption (4/23)		Board Adoption (6/18, if necessary)						
Coachella Valley Mountains Conservancy	Coachella Valley Multibenefit Ecosystem and Watershed Protection and Restoration Projects Grant Program	-	Draft GLs. Outline to Board (1/12)		Draft GLs. to Board/ Public Work-shops	Final GLs. Review by CNRA	Board Adoption (5/12)							
Ocean Protection Council	Proposition 1 Grant Program	-									Final GLs.		Grant Solicitation	
San Diego River Conservancy	Water Quality and Supply, Watershed Restoration and Habitat Enhancement Program	-			Draft GLs. to Board	Public Workshops								
San Gabriel and Lower LA Rivers and Mountains Conservancy	Multibenefit Water Quality, Water Supply, and Watershed Protection and Restoration Program	-			Draft GLs. to Board	Public Workshops	Final GLs. Review by CNRA; Board Adoption	Grant Solicitation			Review of Apps.		Grant Award Rec. to the Board	

TABLE 17: PROPOSITION 1 2015 PROGRAM DEVELOPMENT TIMELINE AND POTENTIAL MOKEWISE PROJECT ELIGIBILITY

ADMINISTERING ENTITY	NAME OF PROGRAM	POTENTIALLY ELIGIBLE MOKEWISE PROJECT TYPES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
San Joaquin River Conservancy	San Joaquin River Conservancy Multi-Benefit Watershed Protection and Restoration Program	Ecosystem/ Habitat Restoration Stormwater/ Flood Protection		Draft GLs. to Board (2/18)/ Draft GLs. Released	Draft GLs. to Board (3/18)	Public Workshops	Final GLs. Review by CNRA	Board Adoption (6/17)						
Santa Monica Mountains Conservancy	Multibenefit Water Quality, Water Supply, and Watershed Protection and Restoration Program	-	In process of being developed											
Sierra Nevada Conservancy	Sierra Nevada Watershed Improvement Program	Ecosystem/ Habitat Restoration Stormwater/ Flood Protection		Draft GLs. Released (2/6)	Draft GLs. to Board (3/4); Public workshops	Final GLs. Review by CNRA		Board Adoption (6/4)	RFP issued					
Coastal Conservancy	Proposition 1 Grant Program	-	Draft GLs. to Board (1/29)		Public Workshops	Final GLs. Review by CNRA		Board Adoption (6/25)						
Sacramento-San Joaquin Delta Conservancy	Proposition 1 Grant Program	Ecosystem/ Habitat Restoration Stormwater/ Flood Protection			Draft GLs. to Board (3/25)		Public Work-shops	Final GLs. Review by CNRA		Board Adoption (08/26, preferred)				
Wildlife Conservation Board	Stream Flow Enhancement Program	Ecosystem/ Habitat Restoration Stormwater/ Flood Protection		Draft to GLs. Board (2/26)		Public Workshops; Final GLs. Review by CNRA	Board Adoption (5/21)							
Santa Monica Mountains Conservancy and San Gabriel and Lower LA Rivers and Mountains Conservancy	An Urban Creek	-	In process of being developed											
Natural Resources Agency	Watershed and Urban River Enhancements Program	Ecosystem/ Habitat Restoration Stormwater/ Flood Protection	Finishing two current grant cycles and starting Prop 1 program development, including assembling team of various departments/ conservancies											
Natural Resources Agency	State Obligations	-	In process of being developed											

TABLE 17: PROPOSITION 1 2015 PROGRAM DEVELOPMENT TIMELINE AND POTENTIAL MOKEWISE PROJECT ELIGIBILITY

ADMINISTERING ENTITY	NAME OF PROGRAM	POTENTIALLY ELIGIBLE MOKEWISE PROJECT TYPES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Dept. of Fish and Wildlife	Watershed Restoration and Delta Water Quality and Ecosystem Restoration Grant Programs	Ecosystem/ Habitat Restoration Stormwater/ Flood Protection	Draft GLs.; Initial Guideline Review by CNRA	Draft GLs. Released		Public Workshops; Final GLs. Review by CNRA	Final GLs.		Grant Solicit.					
DWR	Integrated Regional Water Management	ALL TYPES			Tribal Consultation, Develop Economically Distressed Area definitions/ tool, Develop Program Success Measures (NOTE: Final round of Prop 84 $220m dollars for IRWM to be awarded first)				Public Scoping Meetings to get Input					Post Draft GLs. & PSP for IRWM Planning Grant Program
DWR	Water Use and Efficiency Grants, Round 1 - Urban and Ag	Recycled Water Conservation Local Infrastructure							Post draft GLs. and PSP	Public meetings	Develop and post FAQs	CNRA review		Post final GLs. and PSP
SWRCB	Stormwater	Stormwater/ Flood Protection	In process of being developed											
Water Commission	Water Storage Investment Program	Storage Groundwater		Develop Draft Regulation Package (Commission oversight via monthly meetings)								Submit draft reg.	Public Comment Period	
				Stakeholder Advisory Group Engagement										
				Tribal Consultation										
SWRCB	Water Recycling	Recycled Water Local Infrastructure		Draft GLs. Released		Public Workshops		Final GLs.; Grant Solicitation Ongoing						
SWRCB	Groundwater Sustainability	Groundwater		In process of being developed										
DWR	Groundwater Plans and Project Grant Program - Phase 1	Groundwater			Tribal Consultation, Develop Economically Distressed Area definitions/ tools, Develop Program Success Measures Public Scoping Meetings to get Input									Draft GLs. & PSP for GW Grant Program/ Public Comment Period
DWR and Central Valley Flood Protection Board	Flood Management	Stormwater/ Flood Protection	In process of being developed											

Based on the Proposition 1 funding schedule and identification of potentially-eligible MokeWISE project types, it is recommended that the Implementation Tier review and track development of each proposal solicitation process. Upon program guidelines being published, the Implementation Tier should consult with the project sponsors and the Stakeholder and Public Involvement Tier to determine which whether any projects may be eligible and should be considered for funding pursuit. Based on this assessment, UMRWA and the GBA should determine whether to pursue funding from each solicitation for upper and/or lower watershed MokeWISE projects, respectively, and for suitable bi-regional projects.

Table 18 summarizes the anticipated costs for each project and identifies whether potential water and/or wastewater rates may be available to offset a portion of the project cost. In addition, this table identifies which Proposition 1 program or programs identified in should be evaluated for their ability to provide additional potential funding for each project.

TABLE 18: ESTIMATED MOKEWISE PROJECT COSTS AND POTENTIAL FUNDING SOURCES

PROJECT	GENERAL PROJECT TYPE	ESTIMATED PROJECT COST	POTENTIAL FOR WATER/WASTE WATER RATE FUNDING?	POTENTIAL PROPOSITION 1 FUNDING OPPORTUNITIES															
				SWRCB - SMALL COMMUNITY WASTEWATER	SWRCB - CLEAN, SAFE AND RELIABLE DRINKING WATER	SAN JOAQUIN RIVER CONSERVANCY – SJR CONSERVANCY MULTI-BENEFIT WATERSHED PROTECTION AND RESTORATION	SIERRA NEVADA CONSERVANCY - SIERRA NEVADA WATERSHED IMPROVEMENT PROGRAM	SACRAMENTO-SAN JOAQUIN DELTA CONSERVANCY - PROPOSITION 1 GRANT PROGRAM	WILDLIFE CONSERVATION BOARD - STREAM FLOW ENHANCEMENT PROGRAM	NATURAL RESOURCES AGENCY - WATERSHED AND URBAN RIVER ENHANCEMENTS PROGRAM	DEPT. OF FISH AND WILDLIFE - WATERSHED RESTORATION AND DELTA WATER QUALITY AND ECOSYSTEM RESTORATION GRANT PROGRAMS	DEPT OF WATER RESOURCES - INTEGRATED REGIONAL WATER MANAGEMENT	DEPT OF WATER RESOURCES - WATER USE AND EFFICIENCY GRANTS, ROUND 1 - URBAN AND AG	SWRCB - STORMWATER	WATER COMMISSION - WATER STORAGE INVESTMENT PROGRAM	SWRCB - WATER RECYCLING	SWRCB - GROUNDWATER SUSTAINABLITY	DWR - GROUNDWATER PLANS AND PROJECT GRANT PROGRAM - PHASE 1	DWR AND CENTRAL VALLEY FLOOD PROTECTION BOARD - FLOOD MANAGEMENT
1a Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir	Ecosystem/ Habitat Protection	$180,000 (includes $80,000 for planning and $100,000 for implementation)	N			✓	✓	✓	✓	✓	✓	✓							
1b High Country Meadow Restoration Program	Ecosystem/ Habitat Protection	$40,000 for assessment plus $10,000 per acre restored	N			✓	✓	✓	✓	✓	✓	✓							
1c Mokelumne River Day Use Area Floodplain Habitat Restoration Project	Ecosystem/ Habitat Protection	$150,000 (including $111,000 for implementation and 30% contingency)	Y			✓	✓	✓	✓	✓	✓	✓							
1d Fish Screens for Riparian Diversions in the Lower Mokelumne	Ecosystem/ Habitat Protection	$300,000 for the preliminary assessment and prioritization plus $10,000 per cfs of diversions screened	N			✓	✓	✓	✓	✓	✓	✓							
1f Riparian Restoration Program – Below Camanche	Ecosystem/ Habitat Protection	$10,000 for ranking and evaluation of proposed restoration sites plus $8,000 per acre restored	N			✓	✓	✓	✓	✓	✓	✓							✓
1g Mokelumne Water Quality, Soil Erosion, & Sedimentation Inventory/Monitoring	Ecosystem/ Habitat Protection	$1,080,000 for planning, inventory, mapping, assessment of erosion-sedimentation reduction options, prioritization, stakeholder coordination, publishing the results, and outreach	N			✓	✓	✓	✓	✓	✓	✓							✓
2a Municipal Recycled Wastewater Recharge Program	Recycled Water	$150,000 for the feasibility study and $15 million for implementation	Y		✓							✓				✓			

TABLE 18: ESTIMATED MOKEWISE PROJECT COSTS AND POTENTIAL FUNDING SOURCES

				POTENTIAL PROPOSITION 1 FUNDING OPPORTUNITIES															
PROJECT	GENERAL PROJECT TYPE	ESTIMATED PROJECT COST	POTENTIAL FOR WATER/WASTE WATER RATE FUNDING?	SWRCB - SMALL COMMUNITY WASTEWATER	SWRCB - CLEAN, SAFE AND RELIABLE DRINKING WATER	SAN JOAQUIN RIVER CONSERVANCY – SJR CONSERVANCY MULTI-BENEFIT WATERSHED PROTECTION AND RESTORATION	SIERRA NEVADA CONSERVANCY - SIERRA NEVADA WATERSHED IMPROVEMENT PROGRAM	SACRAMENTO-SAN JOAQUIN DELTA CONSERVANCY - PROPOSITION 1 GRANT PROGRAM	WILDLIFE CONSERVATION BOARD - STREAM FLOW ENHANCEMENT PROGRAM	NATURAL RESOURCES AGENCY - WATERSHED AND URBAN RIVER ENHANCEMENTS PROGRAM	DEPT. OF FISH AND WILDLIFE - WATERSHED RESTORATION AND DELTA WATER QUALITY AND ECOSYSTEM RESTORATION GRANT PROGRAMS	DEPT OF WATER RESOURCES - INTEGRATED REGIONAL WATER MANAGEMENT	DEPT OF WATER RESOURCES - WATER USE AND EFFICIENCY GRANTS, ROUND 1 - URBAN AND AG	SWRCB - STORMWATER	WATER COMMISSION - WATER STORAGE INVESTMENT PROGRAM	SWRCB - WATER RECYCLING	SWRCB - GROUNDWATER SUSTAINABLITY	DWR - GROUNDWATER PLANS AND PROJECT GRANT PROGRAM - PHASE 1	DWR AND CENTRAL VALLEY FLOOD PROTECTION BOARD - FLOOD MANAGEMENT
2b Constellation Winery Wastewater Reuse	Recycled Water	$35,000 for the conceptual design report, $100,000 for securing the Waste Discharge Report permit, $25,000 for securing funding, and $16 million for construction	Y	✓	✓							✓				✓			
2c Amador County Regional Reuse	Recycled Water	$400,000 for the refinement study and $21.35 million for implementation	Y	✓	✓							✓				✓			
4a Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*	Groundwater	$3,605,000 for study	Y		✓							✓		✓	✓		✓	✓	✓
4b Amador and Calaveras Counties Hydrologic Assessment*	Groundwater	$600,000 for study	Y		✓							✓			✓		✓	✓	
4d NSJWCD Infrastructure Improvements	Groundwater	$20,000,000 for implementation	Y		✓							✓					✓	✓	✓
5a Regional Urban Water Conservation Program	Water Conservation	$80,000 (includes $60,000 for planning and $20,000 to prepare materials for a funding application)	Y		✓							✓	✓						
5b Regional Agriculture Conservation Program[11]	Water Conservation	$100,000 (includes $80,000 for planning and $20,000 to prepare materials for a funding application)	Y		✓							✓	✓						
7a PG&E Storage Recovery	Storage	$350,000 for study preparation	Y		✓							✓			✓				
7b Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering	Storage	$750,000 for study preparation	Y		✓							✓			✓				

[11] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix N**.

TABLE 18: ESTIMATED MOKEWISE PROJECT COSTS AND POTENTIAL FUNDING SOURCES

				POTENTIAL PROPOSITION 1 FUNDING OPPORTUNITIES															
PROJECT	GENERAL PROJECT TYPE	ESTIMATED PROJECT COST	POTENTIAL FOR WATER/WASTE WATER RATE FUNDING?	SWRCB - SMALL COMMUNITY WASTEWATER	SWRCB - CLEAN, SAFE AND RELIABLE DRINKING WATER	SAN JOAQUIN RIVER CONSERVANCY – SJR CONSERVANCY MULTI-BENEFIT WATERSHED PROTECTION AND RESTORATION	SIERRA NEVADA CONSERVANCY - SIERRA NEVADA WATERSHED IMPROVEMENT PROGRAM	SACRAMENTO-SAN JOAQUIN DELTA CONSERVANCY - PROPOSITION 1 GRANT PROGRAM	WILDLIFE CONSERVATION BOARD - STREAM FLOW ENHANCEMENT PROGRAM	NATURAL RESOURCES AGENCY - WATERSHED AND URBAN RIVER ENHANCEMENTS PROGRAM	DEPT. OF FISH AND WILDLIFE - WATERSHED RESTORATION AND DELTA WATER QUALITY AND ECOSYSTEM RESTORATION GRANT PROGRAMS	DEPT OF WATER RESOURCES - INTEGRATED REGIONAL WATER MANAGEMENT	DEPT OF WATER RESOURCES - WATER USE AND EFFICIENCY GRANTS, ROUND 1 - URBAN AND AG	SWRCB - STORMWATER	WATER COMMISSION - WATER STORAGE INVESTMENT PROGRAM	SWRCB - WATER RECYCLING	SWRCB - GROUNDWATER SUSTAINABLITY	DWR - GROUNDWATER PLANS AND PROJECT GRANT PROGRAM - PHASE 1	DWR AND CENTRAL VALLEY FLOOD PROTECTION BOARD - FLOOD MANAGEMENT
7d Re-operation of Existing Storage	Storage	$750,000 for study preparation	Y		✓							✓			✓				
7f Blue and Twin Lakes Dams Reliability and Replacement Assessment	Storage	$2,500,000 for study preparation	Y		✓							✓			✓				
8b Rehab of Transmission Main	Water Conservation	$5.2 million (includes $200,000 for the study and $5 million for implementation)	Y									✓	✓						
8c Barney Way Septic System Conversion	Ecosystem/ Habitat Protection	$4.3 million (includes planning, engineering, construction, and a 10% contingency)	N	✓	✓	✓	✓	✓	✓	✓	✓	✓							
8d Lake Camanche Village Recycled Water Project	Recycled Water	$150,000 for study completion	Y	✓	✓							✓				✓			

* These projects are studies and do not have implementation components.

7 IRWM PLAN INTEGRATION

IRWM Plan Integration

This program was developed as a joint effort among the MAC and ESJ IRWM Regions. As discussed previously, the intent is not to supersede either of the regional plans but to coalesce them into an interregional plan. Portions of this program may be incorporated into the individual regional plans to augment those individual plans. The IRWM integration section, provided as **Appendix Q**, summarizes information from the MokeWISE Program that could be integrated into the regional plans. Appending the integration section to the MAC and ESJ IRWM Plans is intended to functionally integrate this program into each respective regional effort.

The IRWM integration section addresses the following IRWM sections.

- Governance – the institutional arrangements for implementing MokeWISE, as identified in the implementation section of this document, are described to supplement the Governance sections of the existing plans.
- Region Description – water supply, water quality, and environmental resources information developed through MokeWISE is be summarized to augment the information included in each IRWM Plan.
- Objectives – the Program Objectives developed for the MokeWISE Program are summarized to augment the MAC and ESJ Region IRWM Objectives.
- Resource Management Strategies (RMS) – the RMS reflected in the implementation projects are summarized to supplement discussions contained within each existing IRWM Plan.
- Integration – stakeholder integration achieved through MokeWISE is described to supplement integration activities occurring at the regional level through the MAC and ESJ IRWM planning processes.
- Project Review Process – project concept descriptions and scopes of work are provided to allow projects to be prioritized by the MAC and ESJ Region IRWM project review processes.
- Impact and Benefit – impacts and benefits of the implementation projects are provided to supplement the MAC and ESJ IRWM Plan impacts and benefits discussions.
- Plan Performance and Monitoring – a proposed approach for monitoring effectiveness of each project, including performance measures and desired outcomes, is identified to supplement the Plan-level performance and monitoring discussions.

- Data Management – approaches for managing data developed through the MokeWISE Program, as well as data generated by implementation and tracking of the implementation projects, is summarized.
- Finance – the approach to funding/financing the implementation projects, as identified in the Implementation Plan, is summarized for inclusion in the respective IRWM Plans.
- Technical Analysis – the technical feasibility analysis of the implementation projects is be summarized.
- Relation to Local Water Planning – the consistency of implementation projects with local water planning is summarized to augment discussions in the MAC and ESJ IRWM Plans.
- Relation to Local Land Use Planning – the consistency of implementation projects with local land use planning is summarized to augment discussions in the MAC and ESJ IRWM Plans.
- Stakeholder Involvement – the stakeholder involvement efforts implemented as part of the MokeWISE Program and identified in Section 2 are summarized, including the outcomes from the Public and DAC Outreach Implementation effort.
- Coordination – the processes used to coordinate water management of participating local agencies and local stakeholders to avoid conflicts and take advantage of efficiencies, as well as the process of cooperating between adjacent IRWM planning efforts is discussed, along with opportunities for State agency assistance in implementation of the implementation projects.
- Climate Change – potential climate change adaptation and/or mitigation benefits associated with the MokeWISE Program, including estimated greenhouse gas (GHG) emissions impacts, are summarized.

8 NEXT STEPS

Next Steps

With MokeWISE Program development complete, MCG member organizations will begin to show support for the MokeWISE Implementation Plan. It is recommended that MCG member entities introduce the MokeWISE Implementation Plan to their respective Boards and draft a resolution and/or letter of support appropriate for their Board. Board-approved resolutions will be included in the final MokeWISE plan.

There are three major next steps that would ensure MokeWISE projects are implemented in the future: (1) form structure for implementation; (2) develop and formalize stakeholder group; and (3) identify and secure funding for implementation.

The first step involves forming the group responsible for furthering the implementation of the MokeWISE projects. It is recommended that the GBA and UMRWA sign an MOU designating each as the lead agencies for soliciting, securing, and administering project funding.

The second step involves assembling a stakeholder group tasked with providing guidance during implementation of projects. A protocols document, outlining decision-making processes and organization, would be developed.

The third and final step includes identifying funding opportunities for each MokeWISE project, compiling funding applications, and securing and administering funding for project implementation. These steps are discussed in further detail below.

STEP 1: FORM STRUCTURE FOR IMPLEMENTATION

The initial step in MokeWISE program implementation is forming the structure that will support implementation. To this end, the GBA and UMRWA would begin to work together to identify agencies, organizations, and other members of the public that are interested in participating in the Implementation Group. Agencies and organizations interested in implementation may include project sponsors and other entities interested in implementation.

During this time, the GBA and UMRWA would begin drafting the MOU that would guide MokeWISE Program implementation. The MOU would specify that project sponsors would be ultimately responsible for implementing their respective projects, but that the GBA and UMRWA would act as the lead agencies for soliciting, securing, and administering funding for project being implemented in each of their regions, respectively, and for bi-regional projects (see **Section 6**). When a draft of the MOU is completed to the satisfaction of both the GBA and UMRWA, these two entities would sign the MOU. Having identified agencies and organizations interested in MokeWISE Program implementation, the GBA and UMRWA would reach out to these entities to determine their desire to become signatories to the MOU. Those interested would also sign the MOU and become part of the Implementation Group.

STEP 2: DEVELOP AND FORMALIZE STAKEHOLDER GROUP

While identifying agencies for the Implementation Tier, the GBA and UMRWA would also identify agencies, organizations, and members of the public interested in participating in the Stakeholder and Public Involvement Tier. This group would advise the Implementation Tier on a programmatic level, including what projects to pursue funding for, changing needs for program implementation, etc. Once this stakeholder group has been assembled, process protocols would be developed. These protocols would guide the Stakeholder and Public Involvement group by outlining the organization of the group and the decision-making process; these protocols would be agreed upon by all members of the Stakeholder and Public Involvement group.

STEP 3: IDENTIFY AND SECURE FUNDING FOR PROJECT IMPLEMENTATION

In coordination with the Stakeholder and Public Involvement Tier, the Implementation Tier would begin to track funding opportunities appropriate for the various MokeWISE projects. Proposition 1, approved in November 2014, provides ample opportunities for funding a variety of water resource projects, including those in the MokeWISE Implementation Plan. **Table 14** in **Section 6** highlights the Proposition 1 opportunities for each MokeWISE project. For each MokeWISE project, the Implementation Tier would identify those funding opportunities providing the greatest potential. When appropriate, the GBA and UMRWA, in coordination with project sponsors, the Implementation Tier, and the Stakeholder and Public Involvement Tier, would pursue these funding opportunities. Any funding secured would be used for project implementation.

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Appendices

A: MOKELUMNE COLLABORATIVE GROUP (MCG) MEMBER LIST

B: MCG CHARTER AND PROTOCOLS

C: MCG MEETING SUMMARIES

D: PUBLIC AND DISAVANTAGED COMMUNITY OUTREACH PLAN

E: PROGRAM OUTCOMES AND MEASURES MEMORANDUM

F: ENVIRONMENTAL CONDITIONS OVERVIEW TECHNICAL MEMORANDUM

G: WATER AVAILABILITY ANALYSIS

H: CLIMATE CHANGE MEMORANDUM

I: PROJECT CONCEPT LIST AND DESCRIPTIONS

J: PRELIMINARY PROJECT ASSESSMENT MEMORANDUM

K: PRELIMINARY PROJECT ASSESSMENT

L: ENVIRONMENTAL ASSESSMENT OF CONCEPTS

M: OBJECTIVES ASSESSMENT PROJECT CONCEPT BRIEFS

N: SCOPES OF WORK/PRELIMINARY ENGINEERING

O: POLICIES AND INITIATIVES

P: SAMPLE MEMORANDUM'S OF UNDERSTANDING

Q: IRWM INTEGRATION SECTION

Appendix A: Mokelumne Collaborative Group (MCG) Member List

Appendix A lists each of the MCG member entities

MokeWISE MCG Member Organizations

Amador County
Amador Water Agency
Calaveras County
Calaveras County Water District
Calaveras Planning Coalition
Calaveras Public Utility District
California Sportfishing Protection Alliance
City of Lodi
City of Stockton
Delta Fly Fishers, Inc.
East Bay Municipal Utility District
Eastern San Joaquin Groundwater Basin Authority
Foothill Conservancy
Jackson Valley Irrigation District
MyValleySprings.com
North San Joaquin Water Conservation District
Pacific Gas and Electric
Restore the Delta
San Joaquin County
San Joaquin County Resource Conservation District
San Joaquin Farm Bureau
Sierra Club California
Sierra Nevada Conservancy
Stockton East Water District
Trout Unlimited (state level)
Upper Mokelumne River Watershed Authority
Woodbridge Irrigation District

Appendix B: MCG Charter and Protocols

Appendix B presents the Charter and Protocols approved by the MCG. These protocols outline MCG organization and guide decision-making processes.

MokeWISE Program:
Mokelumne Collaborative Group Charter

The members of the Mokelumne Collaborative Group (MCG) have collectively developed a structure and protocols by which the MCG will conduct collaborative planning throughout the duration of the Mokelumne Watershed Interregional Sustainability Evaluation (MokeWISE) program. The structure and protocols were established through a series of individual and collective discussions with MCG members and review and comment by the MCG. The result of these discussions is summarized in the attached document: Collaborative Decision-Making Process and Organizational Structure for the Mokelumne Collaborative Group.

The members of the MCG, all individually listed below, collectively and unanimously affirm that the structure and protocols presented in the attached document shall serve as the structure and decision-making protocols to be followed in developing the MokeWISE program. The MCG is committed to working collaboratively to develop a MokeWISE program that will meet the groups' collective objectives.

MCG Member Agencies

Amador Water Agency	Jackson Valley Irrigation District
Amador County	My Valley Springs
Calaveras County	N. San Joaquin Water Cons. District
Calaveras County Water District	Pacific Gas & Electric
Calaveras Planning Coalition	San Joaquin County
Calaveras Public Utility District	San Joaquin County Resource Conservation District
California Sportfishing Protection Alliance	San Joaquin County, Public Works
City of Lodi, Public Works	Sierra Club, SF Bay Chapter
City of Stockton, Municipal Utilities	Sierra Nevada Conservancy
Delta Fly Fishers, Inc.	Stockton East Water District
East Bay Municipal Utility District	Trout Unlimited
Foothill Conservancy	Woodbridge Irrigation District

This charter was approved by unanimous consent of the Mokelumne Collaborative Group on November 8, 2013.

Collaborative Decision-Making Process & Organizational Structure for the Mokelumne Collaborative Group:
PROTOCOLS

Approved: 8 November 2013

Table of Contents

Introduction

The Mokelumne Collaborative Group (MCG) is a diverse stakeholder committee organized with the primary objective of representing varied interests during development of the Mokelumne Watershed Interregional Sustainability Evaluation (MokeWISE) program. Members of the MCG are expected to represent their organizations; commit time to participate in the process; and work collaboratively with fellow MCG members, project team staff, and others involved in the process.

MCG members include water agencies; non-governmental organizations (NGOs); private entities; resource agencies; and local, state, and federal government agencies. Members will learn from and share with one another regarding various water resources issues within the Mokelumne watershed. MCG members will contribute to the program through meaningful and constructive dialogue with one another and by providing input. It is anticipated that the success of the MokeWISE program will hinge on the MCG's ability to work together in a respectful, collaborative environment, with the diversity of the Group contributing to a more complete and inclusive program.

In an effort to guide the MCG process, this Protocols document has been prepared. The purpose of this document is to outline the procedures and guidelines by which the Group will manage its organizational composition, participation, decision-making, documents and the media. This document is intended to enable the MCG to realize the MokeWISE program purpose to develop a broadly-supported preferred water resources program that meets the needs of regional stakeholders and interest groups.

Organization and Participation

In the context of the MokeWISE program, the MCG must operate under well-defined organizational elements to ensure a successful program process. Defining such elements will help the Group understand the general structure and procedural elements of the process so the program stays on schedule. As such, this section outlines organizational and participation-related elements of the MCG.

The MCG has agreed to the following organizational and participation-related elements:

- The MCG is comprised of organizations with a direct interest in the Mokelumne River watershed and the MokeWISE program.
- In addition to the MCG, there will be three additional levels of stakeholder participation: Tier 2 stakeholders, Interested Parties, and general public. Tier 2 stakeholders will include state and federal resource agencies and others that will be solicited for comments and input at key milestones. Interested Parties are agencies/organizations that do not have a direct interest in the project or have elected to not be directly involved as members of the MCG but would like to be made aware of progress, documents available for public comment, public meetings, etc. via email. General public includes all other individuals and organizations including those who respond to the public outreach process.
- Meetings will be open, and will begin at 9AM. Meetings will be held on the second Friday of every month at the San Joaquin Farm Bureau in Stockton, with two meetings held at a venue in the upcountry.
- A designated 16-minute public comment period will be held at each MCG meeting immediately following lunch, and each speaker will be allowed a maximum of four minutes to speak. The comment period is not intended to be a question-and-answer period, and the MCG will generally not respond to comments made during this time.
- A phone number will be provided to allow MCG member(s) to participate by phone if neither they nor their designated alternate is able to attend meeting(s) in-person. The MCG understands the importance and value of attending meetings in-person.
- Meeting summaries will be prepared at a high level, incorporating what was discussed, key factors considered in for decisions, and the ultimate decision and rationale. There will be a three-month cut-off period (November 2013) during which late-comers may join. MCG members may conduct outreach efforts during that three-month period. Late-comers will not be permitted to revisit decisions made prior to their joining the group.
- If poor attendance by an organization becomes an issue, the MCG will discuss it at that time.

Decision-Making

A successful MokeWISE program process includes the creation and fostering of an environment which promotes collaboration. A portion of this environment includes the guidelines which define the decision-making process. As such, this section outlines the protocols which facilitate the decision-making process.

The MCG has agreed to the following decision-making protocols:

- The ultimate goal of decision-making is consensus with an "I/we can live with it" standard.
- Should the Group fail to reach total consensus on a discrete issue, it is understood that:
    - The process is schedule-driven and requires decisions regarding key components of the process before proceeding.
    - Some stakeholders may not agree with all component decisions but the MCG may reach consensus on the total package of preferred options for implementation.
    - For any component of the process where consensus is not reached, outstanding concerns/opinions will be attached to and/or characterized in the document.
    - The above approach would not be effective in dealing fundamental issues (e.g., the definition of available water).
    - Stakeholders who have concerns or unresolved issues are expected to offer solutions for addressing their concerns/issues and moving the process forward.
- Meeting ground rules will follow those outlined in Attachment A.

Documents

Throughout the MokeWISE program, technical work will be developed and provided to the MCG for direction, review, and comment. The general protocols by which the MokeWISE program will proceed are summarized in this section.

The MCG has agreed to the following process-related items:

- When a document requires editing by the MCG, a single-text document will be used, in which everyone works off the same version of a given document.
- Documents will be distributed one week prior to each meeting in Microsoft Word 97-03 format.
- Comments will be due at the end of the week following each meeting, allowing for a total of two weeks for review by MCG members.

- High-level meeting summaries will be prepared and disseminated after each meeting. Should this strategy fail to provide benefit, the MCG may revisit.
- Draft documents and materials will be available via the website to the MCG.
- As a general policy, approved documents will be posted to the public portion of the MokeWISE website; however MCG members may bring up exceptions to discuss with the group. Printed and/or mailed materials will be provided upon request.

Media Contacts

- Valley media outlets will be directed to Brandon Nakagawa (representing the San Joaquin Groundwater Basin Authority) and upcountry media outlets will be directed to Rob Alcott (representing the Upper Mokelumne River Watershed Authority). If Pete Bell (Foothill Conservancy) is approached by the media, he may also serve as a contact, while also referring to Rob or Brandon as appropriate. Any MCG stakeholder can talk to the media generally about published documents and what is on the website.
- MCG members will only express their own concerns and interests when communicating with the media, and they will refrain from characterizing the interests, intentions, or motivations of other stakeholders in the process.

Amendments to the above, if needed, can be made upon consensus approval of the MCG present at any regularly scheduled meeting

Attachment A

Ground Rules

- Be solution oriented
- Participate
- Speak one at a time
- Be concise
- Use "I/We" statements when expressing opinions
- Express concerns and interests (not positions)
- Focus on issues not personalities
- Focus on what CAN be changed (not on what cannot be changed)
- Listen to understand (not to formulate your response for the win)
- Draw on each other's experience
- Discuss history only as it contributes to solutions
- Caucuses can be called by anyone at any time
- Limit sidebar conversations

Facilitator Assumptions

- Managed conflict is good and stimulates creativity and innovation
- Collaborative decisions produce more effective solutions than autocratic decisions
- The group has the solutions to address identified issues
- Everyone is doing the best they can with the knowledge they have now
- Blame is unproductive and dis-empowering

Appendix C: MCG Meeting Summaries

Mokelumne Collaborative Group (MCG)
Meeting #1 Summary

September 5, 2013

Organizations represented

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

City of Lodi, Public Works

City of Stockton, Municipal Utilities

Delta Flyfishers

East Bay Municipal Utilities District

Foothill Conservancy

Jackson Valley Irrigation District

My Valley Springs

Pacific Gas & Electric

San Joaquin County

San Joaquin County, Public Works

San Joaquin County Resource Conservation District

Sierra Club, SF Bay Chapter

Sierra Nevada Conservancy

Stockton East Water District

Key Decisions

- Meeting start time: 9AM. Coffee, snacks, and mingling from 8.45 to 9AM.
- Meeting location: San Joaquin Farm Bureau with two future meetings held at a venue in the upcountry.
- Meeting dates: Second Friday of every month.
- Remote meeting participation: A phone number with 'listen-only' capabilities will be provided should an organization be unable to attend a meeting in-person.
- Meeting documentation: High level meeting summaries will be prepared and include discussion topics, key points made without attribution, action items, and decisions with key rationale.
- Late participation: ~~There will be a three-month cut-off period (November 2013) after which no additional stakeholder organizations will be admitted into the MCG~~New members to the MCG will be considered until the February 2014 meeting. Late-comers will not be permitted to revisit decisions made prior to their joining the group. (revised December 13, 2013)

- Poor attendance: If poor attendance becomes an issue, the MCG will discuss it at that time. A clause to this effect will be written in the Process Design Technical Memorandum to be adopted by the MCG.
- Media communication: Valley media outlets will be directed to Brandon and upcountry media outlets will be directed to Rob. If Pete Bell is approached by the media, he may also serve as a contact, while also referring to Rob or Brandon as appropriate. Any MCG stakeholder can talk to the media generally about their own interests as well as published documents and website content.
- Public comments: Meetings are open to the public. However, public participation will be limited to a designated 16-minute public comment period to be held right after lunch and each speaker will be allowed four minutes to speak. The comment period is not intended to be a question-and-answer period, and the MCG will generally not respond to comments made during this time.
- Process Design Technical Memorandum (TM): A Process Design TM will be drafted by RMC and submitted to a sub-committee consisting of 3 members of the MCG. Comments from the sub-committee will be addressed by RMC and then a revised draft submitted to the MCG at the October meeting for review and adoption.
- Breakfast snacks: MCG organizations will take turns bringing breakfast snacks and coffee to the meetings.
- Lunch: The Group will eat together on-site. Those who do not bring their own lunch will contribute money. Lunch will be 45 minutes.
- Mailing/contact list: Jordie Bornstein will maintain and update the MCG stakeholder list as needed.

Action Items

- All MCG members: Contact Jordie Bornstein regarding contact info for potential new stakeholders. Rainwater & Associates, LLC (R&A), will conduct outreach to the stakeholders once the contact information is provided.
- All MCG members: Complete and send Interest Statement to Katie Cole by Thursday September 12th.
- Rob Alcott: Reach out to our grant representative Jason Preece regarding agencies tracking time spent for possible future reimbursement. Report back to Group.
- RMC: Include a clause in the Process Design TM stating that MCG members are expected to attend meetings and that poor attendance will be handled on a case-by-case basis.
- R&A: Provide breakfast snacks at the October meeting.

Summary

I. Introductory Comments

Rob Alcott and Brandon Nakagawa presented the history of the Mokelumne River Forum and provided context for the current MokeWISE process.

II. Project Overview

Dave Richardson presented on the project, giving a general overview of the IRWM program, the MokeWISE program purpose, the potential benefits of the program, and the schedule and organizational structure.

III. Process Design: Interview Results Overview

Marie Rainwater (facilitator) summarized the Process Design Report, outlining the interview results and answering questions.

IV. Unresolved MCG Process Design Issues

The facilitator went through the following list of identified areas which still needed group consensus after the interviews.

a. *Meeting Schedules & Start Times*

- *Discussed: meeting start time; meeting location; meeting day/date*
- It was decided that meetings should begin at 9 AM to allow additional travel time, though coffee will be provided beginning at 8:45 to allow some time for discussion in advance of the meetings.
- After some discussion, it was decided that every meeting will be held at the San Joaquin Farm Bureau, with two future meetings held at a venue in the upcountry. This will provide a more central meeting location for travel purposes, while ensuring that the group does travel to the upcountry during the course of the project.
- The 2nd Friday of every month was agreed to be the preferred schedule for future meetings.

b. *Remote meeting participation*

- *Discussed: the potential for organizations to remotely participate at meetings*
- It was decided that a phone number with 'listen-only' capabilities will be provided to allow organizations unable to attend meeting(s) in-person to listen in.

c. *Meeting documentation*

- *Discussed: if and how meetings should be documented*

- Meeting notes will include key decisions, a high level summary of discussions, and rationale for decisions. This will allow key decisions to be documented and reasoning for making specific decisions to be documented without requiring significant time for discussion and editing. Comments will not be attributed to specific MCG members to encourage a more honest and open dialogue.

d. *Late participation*

- *Discussed: if and how late stakeholder participation should be handled*

- Late-comers will be allowed to join the group until February 2014~~for the first three months of the program~~, but will not be permitted to revisit decisions made prior to their joining the group. Limiting late participation will ensure that the project continues to move forward with an engaged MCG that has the benefit of understanding decisions made and technical information presented throughout the process. However, allowing some time for additional participants to join provides time for MCG members to do additional outreach to ensure that all interested stakeholders with a clear interest in the project have the opportunity to participate. If potential stakeholders are identified, their contact information will be forwarded to Jordie Bornstein so the facilitation team may schedule and conduct stakeholder interviews. (revised December 13, 2013)

- Resource agencies will generally be involved as Tier 2 stakeholders, meaning that they will be consulted for feedback during specific points in the process, but will not be MCG members and thus will not be directly involved in the collaborative decision-making process. Many resource agencies approached indicated that they did not have resources to fully participate.

- Interested party status is for non-agency stakeholders who want to stay informed of the MCG progress but choose not to participate as a member.

e. *Poor attendance*

- *Discussion: how to handle MCG members whose participation dwindles over time*

- The Process Design TM will include a clause that states that participants are expected to attend meetings, and should poor attendance becomes an issue, the MCG may consider how to address it on a case-by-case basis. This provides flexibility for the MCG to address attendance issues, should they arise, while recognizing that members have committed to participate in this voluntary process.

f. *Media communication*

- *Discussed: the way in which MCG members communicate with the media*
- It was decided that if upcountry media outlets contact a MCG member, they should be referred to Rob, and if valley media outlets contact a MCG member, they should be referred to Brandon. If Pete is approached, he may discuss the project prior to referring the media to the appropriate contact. This will ensure that the media receives consistent information on the project from the contracting entities and provides clear points of contact for media inquiries. Any MCG member can talk to the media generally about their own interests as well as published documents and website content.

g. *Public comments*

- *Discussed: if meeting agendas will allow time for public comments and if meetings are open or public*
- Meetings will be open to the public and a designated 16-minute public comment period will be held immediately following lunch. Comments will be limited to four minutes per commenter. This will allow members of the public to listen to MCG discussions and understand which members may represent their viewpoints prior to commenting. The MCG will not respond to comments at that time, but comments will be taken under advisement by the group.

V. Next Steps – Process Design

The facilitator introduced the Process Design Technical Memorandum as the document which will outline the decisions made by the group during this meeting as well as the consensus items reached during the interviews. This document will serve to outline the process protocols of the group and be adopted by the MCG when completed.

- RMC will prepare a draft Process Design TM that summarizes the process decisions made by the MCG. This document will be provided to a sub-committee for preliminary review on September 20th, with comments back from the sub-committee by September 27th. The revised TM will be provided to the full MCG for review one week prior to the next MCG meeting, consistent with the standard review schedule.

VI. Schedule Overview and Project Work Flow

Dave Richardson presented the program schedule and work flow, going through the timeline for each task, the stakeholder meeting schedule, and how to access documents on the website. There were several fundamental questions raised including the following.

a. *How do the outcomes of this program fit into CEQA?*

The initial expectation has been that the MokeWISE program will be comparable to a planning feasibility document. In any case a CEQA legal review of the MokeWISE program resulting from the MCG process will be performed. Commonly used CEQA terminology (such as "preferred alternative") will be avoided during the MokeWISE development process wherever possible.

b. *What about modeling?*

The project will use MOCASIM as a modeling tool, and assumptions and inputs to the model will be reviewed and vetted by the MCG and / or a sub-committee thereof.

c. *Should agencies be tracking time for possible future grant reimbursement?*

Rob Alcott will check with our DWR grant representative Jason Preece and report back to the group.

VII. Interest Statement Development

The facilitator introduced the Interest Statement Development sheet and explained that each organization is responsible for submitting one. The purpose of this exercise is for each organization to express their interests. There were two components of the exercise: formulating a general interest statement narrative and outlining potential program objectives that reflect those interests.

- Formulating an Interest Statement Narrative: Asks for a general statement about each organization's interests/concerns in the Mokelumne River. What are the few things that each organization most cares about as it relates to the watershed?
- Outlining Potential Program Objectives: This asks organizations to brainstorm *initial* thoughts about MokeWISE program outcomes they would like to see and consequences they would like to avoid. This exercise is intended to be a starting point, not an exhaustive final exercise. The information will be collected, synthesized, and presented at October's meeting to facilitate further discussion.

VIII. Logistics

The facilitator led discussion on who is responsible for providing breakfast snacks and lunch at future meetings. Logistics of mailing/contact list was also discussed. The results of this discussion are captured in the key decisions presented at the beginning of this summary.

Mokelumne Collaborative Group (MCG)
Meeting #2 Summary

October 11, 2013

Organizations represented

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

City of Lodi, Public Works

City of Stockton, Municipal Utilities

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

Pacific Gas & Electric

San Joaquin County

San Joaquin County, Public Works

San Joaquin County Resource Conservation District

Sierra Club, SF Bay Chapter

Sierra Nevada Conservancy

Stockton East Water District

Woodbridge Irrigation District

Key Decisions

- Meeting materials: Jordie Bornstein will send out relevant documents as word document attachments to emailed meeting announcements. Copies of the documents will also be placed on the website.
- Remote meeting participation: If primary and alternate representatives cannot be present, then phone-in participation is an option. Additionally, phone-in participants will be allowed to speak as well as listen. The protocols will be amended to reflect this change.

Action Items

- All MCG members: Review the Process Protocols TM by October 18, 2013. Make comments in MS Word showing track changes and send to kcole@rmcwater.com.
- All MCG members: Review the Charter by October 18, 2013. Make comments in MS Word showing track changes send to kcole@rmcwater.com.
- RMC: Post original interest statements for each agency/organization on the website.
- RMC: Update Process Protocol Technical Memorandum to reflect that phone-in participation at monthly MokeWISE meetings with be allowed to speak as well as listen.
- RMC: Post Department of Water Resources (DWR) Grant on the project website once it is finalized.
- R&A: Send MCG documents needing review in MS Word (97-03) to MCG for redline/strikethrough edit capability.
- Stockton East Water District: Provide breakfast snacks at the November meeting.

Summary

I. Stakeholder Interest Statements

Each MCG member spent 3-4 minutes summarizing the primary interests of their agencies/organizations in the MokeWISE program, including key areas of interest and concern in the watershed, and desired potential project outcomes. MCG members were encouraged to ask clarifying questions. The original statements from each agency/organization will be posted on the website.

II. Process Protocols Technical Memorandum (TM)

Marie Rainwater (facilitator) gave a brief overview of the development and status of Process Protocol TM and reiterated that written comments are due by October 18, 2013.

The MCG revisited the issue of phone-in participation to meetings. It was decided that phone-in participation should no longer be limited just to "listen-only" and instead allow full participation to the degree possible. Language in the Process Protocols TM will be revised accordingly yet will stress the importance and preference for in-person participation.

The facilitator also explained the role of the Charter (it is a requirement of the Department of Water Resources Grant that is funding this program) which was one of the documents that was posted to the website for the October meeting. The charter is a simple 1-page document that explains the purpose of the Process Protocols (outlining the means by which the MCG will be organized and make decisions) and explicitly states that the MCG members unanimously approve the

Process Protocols. The schedule requires that the MCG review the Charter by October 18, 2013.

III. Draft Outcomes and Measures TM

Dave Richardson summarized the Draft Outcomes and Measures TM, outlining the methodology RMC used to synthesize the "project outcomes and measures" input that was provided by each MCG agency/organization. Initial feedback included numerous changes to wording. MCG members were encouraged to submit all suggestions/comments to RMC as a word document with visible track changes. To facilitate this, Jordie will email the MCG and attach the Outcomes and Measures TM in Microsoft Word.

IV. Housekeeping Items and Next Steps

The MCG approved the September draft meeting summary which will be posted on the website as final.

MCG members volunteered to be part of a group tasked with pre-reviewing the next TM which will be on Public and Disadvantaged Community Outreach. Volunteers included John Brodie, Scot Moody, and Tom Infusino.

Scot Moody volunteered to bring breakfast to the November meeting and requested a reminder one week prior. RMC distributed blank timesheet templates and explained their purpose: to track everyone's time, coming up with reasonable estimates of dollars spent, and possibly getting credit in the future for grant matching funds. MCG members were encouraged to estimate their "burdened rates," to include travel time, and to also track time for others in their agencies/organizations who may have attended the first meeting but not the second. NGO members who volunteer their time were asked to estimate a reasonable rate.

Mokelumne Collaborative Group (MCG)
Meeting #3 Summary

November 8, 2013

Organizations represented

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

City of Lodi, Public Works

City of Stockton, Municipal Utilities

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

Pacific Gas & Electric

San Joaquin County

San Joaquin County, Public Works

San Joaquin County Resource Conservation District

Sierra Club, SF Bay Chapter

Sierra Nevada Conservancy

Stockton East Water District

Trout Unlimited

Upper Mokelumne River Watershed Authority

Key Decisions

- Charter: Approved
- Protocols TM: Approved; minor edits required
- Outcomes and Measures TM: further edits will be made, then sent to the MCG. If no further edits from the MCG, TM will be assumed approved on November 22nd.
- Documents: Documents will be provided in both redline and clean versions so members can follow the editing process.
- Meeting Summaries: MCG meeting summaries will be posted to the public portion of the website.
- Public phone line: the public will not be permitted to listen-in on the phone line.
- Public comment period: will be moved to before lunch.

- Public Outreach Workgroup: East Bay MUD, Foothill Conservancy, UMRWA, San Joaquin County
- 'Model-Heads' Workgroup: California Sportfishing Protection Alliance, Amador Water Agency, Calaveras Public Utility District, the City of Stockton, and San Joaquin County/Groundwater Basin Authority

Action Items

- All MCG members: review Public Outreach Plan, return comments to Katie Cole by Friday November 15, 2013.
- RMC: post CEQA TM on website and email MCG when posted.
- RMC: incorporate section about moving approved documents to the public portion of the website into Protocols document and send to MCG.
- All MCG members: review Protocols document, submit any edits to Katie Cole by Wednesday November 13, 2013.
- RMC: post Charter and Protocols documents to website on November 13, 2013, pending no additional comments
- RMC: combine socio-economic 'potential measure to avoid' to address duplicate.
- Calaveras Planning Coalition: send Outcomes and Measures redlines to Katie Cole by Wednesday November 13, 2013.
- RMC: send redlined Outcomes and Measures TM to MCG by Thursday November 14, 2013
- All MCG members: review Outcomes and Measures TM, send comments to Katie Cole by Friday November 22, 2013.
- RMC: If no comments on Outcomes and Measures TM, assume approved, send out to MCG and post to website.
- RMC: add MokeWISE website address to Public Outreach Plan.
- Rainwater and Associates: add Bureau of Reclamation, Bureau of Land Management, Army Corps of Engineers, City of Jackson, and City of Plymouth to Tier 2 list.
- Rainwater and Associates: add Mary Beth from California Fish and Wildlife to Tier 2 stakeholder list.
- RMC: make breakfast snack sign-up sheet.
- RMC: include title of documents in header and page numbers in footer of documents.
- Calaveras County: provide breakfast snacks at the December meeting.

Summary

I. October Meeting Summary, Brief Update, and December Meeting

Meeting #2 (October 2013) summary was approved by consensus. By approved consensus, meeting summaries will be posted to the public portion of the website pending summary approval by the MCG.

The MokeWISE grant representative from the Department of Water Resources (DWR), Jason Preece, was given access to the MokeWISE website so he may review MokeWISE documents.

Facilitator explained that she would not be present at the December meeting; the meeting is still scheduled, but arrangements will be made to prepare an additional facilitator.

II. CEQA Process

Rob Alcott summarized how CEQA will be addressed during the MokeWISE process. He explained that the product of the MokeWISE program will be a non-binding document not subject to CEQA and therefore no CEQA document will be prepared as part of the ongoing MokeWISE process. Any CEQA required to implement the MCG endorsed outcomes will be summarized in the MokeWISE implementation plan; any CEQA discussion will merely look ahead to see what each alternative portfolio might require during a CEQA process.

The Upper Mokelumne River Watershed Authority (UMRWA) has produced a CEQA memorandum which explains how MokeWISE will address CEQA. This memorandum will be posted to the website. Any questions about CEQA should be directed by email to Rob Alcott who in turn will direct them to UMRWA Counsel.

III. MCG Protocols and Charter

Both the Charter and the Protocols documents were finalized by the MCG. The Protocols document had minor edits, which will be made, and sent out the MCG. If no further edits are proposed, the document is assumed approved on November 8, 2013.

IV. Draft Outcomes and Measures TM

Based on comments during MCG Meeting #2, the 'Attributing Stakeholder' column will remain in the document.

There was some discussion about additional comments on the document; these will be provided in redline to RMC by November 13th. RMC will address these comments and send out a redlined copy to the MCG by November 14th. If no further comments are received by November 22nd, the redlined copy will be assumed to be approved on November 22nd.

V. Draft Public Outreach Plan

RMC introduced the Public Outreach Plan, explaining that the purpose is to guide outreach efforts to public and details six levels of stakeholders.

Facilitator suggested that the public not be allowed to listen in on the phone line; by consensus, it was agreed that the public will not be allowed to listen in on the phone line. The public may still attend MCG meetings in-person.

Proposed public outreach meeting locations were presented and additional suggestions were solicited; these included adding West Point, Railroad Flat, Lake Camanche Village, and Valley Springs and removing Pardee.

It was suggested that outreach be conducted at meetings which are already scheduled. Concern was expressed that selectively choosing meetings may be perceived as favoritism. It was suggested that the PowerPoint's made for the five MokeWISE public meetings be made available to the MCG members so they may present these at other meetings.

There was discussion regarding the underrepresentation of DACs within the Tier 2 stakeholder list. It was decided that cities generally viewed as DAC communities who are not represented on the MCG be directly solicited to be added as Tier 2 stakeholders; this includes the Cities of Plymouth and Jackson.

There was a general desire to create a document which would eventually replace the MokeWISE program backgrounder on the public portion of the website. This document will outline what MokeWISE is, what has been done, what the next steps are, and how individuals may get involved. An Outreach Workgroup was formed and includes representatives from East Bay MUD, Foothill Conservancy, UMRWA, and San Joaquin County.

VI. Hydrologic Modeling

RMC presented on the purpose and use of hydrologic modeling in the MokeWISE process. It was explained that the program will explore a wide range of supply alternatives and that each alternative requires a unique methodology for determining how much of that supply is available. The methodology used for evaluating Mokelumne River supply will incorporate the use of the MOCASIM model. Any questions about MOCASIM should be directed to Brandon Nakagawa. It was suggested that American River, Calaveras River, and Stanislaus River water be added as additional supply alternatives for consideration.

RMC will prepare a list of peer-reviewers available for reviewing the methodology and present this list to the MCG. The MCG will consider this list and recommend two peer-reviewers.

A ‘Model-Head’ Workgroup was formed and includes representatives from the California Sport Fishing Protection Alliance, Amador Water Agency, Calaveras Public Utility District, the City of Stockton, and San Joaquin County/Groundwater Basin Authority. This Workgroup will conduct preliminary consideration of MOCASIM modeling logic and inputs. They will meet three times between now and January, with follow-ups in spring 2014 and summer 2014.

VII. Housekeeping Items and Next Steps

Calaveras County will provide the breakfast snacks for the next meeting. RMC will prepare a sign-up sheet so organizations can sign-up for bringing breakfast snacks at future meetings.

Moving forward, all documents will have page numbers in the footers and document titles in the headers.

The public comment period will be moved to the 16-minute period before lunch.

Mokelumne Collaborative Group (MCG)
Meeting #4 Summary

December 13, 2013

Organizations represented

Amador County

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

City of Lodi, Public Works

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

San Joaquin County

San Joaquin County, Public Works

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton East Water District

Trout Unlimited

Woodbridge Irrigation District

Key Decisions

- MCG membership: consideration for inclusion into the MCG will be extended until February, 2014.
- Draft Portfolio and Assessment Criteria: projects will initially be screened by determining if they are feasible, beneficial, attainable, and compatible. At that point, they will be assessed against the objectives to determine if an objective is met. At that point, project groupings will be determined.

Action Items

- All MCG members: review Public Outreach Plan, return comments to Katie Cole by Friday December 20, 2013.
- Rob Alcott: reach out to Native American communities letting them know about the January public outreach meeting.

- RMC: make edits to objective attribution table and send to MCG.
- All MCG members: send further attributions to RMC.
- All MCG members: send RMC additional names for peer reviewers by December 25th, 2013.
- RMC: include CVs of all proposed peer reviewers in January meeting material packet.

Summary

I. November Meeting Summary and Brief Update

Meeting #3 (November 2013) summary was approved by consensus and will be posted onto the public portion of the website.

RMC provided an update on the Model-Heads Work Group and briefly summarized the last meeting which occurred on November 25th, 2013. Subsequent meetings will be held on December 20th, 2013 and January 13th, 2014.

Because no other comments were received on the Outcomes and Measures TM, it was approved on November 22nd, 2013 and posted to the public portion of the website.

Two additions/changes to the MCG membership list were proposed. Restore the Delta and the San Joaquin Farm Bureau were requesting membership. Because the cut-off date for new additions was November, 2013, there was some discussion about extending the cut-off date. It was decided that the cut-off date for inclusion into the MCG would be extended until after the first Public Outreach meeting (extended until February, 2014). Rainwater and Associates, LLC will re-notify organizations that have declined previously to alert them to this change.

II. Draft Public Outreach Plan

There were several minor edits to the document. These edits will be incorporated into the document and included in the packet for the January meeting. All other edits are due to RMC by December 20th, 2013. A call for approval will occur at the January meeting.

It was suggested that there be an addendum to the Plan in the future which will account for which organizations, communities, and individuals have participated in the outreach process. This would serve to track both who has participated and the level of participation.

Native American communities have been targeted for specific outreach by the Upper Mokelumne River Watershed Authority (UMRWA). It was suggested that UMRWA circle back with these communities and alert them to the date of the initial public outreach meeting.

III. Environmental Conditions Overview

RMC provided an overview of the document, detailing both the current geomorphic and fishery conditions on the river, as well as opportunities and challenges for both of these areas.

A number of comments and edits were presented, which RMC will attempt to capture in the subsequent draft of the document. Written comments are due to RMC by Friday, December 20th, 2013.

IV. Draft Project and Portfolio Assessment Criteria TM

RMC explained both the process of creating the assessment criteria and the purpose of the assessment. It was proposed that through a poll, each category and objective be weighted so projects and portfolios could be scored. There was some unease about this ranking/scoring approach.

An advocacy approach was proposed, where scoring would occur once projects were suggested. After some discussion, it was decided that each proposed project will go through a 2-step screening process. The first step is to determine if each individual project is feasible, beneficial, attainable, and compatible. If a project makes it through the first pass, it will then be measured against each of the objectives to assess whether or not the project meets the objective. If all projects have been assessed, it should then be determined if some objectives are not met with the remaining projects. After this process, project groupings will be discussed.

It was noted that agricultural interests are not well represented in the current Program Outcomes and Measures. After some discussion, it was decided that an Agricultural Benefits category be added to the Program Outcomes and Measures, with new objectives. RMC will prepare this new document and send it to the MCG, where MCG members may further attribute their organizations to other objectives.

V. Preliminary Water Availability Approach

RMC explained the proposed process of determining available water for each of the proposed water sources, including groundwater, recycled water, and conservation.

Four peer-reviewers were suggested by RMC to review the water availability approach which will be determined by the MCG. CVs of each of these individuals will be included in the packet for the January meeting. Additional names may be provided to RMC by the MCG until December 25th, 2013 so that RMC may have time to solicit CVs.

VI. Logistics: Lunches and Snacks for Future Meetings

A list of all future meetings was passed around so each organization can sign up to provide breakfast snacks. This list will be posted on the website.

Mokelumne Collaborative Group (MCG)
Meeting #5 Summary

January 10, 2014

Organizations represented

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

City of Lodi, Public Works

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

Restore the Delta

San Joaquin County

San Joaquin County, Public Works

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton East Water District

Trout Unlimited

Upper Mokelumne River Watershed Authority

Woodbridge Irrigation District

Key Decisions

- MCG membership: consideration for inclusion into the MCG will be extended until February, 2014.
- Public Outreach Plan: considered approved, pending three edits.
- Draft Portfolio and Assessment Criteria: projects will initially be screened by determining if they are feasible, beneficial, attainable, and compatible. They will then be assessed against the MCG-approved objectives to determine if an objective is met. At that point, project groupings will be determined.

Action Items

- RMC: incorporate edits to Public Outreach Plan and post to public portion of the website.
- RMC: solidify date and meeting location for the first Public Outreach meeting and send details to MCG.
- All MCG members: submit remaining comments on Environmental Conditions TM to RMC by January 17, 2014.
- RMC: update Project and Portfolio Assessment Criteria TM to incorporate suggestions.
- RMC: create and send out worksheet for initial brainstorming of concepts to MCG.
- All MCG members: fill out worksheet and return to RMC by January 31, 2014.
- All MCG members: send comments on the draft Methodology TM to RMC by January 17, 2014.
- RMC: Coordinate with Bob Center for resume and send out to MCG.
- Brandon Nakagawa: compile materials for presentation at February meeting.

Summary

I. December Meeting Summary and Brief Update

Meeting #4 (December 2013) summary was approved by consensus and will be posted onto the public portion of the website.

RMC provided an update on the Modeling Work Group and briefly summarized the last meeting which occurred on December 20th, 2013. A subsequent meeting will be held on January 13th, 2014.

II. Draft Public Outreach Plan

RMC highlighted the edits that were made to the Plan, specifically the edits made to the DAC Outreach Table. There were several other edits suggested including:

- Adding a footnote to the Outreach Activities Table indicating that the MCG is not necessarily responsible for performing the activities, but may initiate them if they desire.
- Removing the City of Lathrop and City of Manteca as Tier 2 Stakeholder representatives in the DAC Outreach Table.
- Updating a column header in the Appendices.

The Public Outreach Plan was considered approved, pending the three above-mentioned changes.

The first Public Outreach meeting will be held either February 4th, 5th, or 12th, with a preference for the first week. The meeting will run from 7-9 pm to allow for the general working public to attend. It was decided that the meeting should be held in the up-country as there may be more attendance than if the meeting is held in the Valley. Location suggestions were solicited and RMC will reach out to those locations to check availability for the suggested dates and to reserve space for the meeting. RMC will draft a press release and send it out to allow the MCG to distribute it to their networks.

III. Environmental Conditions Overview Update

RMC provided an update on the progress of the document, indicating that edits had been passed onto Balance Hydrologics and Chuck Hanson, but that the deadline for further comments is January 17th. The revised document will be ready for review in February, with MCG approval in February or March. The document will be expanded to include analysis of the portfolios in late spring or early summer.

IV. Revised Project and Portfolio Assessment Criteria TM

RMC provided an overview of how the screening was incorporated and how each of the screens were defined. There was some concern that the feasibility screen definition was too limited and should be expanded to include more than just technical feasibility. After some discussion, it was decided that the definition will remain, but with an understanding that the process will be iterative and that the purpose of this screen is to remove the really bad ideas.

It was suggested that the compatibility screen be expanded to not only include compatibility of other MCG members, but to also be sensitive to those outside the MCG. After some discussion, it was decided that RMC would re-word the definition to better capture the purpose of the screen. There were additional edits suggested, which RMC will incorporate into the document.

To begin brainstorming concepts, RMC will create and send out a worksheet for MCG members to fill out. The worksheet is due back to RMC by January 31st to allow for compilation prior to the February meeting.

V. Draft Water Availability Analysis Methodology

RMC provided an overview of the process and the methodology drafted for each of the supply types. There was extensive discussion about the methodology for each supply type with a number of suggested edits. These edits will be incorporated and a revised methodology presented at a subsequent meeting.

One additional peer-review candidate, Bob Center, was proposed, which precipitated the need for a revised schedule. There was a general consensus that diversity and breadth of experience among the two peer-reviewers is important. It was determined that Karen Johnson will be included as one of the peer-reviewers and that the second peer-reviewer will be determined at the February meeting and will either be Steve Macaulay or Bob Center. RMC will collect Mr. Center's resume and send it out the MCG.

Mokelumne Collaborative Group (MCG)
Meeting #6 Summary

February 14, 2014

Organizations represented

Amador County

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

City of Lodi, Public Works

City of Stockton

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

Pacific Gas & Electric

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Upper Mokelumne River Watershed Authority

Key Decisions

- Public Outreach Plan: was approved by the MCG.
- Project Assessment TM: was approved by the MCG.
- Peer-reviewers: Karen Johnson and Steve Macaulay were selected.

Action Items

- MCG: continue to submit project concepts to RMC; deadline is February 28, 2014.
- RMC: post press release, Public Outreach Plan, and Project Assessment TM to public portion of the website.
- RMC: post San Joaquin County's presentation to the protected portion of the website.
- MCG: submit redlines of Environmental Conditions Overview TM to RMC by February 28, 2014.
- RMC: make change to attribution table in Project Assessment TM.

- RMC: update diversion table with JVID numbers.
- MCG: submit redlines of Mokelumne Methodology to RMC by January 28th, 2014.
- RMC: send out the concept list to the MCG, along with a table indicating which objectives are met by the projects.
- RMC: distribute copy of Feb. 19 public workshop presentation to MCG organizations for potential use in briefing their members on MokeWISE progress.

Summary

I. January Meeting Summary and Brief Update

Meeting #5 (January 2014) summary was approved by consensus and will be posted onto the public portion of the website.

RMC provided an update on the concept brainstorming and encouraged MCG members to continue submitting concepts for future consideration.

II. Final Public Outreach Plan

There were no further comments on the Public Outreach Plan. It was approved by consensus and will be posted to the public portion of the website.

RMC provided an update on the first Public Outreach Meeting to be held on February 19th, 2014 from 7-9pm at Amador County Board of Supervisors Boardroom at 810 Court Street in Jackson, CA. A press release was drafted and distributed to four major papers in the region. A flyer was also drafted and posted to the website; it was suggested that the press release also be posted to the website.

III. Environmental Conditions Overview Update

RMC provided an update on the progress of the document, indicating that Balance Hydrologics and Chuck Hanson had edited the document per the comments received by the MCG. The MCG indicated a need for more time to review the document; the deadline for further comments is February 28th, 2014. The revised document will be ready for MCG approval in March. The document will be expanded to include analysis of the portfolios in late spring or early summer.

IV. Revised Project Assessment TM

There were no further comments on the revised Project Assessment TM. It was approved by consensus and will be posted to the public portion of the website. It was suggested that, under the recreation category, salmon, trout, and steelhead should be included together anytime fish are mentioned. RMC will make this addition.

RMC will send out the concept list to the MCG, along with a table indicating which objectives are met by the projects on the concept list. RMC will also re-send the brainstorming template to allow MCG organizations to continue submitting concepts; the deadline for concept submittal is February 28th, 2104.

V. San Joaquin County Update

Brandon Nakagawa provided an overview of the Eastern San Joaquin Groundwater Basin Authority (GBA), highlighting groundwater projects and programs implemented and currently being considered by the GBA. Stormwater and low-impact development (LID) practices were also presented. These presentations will be posted to the protected portion of the website.

Any MCG member organization is invited to present to the MCG on current organization activities. The City of Lodi has signed up to present during the March meeting; Foothill Conservancy also expressed interest in presenting at a future meeting.

VI. Revised Draft Water Availability Methodology

RMC provided an update on the Non-Mokelumne Methodology, indicating that all comments received were incorporated. There were no further comments and the Non-Mokelumne Methodology was approved by consensus.

RMC presented the Mokelumne Methodology, explaining the work of the Modeling Workgroup and outlining the tasks within the methodology. There was some question about the 2040 CCWD diversion number, specifically that there may be some projects moving forward which would increase that number. CCWD will verify this number internally and report back to the MCG and RMC. JVID diversion numbers have been unintentionally omitted from the presented table; RMC will add them back in.

There was discussion regarding the necessity of Task 2, indicating that a daily time-step in the lower river isn't necessary because it is so heavily regulated. It was also suggested that daily flows in the lower river may be of use when considering flood flows, as there are a number of tributaries which flow into the Mokelumne downstream of Camanche. Foothill Conservancy indicated that PG&E has a document which details roughly 60 years of historical record and may be of use to the Modeling Workgroup. It was decided that Task 2 will remain as it is currently written and that review of the historical record is necessary to determine which periods require a more directed focus.

It is anticipated that the MCG will approve the Mokelumne Methodology at the March meeting. Once the Mokelumne Methodology is approved, it will be combined with the Non-Mokelumne Methodology into one document which will be distributed to the peer-reviewers. After some discussion, Karen Johnson and Steve Macaulay were chosen as peer-reviewers.

Mokelumne Collaborative Group (MCG)
Meeting #7 Summary

March 14, 2014

Organizations represented

Amador County

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

City of Lodi, Public Works

City of Stockton

Delta Fly Fishers

East Bay Municipal Utility District (EBMUD)

Foothill Conservancy

Eastern San Joaquin Groundwater Banking Authority

Jackson Valley Irrigation District

North San Joaquin Water Conservation District (NSJWCD)

Restore the Delta

Pacific Gas & Electric

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Stockton Municipal Utilities

Woodbridge Irrigation District (WID)

Key Decisions

- The Rate Payer Protection Alliance group will be encouraged to join the MokeWISE process as an interested party.
- <u>Environmental Conditions Overview TM</u>: considered approved.
- The April meeting will be located in the upcountry at Pardee; a second upcountry meeting will be scheduled in 2015.
- A subgroup of MCG members agreed to serve on a newly-formed workgroup to collaborate with RMC to further develop and refine the preliminary project concepts list.

Action Items

- RMC/Rainwater and Associates, LLC: will contact the Rate Payer Protection Alliance and explain why the MCG thinks they are better suited to be an Interested Party rather than an MCG member.
- Environmental Conditions Overview TM: will be posted to the website.
- RMC: The City of Lodi presentation materials will be posted to the protected portion of the website.
- RMC: will incorporate new wording to Revised Draft Water Availability Methodology document and will solicit feedback/approval via email.
- April presentations: EBMUD (topic: lower Mokelumne fisheries), WID, City of Stockton, and San Joaquin County Resource Conservation District, and Foothill Conservancy. Other agencies/groups volunteered for subsequent months.
- The newly-formed preliminary project concepts workgroup will meet twice before the May MCG meeting.

Summary

I. February Meeting Summary and Brief Update

Meeting #6 (February 2014) summary was approved by consensus and will be posted onto the public portion of the website.

RMC presented an overview of the initial public meeting held on February 19 in Jackson, CA and a discussion on philosophical aspects of the MokeWISE public participation process ensued. There was also a discussion on whether the Rate Payer Protection Alliance's interest in becoming a member of the MCG. This group requested to join the MCG during the public meeting. The MCG decided to encourage the Rate Payer Protection Alliance to join as an "Interested Party."

II. Environmental Conditions Overview Update

RMC provided a brief update on incorporation of comments in the Environmental Conditions Overview TM dated March 7, 2014. The MCG approved the document which will be posted to the MokeWISE website.

III. City of Lodi Update

Larry Parlin provided an overview of the City of Lodi's water resources management efforts and challenges. The presentation included a description of the water system and infrastructure, surface water treatment plant, historical water data, groundwater data and trends, wastewater treatment and recycling, and storm water systems. The presentation materials will be posted to the protected portion of the website.

MCG member organizations were solicited to present various components of their organization's activities during future MCG meetings. The following assignments were made:

April: EBMUD (topic: lower Mokelumne fisheries), WID, City of Stockton, Foothill Conservancy, and San Joaquin County Resource Conservation District (overview of agency plus key initiatives)

May: EBMUD (upstream infrastructure), possibly also Calaveras Planning Coalition

June: Amador Water Agency, possibly also Calaveras Planning Coalition

July/Aug - NSJWCD

August: Jackson Valley (tentative, depending on staffing availability)

August/September: EBMUD (conservation program)

At the April MCG meeting, topics and dates for future MCG member presentations will be further developed and solidified.

IV. Revised Draft Water Availability Methodology

RMC led a discussion of remaining issues on the Revised Draft Water Availability Methodology document. The document is not yet ready for peer review due to concerns about wording in the bullets under "Task 4" on Page 5, specifically the words "deductible" and environmental "co-insurance" (file name on internal website: WA Analysis Moke Draft TM_7Mar14.doc).

Although the wording of these bullets were specifically included to address potential modeling flow scenarios, two MCG members raised concerns that the current wording does not clearly delineate that such tools are not regulatory or an implicit challenge to current water rights and associated regulations. RMC will add proposed qualifying language to clarify that the modeling option is not such a challenge. RMC will revise the language above the bullets on Page 5 of document, to address these concerns.

The group agreed that if the proposed RMC revisions are acceptable, or can be further developed to a version that is acceptable, the MCG may approve the revised document via email to expedite the submission of the document to the peer reviewers. It is understood that all peer reviewer comments will be submitted to the MCG for consideration and further changes to the document will only be made with approval of the MCG.

V. Preliminary Project Concepts

RMC presented a brief overview of the project concepts development to date. MCG members were then asked to break into four small groups for discussions. Each group was tasked to consider the 60 project concepts using the following four questions as guidance:

- Which, if any, concepts are unclear?

- Where is additional information either necessary or useful?
- Are there opportunities to combine or integrate projects?
- Are there additional projects or types of projects that should be added?

It was understood that this exercise was only part of an iterative process that will further develop, refine, and integrate the initial list of projects. It was also understood that each group would not have sufficient time to address all 60 project concepts. After the small group breakouts, each group reported on their progress to the full MCG. The RMC team took detailed notes regarding specific suggestions for project integration, data gaps, categorization, and refinement and will revise the list accordingly and submit to the MCG for further review and development.

In addition to this effort at the MCG meeting, the MokeWISE planning team suggested developing a workgroup to collaborate with RMC to further develop and hone the concepts list. It was understood that whatever development happened in the workgroup would be submitted to the full MCG for further discussion and refinement. The MCG approved of this process and the following MCG members agreed to serve on the workgroup: John Brodie, Ron Forbes, Tom Infusino, Gene Mancebo, Brandon Nakagawa, Jerry Neuburger, Chris Shutes, and Richard Sykes (or Tom Francis). The workgroup will meet twice before the May MCG meeting. Outcomes of the workgroup will be presented to the larger MCG for consideration during the May MCG meeting.

Mokelumne Collaborative Group (MCG)
Meeting #8 Summary

April 11, 2014

Organizations represented

Amador County

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

City of Lodi, Public Works

City of Stockton

East Bay Municipal Utility District

Eastern San Joaquin County Groundwater Basin Authority

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Upper Mokelumne River Watershed Authority

Key Decisions

- Task 4: Language which was previously included as Task 4 in the Mokelumne River methodology has been removed from the methodology, with the understanding that the language will be retained and included at another point in the process.

Action Items

- RMC: Draft language clarifying that the table included in the 'Other Surface Water' section of the Water Availability Methodology is illustrative of the type of transfer opportunities involved.
- RMC: Coordinate with the GBA to draft language for the 'Groundwater' section of the Water Availability Methodology.

- RMC: Coordinate with CCWD to draft language addressing groundwater in Calaveras County for the 'Groundwater' section of the Water Availability Methodology.
- MCG: Submit comments on the Revised Water Availability Methodology to RMC by April 18th, 2014.

Summary

I. March Meeting Summary and Brief Update

Meeting #7 (March 2014) summary was approved by consensus and will be posted onto the public portion of the website.

RMC provided an update on the Concept Focus Group, stating that the group has been consolidating and integrating the concepts. The next Concept Focus Group meeting is April 15, 2014.

The second public meeting was scheduled for July 10th at the San Joaquin Farm Bureau from 7-9pm. Based on feedback from the last public meeting, the MCG adopted the use of a tagline. Students from Argonaut High School in Amador County submitted taglines; the MCG ultimately chose one, with a slight modification: "It's your watershed, your future – your voice matters!"

II. City of Stockton Presentation

The City of Stockton provided an overview of work done by the City, including the Delta Water Supply Project and conservation efforts. Future projects, including a coordinated approach to recycled water, were also discussed. This presentation will be posted to the protected portion of the website.

III. East Bay Municipal Utility District and Woodbridge Irrigation District Presentation

East Bay Municipal Utility District and Woodbridge Irrigation District provided an overview of lower Mokelumne fisheries, highlighting recent fisheries projects that the two Districts have implemented. This presentation will be posted to the protected portion of the website.

IV. Draft Water Availability Methodology

RMC proposed several changes to the Water Availability Methodology, including the definitions of 'available water' and 'unallocated water.' It was proposed that unallocated water be used to describe Mokelumne River water, while available water would be used to describe all other sources. There was some concern that the proposed definition of unallocated water did not account for water rights reservations. It was explained that the Water Availability Analysis exercise is not intended to assign or diminish any rights to the water, but merely to quantify the water that is in the river. After some discussion, it was decided that the definition of unallocated water be amended to specifically include pre-1914 water rights. No changes were made to the proposed definition of available water.

As a result of much offline work with various stakeholders, it was proposed that the Task 4 language under the Mokelumne River supply be removed from the Methodology and included at another point in the process. While the MCG approved the removal of the Task, the language contained therein has not yet been approved.

RMC then reviewed the comments submitted by peer-reviewers Steve Macaulay and Karen Johnson. Several suggestions were made, which were noted by RMC and will be incorporated into the Methodology.

It was suggested that the Modeling Workgroup be reconvened to review the modeling results. This meeting will be scheduled once the modeling has been done and results are available.

V. Foothill Conservancy Presentation

Foothill Conservancy provided an overview of their work, highlighting the Mokelumne Environmental Benefits Project, the Amador Calaveras Consensus Group, and the State Wild and Scenic River campaign. This presentation will be posted to the protected portion of the website.

VI. San Joaquin County Resource Conservation District Presentation

The San Joaquin County Resource Conservation District provided an overview of their work, highlighting the Mokelumne River Watershed Owner's Manual, Lower Mokelumne River Partnership Fund, and education programs. This presentation will be posted to the protected portion of the website.

Mokelumne Collaborative Group (MCG)
Meeting #9 Summary

May 9, 2014

Organizations represented

Amador Water Agency

Calaveras County

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

City of Lodi, Public Works

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Eastern San Joaquin County Groundwater Basin Authority

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

Pacific Gas & Electric

Restore the Delta

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Upper Mokelumne River Watershed Authority

Key Decisions

- Draft Water Availability Methodology: was approved by the MCG and will be posted to the website.
- Tier 2 Stakeholders: will be emailed the approved Methodology and given two weeks to provide comment.

Action Items

- RMC: edit the preliminary concept assessment based on MCG discussion.

Summary

I. April Meeting Summary and Brief Update

Meeting #8 (April 2014) summary was approved by consensus and will be posted onto the public portion of the website.

The MCG was made aware of a new participant for the City of Lodi.

The MCG was made aware of a response email from the Ratepayers Protection Alliance.

RMC provided an update on the July public meeting, stating that it will be held at the San Joaquin Farm Bureau from 7-9pm on July 10th.

RMC provided an update on the Concept Focus Group, stating that the group has met with the purpose of consolidating and integrating the concepts. The consolidated list of concepts will be presented and discussed at this meeting.

II. Draft Water Availability Methodology

There was brief discussion on the methodology, including one small edit. It was suggested that unappropriated Delta water be considered in the Other Surface Water category.

The Methodology was approved by the MCG pending the above changes and will be posted to the public portion of the website. The document will also be emailed to Tier 2 stakeholders and they will be given 2 weeks to comment. Any substantive comments received will be presented to the MCG at the June meeting.

III. East Bay Municipal Utility District Presentation

East Bay Municipal Utility District provided an overview of their facilities and operations, highlighting Camanche and Pardee Reservoirs, Freeport, and the Mokelumne Aqueducts. This presentation will be posted to the protected portion of the website.

IV. Preliminary Concept Review Assessment

There was discussion regarding the Wild and Scenic River legislation (SB1199) currently proposed. It was decided that an MCG assessment of the Wild and Scenic River concept be tabled until the June meeting. The MCG was advised the existing bill language was expected to be revised within the next two weeks. An update on the legislation and the MCG's assessment of the Wild and Scenic concept will be taken up at the June meeting.

RMC presented an overview of how the preliminary concept assessment process fits into the larger MokeWISE program. RMC then explained to the MCG how the assessment process was structured, as well as reminded the MCG of the four assessment criteria. There was some concern that a concept could only be placed in one of 3 "bins;" a "maybe" bin was added.

An MCG member suggested a new word format for the presentation of the concepts; the concepts will now be presented in both the table and word format.

The MCG discussed the preliminary assessment of each of the concepts and made changes. These changes were noted by RMC and will be incorporated and presented at the June meeting.

Mokelumne Collaborative Group (MCG)
Meeting #10 Summary

June 13, 2014

Organizations represented

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

City of Lodi, Public Works

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Eastern San Joaquin County Groundwater Basin Authority

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton East Water District

Upper Mokelumne River Watershed Authority

Key Decisions

- *None*

Action Items

- MCG: Each MCG member will send July public meeting posting flier (previously sent via email) to their constituents and informal networks.
- RMC: RMC will develop a draft preliminary portfolio development approach that integrates MCG feedback; the conclusions of this integration will be presented at the next MCG meeting.
- Revised Concept Action Items: A variety of action items were assigned during the concept review discussion. Persons responsible and their tasks are listed in Section III below and sorted by concept number.

Summary

I. May Meeting Summary and Brief Update

Meeting #9 (May 2014) summary was approved and will be posted onto the public portion of the website.

July public meeting posting flier has been emailed to MCG members.

Water Availability Analysis was sent to Tier 2 Stakeholders; no comments were received.

Wild and Scenic update: regarding potential implications of this pending legislation on the MokeWISE process, RMC reported that they will be writing a letter to the Department of Water Resources (DWR) to inform them that the MokeWISE process will continue to move forward per the contract; if and when SB1199 is signed into law, the planning team may seek additional consultation from DWR on potential impacts to the MokeWISE process

II. Amador Water Agency (AWA) Presentation

The AWA provided an overview of the genesis of the agency, drinking water and wastewater systems/infrastructure, customer base, challenges, drought impacts, water reuse, recycling, and conservation efforts. Current and future projects, including a gravity supply project being conducted in conjunction with the USDA, were also discussed. This presentation will be posted to the password protected section of the website.

III. Revised Concept Review and Assessment

RMC led a discussion of the revised concept review. The discussion included reviewing the screening criteria, revisiting the process (including emphasizing that just because a concept gets a "yes" doesn't mean it will get into a portfolio), and reviewing the list concept by concept to solicit additional feedback from the MCG. A number of action items resulted from the discussions:

Concept 1B: RMC, Rob Alcott, and Pete Bell will have an off-line discussion to better articulate step-wise tasks.

Concept 1D: Chris Shutes and Richard Sykes will contemplate language off-line and bring suggestions back to the group.

Concept 2B: Richard Sykes will contact Constellation Winery and Woodbridge Irrigation District to see if there is interest in potentially co-sponsoring the project.

Concept 5A: Calaveras County Water District doesn't want to be a sponsor; Pete Bell and (Central Sierra) Larry Diamond (Calaveras County) will conduct outreach to possible sponsors in the areas listed.

Concept 8F: Alyson Watson will attempt to rework language on this concept and will circulate to Larry Diamond, Tom Infusino, Rob Alcott, and Brandon Nakagawa for approval.

IV. Preliminary Portfolio Development Approach

RMC presented an overview of the preliminary portfolio development options. RMC reiterated that the purpose of portfolio development is to create portfolios of broadly-supported projects that meet MCG-developed objectives. The MCG discussed various approaches and provided feedback on the options presented. RMC will develop a draft preliminary portfolio development approach that integrates MCG feedback; the conclusions of this integration will be presented at the next MCG meeting.

Mokelumne Collaborative Group (MCG)
Meeting #11 Summary

July 11, 2014

Organizations represented

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

City of Lodi, Public Works

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Eastern San Joaquin County Groundwater Basin Authority

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

San Joaquin County

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton East Water District

Upper Mokelumne River Watershed Authority

Key Decisions

- Project Groupings: there will be five (5) project groupings, including regional benefits, upcountry benefits, valley benefits, MCG member priorities, and objectives. A sixth grouping will include all of the policies and initiatives identified to date.

Action Items

- AWA: draft language for a new concept that helps with identifying erosion areas within the watershed.
- RMC: send out two polls to MCG member organizations.
- RMC: draft project groupings and present to MCG in August.
- RMC: draft a template for presentation of project concepts.

Summary

I. June Meeting Summary and Brief Update

Meeting #10 (June 2014) summary was approved by consensus and will be posted onto the public portion of the website.

RMC provided an update on the July public meeting, stating that it was held on July 10th and a new member was added to the Interested Parties list.

RMC provided an update on Wild and Scenic, indicating that a letter was sent to DWR. DWR acknowledged receipt, but did not indicate that there would be a response.

The MCG was made aware that a second meeting must be held upcountry. It was decided that pending availability, the January meeting would be held at Pardee.

II. Calaveras Planning Coalition Presentation

The Calaveras Planning Coalition provided an overview of the organization, including their purpose and goal, how the Coalition was developed, and what the Coalition hopes the MokeWISE process will yield. This presentation will be posted to the protected portion of the website.

III. Revised Concept Review and Assessment

RMC reviewed each of the concepts to which there were edits. Concepts discussed include 1b, 2c, 4a, 4b, 4c, 7b, 7c, 7d, 8d, 9a, 9e, and 9f. MCG members suggested further edits, which were incorporated into the PowerPoint. CSPA indicated that Trout Unlimited, while no longer an MCG member, has offered to sponsor concept 1d regarding fish screens. Calaveras County removed their sponsorship from concept 6b regarding Mokelumne Hill stormwater. Because Calaveras County submitted that concept and has removed their sponsorship, the concept has been removed from the concept list.

It was noted that there was a lack of erosion control projects, specifically, that none of the projects focused on identifying erosion-prone areas within the watershed. AWA volunteered to work to draft a concept that would address this issue.

Next steps include discussing potential concept grouping and integration approaches. Concept integration will begin in late summer. Revision and further integration of concepts will occur in early fall after results from the Water Availability Analysis are released.

IV. Portfolio Development Approach and Preliminary Project Groupings

RMC presented the proposed process by which project groupings would both be developed and help inform the final portfolio. RMC reiterated the desire of the MCG to both maintain flexibility for funding and the need to adhere to the

MokeWISE scope, schedule, and budget. RMC proposed that the Concept List be used to develop project groupings, but that the Concept List be maintained for reference once the MokeWISE program is completed. It was explained that the purpose of the project groupings is to identify concepts which can be grouped together to allow for analysis.

MCG members expressed concern about how the Water Availability Analysis results would fit into the process. It was explained that the Water Availability Analysis and concept development are running in parallel and that the results of the Analysis would be included at a later stage in the concept development process. It was noted that some of the concepts may not require the results of the Water Availability Analysis; these concepts may be further developed prior to the results of the Analysis. It was clarified that draft portfolios would be developed after integration of the Water Availability Analysis results and that the MCG would be able to provide input on these portfolios prior to selecting a preferred portfolio.

RMC then proposed three potential project groupings, including implementation status, ease of implementation, and objectives. A number of MCG members expressed concern about these project groupings. After discussion, the MCG decided to form five different project groupings. These include:

1) *Regional Benefits*- concepts that have a regional benefit;
2) *Upcountry Benefits*– concepts that only have upcountry benefits;
3) *Valley Benefits* – concepts that only have valley benefits;
4) *MCG Member Priorities* – concepts that MCG member organizations have identified as important to their organization;
5) *Objectives* – concepts which best meet the most MokeWISE objectives.

It was also determined that there would be a sixth project grouping that would encompass all the concepts listed in the Policies and Initiatives category. Because the nature of this sixth grouping is different than the other groupings, it was decided that this grouping would move in parallel with the other groupings at a different level of analysis. RMC will propose concepts under each of these project groupings and present them to the MCG at the August meeting. After some discussion, it was decided that the Optimization of Calaveras Reservation concept would be moved out of Policies and Initiatives and into the Surface Water category to allow it to be analyzed at a level consistent with similar concepts.

After some discussion, it was decided that RMC will send out two polls to the MCG. It was explained that these polls are not a vote, but instead provide a 'pulse check' of the MCG to gain a better understanding of how MCG organizations are currently feeling about the concepts.

1) The first poll will help determine the MCG Member Priorities project grouping. It will ask MCG member organizations to identify, of the concepts submitted by that organization, which two (2) are their favorite.
2) The second poll will help the MCG see which concepts are currently most popular among all MCG member organizations. It will ask MCG member organizations to identify, of the concepts they did not submit, which five (5) they are most interested in pursuing for analysis.

Because the sixth project grouping consists of all concepts in the Policies and Initiatives category, it was decided that these concepts would not be included in the polls.

To allow for better presentation of the concepts, RMC will draft a concept template which will include information about funding, sponsorship, and if the concept requires results from the Water Availability Analysis.

V. Wrap-Up and Action Items

The Modeling Workgoup will be re-convened to discuss modeling results. The logistics of re-convening the group will be discussed at the next meeting.

Mokelumne Collaborative Group (MCG)
Meeting #12 Summary

August 8, 2014

Organizations represented

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Eastern San Joaquin County Groundwater Basin Authority

Foothill Conservancy

Jackson Valley Irrigation District

Lodi, City of

MyValleySprings.com

North San Joaquin Water Conservation District

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Trout Unlimited

Woodbridge Irrigation District

Key Decisions

- Project Groupings: there will be five (5) project groupings, including regional benefits, upcountry benefits, valley benefits, MCG member priorities, and objectives. A sixth grouping will include all of the policies and initiatives identified to date.

Action Items

- RMC: send out new poll MCG members.
- RMC: change concepts 1a and 7b to Regional Benefits Project Grouping.
- RMC: add WID as co-sponsor to concepts 4c and 4d.
- RMC: set up Policies and Initiatives Workgroup.
- RMC: draft new language for concept 3a, renamed Desalination Study.
- RMC: send out emails asking for additional concept co-sponsors.

Summary

I. July Meeting Summary and Brief Update

Meeting #11 (July 2014) summary was approved by consensus and will be posted onto the public portion of the website.

A new representative from Trout Unlimited was introduced to the MCG.

RMC updated the MCG on the status of communications with Ken Berry, a member of the Ratepayers Protection Alliance (RPA), including that a formal records request was submitted by Mr. Berry. In response to his request, a CD containing all documents provided to the MCG up to this point was sent to Mr. Berry.

RMC provided an update on Wild and Scenic, indicating that the legislation is currently in suspense due to the bill sponsor becoming injured while on vacation.

The MCG was made aware that the facilities at Pardee Reservoir have been reserved for the January meeting.

II. North San Joaquin Water Conservation District Presentation

North San Joaquin Water Conservation District provided an overview of the District, including a brief history of the District, the District's infrastructure, and projects being implemented by the District. This presentation will be posted to the protected portion of the website.

III. Jackson Valley Irrigation District Presentation

Jackson Valley Irrigation District provided an overview of the District, including a brief history of the District, the District's infrastructure, and projects being implemented by the District. This presentation will be posted to the protected portion of the website.

IV. Polling Results

RMC reviewed the polling request, specifically what each poll asked.

1) The first poll was intended to help determine the MCG Member Priorities project grouping. It asked MCG member organizations to identify, of the concepts submitted by that organization, which two (2) are their favorites.

2) The second poll was intended to help the MCG understand which concepts are currently most popular among all MCG member organizations. It asked MCG member organizations to identify, of the concepts they did not submit, which five (5) they are most interested in pursuing for analysis.

RMC explained that the polls were intended as "pulse checks" and results do not mean that any projects would be removed from the list or removed from the analysis phase. RMC explained the process by which the results for Poll1 were completed. This included finding entities' original concept submissions and tracking their evolution over the course of the MokeWISE process. Because some concepts were rolled into others and modified, there was some confusion regarding the accuracy of the results. Because of this confusion, it was decided that entities would not be attributed to their poll responses and Poll 1 would be removed from consideration as a Project Grouping for Analysis.

There was general interest in the results of the Poll 2, which lead to a discussion of facilitating a new poll. This is discussed further in the following section.

V. Preliminary Project Groupings

RMC presented the preliminary Project Groupings for Analysis. These included:

1) *Regional Benefits*- concepts that have a regional benefit;
2) *Upcountry Benefits*– concepts that only have upcountry benefits;
3) *Valley Benefits* – concepts that only have valley benefits;
4) *MCG Member Priorities* – concepts that MCG member organizations have identified as important to their organization;
5) *Objectives* – concepts which best meet the most MokeWISE objectives.

After RMC presented the geographic groupings, there was discussion about the merits of these groupings. It was suggested that project benefits be determined based on where the hardware is located instead of where potential benefits may be seen. A 20-minute caucus was called. After further discussion, the MCG decided that projects 1a and 7b be changed to the Regional Benefits Project Grouping. Pending these two changes, the MCG approved the geographic project groupings, Project Groupings 1 through 3.

Some concern was expressed about how project groupings would be analyzed, particularly where groupings included projects that were very conceptual in nature. After some discussion, two new project groupings were suggested in addition to the three geographic groupings. The fourth project grouping would include projects which required a low level of analysis and the fifth would include projects which required a high level of analysis. Those that require a low level analysis are expected to be the largely conceptual concepts and those concepts that will not alter demands and therefore will not require modeling. Those that require a high level of analysis are expected to include concepts that will alter demands and / or streamflows and will therefore require modeling.

There was general consensus that the results of Poll 2 were more representative of the MCG's priorities, and that another polling effort would be beneficial. This poll would be similar to the previous Poll 2, with a slight modification: the new poll would ask each MCG entity to select its top five concepts to move forward for analysis. The results of this poll would be used to develop a new sixth project grouping.

Based on the discussion, the MCG decided on the following project groupings:

1) *Regional Benefits*- concepts that have a regional benefit (grouping approved by MCG);
2) *Upcountry Benefits*– concepts that only have upcountry benefits (grouping approved by MCG);
3) *Valley Benefits* – concepts that only have valley benefits (grouping approved by MCG);
4) *Low Level of Analysis* – concepts that have low levels of analysis, particularly ones requiring qualitative analysis or ones that do not alter demands and will thus not require modeling;
5) *High Level of Analysis* – concepts that have high levels of analysis, particularly ones that will alter demands and thus will require modeling;
6) *MCG Member Priorities* – concepts that MCG members have identified as important to their entities (informed by new poll);

The concepts within the Policies and Initiatives category are still moving forward under a different analysis method and are therefore not included in any of the above project groupings. A Policy and Initiatives Workgroup will be convened with representatives from the San Joaquin Farm Bureau, San Joaquin County, Calaveras Planning Coalition, Calaveras County, and East Bay Municipal Utility District to work on further developing these concepts.

The issue of sponsorship was discussed, as there are still three concepts with no sponsors. Because concept 9c is a policy and initiative, it is ok that there is no sponsor. Concept 6a has been removed since there was no sponsorship interest among the MCG. The MCG agreed that 3a should be revised to be a study which investigates all desalination opportunities available. RMC will draft a new description for this concept.

There was some question as to the role of a sponsor. It was decided that each concept can have both "Lead" and "Co-Sponsors." RMC will send out an email defining these roles and ask that any MCG entities who wish to act in either of these roles respond to that email. These sponsors will work together to complete the concept request for information that was sent out.

The concept request for information was sent out to identified sponsors for each concept. These requests will help inform the analysis for the project groupings. RMC is hosting a webinar to review these requests on Thursday August 14, 2014. Responses are requested by Monday August 18, 2014.

VI. Wrap-Up and Action Items

None.

Mokelumne Collaborative Group (MCG)
Meeting #13 Summary

September 12, 2014

Organizations represented

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

Lodi, City of

MyValleySprings.com

North San Joaquin Water Conservation District

Restore the Delta

San Joaquin County

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton, City of

Upper Mokelumne River Watershed Authority

Key Decisions

- Concepts: Concept 2d has been removed from the list.
- Project Groupings: Groupings 4 and 5 were approved by the MCG. Grouping 6 will go final on Friday September 19th, pending PG&E response.

Action Items

- RMC: fill in Information Requests for concepts 3a and 8c.
- RMC: include operational scenarios language into Concept 7b.
- RMC: revise Water Availability Analysis to add challenges sections and various edits per MCG discussion; send to MCG on Friday September 19th.
- MCG: review WAA and submit redline edits and comments to RMC by Friday September 26th.
- RMC: reach out to PG&E to determine status of involvement.
- RMC: compile edits, respond to comments, and send revised WAA to MCG on October 3rd.

- Foothill Conservancy: determine whether to retain Mokelumne Wild & Scenic as MokeWISE project concept.
- EBMUD: send Recycled Water and Other Surface Water sections to the appropriate groups within EBMUD to review.

Summary

I. August Meeting Summary and Brief Update

Meeting #12 (August 2014) summary was approved by consensus and will be posted onto the public portion of the website.

There is no further action on the Wild and Scenic legislation this year. Foothill Conservancy will determine and report back to MCG if they would like to pursue the Wild and Scenic policy within MokeWISE.

Concept 2d (Mokelumne Hill Sanitary District Reclaimed Wastewater) has been removed due to the sponsor removing sponsorship of the concept.

The first Policies and Initiatives Workgroup meeting is next Friday; entities with current policies and initiatives related to any of the MokeWISE policies and initiatives were encouraged to send them to RMC for consideration by the Workgroup.

II. San Joaquin Farm Bureau Presentation

The San Joaquin Farm Bureau provided an overview of the Bureau, including a brief history and challenges faced by the Bureau. A number of questions about the Bureau were answered. This presentation will be posted to the protected portion of the website.

III. Revised Concept Groupings

RMC provided an overview of where the MCG is in the MokeWISE process, including that Groups 1 through 3 were approved at the August meeting, that RMC is looking for approval of Groups 4 and 5, and that Group 6 will be presented for initial review at this meeting.

Project Groupings 4 and 5 were approved by the MCG. Discussion ensued about including an operational scenarios component into Concept 7b (Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering). RMC will incorporate this idea into the concept description.

RMC presented the polling results, indicating that the concepts receiving 3 or more tallies were included in Project Grouping 6. Three of the four entities who had not yet responded to the poll responded during the meeting. After accounting for these tallies, one concept moved into the Project Grouping; Project Grouping 6 now includes 17 concepts. RMC will reach out to PG&E to solicit their response to the poll. The Project Grouping will go final if they do not provide their response by Friday September 19th.

IV. Concept/Grouping Assessment Format

RMC presented on the overall process, including how the Concept Information Requests will be incorporated into the process. The sponsors of four concepts, including concepts 1e, 2b, 4a, and 4d, have not yet submitted the information requests. Concepts 3a and 8c have no sponsors, so RMC will complete these requests.

Once all Information Requests are received, RMC will review and augment the requests were possible. The information requests will be submitted to Balance Hydrologics and Hanson Environmental for their use in analyzing the benefits and impacts of each concept. RMC also reviewed the timeline; in September, Balance and Hanson will begin assessing concepts which do not require results from the Water Availability Analysis by using the Information Requests. In October, Balance and Hanson will continue to assess concepts based on Information Requests and Water Availability Analysis findings.

V. Water Availability Analysis

RMC provided an overview of the results from all sections of the Water Availability Analysis, except for Mokelumne River. It is anticipated that Mokelumne River results will be presented to the MCG at the November meeting. The Modeling Workgroup will reconvene to review the MOCASIM results prior to the MCG reviewing the Mokelumne River portion of the Water Availability Analysis.

Comments and suggestions on each of the sections were noted by RMC and will be incorporated into the revised document. There was discussion about the challenges associated with potentially using some of the water that is noted as available in the analysis. Because of this, it was decided that RMC will include a challenges sections in each of the supply types to outline the various challenges associated with using the potentially available supply.

Due to the addition of the challenges section, the timeline was revised. RMC will draft these new sections and incorporate edits that were noted during the discussion. RMC will send this revised version to the MCG on Friday September 19th. The MCG will have one week to review, with redlines due to RMC by Friday September 26th. RMC will compile edits, respond to comments, and send the revised draft back to the MCG on Friday October 3rd. The revised analysis will be reviewed at the October 10th MCG meeting. EBMUD will send the current versions of the Recycled Water and the Other Surface Water sections to the respective groups to receive feedback which can be incorporated within this new schedule.

VI. Wrap-Up and Action Items

None.

Mokelumne Collaborative Group (MCG)
Meeting #14 Summary

October 10, 2014

Organizations represented

Amador Water Agency

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

Lodi, City of

MyValleySprings.com

North San Joaquin Water Conservation District

San Joaquin County

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton, City of

Upper Mokelumne River Watershed Authority

Woodbridge Irrigation District

Key Decisions

- *None.*

Action Items

- RMC: begin drafting language for a resolution process.
- RMC: include potential outreach opportunities on agenda for November meeting.
- Facilitator: reach out to PG&E and Amador County to encourage active MCG participation.

Summary

I. September Meeting Summary and Brief Update

Meeting #13 (September 2014) summary was approved by consensus and will be posted onto the public portion of the website.

Foothill Conservancy indicated that they are not interested in sponsoring the Wild and Scenic Policy. The other entities who have indicated an interest in including a wild and scenic policy within the MokeWISE program have been asked if they are interested in sponsoring. If these entities are not interested in sponsoring, the concept will be removed from the list. If a sponsor is identified, the concept will begin the assessment process.

RMC provided an update on the Policy and Initiatives Workgroup, indicating that they have met once and will be meeting again on October 23rd to review progress made on individual policies and initiatives.

RMC provided an update on the Modeling Workgroup, indicating that they had met to review the MOCASIM model preliminary outputs of the two base cases. Some of these results were later presented that day.

Calaveras Planning Coalition cautioned that the MokeWISE process should not wait until near the end for MCG stakeholders to identify areas of concern about project concepts. The schedule provides time for boards and other decision making bodies to review the preferred alternative. Challenges associated with board approval were discussed, including board turnover. The process of reaching out to newly elected officials was briefly discussed and tabled for the next meeting. The question of "what does support really mean?" was brought up; RMC will draft language for a resolution of support that will outline the definition of support.

II. MyValleySprings.com Presentation

MyValleySprings.com provided an overview of the organization, including history of Calaveras County and the work in which MyValleySprings.com has been involved. A brief question and answer period followed. The handout provided as part of the presentation will be posted to the protected portion of the website.

III. Water Availability Analysis

RMC gave an overview of the peer-review comments submitted on each section, as well as the specific comments where RMC took a different approach than was suggested in the comment.

Comments from the MCG about the proposed response to comments were solicited. Some of these comments included adding an opportunities section to each supply type to capture potential use opportunities and cite page numbers in the in-text citations. All comments stated during the meeting were captured by RMC and will be included in the revised version of the document. MCG members were encouraged to submit further comments through email and redline.

IV. Water Availability Analysis – Mokelumne River Supply

RMC reviewed preliminary results from the MOCASIM modeling effort. Information of interest to the MCG includes average unallocated flow over period of record, seasonal flows, and a comparison of JSA required and modeled flows. RMC will begin drafting the Mokelumne piece and send to the MCG later in October.

V. Preliminary Concept Assessment Information

RMC presented the preliminary environmental concept assessment from Balance Hydrologics and Hanson Environmental. General comments included presenting an explanation of the scale and adding a column to discuss the mitigation measures that could be used to capture more project benefit. These comments will be passed on to Balance and Hanson Environmental for incorporation into the revised version.

VI. Wrap-Up and Action Items

RMC presented a master schedule, highlighting each of the deadlines over the month of October.

Outreach to PG&E will continue to be conducted to potentially identify a new representative. Additionally, outreach to Amador County will be conducted to encourage the County to attend meetings and provide comments on process and documents.

Mokelumne Collaborative Group (MCG)
Meeting #15 Summary

November 14, 2014

Organizations represented

Amador County

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Public Utility District

California Sportfishing Protection Alliance

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

Restore the Delta

San Joaquin County

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton East Water District

Upper Mokelumne River Watershed Authority

Woodbridge Irrigation District

Key Decisions

- Include brief discussion of EBMUDs current stormwater study.
- Include a quadrupled implementation level in the conservation section.
- Include a daily hydrograph from 1998 forward in the Mokelumne River section. Show monthly graphs for wet years and yearly for all other years.

Action Items

- RMC: post EBMUD Board presentation after EBMUD December Board meeting.
- RMC: secure location for January 8th public meeting.
- RMC: develop a list of resource agencies and points of contact for invitations to the March public meeting.
- MCG: comments on WAA to RMC by Wednesday November 26th.
- Amador County: provide breakfast snacks at January meeting

Summary

I. October Meeting Summary and Brief Update

Meeting #14 (October 2014) summary was approved by consensus and will be posted onto the public portion of the website.

RMC presented an update on the Policies and Initiatives Workgroup, including that the members are working on fleshing out those concepts. The final meeting is in January and drafted products will be presented to the MCG in February. The Modeling Workgroup is working with the MOCASIM model and will meet again in December to review project results.

Amador County indicated that it will be increasing its level of participation in MokeWISE by more frequently attending meetings. Foothill Conservancy and CSPA are working with PG&E to encourage them to increase their participation level.

RMC reviewed the MokeWISE process, including where the MCG is currently and the outcomes for the MokeWISE program. Additionally, RMC reviewed the schedule, including the major decision points for each of the remaining 7 months.

II. Outreach Opportunities

RMC presented on the different outreach opportunities available. RMC reiterated that the January meeting at Pardee will be a good opportunity to bring elected officials and introduce/update them on the process. CCWD stated that they have hired a new General Manager and have several new Board members; invitations will be extended to these individuals.

RMC suggested the formation of an Outreach Workgroup, which would help coordinate outreach to elected official, support public meetings, and coordinate additional outreach activities. There was no interest in forming this group. EBMUD did state that they would be updating their Board in the beginning of December and would be willing to make this presentation available to the MCG.

There are three remaining public workshops: January, March, and May.

- The January meeting will be focus on the Water Availability Analysis and the preliminary assessment of concepts. This meeting will be held on January 8th in Calaveras County. RMC will secure a location and develop meeting materials.
- The March meeting will focus on analysis of portfolios. RMC suggested that this meeting, in addition to being a public meeting, target resource agencies. There was a concern that the public is generally available at night and resource agencies are generally available during the day, which would make scheduling this joint meeting

difficult. RMC will compile a list of resource agencies and points of contact.

- The May meeting will focus on the preferred MokeWISE program.

RMC provided a general overview of the draft Resolution of Support and explained that this does not need to be the same resolution for each MCG entity; members can tailor it their entity, but it needs to indicate support for the process. The Resolution would be appended to the final document, but it is understood that the final Board update process will likely happen in June/July. DWR understands this and final Board adoptions will not jeopardize the DWR agreement. MCG members were encouraged to provide comments on the draft Resolution.

III. California Sportfishing Protection Alliance Presentation

California Sportfishing Protection Alliance (CSPA) provided an overview of the organization, including its history and the work in which CSPA has been involved. A brief question and answer period followed. The presentation will be posted to the protected portion of the website.

IV. Water Availability Analysis – Non-Mokelumne Supply

RMC gave an overview of the comments and provided a study hall period for MCG members present to review the proposed response to comments. MCG comments are due to RMC by Wednesday November 26th.

One of the comments on the stormwater section questioned why stormwater potential in the EBMUD service area was not calculated. EBMUD explained that they are currently investigating stormwater potential and will have a technical memorandum in January 2015 with this information. After some discussion, it was decided that to address this comment, information about EBMUD's current effort would be summarized. Several comments on the conservation section expressed a desire to see additional, more aggressive levels of conservation to determine potential savings. It was decided that expanded implementation level currently shown (which is double current levels) would be expanded further to double the expanded levels (or quadrupled the current levels). Additional comments were expressed at the meeting, which were catalogued by RMC and will be incorporated.

V. Water Availability Analysis – Mokelumne River Supply

RMC explained that the implemented methodology differs from the original work plan due to disagreements on the definition of available water. Ultimately, a mutually-agreed upon definition of unallocated water was chosen and fisheries and geomorphology impacts will be considered in conjunction with projects. This history has now been captured in the Mokelumne section. Comments that and concerns that were expressed during the meeting were addressed in the latest version of the section; MCG members were encouraged to read it and provide any further comments or concerns.

RMC reviewed general comments on the Mokelumne section and explained the proposed process for creating a daily hydrograph. There was some concern about creating a daily hydrograph prior to 1998, because historical flow prior to 1998 does not reflect current operating conditions on the River. The MCG decided that from 1998 forward, daily unallocated/allocated flow will be provided with the caveat that it is only shown to provide information about monthly variability and is not meant to provide information on pulse flows and geomorphic work. For the wet years from 1998 to 2010, present graphs that show daily unallocated/allocated by month; for all other hydrologic year types, show daily unallocated/allocated by year. Comments are due to RMC by Wednesday November 26th.

VI. Revised Concept Assessment Approach

RMC reviewed the changes that were made to the environmental assessment, including that an additional column explaining how additional benefits could be captured was added and that a general qualitative explanation of the 1-5 scale was added. No additional comments were provided at the meeting.

RMC explained the concept cut-sheets, including that each cut-sheet would include the concept name, description, and other relevant information. The assessment will be based on the MokeWISE program objectives and include an open, closed, or half circle for each objective with an explanation for the assessment.

VII. Wrap-Up and Action Items

Amador County offered to bring breakfast snacks to the January meeting.

Mokelumne Collaborative Group (MCG)
Meeting #16 Summary

December 12, 2014

Organizations represented

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

Lodi, City of

MyValleySprings.com

Restore the Delta

San Joaquin County

Sierra Club, SF Bay Chapter

Stockton, City of

Woodbridge Irrigation District

Key Decisions

- Water Availability Analysis (without the Mokelumne and Stormwater sections) was approved.
- Update Stormwater section to remove qualifying text and include analysis on average single family potential stormwater use.
- Update Environmental Assessment of Concepts to include both viewpoints.

Action Items

- RMC: send EBMUD Board update materials to the MCG.
- RMC: update Stormwater and Mokelumne sections based on discussions at the meeting.
- RMC: update Environmental Concept Assessment to include both viewpoints on revised concepts; send to MCG by December 15th
- MCG: review Environmental Concept Assessment and provide comments by December 19th.

- RMC: complete remaining concept assessments and send to MCG by Friday December 19th
- MCG: review concept assessments and provide comments to RMC by Tuesday December 30th.

Summary

I. November Meeting Summary and Brief Update

Meeting #15 (November 2014) summary was approved by consensus and will be posted onto the public portion of the website.

RMC provided an update on the Modeling Workgroup, including that the group has met and discussed preliminary modeling results for one of the concepts. The group will meet again in January to review more results.

Sierra Club volunteered to present at the February meeting. EBMUD offered to present on its reservoir operations if the write-up that is to be included in the Mokelumne section of the Water Availability Analysis is not sufficient. There was a strong interest among the MCG for this presentation and EBMUD agreed to internally discuss the possibility of a presentation.

The January 8th public meeting will be at the CCWD Boardroom. RMC will be preparing a flyer to distribute to MCG members. Additionally, a press release will be sent out prior to the meeting. Electeds are encouraged to attend if they are not able to attend the MCG meeting on the 9th. EBMUD has made available their presentation to the EBMUD Board that other entities can use a starting point to begin discussions with their respective Boards.

The MCG is to send in comments on the draft Resolution of Support letter. Comments are wanted now, but the document will be revisited in the spring when MokeWISE program outcomes are more formulated.

San Joaquin County provided a summary of the Settlement Agreement between the County and EBMUD. In a dry year, NSJWCD will get up to 6,000 AF when EBMUD's projected end of September (EOS) total system storage (TSS) is greater than 550 TAF and up to 3,000 AF when EOS TSS is greater than 525 TAF but less than 550 TAF. In wet years, NSJWCD will receive up to 8,000 AF.

RMC reviewed the MokeWISE process, including where the MCG is currently and the outcomes for the MokeWISE program. Additionally, RMC reviewed the schedule, including the major decision points for each of the remaining 7 months.

II. Water Availability Analysis – Non-Mokelumne Supply

RMC presented an overview of the non-Mokelumne edits, including additions to the Groundwater and Other Surface Water sections. RMC summarized discussions held with Foothill Conservancy regarding the Conservation section, including that the expanded program levels of implementation were still not aggressive enough. In an effort to respond to these concerns, an additional level of conservation implementation has been added to the analysis in the Conservation section. This additional level assumes that each agency is able to achieve 85 gallons per capita per day (gpcd). It was made clear that this maximum theoretical level is not something that is being advocated for at this point, but that it is acting as a reference point to examine what is theoretically possible.

There were additional comments from Foothill Conservancy on the Stormwater section. These were discussed over lunch with RMC and a resolution presented to the MCG. There were no objectives to removing the discussion on the Camanche Area Regional Water Supply Plan (CARWSP) and the other qualifying language in the Potential Stormwater Programs section. In place of this, the section will include an analysis of the amount of potable water that an average single family home could offset with stormwater.

III. Water Availability Analysis – Mokelumne River Supply

RMC presented an overview of the comments that were received and summarized the comments that had not yet been incorporated. It was explained that these comments would not affect the model output, but would address formatting and language. After some discussion, it was decided that more results should be moved to the appendices and that more explanation of the results should be included. Additionally, include a description of what each of the appendices are at the beginning of the Mokelumne section and at the beginning of each of the appendices.

The MCG approved the Water Availability Analysis (without the Mokelumne and Stormwater sections). These two sections will be revised and presented to the MCG in January. It is anticipated that the Mokelumne and Stormwater sections will be ready for final approval by February.

IV. Revised Environmental Assessment of Concepts

RMC presented the changes to the environmental assessment of the concepts. There was a general concern that concept 7b (Raise Lower Bear) had been "green-washed" and that the edited concepts had originally presented one viewpoint, but now present another. It was ultimately decided that both viewpoints be included.

RMC will make these changes and send back out to the group by the end of the day on Monday December 15th. The MCG will have until Friday December 19th to provide comments. If no comments are received, then it will be assumed final.

V. Draft Assessment of Selected Concepts

RMC reviewed the assessment approach, including the rating system and the justification of the rating. There was a comment that the concept summary page be re-formatted to include more abbreviated titles; this will help maximize space. RMC will send the remaining concept assessments and the assessments on the project groupings by Friday December 19th. MCG comments on the concept assessments are due back to RMC by December 30th.

RMC will prepare and send out a template that MCG members can use to document concerns about individual concepts. The MCG is to return it to RMC by January 2nd.

VI. Wrap-Up and Action Items

At the next meeting, RMC will provide a 15 minute overview of MokeWISE for electeds and include a brief discussion of what will be expected of electeds at the end of the process.

Mokelumne Collaborative Group (MCG)
Meeting #17 Summary

Located at Pardee Center

January 9, 2015

Organizations represented

Amador County

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

Lodi, City of

MyValleySprings.com

North San Joaquin Water Conservation District

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton, City of

Upper Mokelumne River Watershed Authority

Woodbridge Irrigation District

Key Decisions

- Mokelumne and Stormwater sections of the Water Availability Analysis were approved.
- Environmental assessment on concept 7b (Raise Lower Bear Feasibility) was approved.

Action Items

- RMC: make final changes to Mokelumne section and finalize; post to website
- Foothill Conservancy, CSPA, AWA, Amador County: Discuss language on concept 1a (Anadromous Fish Restoration) and come to February meeting with proposal.
- MCG: provide comments on how generic planning language applied to concept 7b may apply to other planning concepts.

- RMC: draft new Benefit Allocation methodology based on discussion.
- RMC: compile new portfolios to send to MCG; schedule webinar to discuss portfolios prior to February meeting.

Summary

I. MokeWISE Overview

It was determined that because there were no elected officials present at the meeting, the MokeWISE overview was not needed.

II. December Meeting Summary and Brief Update

RMC read the one change to the meeting summary that clarified the San Joaquin Agreement. San Joaquin County clarified that the 6,000 acre-feet in a dry years is in a dry-year sequence. This was added and the summary was approved by consensus; it will be posted onto the public portion of the website.

RMC summarized the key points from the January 8 evening public meeting, including that the Amador Calaveras Consensus Group offered to do a presentation to the MCG. An MCG member commented that SPI's involvement is significant. SPI will have increased involvement if the ACCG presents to the MCG, as SPI is a member of the ACCG.

RMC discussed soliciting comments on the draft Resolution of Support letter and explained that the draft will be revisited at a later date. The purpose of discussing the draft now is to get MCG members thinking about what support for MokeWISE may mean for their particular organization.

RMC reviewed the MokeWISE process, including where the MCG is currently and the outcomes for the MokeWISE program. Additionally, RMC reviewed the schedule, including the major decision points for each of the remaining 6 months.

III. Water Availability Analysis – Mokelumne and Stormwater

RMC presented an overview of Mokelumne and Stormwater revisions, including the new stormwater language on percentage of losses. There were a few remaining comments on the Mokelumne section, including questions on unit conversions and language clarifications. These changes were noted during the meeting and will be made to the document. Given these changes, both the Mokelumne and Stormwater sections were approved by the MCG. Once the Water Availability Analysis is compiled, it will be posted to the public portion of the website.

IV. Revised Environmental Assessment of Concepts

RMC explained that the environmental assessment on concept 7b (Raise Lower Bear Feasibility) was returned to the geomorphologists to revise the assessment given the sensitivities and concerns expressed at the December meeting.

There was a concern about the new assessment under General Comments, particularly that there are a number of generalizations about mitigation and about the potential benefits. It was suggested that the project description be revised to state what the proposed benefits of the project would be, particularly what potential benefits would be evaluated in the study.

Given the discussion, the project description was revised during the meeting to include the following: *The study would include evaluation of the proposed beneficial uses of the project and clarifying operational parameters. It would also identify benefits, impacts, and constraints in the following areas: technical, political, environmental (including both species-related and geomorphic), economic, legal, and recreation – recognizing that a more detailed Environmental Impact Report would be required prior to implementing a project. The study will include consultation with members of the MokeWISE MCG*. After this new description was approved, the environmental assessment was revised to combine assessments from previous revisions. In addition, a sentence explaining that operations would drive benefits and impacts was added at the end of each paragraph. This assessment was approved by the MCG.

There was then discussion on adding the language that was added to the project description of concept 7b to other planning study concepts. RMC sent an email to the MCG with the language that was added to concept 7b with the request that MCG members provide comments on how the language might apply to the other planning concepts. Comments are due back to RMC by February January 23rd.

V. Draft Benefit/Cost Allocation Methodology

RMC presented an overview of the methodology, explaining each task involved. There was a general concern that if a cost is attributed to an agency, that agency may find it difficult to approve the final portfolio. It was further agreed that this methodology would involve many value judgments that would likely be difficult to come to agreement.

RMC suggested a qualitative approach, explaining the general benefits, beneficiaries, and a discussion on the general magnitude of benefits received by beneficiaries. There would also be a general discussion on cost, without apportioning the cost to any beneficiaries. It was suggested to conduct a high-level of costs analysis and clearly state assumptions. It was also suggested that there be a discussion of allocated benefits between entities and between the two regions, as well as a discussion of general public beneficiaries.

RMC will revise the methodology to outline this new approach and send it out prior to the February meeting.

VI. Assessment of Concepts and Concept Groupings

RMC presented the changes resulting from MCG feedback, including the conflicting comment on concept 1a (Anadromous Fish Restoration). The MCG decided to remove objective D-21 (which pertains to data for UWMPs) from the assessment as it pertains more to the MokeWISE program than it does to any one concept. It will remain as an objective, but not be used in the concept assessment. There was a proposal to remove objective E-28 (which pertains to wild and scenic legislation) as no concepts meet that objective. The MCG elected to leave the objective in the assessment. Concept 3a (Solar Powered Desalination Study) does not have a sponsor; it was suggested that this concept be removed for lack of sponsor. The MCG elected to leave it as a concept.

There was concern that concept 1a (Anadromous Fish Restoration) may potentially result in a reduction in flow for water agencies. There was a proposal to remove the sentence about reduction in water supply from the environmental assessment. A counter-proposal suggested adding a sentence that explains that proponents of the concept do not anticipate an impact to water agencies. It was suggested that language added to concept 7b (Raise Lower Bear Feasibility) could also be added to concept 1a. It was ultimately decided that those entities most interested in the language (Foothill Conservancy, CSPA, AWA, Amador County) would discuss language changes offline and bring back a proposal to the MCG in February.

VII. Preliminary Portfolio Proposal

RMC presented the preliminary proposed portfolio, including how the portfolio was compiled. There was a general concern that the modeling results would be helpful in putting the portfolios together. The MCG broke into three groups to discuss the proposed portfolio and each of the concepts. After a period of time, the MCG came back together and each of the groups reported on their discussion. RMC took note of these discussions.

Based on the discussions, RMC will prepare a new set of portfolios to send to the MCG. In an effort to stay on schedule, it was decided that a webinar would be held prior to the February meeting to approve the portfolios so assessment on the portfolios could be presented, reviewed, and discussed at the February meeting. The date and time of the webinar will be determined via email.

VIII. Wrap-Up and Action Items

None.

Mokelumne Collaborative Group (MCG)
Meeting #18 Summary

February 13, 2015

Organizations represented

Amador County

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

California Sportfishing Protection Alliance

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton, City of

Upper Mokelumne River Watershed Authority

Woodbridge Irrigation District

Key Decisions

- Mokelumne and Stormwater sections of the Water Availability Analysis were approved.
- Environmental assessment on concept 7b (Raise Lower Bear Feasibility) was approved.

Action Items

- RMC: edit Concept 1a title to read "Re-Introduction of Fall-Run Chinook Salon Upstream of Pardee Reservoir."
- Climate Change Workgroup: convene to discuss distilling available information on climate change.

- San Joaquin County: present in March about groundwater recharge and in-lieu recharge work performed for the Eastern San Joaquin Integrated Regional Water Management Plan.

Summary

I. January Meeting Summary and Brief Update

Meeting #17 (January 2015) summary was approved by consensus and will be posted onto the public portion of the website.

RMC provided an update on the Modeling Workgroup, including that the group has discussed the concepts that have been modeled and incorporated comments on the modeling.

RMC also provided an update on the Policies and Initiatives Workgroup, including that the workgroup has compiled proposed policies which are ready for the MCG's review. It was requested that the groundwater policy (Policy 9d) not be reviewed by the MCG as there is not yet consensus among the workgroup on this policy. Once consensus within the workgroup has been reached, the policy will be submitted to the MCG for review.

RMC provided an update on Concept 1a (Anadromous Fish), including that discussions with Amador Water Agency, California Sportfishing Protection Alliance, and Foothill Conservancy led to consensus on the updated project description. One edit was recorded during the meeting and the title will be changed to read "Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir." It was noted that AWA requested that an analysis of the project under climate change conditions be included. CSPA remarked that climate change extends beyond this one particular concept and that other concepts may require a similar analysis. It was suggested that available information regarding climate change from Integrated Regional Water Management Plans (IRWMPs) from the Mokelumne-Amador-Calaveras Region and the Eastern San Joaquin Region be summarized and included in MokeWISE. After some discussion, it was decided that representatives from East Bay Municipal Utility District, California Sportfishing Protection Alliance, Foothill Conservancy, Calaveras Planning Coalition, San Joaquin County, and the California Department of Water Resources would convene to distill available information and further discuss climate change as it relates to MokeWISE.

RMC provided an update on Concept 4c (San Joaquin County Groundwater Banking and Exchange), including that discussion with San Joaquin County, California Sportfishing Protection Alliance, and Foothill Conservancy led to consensus on a proposal for moving the concept forward. It was proposed that

Concept 4c be moved to a parallel track to allow additional development. This parallel track would include additional modeling and further discussions of the concept with MCG members that are interested in participating. It was explained that the concept would not be included in the preferred MokeWISE portfolio, but that a new concept (4e) would be considered for inclusion. Concept 4e (San Joaquin Groundwater Banking and Exchange Conceptual Modeling and Feasibility Work), as stated in the proposed description made available to the MCG, would continue the work that would begin in the parallel track. In response to a suggested edit, a sentence has been added to the description that articulates that storage would provide a regional benefit. It was suggested that concepts 4a and 4e be combined to ensure that one feasibility study captures all potential sources. San Joaquin County offered to present in March explaining the work that was done in the Eastern San Joaquin Integrated Regional Water Management Plan regarding source water for groundwater recharge and in-lieu recharge.

A new concept submitted by the Calaveras Planning Coalition was discussed by the MCG. The concept proposes assessing the feasibility of transporting wastewater from the East Bay and Contra Costa County to the San Joaquin Valley for irrigation and/or groundwater recharge. After some discussion, it was suggested that each individual breakout group discuss and decide if the new concept should be added to Concept 4a as a supply source.

II. Portfolio Breakout Discussion

RMC presented an overview of the portfolio breakout discussion process, including the new proposed approach for conducting preliminary engineering. RMC explained that the purpose of the breakout discussion group is to identify a list of projects that would under further development. The concepts selected for further development would undergo preliminary engineering which may include scope definition, mapping, and conceptual engineering plans for some infrastructure. RMC explained that the level of preliminary engineering will depend on the number of concepts selected for focused work.

A revised schedule was presented showing how the proposed preliminary engineering would be incorporated. In March, draft preliminary engineering for each of the concepts selected during this meeting will be presented to the MCG, with finals prepared for the April MCG meeting.

RMC explained during the small group breakout, each group would be given a worksheet to identify concepts that the group feels have low, medium, and high value, as well as projects that the group "can live with." There was discussion about the subjective nature of the word "value" and RMC provided several considerations for the small groups, including the extent to which a concept meets MCG objectives, how the concept might be positioned for funding, and how well the concept reflects a regional balance of benefits. Under the "can live with it" category, the group could live with it as-is, could live with it if additional refinement is completed, or could not live with it under any circumstances.

RMC re-iterated that the process should be completed by consensus and should not include voting of any kind.

III. EBMUD Presentation on Reservoir Operations

East Bay Municipal Utility District provided an overview of the District's reservoir operations, including how and when the District makes decisions about releases from Pardee and Camanche Reservoirs, as well as the requirements mandating those releases. This presentation will be posted to the protected portion of the website.

IV. MCG Decision on Portfolio

Each of the three small groups met to discuss each concept and complete the worksheet provided by RMC. After each group had completed the exercise, RMC presented the concepts that received a high value by any group and a "yes, can live with it" by all groups.

Concepts in group 4 (Groundwater Management) and concepts in group 7 (Surface Water) were addressed by the group in an effort to reach consensus. After some discussion, it was decided that Concept 4c (San Joaquin County Groundwater Banking and Exchange) be moved to the parallel track and that Concept 4a (Groundwater Banking within the Eastern San Joaquin Groundwater Basin) and Concept 4e (San Joaquin Groundwater Banking and Exchange Conceptual Modeling and Feasibility Work) be combined into one concept that would evaluate multiple sources for groundwater banking and exchange. Additionally, it was decided that the proposed concept submitted by the Calaveras Planning Coalition be revised to a feasibility study looking at potential uses for wastewater from the East Bay and Contra Costa County. After further discussion, it was decided that this concept would be combined with concepts 4a and 4e.

After some discussion, there was a proposal to combine concepts 7b (Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering), 7c (Surface Storage Regional Assessment), 7d (Re-operation of Existing Storage), and 7e (Optimization of Calaveras County Reservation) into one concept titled "Water Supply Reliability for Amador and Northern Calaveras Counties." It was further suggested that Concept 7d not be combined and be developed as a stand-alone concept.

The following concepts were approved for preliminary engineering by the MCG:

- 2a: Municipal Recycled Wastewater Recharge Program

- 2b: Constellation Winery Wastewater Reuse
- 2c: Amador County Regional Reuse
- 4a: Groundwater Banking within the Eastern San Joaquin Groundwater Basin
- 4b: Amador and Calaveras Counties Hydrologic Assessment
- 4d: North San Joaquin Water Conservation District Infrastructure Improvements
- 5a: Regional Urban Water Conservation Program
- 5b: Regional Agriculture Conservation Program
- 7b-7e: Water Supply Reliability for Amador and Northern Calaveras Counties
- 7d: Re-operation of Existing Storage
- 8a: Jeff Davis Water Treatment Plant Replacement
- 8b: Rehab of Transmission Main
- 8c: Barney Way Septic System Conversion
- 8d: Lake Camanche Village Recycled Water Project

V. Revised Benefit Allocation Methodology

This discussion was postponed to the March meeting to allow more time for small group discussion.

VI. Wrap-Up and Action Items

None.

Mokelumne Collaborative Group (MCG)
Meeting #19 Summary

March 13, 2015

Organizations represented

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton, City of

Upper Mokelumne River Watershed Authority

Woodbridge Irrigation District

Key Decisions

- Convene Institutional Arrangements workgroup to provide recommendation to MCG during April meeting.
- Hold fourth public meeting at San Joaquin Farm Bureau with targeted invitations to resource agencies.
- Develop problem statements and MokeWISE stakeholder interest statements for select Projects as discussed
- Approve RMC moving forward with implementation of the benefit allocation methodology

Action Items

- <u>MCG</u>: send in redlines on policies and initiatives to RMC by Friday March 20th.
- <u>RMC</u>: distribute public outreach materials and reach out to resource agencies.

- RMC: correct statements regarding WID's water right and upload corrected Water Availability Analysis.
- Institutional Arrangements Workgroup: meet to determine recommendation to present to the MCG at the April meeting.
- RMC: email Project workgroup list to MCG and individual emails to workgroups.
- MCG: work with agreed-upon MCG entities to revise preliminary engineering (expanded project descriptions) and add interest statements where decided for review during the April meeting.
- RMC: revise preliminary engineering (revised project descriptions) for review during the April meeting.
- RMC: implement benefit allocation methodology and distribute to the MCG for review at the April meeting.

Summary

I. February Meeting Summary and Brief Update

Meeting #18 (February 2015) summary was approved by consensus and will be posted onto the public portion of the website.

Prior to the last MCG meeting, write-ups on the policies and initiatives were distributed. At that meeting, RMC indicated that the workgroup had not yet reached consensus on policy 9d. At this meeting, RMC provided an update on policy 9d, indicating that the workgroup was unable to reach consensus and as such, policy 9d is not moving forward. The MCG was instructed to send in any redlines on the remaining policies and initiatives by Friday March 20th.

RMC reviewed corrections made to the Water Availability Analysis, including a correction of Woodbridge Irrigation District's water rights and inclusion of the conversion factor from acre-feet per year (AFY) to cubic feet per second (cfs). During the meeting, it was further clarified the Woodbridge Irrigation District's water rights total 414.4 cfs. This will be corrected in the document; this version will be uploaded to the public portion of the website.

RMC provided an update on the Climate Change Committee, indicating that the Committee met and decided to address climate change programmatically. The climate change section is currently being drafted, which will be shared with the Committee and be distributed to the MCG for review at the April meeting.

RMC also provided an update on Project 1a (Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir), including that Amador Water Agency, California Sportfishing Protection Alliance (CSPA), and Foothill Conservancy reached consensus on the objective assessment and environmental assessment. Foothill Conservancy reiterated that the need for the project is to lead a pilot project, which has more immediate funding needs. Foothill Conservancy and CSPA will propose language for an updated project description, which could include incorporating phases.

At previous meetings, the MCG discussed holding the fourth public meeting in Sacramento and tailoring it to resource agencies. Given that the projects are less capital intensive than originally anticipated, RMC suggested that there may not be the same interest from resource agencies. RMC proposed that the meeting be held at the San Joaquin Farm Bureau on April 9th at 6:30pm and that resource agencies receive personal invitations. The MCG approved the proposal. RMC will draft a flyer and press release to be distributed to local papers and to MCG member agencies so they may distribute to their constituencies.

On Tuesday March 10th, 2015, RMC distributed a draft technical memorandum summarizing potential options for final MokeWISE project implementation governance and stakeholder coordination. RMC explained that this is a required portion of the Final Report and that the MCG will make a final determination on the institutional arrangement during the April meeting. RMC proposed that a workgroup convene to discuss the options and prepare a recommendation to the MCG during April's meeting. Entities involved in this workgroup are: the Upper Mokelumne River Watershed Authority, San Joaquin County, Amador Water Agency, Calaveras Planning Coalition, East Bay Municipal Utility District, and the City of Stockton.

RMC reviewed the schedule for April, May, and June.

II. Sierra Club Presentation

The Sierra Club provided an overview of the Club, including its history, mission, and current projects. This presentation will be posted to the protected portion of the website.

III. San Joaquin County Presentation

San Joaquin County provided information focusing on efforts the County has pursued in terms of alternate water supplies to the Mokelumne River. This presentation will be posted to the protected portion of the website.

IV. Preliminary Engineering (Expanded Project Descriptions)

RMC explained the concern that was expressed by some of the MCG members at the end of the February meeting regarding Project 1a (Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir) not being added to the list of projects. Because Project 1a was the only project that was on the cusp of making onto the list, it was added.

The California Sportfishing Protection Alliance (CSPA) presented an overview of the work the environmental caucus had completed after the draft scopes of work were distributed on Friday March 6th. The environmental caucus recommended using the revised scope for Project 7d as a template for reworking some of the other scopes. Recommended changes included: replacing each abstract with a problem statement and summary of MokeWISE stakeholder interests, and adding more specific information to some of the scopes, including adding specificity to phrases such as "legal issues." It was also decided that RMC would add a climate change as an item as part of the climate change overview section indicating that each project completed as part of the MokeWISE program should address climate change as applicable.

The MCG agreed that this exercise is beneficial and has merit and that the preliminary implementation plan should be pushed from April to May. RMC indicated that doing this means that the MCG will see less material up front (and will instead see some items for the first time when they appear in draft form in the Draft Plan in May). The MCG approved this revised approach and schedule.

During the meeting, each Project was discussed and the MCG determined whether an interest statement was needed. For those Projects that the MCG deemed an interest statement necessary, a workgroup with an assigned lead was identified. This group was tasked with developing a problem statement and stakeholder interest section for the Project; RMC will take the lead on addressing changes to the Project scopes. RMC will email out the final list to the MCG, with individual emails to each workgroup to begin facilitating the discussion. Revised scopes must be completed in time for review during the April meeting.

It was also decided that project 1g, which was not identified for further development in the February meeting, should be further developed and a scope of work prepared. All remaining projects without expanded scopes were discussed, and this was the only project recommended to be expanded.

V. Revised Benefit Allocation Methodology

The MCG agreed to allow RMC to implement the methodology. RMC will bring the implemented methodology back to the MCG for comment in April.

VI. Wrap-Up and Action Items

None.

Mokelumne Collaborative Group (MCG)
Meeting #20 Summary

April 10, 2015

Organizations represented

Amador County

Amador Water Agency

Calaveras County

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

Lodi, City of

MyValleySprings.com

North San Joaquin Water Conservation District

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton, City of

Stockton East Water District

Upper Mokelumne River Watershed Authority

Woodbridge Irrigation District

Key Decisions

- Final decision made on Implementation Plan projects (see Section IV for more information).
- Authority given to project workgroups to make a final determination regarding the assigned project and its inclusion in the Implementation Plan.

Action Items

- RMC: make discussed changes to Institutional Arrangements Memorandum.
- RMC: make discussed changes to project scopes.
- MCG Project Workgroups: meet to discuss projects and come to consensus.

Summary

I. March Meeting Summary and Brief Update

Meeting #19 (March 2015) summary was approved by consensus and will be posted onto the public portion of the website.

RMC provided an update on the fourth public meeting, held April 9th, 2015 at the San Joaquin Farm Bureau. In attendance were six members of the public. The meeting included discussion of the MCG's progress and next steps, including that the MCG was working through determining which projects would be included in the implementation plan.

To date, there have been no comments received on the policies and initiatives. Comments are due by Friday April 17th; the MCG will be discussing endorsement of these policies and initiatives at the May MCG meeting.

Project 8a (Jeff Davis Water Treatment Plant Replacement Feasibility Study) has been removed from the project list because that study has already been completed.

RMC reviewed the schedule for the remainder of the project.

II. Institutional Arrangements

RMC provided an overview of the Institutional Arrangements workgroup process for determining a proposal for the MCG to consider. The workgroup's proposal was presented, which included an MOU between UMRWA and the GBA to support project implementation and a stakeholder workgroup and public workshops for stakeholder coordination and public outreach.

The MCG approved the workgroups proposal with two edits. RMC will incorporate these edits, which include being more specific about who the signatories of the MOU are and allowing individual members of the public to be members of the stakeholder group.

III. Amador Calaveras Consensus Group (ACCG) Presentation

The ACCG provided an overview of the Group, including its history, mission, and current projects. This presentation will be posted to the protected portion of the website pending approval from the ACCG.

IV. Preliminary Engineering (Expanded Project Descriptions)

RMC reviewed the goal and process for the meeting, including that the MCG needed to decide which projects would be included in the Implementation Plan. Projects included in the Implementation Plan are projects that are generally supported and that the institutional structure will focus on funding projects in the Implementation Plan.

RMC reviewed the two list approach. List 1 includes projects which are supported by the full MCG, that is, projects that all MCG members agree should be included in the Implementation Plan. List 2 projects are projects that are supported by an overwhelming majority of the MCG, but that have some remaining issues that are articulated. Projects which are not included in List 1 or List 2 are not a part of the Implementation Plan.

Projects 1g (Soil Restoration), 7d (Storage Reoperation), 7b (Raise Lower Bear), 7f (Blue and Twin Lakes), 4a (Groundwater Banking), and 7a (Storage Recovery) were discussed at length and live edits were made where needed. RMC recorded these edits and other comments and will incorporate them as directed by the MCG. The following table summarizes the MCG's final decision on each of the projects:

Project	**Final MCG Decision**
1a: Re-Introduction of Fall Run Chinook Salmon Upstream of Pardee Reservoir	List 1
1b: High County Meadow Restoration Program	List 1
1c: Mokelumne River Day Use Area Floodplain Habitat Restoration Project	List 1, few small edits from the San Joaquin County Resource Conservation District
1d: Fish Screens for Riparian Diversions in the Lower Mokelumne	List 1, add Lower Mokelumne River Stewardship Council
1f: Riparian Restoration Program – Below Camanche	List 1, included real time edits
1g: Mokelumne Water Quality, Soil Erosion, and Sedimentation Inventory/Monitoring	List 1, use version agreed upon by workgroup
2a: Municipal Recycled Wastewater Recharge Program	List 1
2b: Constellation Winery Wastewater Reuse	List 1

2c: Amador County Regional Reuse	List 1, include district-wide financial planning language
4a: Groundwater Banking within the Eastern San Joaquin Groundwater Basin	Workgroup to meet the week following the meeting
4b: Amador and Calaveras Counties Hydrologic Assessment	List 1
4d: NSJWCD Infrastructure Improvements	List 1
5a: Regional Urban Water Conservation Program	List 1
5b: Regional Agriculture Conservation Program	List 1, San Joaquin Country Resource Conservation District would like to have their interests include in interested statement; if any changes to environmental interests, a call will be required to discuss
7a: PG&E Storage Recovery	Workgroup to meet the week following the meeting
7b: Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering	List 1, include pertinent universal changes from 7d
7d: Re-operation of Existing Storage	List 1, included real time edits
7f: Reliability and Replacement Assessment for Dams at Blue and Twin Lakes	Workgroup to meet the week following the meeting
8b: Rehab of Transmission Main	List 1
8c: Barney Way Septic System Conversion	List 1
8d: Lake Camanche Village Recycled Water Project	List 1

For all projects that required further work by a workgroup, the MCG gave authority to those workgroups to make a final determination regarding the project and its inclusion in the Implementation Plan.

V. Draft Climate Change Section

This was pushed back to allow more time for discussing the expanded project descriptions. The draft section will be included and presented to the MCG in the draft Final Plan in May.

VI. Wrap-Up and Action Items

None.

Mokelumne Collaborative Group (MCG)
Meeting #21 Summary

May 8, 2015

Organizations represented

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

MyValleySprings.com

North San Joaquin Water Conservation District

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Upper Mokelumne River Watershed Authority

Woodbridge Irrigation District

Key Decisions

- Policies 9a, 9b, 9c, and 9f (with changes discussed) will be included in the Implementation Plan.

Action Items

- RMC: include up-front language in the Final Plan regarding interest statements.
- RMC: send public meeting materials to MCG by Friday May 15th.
- AWA and GBA: follow-up regarding CEQA implications of word "adopt" and consider second resolution for UMRWA and GBA Boards to amend existing IRWM Plans to include MokeWISE.
- RMC: make edits to resolution as discussed.
- RMC: compile Staff Reports and schedule of when MCG entities will be discussing MokeWISE with their Boards.
- RMC: determine legality of making cultural assessment publicly available.
- RMC: incorporate comments received on draft Final Plan, integration chapter, and Appendix Q.
- RMC: rename Policy 9e to 9f and make changes discussed.

Summary

I. April Meeting Summary and Brief Update

The Meeting #20 (April 2015) summary sent out prior to this meeting did not have updated "Key Decisions" and "Action Items" section. A revised copy was sent Wednesday May 6th. No additional comments were received. The revised version was approved by consensus and will be posted onto the public portion of the website.

At the last MCG meeting, the MCG empowered workgroups to make the final determination about the projects that were not already identified as List 1 projects. Projects 7a (Sediment Removal) and 7f (Blue and Twin Lakes) have been designed as List 1 projects. Changes to the environmental interest statement in Project 5b (Agricultural Conservation) had been made, which triggered a workgroup call. The workgroup determined this project was List 2. A document characterizing outstanding concerns has been appended to the scope for this project. For project 4a (ESJ Groundwater Banking), NSJWCD expressed concerns regarding the environmental interest statement, particularly that there may be confusion that those interests were part of the project, and as such, that all MCG entities agreed with those interests. It was made clear that this is not the intention, as these interests are included in the Interest Statement section of the scope. There was a recommendation that NSJWCD express this concern and their position in the resolution for their Board. It was also recommended that the Final Plan include generic up-front language that explains what an interest statement is and is not so there is no confusion about how they should be interpreted or used.

RMC reviewed the schedule for the remainder of the project, including key milestones and due dates in May and June. Board resolutions are due to RMC by September 1st so they can be included in the Final Plan.

The fifth and final public workgroup will be on Monday June 1st at 6:30pm at the San Joaquin Farm Bureau. MCG entities were encouraged to attend. Copies of the flyer, agenda, and press release will be provided by RMC on May 15th to allow time for MCG members to distribute.

RMC reviewed the draft resolution language, indicating that this could be used by MCG members as a starting point for their draft resolutions for their Boards. They were encouraged to tailor it as appropriate for their governing bodies. There was some concern that the word "adopt" had CEQA implications.

The representative from DWR attending the meeting clarified that MCG entities do not need to adopt the MokeWISE Plan. IRWM Plans do not need to be re-adopted after minor revisions are made. Depending on how the MAC and ESJ regions define minor revisions, it is likely that the Integration Chapter can be included in the IRWM Plans, and an entity, having already adopted the IRWM Plan, would automatically adopt MokeWISE. It was suggested that the MAC and ESJ regions accept the MokeWISE program as an amendment to their respective IRWM Plans. Agencies that have already adopted their region's IRWM Plan would need to adopt the amendment; agencies that have not already adopted the region's IRWM Plan would need to adopt both the Plan and the MokeWISE amendment.

There were other comments on the resolution, which RMC noted and will incorporate. There was a concern that an action to "adopt" MokeWISE would also mean full support and adoption of the appendices. It was made clear that support of MokeWISE does not imply agreement with the appendices. This will be made clearer.

AWA and the GBA have agreed to do more research regarding CEQA implications with the word "adopt." Additionally, the potential for another resolution for the two regional organizations, GBA and UMRWA, to adopt the MokeWISE integration documents as amendments to the two IRWM Plans will be evaluated along with language about not necessarily supporting the MokeWISE appendices.

There was a request that entities share their Staff Reports with the MCG as they begin to bring MokeWISE to their Boards. RMC will put any shared Staff Reports on the protected portion of the website. Additionally, RMC will compile a schedule indicating when entities will be bringing MokeWISE to their Boards so other MCG members are aware.

Sierra Club announced that while they have been previously representing the San Francisco Bay Chapter, they are now representing the State level Sierra Club. This change will be made where appropriate.

II. Policies and Initiatives

RMC provided an overview of the edits received on the policies and initiatives. Edits to policy 9c were made real-time that specify one or more watershed coordinators and to include UMRWA as a co-sponsor with the SJCRCD. Policies 9a, 9b, and 9c were all approved by consensus to be included in the Implementation Plan.

RMC reviewed Policy 9e (originally the Public Interest Profile Enhancement Project) and indicated that there had been many edits made. Given that there was little interest in what was originally drafted for 9e, the MCG then considered the new version that included the most recent redlines and comments. There was concern that this version was redundant with what it included in the Stakeholder Tier of the Implementation Plan. The MCG agreed that the policy should be structured as a programmatic check-in and that its purpose is to seek funding support for the Stakeholder Tier. It was made clear that the MCG did not intend for this initiative to be redundant. Rather, this initiative supports an annual meeting that provides a programmatic check-in on the progress of individual MokeWISE projects and discusses larger programmatic issues and changes. Given that this new initiative is different than PIPE, it was requested that it be renamed to 9f. The MCG agreed by consensus that with these changes, the new 9f will be included in the Implementation Plan. RMC will make these changes and the updated version will be provided in the revised Final Plan.

III. Draft Final Plan and Draft Implementation Chapter

RMC provided an overview of the documents that the MCG received, including their purpose and how they fit together. RMC also provided an overview of the table of contents for the Draft Final Plan. There was a question about making the cultural assessment publicly available and considering sensitivities about doing this. RMC will follow up on this.

RMC also provided an overview of Chapter 6 of the Final Plan, the implementation chapter. There were several comments received, including that the benefits table should indicate which projects are studies so it's clear that implementation doesn't directly provide those benefits indicated, but that if the project were implemented, these benefits may be achieved. RMC recorded all comments and will incorporate them into the document. RMC also provided an overview of the integration chapter (Appendix Q of the Final Plan). It was requested that these sections be numbered.

RMC provided a printed schedule for the remainder of the project (May/June) that indicates milestones and due dates.

There was a question regarding how many copies would be printed. RMC indicated that it would take between two and a half to three weeks to get the report printed once it is finalized and that each entity would get one copy.

IV. Wrap-Up and Action Items

None.

Mokelumne Collaborative Group (MCG)
Meeting #22 Summary

June 12, 2015

Organizations represented

Amador County

Amador Water Agency

Calaveras County

Calaveras County Water District

Calaveras Planning Coalition

Calaveras Public Utility District

California Sportfishing Protection Alliance

Delta Fly Fishers, Inc.

East Bay Municipal Utility District

Foothill Conservancy

Jackson Valley Irrigation District

Lodi, City of

MyValleySprings.com

North San Joaquin Water Conservation District

San Joaquin County

San Joaquin County Resource Conservation District

San Joaquin Farm Bureau

Sierra Club, SF Bay Chapter

Stockton, City of

Stockton East Water District

Upper Mokelumne River Watershed Authority

Woodbridge Irrigation District

Key Decisions

- Final Plan approved by consensus.

Action Items

- MCG members: work with their respective boards to approve or otherwise show support for MokeWISE as it is outlined in the Implementation Plan.
- MCG members: let RMC know when they anticipate taking MokeWISE to their Boards, and share staff reports.
- RMC: get mailing addresses for each MCG member.
- RMC: compile MCG Board schedule; share staff reports with MCG.

Summary

I. May Meeting Summary and Brief Update

The Meeting #21 (May 2015) summary was approved by consensus and will be posted on the public portion of the website.

RMC provided a summary of the fifth and final Public Workshop, held June 1st and the San Joaquin Farm Bureau. Alex Breitler of the Stockton Record was in attendance. Mr. Breitler's article about the MokeWISE program was published in the Record on June 2nd, 2015.

RMC provided an update regarding the cultural resources review, including that the information had been collected. RMC has reviewed it with their CEQA/NEPA professionals and the information that can be publicly shared has been included in the Final Plan. All cultural resources information collected will be shared with the Department of Water Resources (DWR), as outlined in the grant agreement. If MCG entities wish to see all of the cultural resources information, they are encouraged to reach out to DWR to determine the best avenue for receiving that information.

RMC provided a schedule reminder, asking that MCG entities submit signed resolutions by September 1st so they can be included as an appendix in the Final Plan.

II. MokeWISE Final Plan and Executive Summary

RMC provided an overview of the comments that were received on the Draft Final Plan and the Public Draft Plan, including the entities submitting comments and the general nature of the comments. RMC also reviewed some additional revisions since the document was sent to the MCG for review prior to this meeting. These edits include updating the maps on pages 54 and 55 to address changes made to Projects 1f and 9e/9f and changing the indicator for the Water Quality objectives from WD to WQ. Additional revisions were requested during the meeting, which consisted of including asterisks for the study-based implementation projects within the Implementation Plan and double-checking the name of Project 4a.

RMC then provided an overview of the comments received on the Executive Summary, including who submitted comments and the general nature of the comments.

The MCG approved the Final Plan and Executive Summary going final with the changes that were discussed at the meeting. RMC will provide a printed copy of the Final Plan, with all appendices on a CD. RMC will reach out to the MCG and ask for mailing addresses.

RMC reviewed the draft Resolution, noting that revisions were made per the discussion at the last MCG meeting. Amador Water Agency shared their resolution as well, mentioning that their legal counsel has concluded that AWA can adopt the MokeWISE program and that the action is exempt under CEQA guidelines sections 15262 and 15306. It was noted that this may be the case for other agencies as well. RMC requested that signed resolutions be submitted by September 1st so they can be appended to the Final Plan. MCG members can use the draft Board presentation posted on the website as a starting point for a presentation to their Boards. If any member would like additional slides, they can request them from RMC or find the powerpoint for each MCG and public meeting on the protected portion of the website.

RMC requested that MCG members let RMC know when they anticipate taking MokeWISE to their Boards so RMC can compile a schedule and staff reports to share with the MCG. Some MCG entities shared their Board meeting dates with RMC at the meeting.

III. Wrap-Up and Action Items

None.

Appendix D: Public and Disadvantaged Community Outreach Plan

Appendix D provides the MCG-approved Public and Disadvantaged Community Outreach Plan which outlines public outreach activities for MokeWISE.

MokeWISE Program:

Public & DAC Outreach Plan

Revision Date: 29 January 2014

Table of Contents

Introduction

The Mokelumne Watershed Inter-regional Sustainability Evaluation (MokeWISE) program has emerged following years of dialogue between a diverse set of stakeholders in the Upper and Lower Mokelumne River watersheds. MokeWISE, when concluded, is expected to yield a scientifically-based and broadly-supported water resources program that includes sustainable approaches to water resources management in the Mokelumne River watershed, while respecting the hierarchy of existing water rights and water rights holders. This program builds upon earlier interregional project concepts, including the Inter-Regional Conjunctive Use Project (IRCUP), by expanding the scope to include a thorough evaluation of a wide array of water resource strategies that could be implemented to help balance water supplies and demands and sustain both the local economy and the environment.

MokeWISE will develop and evaluate alternatives to enhance water resources management within the Mokelumne-Amador-Calaveras (MAC) and Eastern San Joaquin (ESJ) Regions. The ultimate purpose of this interregional planning project is to develop a broadly-supported water resources program that substantially contributes to meeting both regions' needs as represented by participating stakeholders and other regional interests.

The MokeWISE program will:

1) Evaluate opportunities for integrated water management on an interregional scale, with the potential to provide water supply and environmental benefits to a broad range of Mokelumne River basin stakeholders
2) Identify actions with broad support amongst participating stakeholders
3) Develop a multi-regional conceptual plan to implement the preferred program

Envisioned program benefits of the MokeWISE program include drought protection, water quality protection and improvement, groundwater recharge, maintained and improved environmental and natural resource conditions, long-term balance of water supply and demand, and resolution of long-standing regional and inter-regional conflicts.

Purpose of Outreach Plan

To facilitate a successful MokeWISE program process and outcome, public and disadvantaged community (DAC) outreach is critical. The purpose of public outreach in this program is to inform the public and DACs about the MokeWISE program and offer opportunities for involvement. Community input and involvement in the MokeWISE process will help ensure water resource issues of concern to the broader public are accounted for and addressed by the MokeWISE program.

This Public and DAC Outreach Plan describes the intended outreach activities for two project phases: (1) MokeWISE program development and (2) preferred program alternatives selection. The first phase will educate the public about the purpose of the MokeWISE program, program evaluation, and the ways in which the public may participate. The second phase will facilitate input on the selection of program alternatives. Outreach activities during these two project phases will be targeted to five different tiers: Tier 2 stakeholders, interested parties, the general public, DACs, and Native American tribal communities.

RMC Water and Environment, a water resources engineering firm, and Rainwater and Associates, a facilitation and mediation firm, were hired by the Upper Mokelumne River Watershed Authority (UMRWA) and the Groundwater Basin Authority (GBA) to help develop and implement the MokeWISE program. The Planning Committee, comprised of RMC, UMRWA, the GBA, and Rainwater and Associates, , met in early July 2013 to formulate the steps necessary to establish the collaborative stakeholder group envisioned as the guiding force in developing MokeWISE and to develop a strategy for capturing other stakeholder and public input.

The Mokelumne Collaborative Group (MCG) has since been established to serve as the primary guiding influence in formulating the MokeWISE program. The MCG is comprised of organizations with a direct and expressed interest in the Mokelumne River watershed and the MokeWISE program. The MCG provides substantive direction for developing the

MokeWISE program and its members have committed to a challenging work schedule that includes monthly group meetings and regular document review. Group members include water agencies; non-governmental organizations (NGOs); private entities; resource agencies; and local, state, and federal government agencies. The MCG will meet monthly for the duration of the program and is the only stakeholder tier that has decision-making authority. The MCG membership list can be found in Appendix A.

This outreach plan describes the strategy to be followed to obtain input from other potential stakeholder interests and the public, referred to here as stakeholder tiers. Outlined below are the five tiers.

Stakeholder Tiers

The five stakeholder tiers which are targeted by this Outreach Plan are described below.

Tier 2

Tier 2 stakeholders include state and federal resource agencies, cities or other organizations which represent DAC communities, Native American tribal groups and other stakeholders that, due to budgetary and/or staffing restrictions, are unable to participate in the MCG. While Tier 2 stakeholders have no decision-making authority in the MCG, the MCG will solicit and consider feedback received from these stakeholders at various program milestones. Tier 2 stakeholders will be invited to review and comment on draft milestone documents that fall within their field of expertise and jurisdiction prior to the MCG's final review and approval of those documents. Tier 2 stakeholders will be invited to attend and participate at those MCG meetings at which the milestone documents are to be considered. The list of Tier 2 stakeholders can be found in Appendix B.

Interested Parties

Interested parties are agencies, organizations and individuals that have registered their interest in the MokeWISE program but are neither members of the MCG nor Tier 2 stakeholders. Interested parties will be made aware of program progress, documents available for public comment, public meetings, etc. primarily through email communications and website postings. The interested parties' membership list can be found in Appendix C.

General Public

The general public includes residents living in the MAC and ESJ regions and others with a potential and general interest in the MokeWISE program. The general public will be the focus of five public workshops to be conducted during the MokeWISE program development process and will be invited to comment on milestone documents during designated comment periods.

DACs

A disadvantaged community (DAC) is defined by the State of California as a community with an annual median household income (MHI) that is less than 80 percent of the statewide MHI. Based on current U.S. Census data, a community with an MHI of $48, 706 or less is considered a DAC. For the purposes of this Outreach Plan, the DACs within the Mokelumne River watershed are organized into two groups. The first group includes DACs which are wholly or largely contained within an incorporated area. The second group includes DAC communities which generally lie within unincorporated areas. See Table 1.

DAC participation in the MokeWISE program will be achieved at two levels: by MCG members and Tier 2 stakeholders who, in conjunction with their official agency duties, will represent DAC communities while developing the various milestone MokeWISE program components; and by conducting at least three of five planned public workshops in DAC communities selected by the MCG and widely advertised in an effort to draw broad DAC resident participation.

Table 1: Disadvantaged Community Representation

Group 1 – DACs within Incorporated Areas			
DAC Community	IRWM Region	MCG Member	Tier 2 Stakeholder
Jackson	MAC		City of Jackson
Plymouth	MAC		City of Plymouth
Lodi	ESJ	City of Lodi (Public Works)	
Stockton	ESJ	City of Stockton (Municipal Utilities)	
Group 2 – DACs located in Unincorporated Areas & Native American Communities			
DAC Community	IRWM Region	MCG Member	Tier 2 Stakeholder
Mokelumne Hill	MAC	Calaveras PUD	
Railroad Flat	MAC	Calaveras PUD	

West Point	MAC	Calaveras County Water District	
San Andreas	MAC	Calaveras PUD	
Thornton	ESJ	San Joaquin County (Public Works)	
Lake Camanche Village	MAC	Amador Water Agency/ Amador County	
Jackson Rancheria Band of Miwuk Indians	MAC		Jackson Rancheria

Native American Tribal Communities

Targeted outreach to tribal communities within the program area will provide an opportunity for these communities to consider participating in the MokeWISE planning process. The three California Native American tribes within the MokeWISE planning region are listed below.

- The Ione Band of Miwok Indians (state and federal)
- The Jackson Rancheria Band of Miwuk Indians (state)
- The California Valley Miwok Tribe, generally known as the "Sheep Ranch Tribe" (state)

Direct outreach will be made to the Ione Band and Jackson Rancheria Band. The outreach will consist of written and follow-up personal communications. Information regarding the alternative forms of participation will be presented to the two bands. The two bands will be invited to participate on the MCG or, alternatively, to be included as Tier 2 stakeholders.

Because the status of the leadership of the California Valley Miwok Tribe, generally known as the Sheep Ranch Tribe, has been in question for years no outreach efforts will be made. The tribe's reservation is a one acre parcel in Calaveras County. Given the ongoing dispute over tribal leadership the tribe's status before the Bureau of Indian Affairs in Washington, DC is uncertain. Based on past communications with Calaveras County representatives regarding potential outreach to this tribe (in conjunction with the 2012 update to the Mokelumne-Amador-Calaveras IRWM Plan) outreach will not be pursued.

Program Start-up Outreach Activities

With an ambitious work plan and a tight project schedule it was essential that certain key MokeWISE stakeholder outreach tasks be completed at the outset of program development activities. Following is a summary of these key start-up actions.

<u>Fact Sheet</u>

A MokeWISE fact sheet was created in June 2013 which provides a brief history and overview of the MokeWISE program as well as details on the ways in which stakeholders and other members of the public can get involved. As part of the initial stakeholder identification process, this fact sheet was used to inform potential stakeholders about the program participation levels. The fact sheet can be found in Appendix D.

<u>Initial Stakeholder Identification and Solicitation</u>

During July and August 2013, the MokeWISE Planning Committee met to identify potential organizations for inclusion in the MCG. Once these initial stakeholders were identified, targeted outreach occurred to gauge their interest in becoming a member of the MCG. One-on-one interviews over the phone and in-person were conducted by members of the Planning Committee to review MCG member commitment expectations, collect initial thoughts regarding MCG process and organization, and answer any questions. These stakeholders were also asked to provide any other potential organizations to which the Planning Committee could reach out. Once organizations committed to being an MCG member, an initial MCG stakeholder meeting was scheduled.

<u>Website</u>

In July 2013, a website was created (www.mokewise.org) to provide a central location in which stakeholders, the public, and DACs can go for information about the MokeWISE program. The website will store information about public meetings, program-related outreach and education documents, and documents available for public comment. A password-protected section of the website will be used for posting working documents and other information to which only the MCG will have access.

<u>Initiate the MCG Stakeholder Process</u>

The MCG was formally constituted at the group's first meeting which was held on September 5, 2013 at the San Joaquin Farm Bureau in Stockton. All twenty four members of the MCG have expressed a direct interest in the Mokelumne River watershed and the MokeWISE program. The MCG will meet monthly for about two years to complete the MokeWISE program. To guide the MCG in this process the group approved on November 8, 2013 the Mokelumne Collaborative Group Charter which unanimously affirms the group's approval of the Collaborative Decision-Making Process and Organizational Structure, also referred to as the MCG's Protocols.

During the first MCG stakeholder meeting, members discussed other potential organizations that should be solicited for inclusion. Per the MCG, potentially interested organizations could petition to join the MCG until November 2013. After this point, identified stakeholders will be considered for inclusion in Tier 2 and Interested Parties. Also, understanding its central role in formulating the MokeWISE program, the MCG determined that its meetings would be open to the public and that meeting agendas would provide an opportunity for public comment.

Targeted and Planned Outreach Activities

As noted above, this document describes the planned outreach activities for two project phases: (1) MokeWISE program development and (2) preferred program alternatives selection. The first phase will educate the public about the purpose of the MokeWISE program, program evaluation, and the ways in which the public may be involved. The second phase of the project requiring outreach is centered on the selection of Program Alternatives and will allow for public input. Thus, outreach in this phase is not only relaying information, but also inviting interaction.

The structure and approach to outreach activities will generally be the same for both phases. The overall outreach objective is to make available tier-appropriate information which targets each of the five stakeholder levels. For phase 2 additional provisions will be made to solicit, receive and evaluate comments and suggestions submitted.

<u>Tier 2 Stakeholders</u>

Actions which facilitate review and input by Tier 2 agencies and organizations on key MokeWISE milestone documents are high priorities of this outreach plan. To accomplish these Tier 2 stakeholders will be: sent draft copies of the milestone documents with an explanation of their content and purpose; provided two (2) weeks to submit comments and suggestions on the draft milestone documents; and invited to attend the associated MCG meeting at which those documents will be considered. The milestone documents are listed below.

- draft Water Supply Availability methodology
- draft Water Supply Availability TM
- draft Portfolios Development & Assessment TM
- draft Environmental Resources TM
- draft Economic Impacts TM

Interested Parties

The individuals and organizations on the Interested Parties list will receive email notifications of scheduled workshops which they may attend. Interested parties may also review MokeWISE documents that have been posted on the website for public review.

Disadvantaged Communities

DAC participation will be accommodated through several means. As noted earlier in this plan DAC's are either represented on the MCG or as Tier 2 stakeholders. Additionally, at least three public workshops will be held at meeting locations within DACs. DACs may also review MokeWISE documents that have been posted on the website for public review.

Native American Tribes

The Jackson Rancheria Band of Miwuk Indians and the Ione Band of Miwok Indians participation will be either as members of the MCG, as Tier 2 stakeholders, or through any other means the Tribes elect under this plan.

General Public

The public's access to MokeWISE program information will be provided through several outlets. Comprehensive updates on MokeWISE will be presented at five public workshops held through the region. The public will also have access to information posted on the website for public review. Additionally, the public may observe MCG meetings which are open and include an opportunity for public comment.

The following table displays planned MokeWISE outreach activities and how those activities relate to the five tiers of stakeholders.

Table 2: Relation between MokeWISE Outreach Activities and Stakeholder Tiers[1]

Outreach Target Group	Outreach Activity				
	Solicit/Comment on Milestone Documents	Targeted Emails	Public Workshops	MCG Member Presentations	Website Postings
Tier 2 Stakeholders	X		X		X
DACs	X		X		X
Native American Tribes	X		X		X
Interested Parties		X	X	X	X
Public			X	X	X

Implementing Actions

Described below are the actions that will be taken to implement the outreach activities described in the previous section.

Outreach Work Group

The MCG may opt to create a sub-committee, or Outreach Work Group, to assist with implementing the Public and DAC Outreach Plan. The Work Group could be very helpful coordinating outreach activities and members might serve as MCG representatives at certain outreach venues. While the Work Group would report on their activities and seek MCG approval where necessary, much of this work could be conducted outside of normal MCG meeting periods.

[1] The MCG is not necessarily responsible for implementing these outreach activities, but may take it upon themselves to organize and conduct them as they deem appropriate.

Public Workshops

It is recommended that five public workshops be held at strategic points throughout the MokeWISE project. Their purpose is to keep the general public and DACs informed of project status and provide a structured opportunity for the public to offer comments, questions, and concerns. A list of potential meeting locations is provided below; the MCG will be consulted as to the best location for these meetings (Table 3). To further engage DACs within the project area, at least three public meetings will be held within DACs at locations to be determined by the MCG. Press releases suitable for posting on agency and NGO websites will be prepared in advance of each of the five public workshops (as well as the public comment period for the final MokeWISE document); these releases will be posted to the MokeWISE website as well as the websites of other agencies and NGOs willing to post the release. In addition, Tier 2 and Interested Parties stakeholders will be notified by email in advance of all workshops. Below is a proposed timeline and major topics for each public workshop.

1. January 2014; provide an overview of MokeWISE program and purpose.
2. June 2014; outline finalized program objectives, finalized environmental water needs, and discuss water supply availability approach.
3. August 2014; discuss program alternatives and preliminary assessment of alternatives.
4. November 2014; discuss technical, environmental, cultural feasibility, and economic impacts of three selected alternatives.
5. April 2015; present the preferred program.

Table 3: Potential Public Workshop Locations

Eastern San Joaquin Region	**Mokelumne-Amador-Calaveras Region**
Clements	Ione/Lake Camanche Village
Linden	Jackson
Lockeford	Pine Grove
Lodi	San Andreas
Stockton	Sutter Creek
	Railroad Flat
	Valley Springs/Burson/Wallace
	West Point

Newsletters

Newsletters are an effective way to keep the public informed of project status in between public workshops and can be posted on MCG member websites, in local libraries, coffee shops, and other community boards. Should the MCG use newsletters as an outreach tactic, they would be responsible for both providing the material and disseminating to the public.

Press Releases

Press releases can be used to inform the local media about specific program milestones, such as the release of a public draft or the scheduling of a public meeting. Should the MCG use press releases as an outreach tactic, they would be responsible for both providing the material and disseminating to the media.

Website Updates

Website updates can play a critical role in keeping both the public informed about the program and ensuring that the MCG has the necessary materials. It is recommended that the public website and MCG member websites be updated whenever there is a relevant status update on the program, such as a public meeting notice or a published document. The password-protected portion of the website for the MCG should be updated monthly with the documents needed for the upcoming MCG meeting.

Additional Communication

Another effective means of public outreach is the creation and use of a master public outreach email list. This could be a very effective tool for outreach to interested parties. Emails are drafted and sent out to the email list at various points and could include general program updates and information regarding public meetings and public documents available for comment.

MCG Meeting Comment Period

During each regularly scheduled MCG meeting, there is an identified public comment period, allowing each speaker four minutes. While the MCG will generally not respond to comments made during this time, it is recommended that the MCG discuss comments made.

Public Comment Period on Documents

After documents are approved and posted on the website by the MCG, the public may respond with comments. Email notifications will be sent to both Tier 2 and Interested Parties stakeholders when approved deliverable(s) are moved to the public portion of the website. The MCG may modify documents in response to public comments. In addition, a press release suitable for posting on agency and NGO websites will be prepared in advance of the public comment period for the final MokeWISE document; this release will be posted to the MokeWISE website as well as the websites of other cooperating agencies.

Proposed Schedule for Outreach Activates

The table below outlines a proposed schedule for outreach activities.

Activity	Timeline	Responsible Party*
Public Workshops	Held at milestones (identified above) during 22-month program duration	MCG/Work Group/RMC
Newsletters	Distributed at identified milestones during 22-month program duration	MCG/Work Group
Press Releases	Distributed at identified milestones during 22-month program duration	MCG/Work Group
Website Updates	Updated at identified milestones during 22-month program	MCG/Work Group/RMC
Additional Communication	Sent at identified milestones during 22-month program duration	MCG/Work Group/ Rainwater & Associates
Other	TBD	MCG/Work Group
MCG Meeting Comment Period	At each regularly-scheduled MCG meeting	MCG
Public Workshops	January 2014; June 2014; August 2014; November 2014; April 2015	MCG/Work Group/RMC/ Rainwater & Associates
Public Comment Period	A designated time-period after each finalized, released document	MCG/Work Group
Tier 2 Stakeholder	February 2014; May 2014; July	MCG/Work Group

Activity	Timeline	Responsible Party*
Participation	2014; September 2014; December 2014	

* The MCG is not necessarily responsible for conducting these activities, but may take it upon themselves to organize and implement any of the activities listed.

Appendix E: Program Outcomes and Measures Memorandum

Appendix E provides the MCG-approved Program Outcomes and Measures Memorandum which outlines the MokeWISE Program Objectives and Consequences to be Avoided.

MokeWISE Program Memorandum:
Program Outcomes & Measures

Revision Date: 22 November 2013

Table of Contents

Introduction

The Mokelumne Watershed Inter-regional Sustainability Evaluation (MokeWISE) program has emerged following years of dialogue between a diverse set of stakeholders in the Upper and Lower Mokelumne River watersheds. MokeWISE, when concluded, is expected to yield a scientifically-based and broadly-supported water resources program that includes sustainable approaches to water resources management in the Mokelumne River watershed.

This effort includes establishing program outcomes and measures through a stakeholder-driven process. The program outcomes and measures will ultimately serve as the basis for developing and evaluating program options. As a first step in developing program outcomes and measures, members of the Mokelumne Collaborative Group (MCG) were asked to provide initial thoughts related to desired program outcomes and consequences to be avoided. This memorandum documents the process implemented to solicit initial thoughts, feedback received from MCG members, and the process for using this feedback moving forward.

The MCG was asked to complete an interest statement template designed to capture initial thoughts on desired program outcomes and consequences to be avoided. In completing the template, MCG members were asked to draft a one to two paragraph interest statement narrative summarizing their organizations' interest in the MokeWISE program, including key areas of interest and concern in the watershed and desired potential project outcomes. They were then asked to complete a table summarizing initial ideas related to desired potential benefits to be achieved and potential consequences to be avoided by the program, and potential ways of measuring these outcomes. Finally, members were asked to indicate the relative importance of each potential outcome to their organizations on a scale of 1 to 3, with 1 as highest priority. The interest statement template provided to the MCG can be found in Appendix A. The narrative interest statements provided by MCG members can be found in Appendix B.

Information provided through this exercise was compiled by the project team with the goal of identifying areas of common interest, which were used to develop joint program objectives and measures. In addition, the interest statement narratives were shared with the MCG to aid in increasing each member's awareness of the specific interests of the other participating organizations.

Program Objectives and Consequences to be Avoided

The project team reviewed, categorized and in some cases revised potential outcomes identified by MCG members in order to develop a consolidated list of potential desired outcomes and consequences to be avoided. As such, this consolidated list represents the project team's synthesis of all input received. Not all interests expressed by MCG members are included in the consolidated list. The preliminary list was reviewed and revised by MCG members so that each stated interest accurately reflects the interest of the MCG member organizations to which it is attributed. The inclusion of a stated interest does not indicate general support of all stakeholders. On the other hand, attribution of an interest to specific stakeholders does not mean that other stakeholders do not support that interest.

Table 2 provides the consolidated list of potential program outcomes suggested by MCG members. Potential outcomes are summarized by category, and the MCG member organizations that identified each outcome are identified.

Table 3 summarizes consequences to be avoided that were identified by MCG members through the interest statement exercise. Each consequence to be avoided is summarized, along with the general category in which it falls and the attributing stakeholders.

Program Constraints

The MokeWISE program is funded by a Proposition 84 Integrated Regional Water Management (IRWM) planning grant, administered by the California Department of Water Resources (DWR). The program is envisioned to be a stakeholder-driven process, with the MCG determining the program objectives, project alternatives to be considered, assessment criteria, etc. The scope of work was written to explicitly indicate this intent.

However, as a grant-funded program with a defined scope of work, schedule, and budget, there are some limitations in terms of what can be achieved as part of the planning process. For example, the deliverables identified in the DWR agreement must be achieved in order for expenses to be reimbursed, and any expenses above and beyond the grant funds available will not be reimbursed. Further, as an IRWM-funded program, the MokeWISE program must adhere to the guidelines established for the IRWM program.

Next Steps

This document reflects the Planning Team's initial interpretation and summarization of the interest statements that were provided by MCG members. This document will be provided to and reviewed with the MCG to ensure that all interests and concerns have been accurately and adequately captured. Based on written comments received, the MokeWISE program objectives will be revised and resubmitted for acceptance by the MCG at the November meeting.

Table 2: Program Objectives and Desired Outcomes

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
Water Supply	Promote demand-side management strategies	The program should promote projects and policies that support demand-side management strategies including conservation, water use efficiency, peak period rationing and leak detection.	Cost/benefit of conservation vs. new supply; amount of water saved per project implemented	AWA, Calaveras Planning Coalition, Foothill Conservancy, Calaveras County, JVID, Sierra Club
	Increase supply reliability	The program should result in increased water supply reliability for water purveyors.	Water accounting system for surface and groundwater; Acre-feet (AF) of supply in various hydrologic year types	EBMUD, AWA, Lodi, NSJWCD, GBA/SJ County, CCWD, CPUD, JVID
	Increase amount of stored water	The program should result in an increase in the amount of water stored within the watershed and consider both ground and surface options.	Acre-feet per year (AFY) of supply diverted for recharge; groundwater level monitoring; AF of surface storage available	CCWD, Stockton East, JVID, GBA/SJ County, Stockton Municipal Utilities, Calaveras County, AWA, Calaveras PUD, JVID
	Promote smart, responsible development	The program should promote projects and policies that ensure that the water needs of new development are met while limiting negative externalities and end use harm.	Inclusion of land use coordination component(s) in recommended program	Calaveras County, MyValleySprings.com, Foothill Conservancy
	Reduce reliance on groundwater for irrigation	The program should result in a reduced reliance on groundwater for irrigation and explore surface water alternatives.	AFY of groundwater used for irrigation	SJRCD
	Promote a long-term groundwater balance	The program should promote projects and policies that seek to contribute to a positive long-term groundwater balance.	Groundwater level monitoring; flow diversion measurements	CA Sport Fishing, MyValleySprings.com, Stockton East, Stockton Municipal Utilities
	Maximize water resource availability for all beneficial uses	The program should promote projects and policies that allocate water to the full spectrum of beneficial uses based on full analysis of all potential sources of supply.	Number of different types of uses supported by the recommended program; number of different supply sources studied	Calaveras County, CCWD, Calaveras Planning Coalition, Foothill Conservancy
	Decrease the need	The program should seek to implement	The amount of water	Calaveras Planning

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
	to import water	state legislative goals to improve self-sufficiency and reduce the need to import water	imported	Coalition
Water Demands	Review and understand existing agency demand estimates	The MCG should review and come to a common understanding of water demand estimates described in existing planning documents	Number of MCG stakeholders who understand existing demand numbers.	Foothill Conservancy, Calaveras Planning Coalition, MyValleySprings.com, Trout Unlimited
	To identify water demand issues for timely consideration by the water agencies during their next UWMP update.	The program should identify issues and analyses for water agencies to consider as they prepare demand and population estimates.	Number of demand issues and analyses identified for water agency consideration as they prepare demand and population estimates for their UWMP Updates.	Calaveras Planning Coalition, Foothill Conservancy
Water Quality	Protect and improve surface and groundwater quality	The program should result in improved water quality within the watershed for both surface water and groundwater.	Groundwater and surface water quality monitoring .	Lodi, NSJWCD, EBMUD, SJRCD, CCWD, JVID, Sierra Club
	Match delivered water quality to use	The program should try to avoid wasting high quality water on uses that do not need it.	The amount of high quality water saved by substitution with lower quality water; he amount of high quality water that is put to uses that do not need it.	Calaveras Planning Coalition
	Use water purification technology as a tool to maximize beneficial uses	The program should seek to implement the state's legislative goals to use water purification technology as a tool to increase the beneficial uses of water.	The amount of water that was put to additional beneficial uses through purification technology.	Calaveras Planning Coalition
Recreation	Increase access for water-based recreation	The program should result in increased access to the Mokelumne River from Highway 12 to the headwaters.	Number of new public access points	Delta Fly Fishers
	Increase angling	The program should result in increased	Number of fish observed	Delta Fly Fishers

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
	and other recreational opportunities	spawning habitat, designating sections of the river for hatchery and wild species, and designating appropriate environmental flows.	during annual fish counts; amount of spawning habitat created or enhanced; length of river designated for wild species; amount and timing of environmental flows	
	Increase angling and other recreational opportunities	The program should result in the stocking of hatchery-raised trout in designated areas on the Upper Mokelumne and designating and managing wild trout sections.	Number of hatchery-raised trout observed during angling surveys	Delta Fly Fishers
	Increase angling and other recreational opportunities	The program should result in the reintroduction of salmon in the Upper Mokelumne river.	Number of salmon observed during fish counts	Delta Fly Fishers, MyValleySprings.com
	Increase angling and other recreational opportunities	The program should result in increased angling, harvesting, and other recreational opportunities.	Estimated monetized, or otherwise quantified, benefit of recreational enhancements included in recommended program(s)	EBMUD, JVID, Trout Unlimited
Water Rights	Resolve existing water rights conflicts in the watershed	The program should seek to resolve existing water rights protests and to achieve a common understanding of the application of relevant water rights law in the watershed.	Number of water rights protests resolved	GBA/SJ County, EBMUD, JVID, Foothill Conservancy, CA Sport Fishing, Woodbridge Irrigation District, Sierra Club
Flood Management	Enhance flood protection and management	The program should result in multi-benefit projects which provide flood protection for residents and businesses within the watershed and enhance ecosystem function.	Cost of flood-related damages in the watershed	NSJWCD
Data	Use sound, agreed-upon data to evaluate program alternatives	The program should produce an agreed-upon hydrology dataset and Water Availability Analysis	MCG approval of data used during program	CA Sport Fishing, Foothill Conservancy, Trout Unlimited, US Forest Service, Sierra Club

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
	Use sound, agreed-upon data to evaluate program alternatives	Program components should be described with sufficient detail to allow for evaluation.	Ability of program component to be evaluated	CA Sport Fishing, Calaveras Planning Coalition
	Promote the contribution of sound scientific data to current body of knowledge	The program should generate and promote projects with monitoring and reporting requirements to increase water resources data	Number of recommended project(s) including a data collection and reporting component	Calaveras County, Calaveras Planning Coalition
Environment	Protect and enhance natural environment	The program should result in the protection and enhancement of the natural environment of the Mokelumne watershed.	Number and extent of protection and enhancement measures; monetization or other quantification of environmental benefits / enhancements	EBMUD, CA Sport Fishing, Foothill Conservancy, JVID, Trout Unlimited, Sierra Club
	Protect and enhance natural environment	The program should include support for wild and scenic designation of the Mokelumne River down to the Pardee High Pool.	Degree of support for Wild and Scenic designation	Calaveras Public Utility District, Calaveras Planning Coalition, Sierra Club
	Protect and restore fisheries	The program should protect, restore, and enhance fisheries in the Mokelumne River downstream of Woodbridge Dam.	Number of fish counted during annual fish counts and surveys	Delta Fly Fishers, Trout Unlimited
Collaboration	Foster long-term regional relationships and avoid unnecessary conflict and litigation	The program should foster long-term regional relationships which will promote continued collaboration on water management issues and reduce unnecessary litigation.	Percentage of MCG stakeholders continuing commitment throughout project duration and number of issues resolved in the process Number of issues resolved through the MokeWISE program	USFS, Foothill Conservancy, Calaveras County, Calaveras Planning Coalition, EBMUD, NSJWCD, JVID
	Promote broadly-supported outcomes that	The program should promote projects and policies that support outcomes benefiting a wide range of interests within the	Percentage of MCG member organizations that receive a tangible benefit from	SJRCD, GBA/SJ County, MyValleySprings.com, Foothill Conservancy

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
	benefit a wide range of interests	watershed.	implementation of the preferred program	
	Promote broadly-supported outcomes that benefit a wide range of interests	The program should promote the least controversial projects and policies.	Degree of consensus among MCG members on selected alternative	NSJWCD, Foothill Conservancy
	Promote broadly-supported outcomes that benefit a wide range of interests	The program should result in agreements that reduce conflict.	Number of agreements that reduce conflict	Foothill Conservancy
	Develop a program consistent with all existing licenses, permits, and agreements affecting the River	The program should facilitate a common understanding of the requirements contained in all existing licenses, permits, and agreements affecting the Mokelumne River and ensure that MCG proposals will not interfere with their implementation.	Number of existing licenses, permits, and agreements violated by the recommended program(s) and severity of violation	Trout Unlimited, Foothill Conservancy
	Develop a program consistent with all existing licenses, permits, and agreements affecting the River	The program should adhere to all CEQA/NEPA regulations.	Completion of CEQA/NEPA documentation	Calaveras Planning Coalition
Other Human Values	Increase investment in forest management	The program should promote forest management that reduces the economic impact of wildfires and other natural disasters, particularly on water supply.	Flux of sediment discharged post-fire compared to historic events (e.g., Power Fire); monetization of costs avoided by pre-emptive management	Sierra Nevada Conservancy
	Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a	The program should seek to design projects and policies to improve socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on DACs.	Acres of cultural resource areas preserved; acres of recreational area maintained; miles of stream enhanced for fisheries	Calaveras Planning Coalition

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
	particular emphasis on disadvantaged communities (DACs)			
	Achieve equity	The program should be designed to achieve equity across regions, cultures, incomes, and time,	Amount of perceived equity across regions, cultures, incomes, and time.	Calaveras Planning Coalition, MyValleySprings.com

Table 3: Consequences to be avoided during the MokeWise Program

Category	*Consequence to be Avoided*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
Data	Avoid basing decisions on incomplete or inaccurate information	The program should avoid decision-making based on incomplete or inaccurate information.	MCG approval of data used for program decision-making	Calaveras Planning Coalition
Environment	Avoid demand for new or larger on-stream dams	The program should avoid demand for new or larger on-stream dams.	Number of new on-stream dams or dam expansions recommended	Foothill Conservancy
	Avoid harmful impacts to fisheries and other wildlife	The program should avoid harming fisheries and other aquatic and terrestrial wildlife.	Number of species harmed by the program and degree of harm; miles of fishery habitat degraded	Foothill Conservancy
	Avoid conversion of agricultural lands to developed uses	The program should avoid urbanization of agricultural lands.	Number of agricultural acres urbanized	Foothill Conservancy
	Avoid shifting environmental impacts from one	The program should avoid shifting environmental impacts from one sensitive area to another.	Number and extent of adverse environmental impacts shifted from one	Foothill Conservancy

	area to another		location to another	
	No diminishment of the benefits of existing in-stream flow	The program should protect against any decrease in benefits to public trust resources of existing in-stream flows.	Quantification of the benefits of existing flows in the River; quantification of impacts resulting from potential reduction of these flows	CA Sport Fishing
Collaboration	Avoid closing the process to the public	The program should avoid closing the process to the public.	Percentage of MokeWISE planning meetings open to the public; percentage of MokeWISE implementation meetings open to the public	Calaveras Planning Coalition
Other Human Values	Avoid dependency on potentially unreliable supply	The program should support projects and policies that will prevent downstream users from becoming dependent on unreliable supplies	Percent of time recommended supplies will be unavailable due to reliability issues	CCWD
	Minimize adverse socio-economic and public health and safety impacts	The program should promote projects and policies that limit or appropriately mitigate adverse socio-economic and public health and safety impacts.	Cost benefit analysis of recommended program considering social, environmental, and cultural impacts required of projects; comparison of projected cost to published "willingness to pay" benchmarks	EBMUD, Foothill Conservancy, MyValleySprings.com, Calaveras Planning Coalition, Calaveras PUD, JVID
	Avoid end use harm	The program should seek to allocate water in ways that do the least end use harm.	Amount of end use harm	Calaveras Planning Coalition, MyValleySprings.com
	Avoid violating procedural or substantive laws.	The program should commit to completing CEQA/NEPA analysis prior to the agencies adopting and implementing the program.	Number of lawsuits filed for failing to comply with CEQA/NEPA	Calaveras Planning Coalition
	Avoid interregional inequity	The program should provide parity or equity among the regions.	Degree to which program alternatives serve inter-regional equity	MyValleySprings.com

Appendix A

MokeWISE Interest Statement

Please return to Katie Cole (kcole@rmcwater.com) no later than Thursday, September 12.

Organization Name:

Representative Name:

Interest Statement Narrative

[Please provide one or two paragraphs summarizing your organization's interest in the MokeWISE program, including key areas of interest and concern in the watershed, and desired potential project outcomes.]

Potential Program Objectives

[Please complete the table on the following page summarizing initial thoughts related to desired potential benefits to be achieved and potential consequences to be avoided by the program, as well as ways of measuring those outcomes, to the extent possible. Please also indicate how critical each potential benefit / consequence is to your organization by providing a priority of 1, 2, or 3, where priority 1=highest priority / of critical importance, 2= medium priority / important but not critical, 3= lower priority / desired outcome but not critical. Please feel free to add rows as needed.]

Table 1: Initial Thoughts Related to Potential Benefits to be Achieved and Potential Consequences to be Avoided

Potential Benefit / Consequence	Summary Description	Potential Measurement Approach(es)	Priority (1, 2, or 3)
EXAMPLE: Increased groundwater recharge	*EXAMPLE: The project should result in a net increase in water recharged to the Eastern San Joaquin Groundwater Basin.*	*EXAMPLE: Flow meters to measure new / additional supply diverted for recharge.*	*EXAMPLE: 2*

Appendix B

MokeWISE Program:
Mokelumne Collaborative Group Interest Statements

Amador Water Agency

The Amador Water Agency is the largest purveyor of treated water in Amador County and strives to meet the needs for water and wastewater service throughout the County consistent with land use agency plans and approvals. The Amador Water Agency projects a shortfall in available water for Amador County and seeks to secure water for those future needs. Amador Water Agency plans to utilize water reclamation, conservation, and new water supply projects to meet future demands. Amador Water Agency also recognizes natural, recreational, and cultural resources within the Mokelumne Watershed, as well as the needs and rights of others who all rely on water that originates in the Mokelumne Watershed.

The MokeWISE program offers an avenue to develop and evaluate solutions to balance water needs with the finite water resource within the watershed and the Amador Water Agency desires to be a part of this program in seeking to meet current and future water needs throughout Amador County.

Calaveras County

Calaveras County is interested in the MokeWISE program for a few reasons. Development, specifically residential, in the lower part of the County will continue to struggle without water. In preparing for future development, the County would like to have a better understanding of what water from the Mokelumne River would be available for land use planning purposes.

The County would like to improve the linkage between land use planning decisions and water planning. We need to have a better understanding of water issues and needs. As the Lead Agency, projects cannot be approved without proof of services such as water and has struggled to obtain this type of data in the past.

Within the boundaries of the County there are various agricultural opportunities, especially in the lower part of the County. Having the knowledge and ability to provide land owners with the necessary resources to have an agricultural operation is important to the County. This process may present opportunities to work with agencies to come up with a way to supply agriculture with raw surface water and/or recycled water.

Calaveras County Water District

To enhance the use of Mokelumne River water in Calaveras County, providing water to underserved and water distress communities in Western Calaveras County, enhancing agriculture and economic development in Calaveras reducing or eliminating the balance of water flowing west without offsetting compensation.

To gain relief from unreasonable and restrictive conditions imposed upon the use of Calaveras County Water by downstream interests. To provide an education to downstream users of the historical abuses and perpetual disadvantages to area of origin, which all similar in impacts whether perpetrated by Los Angeles, Oakland or Stockton.

Calaveras Planning Coalition

The CPC is a group of community organizations and individuals who want a healthy and sustainable future for Calaveras County. We believe that public participation is critical to a successful planning process. United behind eleven land use and development principles, we seek to balance the conservation of local agricultural, natural and historic resources, with the need to provide jobs, housing, safety, and services.

Consistent with the public interests provisions of the water code, our overarching interest is to see Moke water allocated in a way that does the most good and/or the least harm. This interest can be broken down into at least five parts.

First, our interest is to see Moke water used for a broad spectrum of beneficial uses: development uses, agricultural uses, salmon fishery restoration, recreational whitewater boating, and Delta habitat maintenance.

Second, our interest is to make the most out of Moke water conservation, re-use, and rationing.

Third, with regard to the allocation of Moke water for developed uses, we want to see the water used for development that promotes economic, social, and environmental benefits.

Fourth, our interest is to see Moke water allocated for development in those communities that are most committed to mitigating the adverse economic, social and environmental impacts associated with that development.

Fifth, from a process standpoint, we want Moke water, wastewater, and rate-setting activities carried out in forums with more effective, more valued, and more heeded public participation activities.

Calaveras PUD

The Calaveras Public Utility District interest in the MokeWISE project is to collaborative work with the stakeholders in the watershed. Using the knowledge to evaluate the resource and develop the strategies to support the interregional success. Collectively set goals that represent the comprehensive evaluations, development and future implementation of the needs of the stakeholders group in planning for a "MokeWISEr" future.

California Sport Fishing Protection Alliance

CSPA's primary goal in the MokeWISE process is to develop a defensible, sustainable and replicable water availability analysis for the Mokelumne watershed and for other potentially connected watersheds from which Mokelumne watershed water uses may seek to draw.

CSPA's second goal in the MokeWISE process is to evaluate water availability for potential projects in the Mokelumne watershed in the context of alternative Delta export operations, including operation of the Cross Channel Gates.

CSPA's third goal in the MokeWISE process is to agree on a hydrology dataset and water balance model that will allow the technical analysis necessary to achieve the first two goals. Ideally, this technical information and tool would be publicly available.

CSPA's fourth goal in the MokeWISE process is to create a positive long-term groundwater water balance in Eastern San Joaquin County, in order to enable responsible water management, and so that present and future management actions do not exacerbate the current unsustainable condition in which more groundwater is pumped than is recharged.

CSPA's fifth goal in the MokeWISE process is to build on achievement of the first three goals to resolve CSPA's existing water rights protests with San Joaquin County entities.

CSPA's sixth goal in the MokeWISE process is to assure reasonable protection for Amador and Calaveras County state filings and for Amador and Calaveras counties' area of origin water rights interest in general.

CSPA's seventh goal is to protect and maintain the benefits to the Mokelumne River that derive from the Mokelumne Settlement Agreement for Project 137.

City of Lodi, Public Works

1. Water Quality Protection for the Watershed:

The Mokelumne River is the water supply for Lodi Lake which serves as a significant cultural, economic, and recreational resource to the residents of Lodi. The City of Lodi allocates significant resources to protect the river and lake through control of storm water and other sources of runoff within the City.

2. Protection of the Drinking Water Supply:

The Mokelumne River is the water supply for the new City of Lodi Surface Water Treatment Plant (SWTP) that currently provides 6,000 acre feet of drinking water annually to the residents of Lodi. The SWTP significantly reduces groundwater pumping and depletion in the Lodi area. It is essential that the water supply be available to provide high quality drinking water and reduce groundwater depletion. The SWTP is capable of treating 11,000 acre feet annually, and can be expanded to treat 22,000 acre feet annually.

Delta Fly Fishers, Inc.

In dealing with issues on the Mokelumne, I view the river as three segments;

Segment One -confluence with the San Joaquin to the base of Woodbridge Dam

Segment Two - Woodbridge dam to Electra Road including Lodi Lake, Camanche and Pardee Reservoirs.

Segment Three - The river above Electra Road.

Areas of Interest and Concern:

Segment One - Restoration of smallmouth, largemouth, American Shad and Striped Bass fishing in this portion of the river. Adequate water volumes for passage for anadromous fishes (chinook salmon and steelhead). Increased public recreational access.

Fisheries restoration could include improvements to the river bed due to possible silting and other negligence and restoration of adequate flows. Public access through what is now almost 100 percent private property to be able to fish for the above mentioned species.

Segment Two - Further restoration of the salmon and steelhead fisheries and adequate monitoring, insuring that the fisheries do not deteriorate due to neglect. Increased public access for both fishing and other recreational purposes including access to the river portions between Camanche and Pardee and above Pardee to Highway 49.

Segment Three - Proper management of the Mokelumne as a sustainable trout fishery, including the possibility of establishing a wild trout section with special regulations and the public access to allow for the development of public access to those portions of the river.

The possibility also exists for the expansion of the chinook salmon fishery above Pardee through a trucking and trapping program or improved fish ladder access through Camanche and Pardee dams.

Note: All of the above are public trust issues. The river, before being over developed and over drafted provided all of these fisheries and recreational opportunities to the citizens of the state. Commercial interests and developments have severely impacted these public trust assets with little in the way of mitigation, causing a great loss to the citizens of the state.

EBMUD

EBMUD obtains 90% of its water supplies from the Mokelumne River. Our interest as a participant in the UMRWA-GBA MokeWISE program is directly related to our desire to maintain the reliability of that resource. Participation also affords EBMUD an opportunity to strengthen our relationship(s) with other water agencies and interest groups that share our desire to protect the River and its' associated environment benefits (recreational, fisheries, biologic, water supply, etc.).

As part of the District's recently completed Water Supply Management Program 2040 (WSMP 2040) effort, EBMUD identified objectives used to guide how we would go about planning to meet our water supply needs over the coming 30 years. Those objectives fell under four main categories. WSMP 2040 objectives align with how we'd approach our MokeWISE participation, in that we'd want to see MokeWISE project outcomes that address one or more of those objectives:

1. Operations, Engineering, Legal & Institutional Objectives:
   - Provide water supply reliability
   - Utilize current water right entitlements.
   - Promote District involvement in regional solutions
2. Economic Objectives:
   - Minimize cost to District customers.
   - Minimize drought impact to District customers.
   - Maximize positive impact to local economy
3. Public Health, Safety & Community Objectives:
   - Ensure the high quality of the District's water supply.
   - Minimize adverse sociocultural impacts (including environmental justice).
   - Minimize risks to public health and safety.
   - Maximize security of infrastructure and water supply.
4. Environmental Objectives:
   - Preserve and protect the environment for future generations.
   - Preserve and protect biological resources.
   - Minimize carbon footprint.
   - Promote recreational opportunities.

Foothill Conservancy

The Foothill Conservancy, a community-based nonprofit organization based in Amador and Calaveras counties, has a 24-year history of working to protect and restore the upper Mokelumne River and its watershed. Consequently, we have a deep interest in the MokeWISE program and its outcomes. The Foothill Conservancy's mission is to protect, restore, and sustain the natural and human environment of our counties for the benefit of current and future generations. We are committed to finding positive solutions that will work for all interests, focusing on fact, science, and law, while supporting community-based solutions. We are dedicated to helping develop lasting, long-term water solutions that will assure the future health of the Mokelumne while addressing future water needs.

Our priorities for MokeWISE include protecting the ecological values of the river and avoiding actions that could preclude future restoration of its anadromous fisheries; ensuring the protection of the river's historical, recreational, and cultural resources and uses; protecting terrestrial and aquatic wildlife; and ensuring that Amador and Calaveras counties are assured a reasonable future water supply while addressing the water needs of downstream users. We hope the MokeWISE project will resolve interregional water disputes, address the question of water availability in a definitive way that looks at all potential water sources, include meaningful demand-side approaches to water supply, and establish productive, watershed-wide working relationships that can address future issues regarding water supply and watershed health.

GBA/San Joaquin County

The Mission of the GBA is to employ a consensus-based approach to collaboratively develop stakeholder-supported projects and programs that mitigate and prevent the impacts of long-term groundwater overdraft. Managing the underlying groundwater basin is critical in providing reliable water supplies, which are essential for the economic, social, and environmental viability of the San Joaquin County Region. Yet, the problem of significant groundwater overdraft and the resulting decline of groundwater levels in Eastern San Joaquin County has created a "silver-lining" with an estimated 1 to 2 million acre-feet of potential operable groundwater storage capacity, a volume equivalent to Folsom Reservoir.

Member agencies in the GBA have long looked to the Mokelumne River as a major source of water for conjunctive use projects. The GBA's desire to develop a project with broad based support is reflected in the GBA's commitment to the Mokelumne WISE effort. The vision for a conjunctive use program utilizing Mokelumne River water hopes to accomplish increased dry-year water supplies, improved groundwater management, maintained or enhanced agricultural viability, and protection of water rights in a manner that sustains the environmental, social and economic viability of the Mokelumne Watershed, project partners and San Joaquin County as a whole.

Jackson Valley ID

The Jackson Valley Irrigation District serves Irrigation, Raw Domestic and soon Treated water to members of our district located just north of Lake Pardee and Camanche near Ione, California. The Districts primary source of water is from the Jackson Creek Watershed but we do receive 3,850 Acre Feet of water annually from the Mokelumne River Watershed through Lake Pardee. The district encompasses roughly 12,000 acres of land and roughly 8,500 acres of land used for irrigation and serves a population of about 1,000 people. The District faces many hurdles being that we are a somewhat small district and work with a small staff of three running and operating the system which include 2 large distribution laterals stretching miles through the district, maintaining a dam and headwork's, a 500 kw hydro-electric plant, pumping stations and soon a newly installed 175gpm water treatment plant.

In the last several years the district has seen an increase in demand for water primarily for irrigation purposes. The new addition of several vineyards and the development of more irrigated pasture lands have been on the rise. As California's population grows and regulations from the Federal and State Environmental agency's clamp down on how and where to grow crops and raise cattle, it makes JVID unique and will create more demand from farmers and ranchers looking to comply with the new regulatory standards. JVID is reaching a tipping point where the amount of water we currently serve yearly does not leave an adequate water supply in our reservoir to prepare for drought events once the season is concluded. As more and more people put a finical stake into the system JVID plays a very important role to insure the water is available and the system is capable of serving the water. The lack of adequate storage is one of JVID's biggest concerns but not just for JVID but we believe for the whole State of California. JVID's primary interests of being MokeWISE member is to insure a clean, plentiful and guaranteed source of water for farming, livestock, raw domestic, industrial, recreation, and treated water to the members of our District for now and years into the future.

MyValleySprings.com

It is the mission of MyValleySprings.com (MVS) to promote responsible growth and development through public participation in community planning in order to preserve the quality of rural life in the greater Valley Springs area. Community land use planning impacts every aspect of our lives, and so the interests of MVS are far-reaching and include, of course, water quantity and quality. Responsible, sustainable growth and development cannot occur without an adequate clean water supply.

Consequently, some of our interests and concerns are: retaining a reliable water supply for area residents, agriculture, and wildlife; groundwater quality, quantity, and recharge; protection of surface water and the watershed; identifying (and to the extent practical, quantifying) current and future water supply relative to land use planning; and water conservation and recycling.

Of particular concern to MVS are the falling groundwater levels in that portion of western Calaveras County which overlies the Eastern San Joaquin Sub-basin. Without intervention, dwindling groundwater supplies will necessitate land use restrictions and intensify the need for surface water, but we wonder if groundwater recharge and groundwater banking (if feasible) are practical solutions without groundwater regulation.

MVS is also interested in promoting an increased awareness among downstream users of the historical, cultural, and economic significance of the Mokelumne River to Calaveras and Amador Counties.

As potential outcomes, MVS would like to see: 1) existing water (surface, groundwater, precipitation) supplies quantified; 2) existing water needs (residential, municipal, agricultural, and aquatic and terrestrial habitat) quantified; 3) a determination of the amount (if any) of "excess" water available from the Mokelumne; 4) a realistic needs assessment for future water demand; 5) increased commercial recreation and fishing on the upper Mokelumne; 6) a greater emphasis on water conservation as a routine strategy; 7) more cooperation across political boundaries and philosophical divides; and 8) more public outreach, education, and participation.

MyValleySprings.com supports, in principle, the "envisioned program benefits" as outlined in the MokeWISE program description (page 4). However, we have concerns about the process and implementation measures that will be used to produce those benefits. For example, how and where will wet weather flows be stored? If storage means an off-stream reservoir, we have reservations about the cost and location of such a reservoir. If storage means groundwater banking, we have concerns about how such stored groundwater will be regulated.

In the table below we have tried to focus on a few benefits and consequences more specific to the greater Valley Springs area.

North SJC Water Conservation District

Desire to work with other interested parties to provide a dependable water supply to our customers, enhance the groundwater basin, capture flood flows, maintain good water quality and establish a network of parties interested in the long term interests of the Mokelumne River.

Pacific Gas & Electric

Pacific Gas and Electric is a major stakeholder on the Mokelumne River. PG&E has a license with the Federal Energy Regulatory Commission (FERC) which allows the company to operate a major power generation project on the river consisting of 5 power generating facilities and 13 reservoirs which are used as storage facilities to keep the power generating facilities supplied. PG&E's primary interest regarding the Mokelumne River will always be to remain in compliance with that FERC license. Doing so requires numerous different activities, including providing access for recreation at many of the facilities along the river. PG&E is interested in maintaining the ability to operate all generating facilities as close to full capacity as possible, so that we may provide our customers with this clean, renewal, and affordable energy supply. PG&E is also interested in having the flexibility to consider increasing power generation on the river as future opportunities may allow.

Sierra Club

Sierra Club California would like the MokeWISE process to result in the following:

- Protect and restore the Mokelumne River as aquatic and riparian habitat, including traditional floodplain areas, especially in view of sensitive fish species.
- Increased flows on the Mokelumne as needed to accomplish the above and to help restore Delta inflows.
- Increased access for anadramous species to upper river reaches.
- Develop clear data on historic and current flows ("available" supply), current diversions, and intended future diversions by all diverters.
- Clarify water rights and contractual agreements, including where there are conflicts. We would very much like to see some resolution of such conflicts to help avoid diverters overstating of future demand.
- Stabilize and reduce urban and agricultural demand for Mokelumne water by maximizing water use efficiency and conservation, urban and agricultural pricing incentives, and adoption of alternative supply strategies (reuse/recycling, conjunctive use, graywater use, rainwater harvesting, etc)
- Promote sustainable management of groundwater basins and resources throughout the watershed; no 'water mining'.
- Protect Mokelumne River water quality.
- It is an explicit goal of Sierra Club California for the Mokelumne River to be designated as a Wild and Scenic River for approximately 37 miles of the North Fork and Main Stem.

Sierra Nevada Conservancy

The Sierra Nevada Conservancy has invested heavily over the last five years in the Mokelumne Watershed. Those investments have advanced collaborative forest management. SNC also maintains its involvement in the Mokelumne Avoided Cost Analysis, which will quantify the economic impacts of wildfire on water resources and serve as a guide to foster investment in the watershed. SNC has also provided grants to Amador Water Agency, the Amador FireSafe Council, and US Forest Service among others.

The establishment of an appropriately scaled Bioenergy facility in the upcountry, increasing the pace and scale of sustainable forest management, protection and enhancement water resources, and building consensus where it has been elusive or non-existent generally encompasses the SNC's priorities in the watershed.

Stockton East WD

My District does not have any particular project in mind for the group. The Mokelumne River is not part of SEWD's primary water shed but does impact the water basin that encompasses our service area. SEWD is participating in this process as it is a groundbreaking opportunity to learn how this type of forum could potentially apply in other areas of the State (specifically the San Joaquin River).

My District is interested in any type of ground water recharge project that would benefit the basin lying beneath the majority of San Joaquin County.

Stockton Municipal Utility

As a supplier of potable water for municipal and industrial uses to over half of the Stockton Metropolitan Area, the City of Stockton has a vested interest in water supply availability from the Mokelumne River watershed. Under a long-term contract for 6,500 acre-feet per year of Mokelumne River water with the Woodbridge Irrigation District (WID), with an option for an additional 6,500 acre-feet, Mokelumne supplies aid the City's effort to provide surface water in-lieu of groundwater pumping to help recharge the critically over-drafted Eastern San Joaquin Groundwater Basin. The WID supply, along with supply from the Stanislaus, Calaveras and San Joaquin Rivers has allowed the City to greatly enhance its ability to provide a high-quality source of supply to its customers while protecting and preserving groundwater supplies for periods of drought.

The City's interest in the MokeWISE program is to support efforts in the Mokelumne watershed to protect all beneficial uses and increase local use of available surface supplies now and in the future. This effort brings together, in a collaborative manner, those parties that are positioned to support or oppose future Mokelumne River uses. The City's desired project outcome is one in which available Mokelumne River supplies are put to greater beneficial use, in full disclosure to the interested parties engaged in the MokeWISE process, in an environmentally protective manner.

Trout Unlimited

Trout Unlimited (TU) is a non-profit organization with a mission to protect, restore and enhance cold-water fish species and their habitats. TU's mission is furthered by its 10,000 California members as well as statewide staff. TU members fish the waters in the Mokelumne River watershed and many actively participate in relevant processes and activities ranging from local watershed clean-up efforts to the MAC plan update. TU views this process as an opportunity to provide input regarding potential multi-benefit solutions that would achieve many outcomes including protecting and enhancing the condition of the watershed for cold-water fish. TU has a long history of engaging in collaborative stakeholder discussions that aim to find efficient and creative solutions to issues of water allocation that ensure the health of the watershed while meeting other objectives.

In this process, TU's main priority is ensuring that proposed actions adequately protect the cold-water fish species that currently exist in the watershed. This includes advocating for the completion of a robust and defensible water availability analysis for the Mokelumne

River watershed that does not assume that water needed for fisheries or other environmental needs is available. In addition, it includes ensuring that flow regimes established in permits/settlements etc. are not compromised. TU also has an interest in the program producing scientifically supported proposals and utilizing models or other tools that are transparent, vetted within the group and publicly available.

Appendix F: Environmental Conditions Overview Technical Memorandum

Appendix F provides the MCG-approved Environmental Conditions Overview Technical Memorandum which provides an overview of current environmental conditions within the watershed, including geomorphic and fisheries conditions.

MokeWISE Program Technical Memorandum:
Environmental Conditions Overview

Date: 7 March 2014

Prepared by:

Balance Hydrologics, Inc. (Anne Senter; Barry Hecht, CEG, CHg and Gregory Pasternack, PhD with UC Davis) and

Hanson Environmental, Inc. (Chuck Hanson, PhD)

in Association with RMC Water and Environment

Table of Contents

1. Introduction

Basin-scale planning is currently underway within the Mokelumne River Watershed under the auspices of the Upper Mokelumne River Watershed Authority (UMRWA) and the Eastern San Joaquin Groundwater Basin Authority (GBA), which represent the Mokelumne-Amador-Calaveras (MAC) and Eastern San Joaquin (ESJ) Integrated Regional Water Management (IRWM) Planning Regions, respectively. Grant funding has been secured from the Proposition 84 Integrated Regional Water Management Program to develop the Mokelumne Watershed Interregional Sustainability Evaluation (MokeWISE) program.

The MokeWISE program has emerged following years of dialogue among a diverse set of stakeholders in the Upper and Lower Mokelumne River watersheds. MokeWISE, when concluded, is expected to yield a scientifically based and broadly supported water resources program that includes sustainable approaches to water resources management in the Mokelumne River watershed. This resources program will foster approaches that are consistent with physical and geomorphic processes that provide enhanced habitat conditions consistent with geomorphically appropriate instream channels, floodplains and riparian corridors for key life stages of resident and migratory fish species and other aquatic and terrestrial species.

As part of the MokeWISE program, members of the Mokelumne Collaborative Group (MCG), the stakeholder group driving development of the MokeWISE program, will explore developing a set of new or newly envisioned water supply alternatives from a variety of water sources, potentially including the Mokelumne River. This report provides a brief overview of current hydrologic, geomorphic, riparian and fishery conditions in the Mokelumne River, and provides an initial framework to help guide the Mokelumne Collaborative Group in developing and selecting alternatives. Gaining a general geomorphic and aquatic habitat understanding of channel- and landscape-forming processes in the Mokelumne River basin is essential for basin-scale planning by and for local stakeholders. It is critically important to retain geomorphic integrity and renewal processes within a watershed to the greatest extent possible. These natural physical processes affect sediment dynamics – which in the river include spawning gravel recruitment and well as instream aquatic habitat diversity important to fishery and other aquatic biota, and on the banks include supporting growth of and occasionally renovating riparian vegetation. The loss of natural stream functions due to extraction of water resources for other societal benefits is no longer an acceptable pathway, and the Integrated Regional Water Management program encourages alternatives that either minimize and mitigate the loss of natural stream functions or offset those losses with strategies that enhance them or provide additional resilience.

This report is broad in geographic scope and necessarily limited by the constraints of the planning structure. It provides an overview of existing conditions, and summarizes the ways in which flows drive geomorphic functions that ultimately provide ecological benefits to the river. In addition, a brief screening of potential challenges and opportunities that fall within the geomorphic and fishery purview is provided, along with general conclusions and suggestions for geomorphic data collection scenarios to enhance understanding of physical processes at the basin-scale and narrow the complexity of the geomorphic and aquatic habitat enhancement questions.

Once the collaborative group identifies potential Mokelumne supply concepts, this report will be expanded to describe qualitative geomorphic processes specific to those concepts that may affect the final selection process. Logically, the geomorphic scenarios will be developed to make fiscal and water-management sense both under normal conditions as well as under future climate change scenarios and episodic conditions which may inevitably affect the watershed in the years to come, such as post-fire, post-flood, post-landslide and during and after drought conditions. The process also identifies potential opportunities and constraints for protecting and enhancing conditions within the watershed for a diverse assemblage of resident and migratory fish and other aquatic and terrestrial species.

2. Current Conditions

2.1 Watershed Scale

The Mokelumne River drains about 627 square miles in the central Sierra Nevada. Mean precipitation in the watershed during 1981-2001 was 48 inches, with a range of 23-65 inches depending on geographic location (Null and others, 2010. In the Mediterranean-montane climate, most precipitation occurs October through May and generally falls as snow above about 3,000 to 5,000 feet in elevation, depending on temperature. As with all other Sierran watersheds, the flow regime of the Mokelumne River is highly dependent on annual snowpack. The California Department of Water Resources (CDM, 2011) projects that the effects of warming due to climate change, if experienced, will significantly alter mean annual runoff, thus affecting the ability of existing facilities to be fully utilized if runoff decreases. Overall, DWR projects that there will be less cold weather and more hot weather, with less light precipitation and more heavy precipitation. Higher temperatures on average could result in more winter precipitation falling as rain rather than snow, resulting in a 20-40 percent decrease in statewide snowpack (CDM, 2011; RMC, 2012). On the other hand, potential increases in water demands for irrigation and other uses as droughts become more common.

Null et al. (2010) performed an analysis using the WEAP21 rainfall-runoff model to better understand how individual watersheds might be affected with changes in runoff quantity and timing due to climate warming. The Mokelumne River watershed, along with the American

River watershed, was found to be most vulnerable to a combination of the three metrics that were studied: water supply, hydropower generation, and montane ecosystems. This result may indicate that the Mokelumne River watershed is less resilient to climate change than some of the other Sierran watersheds. Within the Mokelumne River watershed, reservoir storage as a ratio of watershed area is relatively large compared to other Sierran watersheds, at 0.70, and the runoff yield of the watershed is also comparatively large at 0.65; both metrics fall within the top 30% of the 15 studied watersheds. Assessment of potential climate warming impacts at the watershed scale provides a valuable planning tool at a local and regional scale that can provide water resources managers with general trends as understood through the spectrum of the WEAP21 model environment.

Natural processes such as fire and consequent loss of vegetative cover in the Mokelumne River watershed will continue to expose soils on hillslopes and in riparian corridors, leading to potential spikes in sediment yield that will gradually diminish as disturbances heal. The variation in yearly rainfall can result in moisture conditions ranging from extreme drought to very large episodic events that deliver a high proportion of sediment and wood into the system, similar to conditions seen in the winter of 2005-2006, where very heavy rains brought sediment and wood into reservoirs across the Sierran watersheds. Climate changes will likely result in warming as well as larger fluctuations in yearly precipitation, leading to more intense individual storms and earlier snowmelt. Each of these potential situations can result in more rain and less snowpack storage that could lead to larger floods, and lower summer or dry-year flows (Null and others, 2010; CDM, 2011).

The natural flow regime for the Mokelumne River has been highly altered by existing projects, including 13 impoundments that each hold greater than one thousand acre-feet of water (Null and others, 2010). The facilities that support this degree of water management have dramatically altered natural flows. On the other hand, the flow schedule for the PG&E project has been designed to mimic the natural hydrograph both in seasonal magnitude and in ramping rates, and to provide hydropower and water to around 1.5 million California residents. Other significant alterations to the natural environment include gold mining, gravel extraction, logging, channelization, and conversion of floodplains and riparian corridors to agricultural fields via shallow floodplain lake infill, channel cutoff and levee building (Kattelmann, 1996).

Although the Mokelumne River and its waters provide for consumptive water use, more water is often desired than is available from surface water alone. Agriculture and other developments have come to depend on groundwater as a reliable supplemental water source. Prior to development, groundwater generally infiltrated into the subsurface and moved from uplands areas to lowland areas further downstream. Below Camanche Dam, the Mokelumne River tends to be a losing stream (i.e., one in which surface water infiltrates into the groundwater system through the channel bed rather than groundwater filtering up into the wetted channel). Recent increases in planted acreage of permanent, irrigated crops with higher water demand such as orchards and vineyards have likely increased the rate of groundwater extraction.

2.2 Watershed above Pardee Dam

PG&E operates a large network of hydropower generation facilities that divert streamflows into over 30 miles of canals and tunnels to produce power (c.f., EDF and CHRC, 2000). Between PG&E and EBMUD, there are seven hydropower facilities that have a maximum 374 megawatts (MW) of total online capacity (Null and others, 2010). Potentially, other than winter floods and spring snowmelt flows that may overwhelm the system, almost all upper watershed flows are subject to flow attenuation as governed by hydropower licensing terms and as predicated by yearly precipitation and snowmelt patterns. Minimum streamflow requirements meant as partial mitigation for hydropower effects are recommended in the 2000 Federal Energy Regulatory Commission license for the PG&E project and a related settlement agreement, which specify flow requirements by month and water year type (FERC, 2000; FERC, 2001). Prescribed requirements are environmentally important, but do not replace natural flow conditions.

Hydropower development including dams, diversions, canals, forebays, and afterbays can effect channel geometry and channel interactions with local floodplain/riparian corridor habitat, as flows are stored, diverted and released according to prescribed schedules, regardless of specific flow requirements. Below diversion dams, for instance, the loss of sediment supply may lead to a coarsening of bed materials, potential incision and riparian encroachment into the formerly active channel.

The Mokelumne River watershed has a long history of mining operations. Over the past 160 years, mining operations have included placer mining for gold in the mid-1800s, dredge mining for gold, and hard rock mining for copper and zinc (Penn Mine and Poison Lake Mine) and gold (Blazing Star Mill and Mine, Lincoln Mine, Gwin Mine) (CVRWQCB, 2013). Land- and water-use practices over the years have included large, unregulated releases of acidic mine drainage into the Mokelumne River network that has included heavy metals such as mercury. Dissolved metals have been found in fish samples and riverbed sediments, and in reservoir sediments at Pardee and Camanche Reservoirs (Kattelmann, 1996). For instance, the Penn Mine is downstream of Pardee Reservoir and adjacent to Camanche Reservoir. It was mined for copper and zinc from 1861 to the 1950s before being abandoned. In recent years, the mine site including waste rock and runoff was remediated through a joint project by the State of California and the East Bay Municipal Utility District (SVRWQCB, 2010).

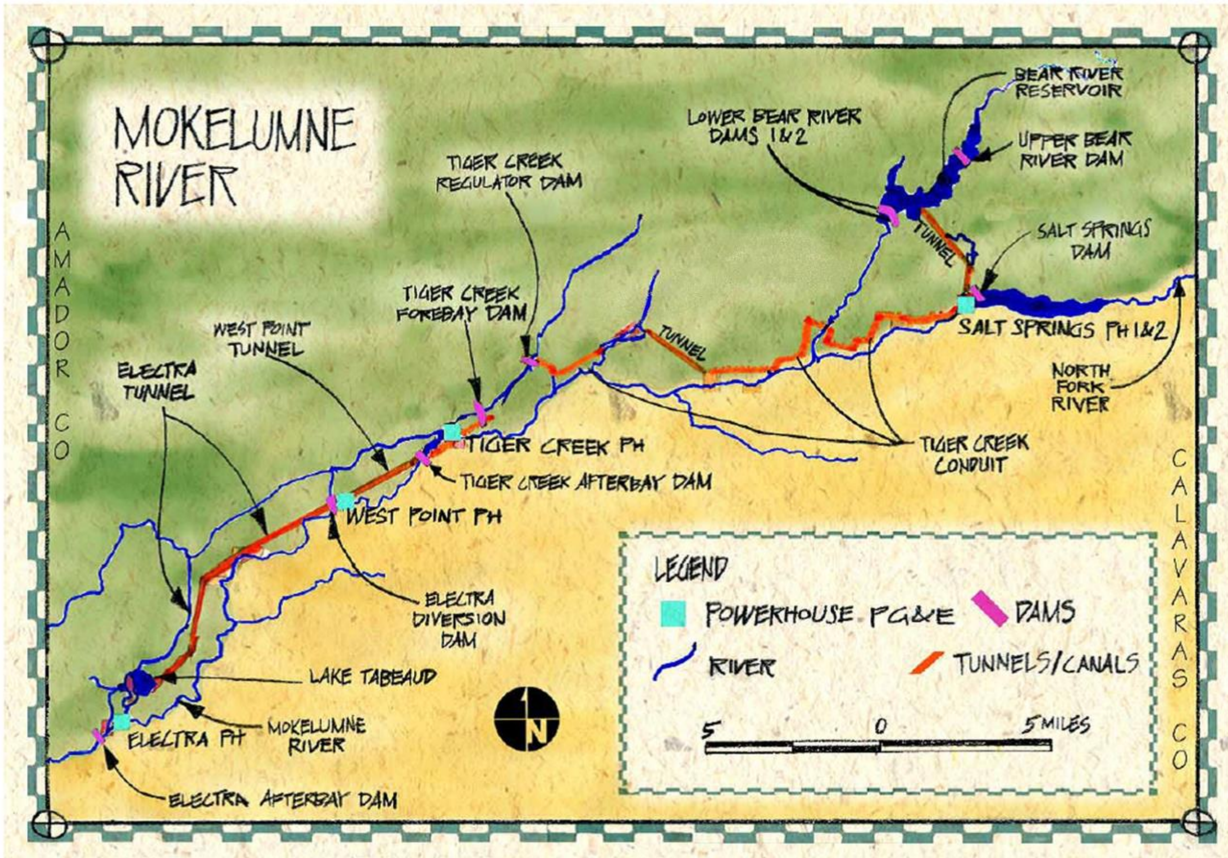

Figure 1. PG&E projects on the Upper Mokelumne River (modified from EDF and CHRC, 2000)

Land management related to timber harvesting, building of roads to provide access to and from the logging sites and redirecting runoff captured by roads can have dramatic effects on sediment and water yield, such as accelerated mass wasting, denudation of soils on steep mountain hillslopes, extension of the channel network, and gullying at channel heads. Potential increased fire incidence is a more natural form of denudation, yet fire suppression practices of the last 100 years have led to hotter-burning fires that burn hillslopes more completely. Landsliding potential may increase after logging or fire; both processes can lead to the deposition of large quantities of sediment into the channel network. Rapid delivery of sediment to the stream network, whether human-induced or naturally occurring, can yield elevated rates of suspended and bedload sediment transport, which affects water quality and can spread widely across downstream habitat. Denuded landscapes also result in increased peak flows, increased flow volume, decreased time to peak, and decreased flow duration (Kattelmann, 1996). There are also potential nonlinear cumulative effects when wildfire, logging, and road building occur in the same basin sequentially (MacDonald, 2000; Constantine and others, 2005). It is important that such cumulative impacts to fish and to other aquatic species, and to stream habitats from damming, water diversions, roads, logging, fire, agriculture, mining, grazing and other human development activities not be overlooked (Euphrat, 1992). A regionally specific study headed by the Sierra Nevada Conservancy, the Mokelumne Avoided Cost Analysis (MACA), is currently in development to address concerns related to increases in fire risks by studying the differences in cost between investing in active forest treatments and fuels reduction and post-fire costs, such as reducing the risk of large damaging fire in the upper watershed, restoring ecological functions and identification of specific areas that may be most important to restore for water quality and habitat (SNC, 2013).

2.3 Watershed at Pardee and Camanche Dams

The storage volume, landscape position and dam operations at Pardee and Camanche Dams are highly disruptive to the geomorphic continuity of the Mokelumne River watershed, as these two dams form an impenetrable boundary between the upper and lower watershed. Functions that are disrupted include flow magnitude, frequency, duration, timing and rate of change, which as a group are defined as flow attenuation features that can alter ecological and geomorphic processes (Poff and others, 1997).

Pardee Dam was completed in 1929. The East Bay Municipal Utility District (EBMUD) has the right to divert 325 million gallons of water per day (mgd) from this facility to Alameda and Contra Costa Counties (EBMUD, 2013). Camanche Dam was completed in 1964 to provide flood control and to help meet downstream water demands. A large proportion of the available water is stored and later released to the Mokelumne River, while larger organic materials (biological sediments) and inorganic sediments are mostly captured within the reservoirs. Dissolved organics and inorganics may pass through the dam, but not at a natural rate. These, too, can settle through the water column, changing concentrations and affecting water quality. Inorganic sediments entrained in the water column settle onto the reservoir bed except for very small particle sizes; thus, turbidity can increase but bedload transport ceases. Both Camanche and Pardee Reservoirs show signs of increasing rates of sediment accumulation (Kattelmann, 1996) in concert with a dramatic decrease in flow velocity due to containment. This watershed-scale discontinuity prevents the natural flow regime from maintaining the geomorphic and ecological integrity of the watershed. In many cases, not all geomorphic functions were considered in evaluating and mitigating effects when the dams were built; awareness of the environmental consequences of dams has grown in recent decades.

2.4 Watershed below Camanche Dam

Water regulation from a fluvial geomorphic perspective has had negative effects on the lower Mokelumne River environment, with positive effects for development such as flood control and water supply benefits. Pardee and Camanche Dams have fundamentally altered the ability of the river to perform geomorphic work downstream of these dams by capturing sediment and attenuating flows. Peak flows associated with winter floods and snowmelt hydrographs are significantly lower than pre-dam peak flows. Hydrologic analysis of pre-Camanche Dam flows over the period 1904-1963 showed that annual peaks exceeded 7,000 cubic feet per second (cfs) in about one-third of the years, while in post-dam years 1964-1999, annual peaks never exceeded 7,000 cfs (Pasternack and others, 2004). Median monthly flows for the geomorphically critical snowmelt month of May decreased on average by a factor of approximately six, from 3355 cfs before Pardee to 565 cfs after Camanche (flow records 1905–1929 and 1964–2003, respectively) (Escobar-Arias and Pasternack, 2011). Water storage in the reservoirs and maintenance of instream flows downstream of Camanche Dam throughout the year provide suitable habitat to support adult migration, spawning and egg incubation, juvenile rearing, and juvenile downstream migration by both fall-run Chinook salmon and steelhead.

Construction of Camanche provided Lodi, Woodbridge and surrounding areas with significant flood protection, particularly for floods of high recurrence intervals. Such 50- or 100-year events may occur only several times per century, yet they may alter habitat conditions perhaps almost as much as human habitations and infrastructure. Floods of moderate recurrence – the 5-, 10- and 20-year events that renew habitat, move and clean the large bed-material that ‘armors’ the channel, and promote fresh and renewed riparian vegetative growth – are disproportionately modulated and muted by Camanche, as they are by most mid-sized reservoirs. The dams provide some flood-protection benefits downstream during events of moderate recurrence, but to only a limited degree and at fairly specific locations. Such events also have little regulatory implications, and do not meaningfully affect flood-insurance premiums or availability. There may be 20 or 30 such events per century, a frequency which appreciably affects habitat and geomorphic configuration of the channel but which is lost due to the muted hydrograph created by dam effects. In summary, geomorphic conditions affecting natural values tend to benefit from control at the very highest of flows, those of the magnitude likely to induce massive flooding. The much more frequent lower-magnitude floods, though, have important geomorphic functions which can be provided without impairing conventional flood-protection benefits.

The term “bankfull” flow is defined as the flow that just fills a channel up to the bank tops (Williams, 1978), and begins spilling over onto the active geomorphic floodplain. It is widely thought that near-bankfull flow is needed to maintain and renew the geomorphic integrity of a channel. Hydrologic analysis has found that it is the natural flow rate that returns to a particular location in a stream at approximately a 1.5 to 2-year return interval (Knighton, 1998). Prior to Pardee Dam, the estimated 2-year flow was almost 9,000 cfs. Post-Pardee Dam, a 2-yr flow was reduced to about 3,400 cfs due to diversion and flow regulation. Camanche Dam further reduced the 2-year return flow to about 2,000 cfs. Statistically this means that the historic 9,000 cfs 2-year flow may now occur only once every 50 years (Edwards, 2004). Note that Camanche Dam cannot release more than 5,000 cfs through its facilities, so any amount above that goes over the emergency spillway that bypasses the Day Use Area. In the 49 years since Camanche came online, the maximum mean daily flow at the dam was only 5,750 cfs. Loss of sediment continuity in a watershed can create an effect termed ‘hungry water’ (c.f., Kondolf, 1997). This change in geomorphic functionality can result from gravel mining of floodplain alluvium and from discontinuities related to dams. All flows, regardless of how small, carry dissolved particles and suspended particles. As flows increase in volume, flows become capable of moving coarser sediment along the channel bed (i.e., bedload transport). If these coarser sediments are not present in transport or are greatly reduced in supply, channel banks, beds and floodplains become more prone to erosion. This hungry water effect can result in channel incision, bank widening, and bed armoring, particularly at, and downstream of, a dam. Channel incision and bed armoring have occurred below Camanche Dam, while bank widening has not occurred for two reasons that are discussed next.

First, significant flow reductions enabled vegetation to encroach into the active river corridor and stabilize the ground with its roots. Today, the channel is approximately 30 to 50 percent narrower than it was prior to construction of the dams (Edwards, 2004). Riparian vegetation found along both banks of the lower Mokelumne corridor provides some shading and large woody debris/cover habitat beneficial to juvenile salmonids and other fish, although not to the extent of years prior to dam building and introduction of levees and gradual expansion of fields into the vegetated margin along the riverbanks. Overstory species that are currently along the channel margin include cottonwoods, valley oaks, and black walnuts in mixed stands. Box elder, willow, alder and Oregon ash are also present in a second canopy layer. This transition from extensive riparian forests covering the floodplains to what could be termed as a sparse riparian corridor on an “inset floodplain” inside the levees, suggests a geomorphic adjustment of sorts to the post-dam bankfull flow regime. In other words, a markedly sparser riparian corridor exists close to the channel banks where possible, in many cases between the levee and the channel edge. These areas do provide important habitat areas for wildfowl and other species that currently inhabit the area.

Second, an extensive levee system was emplaced in the lower watershed. Over 60 percent of channel banks are leveed in the approximately 33 miles of the Lower Mokelumne River channel between Camanche Dam and its confluence with the Sacramento-San Joaquin Delta (Merz and Setka, 2004). Many fields are located on the historic floodplain, as these overbank areas were where finely sized sediments settled out from the water column as floods recede, creating very rich soils well suited to supporting riparian forests and myriad terrestrial species. Levees were built mostly to protect agricultural fields from flooding and have led to channelization of the river corridor. Levees confine flow to a narrower channel by design, tending to promote incision, so geomorphic functions including gravel deposition and bar formation, channel movement across the floodplain, and creation of side channels are no longer possible in leveed areas. Recently, the Three Rivers Levee Improvement Authority has implemented plans to create levee setbacks along the Feather, Yuba, and Bear Rivers to the north. Levee setbacks are designed to help regain lateral distance next to the channel to promote geomorphic function and increase high quality habitat area, while concurrently providing flood protection to the 200-year recurrence interval level (TRLIA, 2014)..

The conversion of topographically complex floodplains to level fields leads to woodland fragmentation and loss of continuity, complexity, and width of the vegetated corridor, generally due to tree removal during levee building or during plowing and planting of available acreage. Following such practices, there often remains only a narrow band of trees one canopy diameter wide in places where once the riparian forests were up to one-mile wide. Along the Mokelumne River, over 70 percent of forested floodplains have been cleared and over 80 percent of seasonal lakes have been converted to agricultural land use (Edwards, 2004).

Gravel mining in previous decades occurred adjacent to and in the river channel, resulting in a series of pits that in some cases remain connected to the river channel. These pits alter water quality, leading to warmer water, and act as sediment traps for what little sediment might be transported; they also provide habitat for predatory fish such as bass. Current gravel mining operations have moved away from the wetted channel, but still remain within the river's floodplain extent in areas where channel-related effects such as avulsion or meandering deposited gravels in those locations.

A riverine habitat characterization study was conducted on the lower Mokelumne River by Merz and Setka (2004). The study found that riffles (fast, shallow flow across gravels, high degrees of turbulence, higher slopes), which are associated with cobble- and gravel-bedded reaches and are necessary to salmonid species' reproductive success, comprise less than 1 percent of the total habitat; riffles constitute 10 percent to 25 percent of the length of many unregulated rivers. Gravels are found in limited quantities for up to about 10 miles downstream of Camanche Dam—mostly in the rehabilitated reaches where gravel augmentation by EBMUD over the past decade has taken place or where gravels have been transported during high flow events. This 10 mile reach corresponds with the highest river gradient below Camanche Dam. The channel bed becomes sand-dominated at Elliot Road located about 10 miles downstream of Camanche Dam, then transitions to mud-dominated downstream to Woodbridge Dam. In the lowest reaches, the channel bed is muddy-sand and aquatic-plant dominated. Glide habitat (moderately shallow water, smooth surface, low velocity) comprised over 95 percent of the wetted channel habitat within the lower Mokelumne River. These geomorphic variations in channel bed substrate influence the array of possible aquatic functions.

There is one impoundment facility below Camanche Dam. Woodbridge Dam is an adjustable weir dam that provides the Woodbridge Irrigation District with a small reservoir about 470 acres in size. The facility has a fish ladder and fish observation facilities used by EBMUD to monitor upstream fish passage. In addition, there is a bypass pipeline that conveys fish moving downstream from the fish screen at Woodbridge Irrigation Canal. A smolt trap is located at the end of the bypass pipeline and captures fish migrating downstream when the trap door is in place.

2.5 Aquatic Habitat Conditions

The Mokelumne River supports a diverse assemblage of resident and migratory fish species. Resident rainbow trout and other native fish inhabit the upper basin watershed. Impoundments, including Camanche and Pardee reservoirs, provide habitat for a number of native and introduced fish species, including largemouth bass that support recreational fisheries. The Mokelumne River downstream of Camanche Dam supports a diverse assemblage of resident and migratory fish species including fall-run Chinook salmon and steelhead, which prior to construction of the river's dams continued where they spawned upstream in the upper watershed. Historically, aquatic habitat conditions within the Mokelumne River watershed have been influenced by a number of factors including, but not limited to the following.

- Mining activity following the discovery of gold in 1848 and copper in 1861 resulted in the disposal of mining waste and tailing piles, which generated lethal heavy metal concentrations and associated fish kills in the Mokelumne River. In addition to gold and copper mining, sand and gravel mining also adversely affected habitat conditions for spawning and juvenile rearing by Chinook salmon and other fish species.
- Winery and cannery operations historically degraded water quality due to the discharge of organic waste into the lower Mokelumne River. The discharge of organic waste into the river resulted in increased biological oxygen demand and associated depressed levels of dissolved oxygen, which created stressful or unsuitable habitat conditions for fish and other aquatic resources. In recent years, no releases of winery or cannery waste to the river have been reported.
- Dams and water diversions have resulted in changes to the quantity and seasonal timing of instream flows occurring within various portions of the watershed. These changes have included water storage and releases associated with hydroelectric power generation, historic water diversions associated with mining activity, and water storage and diversions for municipal, industrial, and agricultural uses. Construction of Pardee and Camanche dams created impassable barriers to upstream migration by anadromous fish species including Chinook salmon and steelhead. Reservoir releases and water diversions largely regulate instream flows currently supporting fishery habitat within the Mokelumne River system.
- Levee construction has resulted in changes to the hydraulic and geomorphic characteristics of the Mokelumne River watershed by constraining the river channel, in many areas reducing riparian vegetation, and restricting or eliminating seasonally inundated floodplain habitat within the lower portions of the Mokelumne River.

Reservoir storage operations, in addition to levee construction, have altered many of the dynamic processes and degraded the quantity and quality of habitat for fish and other aquatic resources.

- Land-use changes within the Mokelumne River watershed, particularly adjacent to the lower reaches of the river, have resulted in changes to the native riparian vegetation, which in many areas has been replaced by agricultural operations, sediment and erosion, reductions in instream habitat diversity and complexity through channelization, levee construction, and reclamation, as well as point and nonpoint discharges from urban and agricultural areas.
- As part of fishery mitigation for the loss of spawning and juvenile rearing habitat associated with construction of Camanche Dam, the Mokelumne River Fish Hatchery was constructed in 1964 by EBMUD and is operated by the California Department of Fish and Wildlife (CDFW). Production of fall-run Chinook salmon and steelhead within the Mokelumne River hatchery has altered the dynamics of salmonid populations inhabiting the lower reaches of the Mokelumne River.

Other factors have also influenced the population dynamics and habitat conditions within the Mokelumne River watershed, including recreational angling, illegal harvest, and the introduction of a number of non-native fish and other aquatic species including striped bass and largemouth bass.

Instream flows within the lower Mokelumne River are a key element in determining the quality and availability of suitable habitat for salmon and steelhead spawning and juvenile rearing, as well as habitat for other resident and migratory fish and aquatic species. In 1961, EBMUD entered into an agreement with CDFW regarding releases of water from Camanche Reservoir storage to support fishery habitat within the lower river. The 1961 agreement required reservoir releases for minimum instream flows totaling 13,000 AFY. The 1961 agreement was subsequently superseded in 1998 by the Joint Settlement Agreement (JSA), which included an increase in minimum instream flows, a more comprehensive linkage between water allocations for fishery habitat and hydrologic conditions within the Mokelumne River watershed, cold-water pool and temperature management, and funding for habitat restoration and maintenance activities within the lower watershed. The JSA, which has become a part of the State Water Resources Control Board (SWRCB) water right permits as well as the Federal Energy Regulatory Commission (FERC) license for EBMUD operations, includes provisions for seasonal management of instream flow releases within the lower Mokelumne River for salmonid adult migration, spawning and egg incubation, juvenile rearing, and juvenile downstream migration. While the 1961 minimum instream flow agreement provided an allocation of 13,000 AFY, the JSA provides minimum water allocations ranging from 22,500 acre-feet (AF) in critically dry years up to 165,900 AF in wet years depending on water storage levels in Pardee and Camanche reservoirs. The JSA includes provisions for seasonal releases from Camanche Reservoir with the greatest releases occurring during the late fall, winter, and early spring months associated with salmonid spawning, egg incubation, and juvenile rearing, although baseflows are provided year round to support fishery habitat, as well as minimum instream flows required downstream of the Woodbridge Irrigation District (WID) dam.

Under the JSA water allocations and instream flow schedules during the period from October through March are determined based on the combined storage of water in Camanche and Pardee reservoirs on November 5, while water allocations and instream flows during the period from April through September are based on estimates of unimpaired runoff into Pardee Reservoir. The JSA offers opportunities to adaptively manage instream flows and in recent years, reductions in early spring baseflows have been used to accumulate water in storage which has then been released during the fall to provide attraction flows (pulse flows) for upstream migrating adult fall-run Chinook salmon. For example, instream flows during the early spring of 2013 were adaptively managed to accumulate approximately 4,200 AF of water that was stored in the reservoirs for adult salmon attraction pulse flows during the fall (October-early November) 2013. The 2013 pulse flow operations were further enhanced through coordinated operation of the WID dam to surcharge Lake Lodi from upstream releases and then rapidly release the water downstream to increase the magnitude of the pulse flows in the lower river. Periodic closure of the Delta Cross Channel gates during the fall appears to further benefit attraction of adult Chinook salmon into the Mokelumne River. Results of preliminary results of adult salmon monitoring in the river at the WID fish ladders suggests that adult salmon responded to the pulse flows and migrated upstream into the river.

The JSA also includes specific provisions for ramping rates as flows are reduced in magnitude from one level to another as well as provisions for gain sharing in which a portion of water developed through various projects within the watershed that would benefit EBMUD water supplies and reliability would be allocated to enhanced instream flows to support fishery habitat.

The JSA also includes provisions for non-flow actions such as cold-water pool management in Camanche Reservoir, including a goal to maintain a minimum hypolimnion volume of 28,000 AF during the summer and fall in combination with modified release operations from Camanche Reservoir to maintain suitable water temperatures for salmonids downstream of the dam throughout the year. The JSA includes provisions for operation of the Camanche Reservoir hypolimnetic oxygenation system to improve water quality within the reservoir (reduce hydrogen sulfide and increase dissolved oxygen concentrations) subsequently released to the Mokelumne River Fish Hatchery and lower river. The JSA also includes provisions for enhancing riparian vegetation, spawning gravel augmentation and habitat enhancement for salmonid spawning and juvenile rearing, fish passage enhancement in collaboration with WID construction and operation of a new dam and fish ladder complex, modifications to Mokelumne River Fish Hatchery operations such as brood stock selection and other genetic management activities and juvenile release strategies. The JSA also includes provisions for EBMUD monitoring of fishery resources, such as adult Chinook salmon and steelhead spawning escapement, redd construction, and juvenile outmigration, as well as habitat monitoring, maintenance, and enhancement.

3. Interactions between Flow, Sediment and Existing Geomorphic Conditions

It cannot be emphasized enough that on the Mokelumne River, all of the dams and reservoirs in the upper and lower watershed create sediment and flow discontinuities within the channel network. The large dams and reservoir systems of Pardee and Camanche Dams diminish flow and sediment between the upper and lower watershed. The watershed issues that arise from the discontinuity of sediments and water are fundamentally linked to the overall geomorphic health of the river-hillslope-floodplain ecosystem.

Since coarse sediment cannot move from the upper to the lower watershed, one of the most important natural "tools" used by the river for geomorphic work is fundamentally lost. In the upper watershed, sediments are captured in reservoirs, while at other locations concentrated flows may increase erosion and add sediment to the system. At the transition from upper to lower watershed, Pardee and Camanche Dams block larger sediments such as sands, gravels and cobbles from transporting downstream. These sediments therefore are not available to perform work within the lower watershed river-floodplain environment. Levees and other structural elements such as bridges and bank protection limit the ability of any available sediment that do move to fan out across the floodplain, potentially leading to channel incision instead. The sediment linkage that most strongly remains is that of suspended fine silts and clays that are still able to transport through the system, but those may affect water quality issues such as elevated nutrient transport and turbidity. The organic component of river load also fundamentally changes at the break between the upper and lower watershed, with loss of large wood and organic materials components of sediment transport. The continuity of organic materials that lend complexity to riverine conditions and habitat values is therefore truncated in a similar manner to that of inorganic sediment.

Water diversions for hydropower generation in the upper watershed leave some channel reaches with a water deficit and others with a surging-water effect. In channels with low flows due to diversion, sediment derived from hillslopes may not be moved, while in areas with concentrated flows, additional erosion may occur. Storage at the mid-watershed dams dampens variability in the flow hydrograph for the lower watershed year after year, leading to very different flow availabilities between the upper and lower basin, regardless of required flow schedules. Below the dams, the former bankfull flow is no longer achievable, so little geomorphic work is being performed in the channel. Levees and other structures do not allow what flows remain to move onto the floodplains. Suspended sediment particles move west into the Delta with flows, but also settle out and fill channel bed spaces in the gravel-bedded areas, creating potential problems for fish and other aquatic species by filling interstitial spaces between larger sediments. This process is damaging to spawning habitat and can smother salmon redds. Bankfull flows and larger flood flows—which now rarely occur in the lower watershed due to regulated flows—normally move fine particles onto the floodplains and replenish the rich soils found there; this process occurs much too infrequently to keep up with soil losses in the agricultural fields now located on floodplain areas.

4. Interactions between Flow, Geomorphic Function and Ecological Needs

The level of geomorphic function available to a river ecosystem directly affects the ability of the system to provide the services needed for healthy aquatic and riparian communities. The cumulative effects of a long series of human activities can be damaging, and leave little room for additional loss of function. Euphrat's (1992) work makes the point that new and potentially more severe effects act upon the tributaries of the Mokelumne as the level of disturbance increases. In other words, above certain thresholds, geomorphic and hydrologic effects can be more damaging and the damage can be more persistent. Mokelumne River collaborative members may wish to seek alternatives that do not exceed these thresholds. Euphrat's work was focused on upper watershed timber harvests, but the notion that loss of function increases exponentially with disturbance beyond certain thresholds can be extended to other changes throughout a river network. Some of these thresholds are self-evident. As one example, total interception of sediment transport can be more damaging than partial interception, and a longer period of time in which sediments are truncated produces greater effects—an example relevant to the Mokelumne River watershed. As the MokeWISE process moves forward, it will be important to avoid alternatives that induce proportionately greater loss of channel stability or other geomorphic functions.

Changes in geomorphic function can lead to loss of habitat or populations of fish or amphibians. The lower Mokelumne River supports more than 35 fish species, including five anadromous species: fall-run Chinook salmon, winter steelhead trout, American shad, striped bass and Pacific lamprey (Merz, 2004). Wild (in-river spawning salmon) Chinook salmon comprise a relatively small percentage of the fall-run population, with hatchery stock greatly enhancing natural spawning numbers produced in the rehabilitated channel directly below Camanche Dam (Johnson and others, 2012; Stephens, 2012). Prior to construction of Pardee and Camanche Dams, spawning areas accommodated approximately 40,000 adults at 400 cfs (CDFG, 1955). By the time Camanche Dam was built, about 85 percent of spring-run Chinook salmon and steelhead habitat was lost to both species. Post-Camanche Dam (1964-2012), Chinook salmon runs have averaged approximately 5,000 spawners (CDFW, 2013). USFWS (1997) called for a lower Mokelumne River fall-run Chinook salmon population target of 9,300. Average annual lower Mokelumne River salmon escapement has been monitored by video at Woodbridge Dam from1990-2013. Chinook escapement averages 6,839 (minimum 410; maximum 18,596). The Anadromous Fish Restoration Program doubling period average for the Mokelumne River is 8,372 salmon. Steelhead trout populations are quite low compared to Chinook, with an escapement of less than 100 in the early 2000's (Workman, 2003). Most anadromous spawning occurs in the 10 miles of channel between Camanche and Elliott Road.

It may be that more instream capability is expected in the lower Mokelumne River because it now serves as spawning, emergence, rearing and sheltering habitat for aquatic species. Prior to dam construction, much of the lower river could be seasonally dry, and was mainly used as a migration corridor, with salmon and steelhead, for instance, spawning further into the watershed network at higher elevations. A voluntary collaborative effort led by the Foothill Conservancy is considering the feasibility of restoring fall run Chinook salmon to the Mokelumne River above Pardee and Camanche Dams.

Through the 1990s and early 2000s, a consensus emerged that instream habitat rehabilitation is required to stave off further salmonid population declines and eventually recover self-sustaining wild populations. FERC (1993) ranked the various factors limiting the production of salmonids in the lower Mokelumne River and concluded that spawning habitat quality and quantity were the second most important factors. Examples of the numerous policy documents from that era stating that habitat is degraded and prioritizing spawning habitat rehabilitation as an important goal include Flosi and others (1995), USFWS (2001), DWR (1994), and CMARP (1999). The creation of spawning habitat below Camanche Dam was encouraged by FERC as a non-flow alternative to habitat improvement thorough addition of clean, river-run sediments of the sizes used for spawning.

In response to this consensus, spawning habitat rehabilitation was undertaken and continues today. In the earliest phase, riffle enhancement for improved spawning was instituted by EBMUD and others in 1990 and guided by on-site field biologists (Pasternack and others, 2004). In 2001, CALFED sponsored a three-year demonstration project to use the lower Mokelumne River as a testbed for a new framework for geomorphically guided river rehabilitation that would not only enhance spawning habitat in the short-term, but also restore key geomorphic processes that aid a river in self-sustaining its ecological functionality. That framework is now known as the Spawning Habitat Integrated Rehabilitation Approach (SHIRA). What sets SHIRA apart from pre-existing schemes is that it integrates widely accepted concepts from hydrology, civil engineering, aquatic biology, riparian ecology, and geomorphology to design alternative river configurations for a degraded section of river and then uses predictive computer models to evaluate the relative performance of the different configurations in their specific details before implementing a final design, thereby avoiding costly mistakes (Wheaton and others, 2004, a,b). Extensive information about the use of SHIRA on the lower Mokelumne River is available online at http://shira.lawr.ucdavis.edu/mokelumne.htm. A gravel augmentation program remains in effect as of 2013 in the 1 kilometer river reach adjacent to the Mokelumne Day Use Area just below Camanche Dam.

As part of the carefully designed and monitored river rehabilitation, approximately 54,000 metric tons (2,204 pounds per ton) of spawning-sized gravel and cobble were added to the channel from 1999 to 2012. The spawning gravel enhancement projects have included placement of suitable sized clean rounded gravel in addition to boulders and large woody debris to enhance areas for Chinook salmon and steelhead spawning, egg incubation, and juvenile rearing in the river in the reach adjacent to the day use area downstream of Comanche Dam. It is anticipated that additional gravel will continue to be added to the river in the future as part of habitat maintenance of spawning areas downstream of Comanche Dam. Gravel additions were sculpted by front loaders in the channel (Sawyer and others, 2009) according to grading plans designed through empirical analysis and computer simulations of project alternatives. Key immediate river enhancements included a steeper longitudinal profile, improved relief between naturalized riffles and pools, significant reduction in gravel armoring, improved connectivity between the channel and floodplain, habitat heterogeneity and hydraulic structures composed of boulders and/or streamwood, two side channels for rearing habitat, and available sediment supply to transport downstream (e.g., Wheaton and others, 2004c; Elkins and others, 2007; Wheaton and others, 2009). Over time, the river has experienced secondary positive responses, such as re-activation of bank scour to widen the channel, more frequent floodplain inundation, development of persistent freshwater wetlands, increased snag and streamwood production, and migration of sediment downstream. After a 5,000 cfs flood in 2005, a rehabilitated riffle on the river was observed to increase high-quality spawning habitat due to redistribution of placed sediment that occurred as predicted (Wheaton and others, 2009).

Despite these successes, the profound loss of appropriate riverbed substrate and instream large wood structure as well as long-term degradation of channel bed features means that the need for more patches of channel suitable for fish spawning, rearing and migration may remain. Regulatory and stakeholder groups may agree at some further time that maintenance of existing habitat will be sufficient. Gravel augmentation is but one component of rehabilitation steps that are needed to provide the suite of functions necessary to maintain geomorphic and ecologic integrity of the channel below Camanche Dam, and none of these components will truly bring back historic conditions. For example, Senter and Pasternack (2011) showed that large wood plays an important role in the geomorphic structure of landforms in the Lower Mokelumne River and also aids Chinook salmon spawning where habitat is otherwise insufficient. Likewise, Elkins and others (2007) showed that slope creation was an important component to increasing the downstream limit of suitable spawning rehabilitation habitat; at some point the low gradients in the lower

Mokelumne may preclude extending rehabilitation achievements further downstream.

Nevertheless, some mitigation and local increases in resilience may be achievable. To explore interactions between hydrologically-driven geomorphic functions and ecological need conditions of salmonid spawning reaches on the Mokelumne River pre- and post-gravel augmentation, a functional flows model was developed to assess how rejuvenation of ecological conditions is linked to sediment transport regimes (Escobar-Arias and Pasternack, 2010). Functional flows are defined as discharge values that provide enough shear stress to mobilize bed sediments, leading to geomorphic changes in bed morphology that serve ecological purposes.

Input variables included discharge, slope, median grain size, a depth parameter, and shear stress, along with topographic data for the channel reaches being studied. To calibrate the model and to provide relevance to current environmental needs, physical habitat requirements needed by fall-run Chinook salmon spawners were used (other biological species or lifestages could be used in place of Chinook spawning needs). Requirements for spawning Chinook include (1) the need for flows that mobilize sediments and revitalize the channel bed prior to spawning activities; and (2) flows that enhance egg-nest preparation, survival rates of incubating salmon eggs, and support the emergence of salmon fry.

Physical processes driven by discharge and necessary for spawning salmon include bed-renovation periods where (1) the channel bed is fully mobilized, (2) interstitial fines are mobilized, and (3) superficial fines are mobilized (Escobar-Arias and Pasternack, 2011). Each type of mobility plays a role in the ecological health of the system. Model results showed that gravel augmentation increased the number of days in which existing flows performed functional work, but that the range in flows was small. The study concluded that the next step in increasing ecological functionality below Camanche Dam would be to provide a greater range in flows. However, a known limitation is that due to flood risk, operations are currently designed to prevent flows above 5,000 cfs and to minimize flows greater than 3,000 cfs when possible, thus narrowing the ability for additional changes to functional flows without additional changes to dam operations.

5. High Priority Focal Species

Within the Mokelumne River watershed, three fish species receive the highest priority attention. Within the watershed upstream of Pardee Reservoir, resident rainbow trout have been identified as the priority species. Rainbow trout support recreational angling and serve as an indicator of overall habitat conditions for the resident fish community inhabiting the upper portions of the Mokelumne River watershed. Foothill Yellow-Legged Frogs in the North Fork above Tiger Creek After Bay are also a species of special concern and frogs require more specific management than trout. Much of the current emphasis on species management in the upper watershed has focused attention of Yellow-Legged Frogs and resident rainbow trout. Currently there is interest among a collaborative group of watershed stakeholders including, but not limited to the Foothill Conservancy, Trout Unlimited, California Sportfishing Protection Alliance, EBMUD, CDFW, USFWS, NMFS and others to explore opportunities for relocating fall-run Chinook salmon into the upper watershed above Pardee Reservoir. Early consideration in the process for assessing opportunities include defining the goals and objectives of relocation (e.g., simply moving some Chinook salmon into the upper watershed, re-establishing a self-sustaining population, etc.), determining habitat suitability and potential barriers or impediments to fish movement, and other elements of the initial planning process. A key consideration is to avoid potential impacts to maintaining the existing fall-run Chinook salmon population inhabiting the lower river and meeting the JSA fishery management goals and objectives. The planning and feasibility discussions regarding relocation of fall-run Chinook salmon into the upper watershed are in the early stages of development.

Downstream of Camanche Reservoir the two priority fish species that receive the greatest attention are fall-run Chinook salmon and anadromous steelhead. Fall-run Chinook salmon support an important commercial and recreational fishery. Anadromous steelhead are a native fish species currently listed as threatened under the federal Endangered Species Act (ESA) by the National Marine Fisheries Service (NMFS) and a species of special concern by the CDFW. Both Chinook salmon and steelhead serve as important indicators of the quality and availability of fishery habitat within the lower Mokelumne River. It has generally been assumed by regulators and resource managers that if habitat conditions support healthy and robust populations of resident rainbow trout, fall-run Chinook salmon, and anadromous steelhead, the watershed is assumed to be properly functioning and would provide habitat conditions that would maintain a diverse fishery community in good condition.

6. Environmental Water Needs

Instream flows and associated water quality conditions, including seasonal water temperatures and dissolved oxygen concentrations, are a key element in determining the quality and quantity of suitable habitat available for resident and migratory fish species. Instream flows that support various physical processes and meet the habitat requirements for various lifestages of fish typically follow a natural seasonal hydrologic pattern with the greatest instream flows occurring during the late winter and spring months, lower but stable flows during the summer and early fall months, and periodic increases in pulse flows during the fall months and early winter associated with precipitation and stormwater runoff. Fish species inhabiting the Mokelumne River watershed have evolved and adapted to these seasonal patterns as well as inter- and intra-annual variation in flows and water quality conditions under natural unimpaired hydrologic conditions as reflected by variation in habitat requirements by lifestage. The most effective instream flow schedule is based on a consideration of seasonal patterns in hydrologic conditions, seasonal water temperatures, dissolved oxygen concentrations, periodic flushing flows that scour fine silts and sediments from spawning gravel as well as provide bedload transport for gravel recruitment into areas that serve as spawning and juvenile rearing habitat. Currently the JSA establishes a framework on the lower Mokelumne River for allocating water storage and instream flow releases. The JSA flows were developed based on consideration of the relationship between instream flow and habitat quality and availability for various lifestages of salmonids, The JSA flows were also based on consideration of maintaining cold water pool reserves that help achieve suitable water temperature conditions that vary depending on seasonal time periods, habitat requirements for various lifestages, and water supply availability within Camanche and Pardee reservoirs. Instream flow schedules have also been established for storage and release from hydroelectric generation facilities located in the upper portions of the Mokelumne River watershed, with minimum streamflow based on month and water year type, and approximately mimicking the annual natural hydrograph in terms of magnitude, times and duration (FERC, 2000; FERC, 2001). Instream flow schedules to support habitat for resident and migratory fish species in both the upper and lower portions of the Mokelumne River system are required as provisions of SWRCB water right permits and FERC licenses.

7. Geomorphic and fisheries related opportunities, challenges and trade-offs

The following sections provide an overview of geomorphic- and fishery-related opportunities, challenges, and trade-offs associated with water resources management in the Mokelumne River basin.

7.1 Geomorphic Opportunities and Challenges

Opportunity G1: In the upper watershed, the timing of hydropower generation could potentially be changed such that large flow pulses do not dominate flow dynamics. These could potentially be achieved via adaptive management decisions as discovered during the 30-year licensing agreement and the attendant monitoring program.

Challenge G1: In the upper watershed, flows are rerouted to support hydropower capabilities. However, the need for hydropower generation will remain, so a return to more natural flow dynamics will be difficult to achieve. Adjustments to flow pulses has been achieved as stipulated out in the FERC relicensing agreement for PG&E's upper watershed Mokelumne River project 137; additional changes may or may not be achievable given current conditions.

Opportunity G2: Below Camanche Dam, (a) an increase in sediment supply, (b) a return to a flow regime that mobilizes the bed and banks at frequencies similar to or approaching

those which prevailed historically, and (c) additional (re)connection of the river with its historic floodplain are three of the most important management actions that could help reinstitute sustainable geomorphic functions and ecosystem health.
Challenge G2: Camanche and Pardee Dams and flow regulation are not going away, so lower watershed flows should be managed to achieve essential geomorphic functions that aid self-sustainability to the extent possible (e.g., Richter and Thomas, 2007). In addition, flows must be managed to minimize potential downstream flooding impacts.

Opportunity G3: Peak flows could be increased during yearly flood events so that significant geomorphic work might be accomplished during those windows of opportunity. This principle is in line with the concept of environmental and functional flows needed to maintain healthy aquatic ecosystems. The potential to increase the variability of flow timing or rates during wet years may be achievable through such means as operating the dam at higher levels earlier in the season, allowing larger flood flows to pass-through more than occurs now, and conscious management of the duration, timing and magnitude of flood flows to meet specific geomorphic and biological thresholds,
Challenge G3: Management of flood control releases to meet geomorphic and biological thresholds adds to the complexity of dam operations. Flood control releases must be managed to minimize potential downstream flooding impact. In addition, potential future conditions hinge in part on how water is managed within the system from this point forward. A major unknown is climate change, which may determine future conditions. Climate change models generally predict an increase in air temperatures across the Sierra Nevada (Null and others, 2012). These changes could alter precipitation patterns (i.e., more rain, less snow), both of which could dramatically affect snowpack and runoff patterns. While much remains unknown about future conditions, preparation for episodic-event scenarios such as flood conditions, landsliding, fire, or drought will be important management components in future years.

Opportunity G3A: Implement a spring flow requirement that requires release of a percent of unimpaired flow downstream of Camanche Dam; this approach could replace or be overlaid on the JSA flows, in a defined subset of years or in all water years. This would increase the variability of flows downstream of Camanche and potentially increase the frequency of flows that do geomorphic work. Replicating natural rates of recession could also improve the settling and sorting of sediment in the river channel.

Challenge G3A: Water supply impacts and operational complexity. Physical constraints and limitations of facilities and stream channel.

Opportunity G3B: The potential to increase groundwater recharge to supplement irrigation in subsequent years may be achievable by physical improvements in the available wetted area and by dovetailing geomorphic actions with area diversions further downstream to groundwater recharge areas and facilities.
Challenge G3B: Physical manipulation of the stream channel and its floodplain has land ownership constraints, may create local flooding concerns, and may require substantial financial investment, Groundwater recharge areas and facilities must be sufficiently sized and efficient to allow diversion of water when it is available; many geomorphic functions require flow much higher than the diversion capacity of groundwater facilities likely to be constructed.

Opportunity G4: Whereas channel configuration and microrelief in other regulated rivers in the region such as the lower Stanislaus, American, Yuba, and Feather Rivers have now been comprehensively mapped, the lower Mokelumne River has not been mapped (e.g. Lower Yuba River Accord, River Management Team documents, www.yubaaccordrmt.com). A detailed topographic map of the river is an important geomorphic foundation to many analyses and engineering opportunities.
Challenge G4: Funding for additional projects can be difficult to achieve.

7.2 Fishery Opportunities and Challenges

There has been substantial improvement in habitat quality and availability for fishery populations inhabiting the lower Mokelumne River. Many of the early sources of habitat degradation, such as runoff from mine tailings, discharge of organic material resulting in depressed dissolved oxygen concentrations, loss of spawning gravels as a result of sand and gravel mining activity, and others have been largely addressed and resolved over the past 50 years. The 1998 JSA (with voluntary operations and instream flows according to the JSA schedule implemented since 1996), as well as additional habitat improvements such as spawning gravel augmentation downstream of Camanche Dam, have resulted in improvements in habitat conditions for salmonids and other fish species as reflected in an increasing trend in abundance of fall-run Chinook salmon originating from the Mokelumne River. A process is now underway whose goal is to reintroduce fall run salmon to the upper watershed. Building on the foundation provided by the JSA, additional opportunities and constraints for further enhancing fishery habitat conditions have been identified, many of which reflect greater reliability in meeting habitat needs under all hydrologic conditions, which include, but are not limited to, the following.

Opportunity F1: Modify flood control management and operations to increase water storage and support ecological processes without undue risk of flood damage.
Challenge F1: Modifying existing Army Corps of Engineers flood control management rules in a way that does not increase the risk of flooding and damage downstream of the dams. For actions at reservoir levels below the Corps' rule curve, risk of water costs. Flood liability and the risk of property damage are major concerns.s.

Opportunity F2: Modify channel margins to reduce the risk of flood damage and increase access to seasonally inundated floodplain habitat.
Challenge F2: Challenges include limited funding, limited access to private property along the river channel, durability of physical improvements, and existing infrastructure constraints.

Opportunity F3: Manage Camanche and Pardee Reservoirs in a manner that optimizes for water temperature in the lower rivers and needed to provide suitable habitat for salmonids.
Challenge F3: Challenges include reservoir storage management to meet a variety of beneficial uses in combination with periods of drought and low reservoir inflows.

Opportunity F4: Close the Delta Cross Channel throughout the period October 1 to November 15 in all years. Closure of the Delta Cross Channel in the fall offers benefits to reducing straying and enhancing returns of adult fall-run Chinook salmon to the Mokelumne River.
Challenge F4: Closure of the Delta Cross Channel may contribute to degraded water quality (e.g., increased water quality concerns such as electrical conductivity in the central and south Delta). Several efforts are currently underway to find ways to balance these competing fishery and water quality goals including (1) exploration of the potential application of an electrical barrier to help guide adult salmon from migrating upstream into the Delta Cross Channel and providing benefits to increased adult returns to the Mokelumne River, and (2) exploration of opportunities for partial opening of the Delta Cross Channel

gates during the fall (e.g., closing the gates during the night for fishery benefits and opening the gates during the daytime for water quality benefits, opening the gates partially to allow water to pass under the gates into the central Delta while guiding downstream migrating juvenile Chinook salmon downstream in the Sacramento River, etc.). Testing has been conducted in recent years, and additional gate operational testing is anticipated in early 2014, to evaluate some of these alternative operational strategies for meeting both fishery and water quality goals

Opportunity F4A: Make flow releases from Camanche Dam and operate the Mokelumne River Hatchery in coordination with the operation of the Cross Channel Gates and Delta exports, with the goal of improving outmigration success of Mokelumne River salmon and steelhead.
Challenge F4A: Open Cross Channel Gates in spring could improve outmigration success of Mokelumne fish, but spring export operations of the CVP and SWP exports in the spring entrain juvenile salmon and steelhead from the Mokelumne, changing a potential benefit into a severe impact. Export operations also diminish the benefit of spring flow increases and pulses in the Mokelumne River.

Opportunity F5: Continue to meet the minimum JSA instream flow requirements in all years.
Challenge F5: Challenges include predicting runoff and reservoir storage, managing reservoir releases to meet multiple beneficial uses, and low flow levels for Camanche Reservoir releases and flows downstream of WID dam under dry and critically dry JSA conditions.

Opportunity F5A: Implement a spring flow requirement that requires release of a percent of unimpaired flow downstream of Camanche Dam; this approach could replace or be overlaid on the JSA flows, in a defined subset of years or in all water years. This would increase the variability of flows downstream of Camanche and provide natural biological cues.
Challenge F5A: Water supply impacts and operational complexity. Physical constraints and limitations of facilities and stream channel.

Opportunity F6: Maintain spawning gravel supplies through gravel augmentation (annual average estimated augmentation of 600-1,200 cubic yards of suitable gravel). Spawning

gravel augmentation has been shown to benefit fall-run Chinook salmon spawning in the lower river. It is expected that in the future additional gravel will be added to the river in the reach immediately downstream of Camanche Dam to maintain suitable spawning habitat. In addition, habitat enhancement projects have been conducted to provide access to shallow water lower velocity side channel habitat immediately downstream of the dam to benefit juvenile salmonids rearing and provide velocity refugia during periods of high spring flows when salmon and steelhead fry and juveniles are rearing within the river.
Challenge F6: Challenges include securing funding through AFRP to assist in gravel purchase and placement, and identifying local sources of gravel of suitable size for spawning.

Opportunity F7: Increase availability of seasonally inundated floodplain habitat for juvenile salmon rearing.
Challenge F7: Challenges include limited funding and limits to the locations where topography and proximity to the river are suitable for improving access to seasonally inundated floodplain habitat for juvenile rearing.

Opportunity F8: Increase availability of lower velocity side channel habitat.
Challenge F8: Challenges include limited funding and limits to the locations where topography and proximity to the river are suitable for developing side channel habitat for juvenile rearing. Durability of physical improvements during high flow events is also a concern.

Opportunity F9: Implement habitat restoration and conservation actions along the lower river channel to protect and enhance riparian vegetation, reduce erosion, and reduce disturbance to channel banks and adjacent areas.
Challenge F9: Challenges include limited access to private property along the river channel for restoration actions and existing land use.

Opportunity F10: Encourage installation of state-of-the-art positive barrier fish screens on all water diversions from the river.
Challenge F10: Challenges include a lack of funding for fish screen installation and maintenance, concerns by private property owners regarding the cost and maintenance of fish screens, and the lack of authority to require fish screen installation and operation.

Opportunity F11: Optimize operations with a goal to maintain water temperatures in the reach from the Camanche Dam to Elliott Road at less than 56 F (13.3 C) from November 15 through March 15 for Chinook salmon and steelhead egg incubation.
Challenge F11: Challenges include managing cold water pool volume and releases from the dams, and exposure of the river to elevated seasonal air temperatures that increase water temperatures as a function of distance downstream of the dam.

Opportunity F12: Optimize operations with a goal to maintain water temperatures in the reach from the Camanche Dam to Elliott Road at less than 64 F (18 C) from March 15 through October 31 for juvenile salmon and steelhead rearing and migration.
Challenge F12: Challenges include managing cold water pool volume and releases from the dams, and exposure of the river to elevated seasonal air temperatures that increase water temperatures as a function of distance downstream of the dam.

Opportunity F13: Avoid flow fluctuations (reductions) during the period from November 15 through March 31 that would result in redd dewatering.
Challenge F13: Challenges include managing fall pulse flow releases in October and early November that provide short duration attraction pulses but avoid dewatering redds if surveys determine spawning has begun.

Opportunity F14: Continue to manage instream flows using existing approved ramping rates in all years, except during flood releases and in case of emergency, to reduce the risk of fish stranding.
Challenge F14: Rapid ramping rates during flow increases and decreases associated with fall adult salmon pulse attraction flows, as implemented in 2012 and 2013, occur at a time of year when the risk of juvenile standing is low. Given limited water supplies, the benefits of multiple short-duration pulse releases is considered to be substantially greater than the risk of stranding during the fall

Opportunity F15: Provide water to support several fall pulse flow events during October for adult Chinook salmon attraction and upstream migration; coordinate fall pulse releases with Woodbridge Dam operations and releases from Lodi Lake.
Challenge F15: Challenges include implementing adaptive management operations to

accumulate water supplies to support fall pulse flows. Water supplies for fall pulse flows have been made available through adaptive management of Camanche Reservoir releases in the late winter and early spring but require approval by JSA participating agencies and the State Water Resources Control Board for implementation.

Opportunity F16: Reduce predation mortality on juvenile salmonids through management actions such as harvest, relocation, and/or habitat modifications. Striped bass have been identified as a major predator inhabiting the river downstream of the WID dam that prey of juvenile salmon during the spring downstream migration period. In addition, results of juvenile salmon survival studies have shown substantial losses in the reach upstream of the WID dam that are likely to be associated with predation in Lake Lodi by species such as largemouth bass.
Challenge F16: Challenges include rapid recolonization of areas of the river where predatory fish have been removed, cost and labor required for ongoing predator capture and relocation, uncertainty regarding the overall effectiveness of predator management actions in improving juvenile salmonid survival, and public and agency concerns regarding mortality and disposition of predatory fish collected as part of a predator removal effort.

Opportunity F17: Operate the hypolimnetic oxygenation system to maintain dissolved oxygen concentrations in Camanche Reservoir hypolimnion greater than 2 mg/L at CAMC from May to November in all years. The oxygenation system has proven to work reliability and be effective in reducing hydrosulfide and increasing dissolved oxygen concentration is water released from Camanche Reservoir to the hatchery and lower river.
Challenge F17: Challenges include the costs of operation and maintenance of the system.

Opportunity F18: Continue to manage and operate the Mokelumne River Fish Hatchery to produce Mokelumne River origin Chinook salmon and steelhead and manage releases to improve juvenile survival while reducing adult straying. Manage the hatchery to maintain genetic diversity of the stocks and reduce and avoid impacts to salmonids spawning and rearing in the river.
Challenge F18: Challenges include brood stock selection and other hatchery management actions that provide genetic diversity and produce healthy salmonids. Additional challenges include identifying suitable release sites that improve juvenile survival, reduce adult straying, and are compatible with river flows, water temperatures, and other

environmental conditions. The hatchery operations are currently undergoing a major review and recommendation for modifying hatchery facilities or operations may prove to be a future challenge.

Opportunity F19: Increase game warden presence and fishing regulation enforcement to reduce poaching and illegal harvest of Chinook salmon, steelhead, and other fish in the lower river.
Challenge F19: Challenges include limited warden staffing, limited funding, competing needs for enforcement in other watersheds, and limitation of access to areas of the river by private property.

Opportunity F20: Manage Camanche and Pardee reservoir fish planting for recreational angling to avoid potential impacts to steelhead downstream of the dams (e.g., plant triploid rainbow trout). Actions such as planting triploid fish offer an opportunity to avoid interbreeding between wild and planted stocks.
Challenge F20: Challenges include increased costs and additional complexity associated with obtaining stocks for planting in support of recreational fishing.

Opportunity F21: Explore the feasibility and potential benefits of relocating fall-run Chinook salmon into habitats in the watershed upstream of Camanche Reservoir. As briefly discussed above, a collaborative effort among stakeholders has begun to investigate the potential habitat suitability and opportunities to relocate salmon upstream of Camanche and Pardee Reservoirs.
Challenges F21: Challenges to this effort include achieving a collaborative consensus on the goals and approach for relocation, habitat suitability and existence of passage barriers and impediments to migration, predation by resident fish and other wildlife, potential management conflicts with other species such as Yellow-Legged Frogs, the inability of salmon upstream of the dams to successfully complete an anadromous life history, and potential conflicts with maintaining the fall-run Chinook salmon population downstream of Camanche Dam and continued successful implementation of the JSA fishery management program. Any action ultimately selected to reintroduce anadromous fish upstream of Pardee Reservoir will require funding.

Opportunity F22: Removal of existing dams and passage barriers from the upper watershed. Opportunities exist to potentially remove several small dams from the watershed such as East Panther Dam and a small dam located on a tributary east of West Point.

Challenges F22: Challenges include permitting, potential releases of accumulated sediments, changes in channel erosion following dam removal and funding.

Opportunity F23: The Ponderosa Way Restoration Project would restore Ponderosa Way to minimize erosion, provide watershed access to fire service, and allow river access to the public for recreation. The restoration project is a collaborative effort that has been planned in three phases with the first phase restoration of Ponderosa Way having received funding.

Challenge F23: Challenges include completing restoration actions in a steep grade and implementing a successful storm runoff system that reduces and avoids erosion. Erosion of the area has been accelerated by 4-well vehicle traffic during the wet season.

7.3 Additional Fishery Challenges

There are a number of challenges and impediments associated with implementing various management actions that would enhance conditions for fishery resources on the Mokelumne River. For example, changes in flood control operations of Camanche and Pardee reservoirs are a complex technical and regulatory challenge. There are also challenges associated with other planned or proposed changes to water operations and facilities in the upper watershed that would have an effect of hydrology and instream flows and other factors that may impact fish and other wildlife such as Yellow-Legged Frogs. For example, Pacific Gas and Electric Company has considered developing a pumped storage project that would raise Little Bear Reservoir approximately 8 feet with an interconnection to Salt Springs Reservoir. Water levels in the reservoirs would fluctuate approximately 6-7 feet daily in response to pumped storage operations. The project would require a number of approvals (e.g., FERC) before implementation. In addition, consideration has been given to raising the level of Lower Bear Reservoir by approximately 20-28 feet to increase winter storage that could then be released down the river during the summer for conjunctive use with power operations. This project could conflict with restoration efforts focused on Yellow-Legged Frogs and would require a number of approvals (e.g., amendment to PG&Es FERC license) before being implemented.

Additional challenges to implementing many of the potential management actions designed to enhance fishery habitat are determined by hydrologic conditions and runoff within the watershed. Runoff varies substantially within and among years and is difficult to accurately predict from one year to the next. Therefore variation in hydrologic conditions and runoff poses a major challenge to effectively managing water storage allocations and instream flows to maximize benefits for fisheries. For example, maintaining a minimum hypolimnetic volume of 28,000 AF in Camanche Reservoir in every water year represents a major water supply challenge, particularly during periods of multiyear critically dry drought conditions. Similarly, maintaining water temperatures that would be optimally suitable for all lifestages of salmonids and other fishery resources in all water years during all months represents a major challenge based on seasonal variation in air temperature as well as variation in cold-water storage availability to meet downstream temperature requirements.

Preliminary results of studies in progress on attraction and straying of adult fall-run Chinook salmon between the Mokelumne River and the American River suggest that pulse flow releases from Camanche Reservoir during the months of October and possibly November, in combination with closure of the Delta Cross Channel gates during the fall period of adult Chinook salmon upstream migration, suggest that these actions contribute to increased adult salmon returns to the Mokelumne River and reduced straying of adults of Mokelumne River origin to the American River. Pulse flow studies have been conducted during the fall using Mokelumne River pulse flows over the past several years but require further analysis and review, in addition to potentially more testing, as part of the continuing efforts to identify and refine fishery management actions that benefit the Mokelumne River while avoiding and minimizing adverse effects to other water users (e.g., work with WID operations, avoid adverse water quality conditions in the Delta, etc.). Providing water supplies to support the fall pulse flows for adult salmon attraction and upstream migration represents a water supply challenge that has been addressed, in part, through JSA adaptive management. Closure of the Delta Cross Channel gates during the fall months, however, represents a major water quality and institutional challenge within the Delta. Closure of the Delta Cross Channel gates during the fall results in reduced flushing of high quality water from the Sacramento River system through the central portions of the Delta and results in localized increases in salt concentrations. The US Bureau of Reclamation (USBR) operates and manages the Delta Cross Channel gates, in part, to help meet water quality conditions within the Delta during the fall months by keeping the Delta Cross Channel gates open. Modifying Delta Cross Channel gate operations to include prolonged gate closures during the fall represents a challenge in terms of water quality for municipal and agricultural usage within the Delta as well as institutional challenges associated with SWRCB D – 1641 and other regulatory requirements to maintain water quality conditions (e.g., salinity) within the Delta within acceptable limits.

7.4 Trade-Offs

Efforts to increase and enhance habitat conditions for fishery resources within the Mokelumne River are currently accomplished by balancing competing interests and demands. Modifying the existing balance of management actions has the potential to result in major trade-offs among competing needs. For example, modifying reservoir operations and flood control rules to increase winter storage within the reservoirs for fishery purposes has the potential to result in a greater frequency of flooding and damage to property along the Mokelumne River downstream of Camanche Dam. Similarly, an increase in instream flows released from Camanche Reservoir to the lower Mokelumne River, depending on reservoir storage and subsequent hydrologic conditions, has the potential to deplete cold water storage within the reservoir resulting in adverse fish habitat impacts associated with exposure to elevated water temperatures. Evaluating the competing interests and needs, in these examples, between flood control risk and increased storage for fishery allocation, or between increased instream flow releases and the potential expense of exposure to stressful or unsuitable seasonal water temperatures for salmonids, requires substantial modeling and technical analysis.

8. Conclusions

The following sections provide general conclusions; recommendations, including future data collection and studies; and closing remarks to serve as guidelines as the Mokelumne Collaborative Group assesses future water management actions.

8.1 General Conclusions

a. The hydrology of the entire Mokelumne River watershed is highly manipulated, changing the channel and overbank environment throughout the watershed. The type of alterations varies to some degree due to differences in land and water uses between the upper watershed and the lower watershed. Typically, these changes result in net loss of both geomorphic and ecological function. A return to conditions more closely mimicking historical flow regimes must be balanced with potential for downstream flooding impacts.
b. Regulated flows result in loss of natural functions that often reside at the intersection between flow conveyance, conjunctive use and functional flows that serve environmental needs.
c. Flow attenuation and the inability of most sediment to transport from the upper watershed into the lower watershed are large drivers, but not the only drivers, contributing to loss of geomorphic integrity in the system.
d. The seasonal timing of instream flows to meet habitat requirements for various species and lifestages of fish need to meet habitat requirements for adult migration, holding, spawning and egg incubation, juvenile rearing, and juvenile migration. Changes in instream flows alter water surface elevations, water depths and velocities important to determining the quality and availability of aquatic habitat. While instream flow requirements are meant to mimic natural flows to some degree, regulated flows do not

and cannot replace the natural flow regime. It is nevertheless an important goal to provide as close to a natural flow regime as is possible given the constraints of current conditions (i.e., minimizing potential downstream flooding impacts).

e. Drought conditions represent a major challenge for meeting and improving habitat conditions for fish within the watershed.

8.2 General Recommendations

- Planning should anticipate the types of changes in the seasonal hydrograph and frequency of rain-on-snow and other episodic events associated with climate change predictions, including a greater likelihood of fire and a higher degree of variability in yearly precipitation.
- The intensified use of the lower river corridor by species of all sorts, and thus the activities and conditions that exist in the lower Mokelumne River may warrant an increased level of attention. Such attention can be seen in the efforts by many stakeholders over recent decades. It may be that the MokeWISE stakeholders identify alternatives which seek even more habitat or denser species populations in the lower Mokelumne River. Functional flows analyses using various instream flow values may be useful here.
- Geomorphic data collection efforts that would enhance basin-scale planning include:
    a. Geomorphic characterization of the upper watershed above Pardee Dam to supplement previous stream geomorphology characterization (PG&E, 2011), if needed
    b. Measurement of reservoir sedimentation in Pardee Reservoir and Camanche Reservoir to understand upstream sediment yield responses to large-scale logging and road building in a forested watershed (Kattelmann, 1996)
    c. Measurement of sedimentation in upper watershed reservoirs and diversion structures.
    d. High-resolution topographic mapping of the lower Mokelumne River
    e. High-resolution topographic mapping of selected channels in the upper Mokelumne River basin

A great deal of information is available on the role of instream flows and water quality on fishery habitat within the Mokelumne River system. Adaptive management of limited water supplies can be and has been used, as a management tools for improving habitat conditions (e.g., providing pulse flows in the fall for adult Chinook salmon upstream attraction and migration and flows related to instream conditions for Foothill Yellow-Legged Frogs in the upper watershed). Challenges exist in providing more reliable habitat conditions over a range of hydrologic conditions as well as meeting institutional and regulatory needs for competing beneficial uses. The FERC Joint Settlement Agreement provides a foundation for exploring opportunities to further enhance habitat for Chinook salmon, steelhead, other fish species, and other aquatic and terrestrial species that depend on instream flows. Collaborative stakeholder efforts and restoration programs are also underway in the upper watershed to benefit resident fisheries, amphibians, and other wildlife.

8.3 Closing

What the future will bring, specific to the Mokelumne River watershed, is unknown. It has been well documented that sediment and flow discontinuities fundamentally alter the geomorphic character and ecosystem functions of the system, both on the Mokelumne River and worldwide. Nonetheless, opportunities are possible as shown in the story of gravel augmentation and spawning habitat renewal. Trends in climate will play a large role in flow dynamics in the coming decades, with potential changes to flow frequency, timing, duration, magnitude and rates of change on top of those already in place due to flow regulation, which will provide plenty of challenges in the years ahead. Assessing potential opportunities and constraints for enhancing habitat conditions for aquatic resources and geomorphic processes on the Mokelumne River will involve consideration of a number of potentially competing and conflicting objectives, outcomes, risks, and benefits. These challenges are accentuated by large interannual variation in hydrologic conditions within the watershed. Planning to address these interacting factors will require an understanding of the physical and biological processes affecting habitat on the river as well as interdisciplinary consideration of balancing tradeoffs as part of short- and long-term planning and enhancement.

The assessment of additional or specific trends in the geomorphic functions discussed herein should include not only water management during typical ranges of conditions, but also recovery from legacy effects, as well as adaption to future conditions associated with watershed management and climate change. It should also recognize that all channels will be periodically disturbed by episodic events, such as major floods, wildfires or droughts. It is important to understand that geomorphic change, although predictable in a broad sense and when specific drivers are in place such as dam operations, is also a very unpredictable process, with complex effects that will change as further adjustments occur in the sediment budget, water supply, and other human activities and natural processes. We agree with the primacy of ‘typical ranges of conditions’, but have learned over the years that there will be periods of episodic disturbances in most Western US stream. It is important to have a common understanding of and standards for those periods when typical ranges of conditions do not prevail. Once stakeholders identify alternatives or component ideas, engaging in the development of sustainable, productive and dynamic equilibrium conditions between consumptive and conjunctive uses of water resources and the geomorphic and ecological integrity of specific concepts can be addressed more thoroughly.

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Appendix G: Water Availability Analysis

Appendix G provides the MCG-approved Water Availability Analysis which analyzes the potentially available water for MokeWISE projects, including groundwater, agricultural drainage water, Mokelumne River water, recycled water, stormwater, and desalination.

MokeWISE Program Final Memorandum:
Water Availability Analysis

9 January 2015

Table of Contents

List of Figures

List of Tables

List of Acronyms

20x2020	Water Conservation Act of 2009
ADWF	Average dry weather flow
AF	Acre-feet
AFY	Acre-feet per year
AGRIMET	Bureau of Reclamation Agricultural Weather Network
ARSA	Amador Regional Sanitation Authority
AWA	Amador Water Agency
AWMP	Agricultural Water Management Plan
B/C	Benefit-cost
BARDP	Bay Area Regional Desalination Project
BMPs	Best Management Practices
CARWSP	Camanche Area Regional Water Supply Plan
CCSD	Crockett Community Services District
CCCSD	Central Contra Costa Sanitary District
CCWD	Calaveras County Water District
CDCR	California Department of Corrections and Rehabilitation
CDEC	California Data Exchange Center
cfs	Cubic feet per second
CII	Commercial, industrial, and institutional
COCORAHS	Community Collaborative Rain, Hail and Snow Network
COOP	National Weather Service Cooperative Observer Program
COSMUD	City of Stockton Municipal Utilities Department
COWRP	Castle Parks Water Reclamation Plant
CPUD	Calaveras Public Utility District
CSD	Community Services District
CSD	Crockett Sanitary Department
CUWCC	California Urban Water Conservation Council

CVP	Central Valley Project
CWC	California Water Code
DFW	California Department of Fish and Wildlife
DMM	Demand Management Measure
DSRSD	Dublin San Ramon Services District
DWR	California Department of Water Resources
DWSP	Delta Water Supply Project
EBMUD	East Bay Municipal Utility District
EPA	United States Environmental Protection Agency
ESJ	Eastern San Joaquin
EWMP	Efficient Water Management Practices
FY	Fiscal year
GBA	North Eastern San Joaquin County Groundwater Basin Authority
GHMWC	Garden Highway Mutual Water Company
GIS	Geographic Information System
gpcd	Gallons per capita per day
gphd	Gallons per household per day
gpd	Gallons per day
GWMP	Groundwater Management Plan
HET	High Efficiency Toilet
ILRP	Irrigated Lands Regulatory Program
IRWMP	Integrated Regional Water Management Plan
JVID	Jackson Valley Irrigation District
LAVWMA	Livermore-Amador Valley Water Management Agency
LID	Low impact development
MAC	Mokelumne-Amador-Calaveras
MAF	Million acre-feet
MCG	Mokelumne Collaborative Group

MGD	Million gallons per day
MHSD	Mokelumne Hill Sanitary District
MokeWISE	Mokelumne Watershed Interregional Sustainability Evaluation
MOU	Memorandum of Understanding
MSPS	Mallard Slough Pump Station
MWELO	Model Water Efficient Landscape Ordinance
NLCD	National Land Cover Database
NMFS	National Marine Fisheries Services
NOAA HDSC	National Oceanic and Atmospheric Administration Hydrometerological Design Studies Center
NPDES	National Pollutant Discharge Elimination System
NRWRP	North Richmond Water Reclamation Plant
NSJWCD	North San Joaquin Water Conservation District
OLSD	Oro Loma Sanitary District
PCWA	Placer County Water Agency
PMWC	Plumas Mutual Water Company
RARE	Richmond Advanced Recycled Expansion
RAWS	U.S. Forest Service and Bureau of Land Management Remote Automated Weather Stations
RO	Reverse osmosis
RSD	Rodeo Sanitary District
RWCF	Stockton Regional Wastewater Control Facility
RWQCB	Regional Water Quality Control Board
SASD	San Andreas Sanitary District
SAWPA	Santa Ana Watershed Project Authority
SAWS	Stockton Area Water Suppliers
SBx7-7	Water Conservation Bill of 2009
SCVWD	Santa Clara Valley Water District
SCWA	Sacramento County Water Agency

SCWWTP	Sutter Creek Wastewater Treatment Plant
SD	Sanitary District
SEWD	Stockton East Water District
SFCFCWCD	San Joaquin County Flood Control and Water Conservation District
SFPUC	San Francisco Public Utilities Commission
SMCL	Secondary Maximum Contaminant Level
SNOTEL	Natural Resources Conservation Service Snowpack Telemetry
SNOWCOURSE	Natural Resources Conservation Service Snow Course
SWRCB	State Water Resources Control Board
TAF	Thousand acre-feet
TBF	Tule Basin Farms
TDS	Total dissolved solids
TMDL	Total maximum daily load
UAW	Unaccounted-for water
ULFT	Ultra low flow toilets
UMRWA	Upper Mokelumne River Watershed Authority
USBR	United States Bureau of Reclamation
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Services
UWMP	Urban Water Management Plant
VSPUD	Valley Springs Public Utility District
WCMP	Water Conservation Master Plan
WCSD	Wallace Community Services District
WCWD	West County Wastewater District
WDRs	Waste discharge requirements
WID	Woodbridge Irrigation District
WPCP	Water Pollution Control Plant
WRCC	Western Regional Climate Center

WRO	Water Rights Order
WSMP 2040	Water Supply Improvement Program 2040
WSS	WaterSense Specification
WSWPCF	White Slough Water Pollution Control Facility
WWMP	Wastewater Master Plan
WWTP	Wastewater treatment plant
YCWA	Yuba County Water Agency
Zone 7	Zone 7 Water Agency

List of Definitions

Unallocated water – The quantity of water in the Mokelumne River that is not diverted pursuant to a riparian or appropriative water right and that is not required to be in the river pursuant to a prescribed pre-1914 regulatory requirement.

List of Appendices

Appendix A presents the scope of work for a stormwater quantification project currently being implemented by EBMUD.

Appendix B presents further information on the conservation analysis, including the methodology and assumptions used to quantify the conservation BMPs for each agency.

Appendix C provides the MOCASIM for the MokeWISE Program Technical Memorandum, which further describes the MOCASIM model.

Appendix D shows the annual flow duration curves at four locations along the river. Flow duration curves indicate the percentage of time over the period of record that flow in the river would be expected to be equal to or exceed a certain amount of water, based on historical hydrologic conditions and projected diversion levels. Results indicate that total flow decreases downstream and that there is projected to be less flow in 2040 than in 2010 due to increased diversions.

Appendix E shows monthly unallocated flow alongside regulated flow and unimpaired flow for the full period of historical hydrology as simulated by the model. This appendix also shows flow distributions by month for five different hydrologic year types, at selected threshold flow levels. Results indicate that there is generally more unallocated flow in wetter years, and that there is a higher likelihood of unallocated flows occurring in the months from January to June compared with the months from July to December. Results also show less unallocated flows in 2040 than in 2010 due to increased diversions.

Appendix F compares average total natural flow at Mokelumne Hill and unallocated flow below Camanche in 2010 and 2040 by water year type. Results indicate that total natural flow is greater than unallocated flow at Mokelumne Hill and that unallocated flow in 2010 is greater than unallocated flow in 2040 due to increased diversions. This pattern holds for each of the five hydrologic year types.

Appendix G compares annual JSA required flows and annual modeled flows. Results indicate that the amount of water being released decreases from 2010 to 2040, but that in each case, more water is being released than is required by the JSA.

Appendix H presents a constructed daily flow regime downstream of Camanche Dam by year for all years between 1998 and 2010. For the three wet years during that period (1998, 2005, and 2006), daily allocated and unallocated flows are presented on a monthly basis. This information is shown to provide information regarding historical daily flow variability. It is not intended to establish estimated pulse flows or geomorphic and/or fishery impacts.

Appendix I shows the riparian diversions at Highway 99, Woodbridge Dam, and Interstate 5. Results indicate that diversions are greatest from May through July.

Appendix J shows unallocated water below Camanche for the 2010 and 2040 baselines. Results indicate that there is generally more unallocated water in the months from January to May, and that there is more unallocated water in the 2010 baseline than in the 2040 baseline.

Appendix K presents data for all relevant figures and tables from Appendices D through J in cubic feet per second (cfs) rather than in acre-feet. The values stated provide the average flow in cfs over the time period specified (year, month, etc.). One acre-foot per year is equivalent to 0.00138 cfs.

Introduction

Basin-scale planning is currently underway within the Mokelumne River watershed under the auspices of the Upper Mokelumne River Watershed Authority (UMRWA) and the Eastern San Joaquin Groundwater Basin Authority (GBA), which represent the Mokelumne-Amador-Calaveras (MAC) and Eastern San Joaquin (ESJ) Integrated Regional Water Management Planning (IRWMP) Regions, respectively. Grant funding has been secured from the Proposition 84 Integrated Regional Water Management Program to develop the Mokelumne Watershed Interregional Sustainability Evaluation (MokeWISE) program, which seeks to improve water management in the Mokelumne River watershed.

The MokeWISE program has emerged following years of dialogue among a diverse set of stakeholders in the upper and lower Mokelumne River watersheds. MokeWISE, when concluded, is expected to yield a scientifically-based and broadly-supported water resources program that includes sustainable approaches to water resources management in the Mokelumne River watershed. Driving the development of the MokeWISE program is the Mokelumne Collaborative Group (MCG), a diverse and multi-faceted stakeholder group that includes water agencies, non-governmental organizations, private entities, resource agencies, and local, state, and federal government agencies.

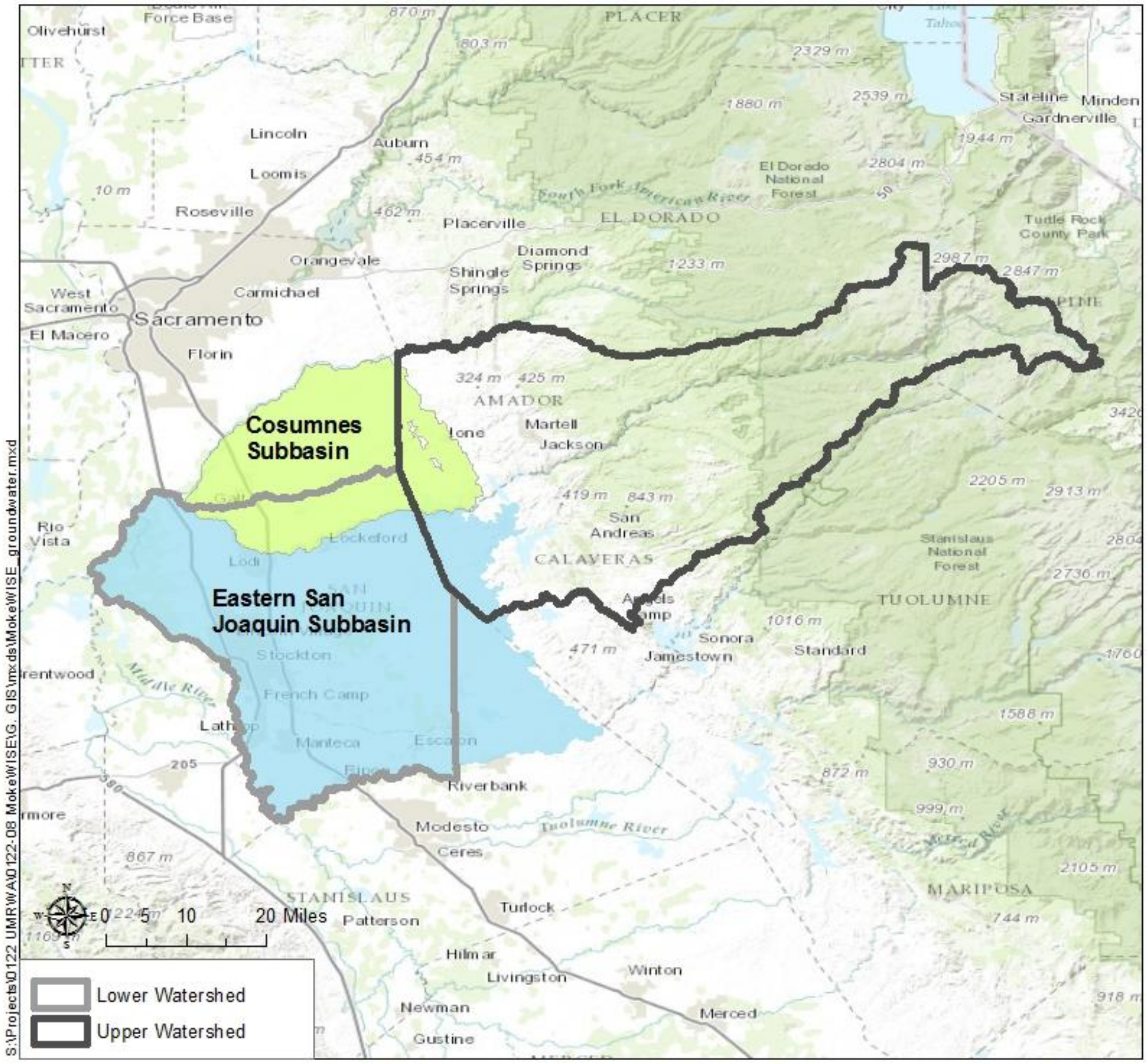
As part of the MokeWISE program, the MCG will evaluate potential water management actions that involve a variety of water sources. The purpose of this document is to assist in determining the quantity of water potentially available from each source, including groundwater, agricultural drainage, stormwater, recycled water, conservation, desalination, the Mokelumne River, and other surface water. These sources were investigated over a 30-year planning horizon, spanning from 2010 to 2040 and evaluated for their potential to provide supply to the upper and lower Mokelumne watersheds. In order to develop an effective water resource management projects that could affect both regions, there is a need to identify water supply.

The results of this water availability analysis will help develop the project concepts currently being considered in the MokeWISE process. The following sections summarize the results of the water availability analysis for each water supply source considered. The study area for this analysis covers the portions of the MAC and ESJ IRWMP regions in the Mokelumne River watershed, which are identified as the upper and lower watersheds, respectively. In some instances, water supplies from outside the watershed could be exchanged to free up additional supply within the watershed. These opportunities were also evaluated.

Groundwater

Available groundwater supply in the Mokelumne Watershed and adjacent areas was assessed by collecting information about the current conditions of the groundwater basins underlying the project area (including both western Calaveras and Amador counties, and Eastern San Joaquin County groundwater basins). Data was collected from available groundwater management plans, urban water management plans (UWMPs), groundwater models, other groundwater resource evaluations, and relevant agencies. As shown in Figure 1, the MAC and ESJ regions overlie the Cosumnes and Eastern San Joaquin groundwater subbasins of the San Joaquin Valley Groundwater basin. This evaluation considered potential groundwater supplies from the groundwater subbasins underlying the upper and lower watersheds.

Figure 1: Groundwater Basins within the MokeWISE Region



Existing Groundwater Conditions

Groundwater in the Upper Watershed

The Cosumnes Subbasin is approximately 440 square miles in size, and is bounded on the north and west by the Cosumnes River, on the east by the bedrock of the Sierra Nevada, and on the south by the Mokelumne River. The groundwater storage capacity of Cosumnes Subbasin is estimated to be about 6,000,000 AF. Basin inflows are estimated to be about 269,500 acre-feet per year (AFY). Water leaves the Subbasin through subsurface flow (144,600 AFY), urban extraction (35,000 AFY), and agricultural extraction (94,200 AFY). Based on this water balance, the Subbasin is in overdraft by about 4,300 AFY (RMC 2013, 1-35). As such, no additional groundwater supply is available in this area. Due to the variable quality and supply of the basin, groundwater storage potential is considered negligible (RMC 2012).

A portion of western Calaveras County, served by Calaveras County Water District (CCWD), overlies the Eastern San Joaquin Subbasin, which is part of the larger San Joaquin Valley Groundwater Basin. The Eastern San Joaquin Subbasin is estimated to cover approximately 70 square miles (7 percent) of Calaveras County. This groundwater subbasin extends from the western corner of the County west of the cities of Stockton and Lodi. Use of groundwater for irrigation, domestic, and municipal purposes has resulted in a continuous decline of available groundwater over the past 40 years. The California Department of Water Resources (DWR) designated the Eastern San Joaquin Subbasin as "critically overdrafted" in Bulletin 118-80. The Subbasin is currently being managed under an AB 3030 Groundwater Management Plan (GWMP), prepared by the GBA. The Camanche/Valley Springs area is managed under a separate GWMP, adopted by CCWD in 2001, for investigation of opportunities to improve management of groundwater resources in western Calaveras County (RMC 2013).

In 2012, the U.S. Geologic Survey (USGS), in cooperation with CCWD and DWR, completed test drilling and data collection for the Calaveras County portion of the Eastern San Joaquin Groundwater Subbasin to better understand aquifer conditions in the Camanche/Valley Springs area (USGS 2012). As described in the study, groundwater is typically suitable for agricultural, domestic, and public-supply uses. However, high concentrations of naturally occurring dissolved solids, iron, arsenic, and increasing nitrate concentrations could limit future use and/or increase costs for treatment. Some areas, especially near Burson, have experienced drying wells due to declining groundwater level.

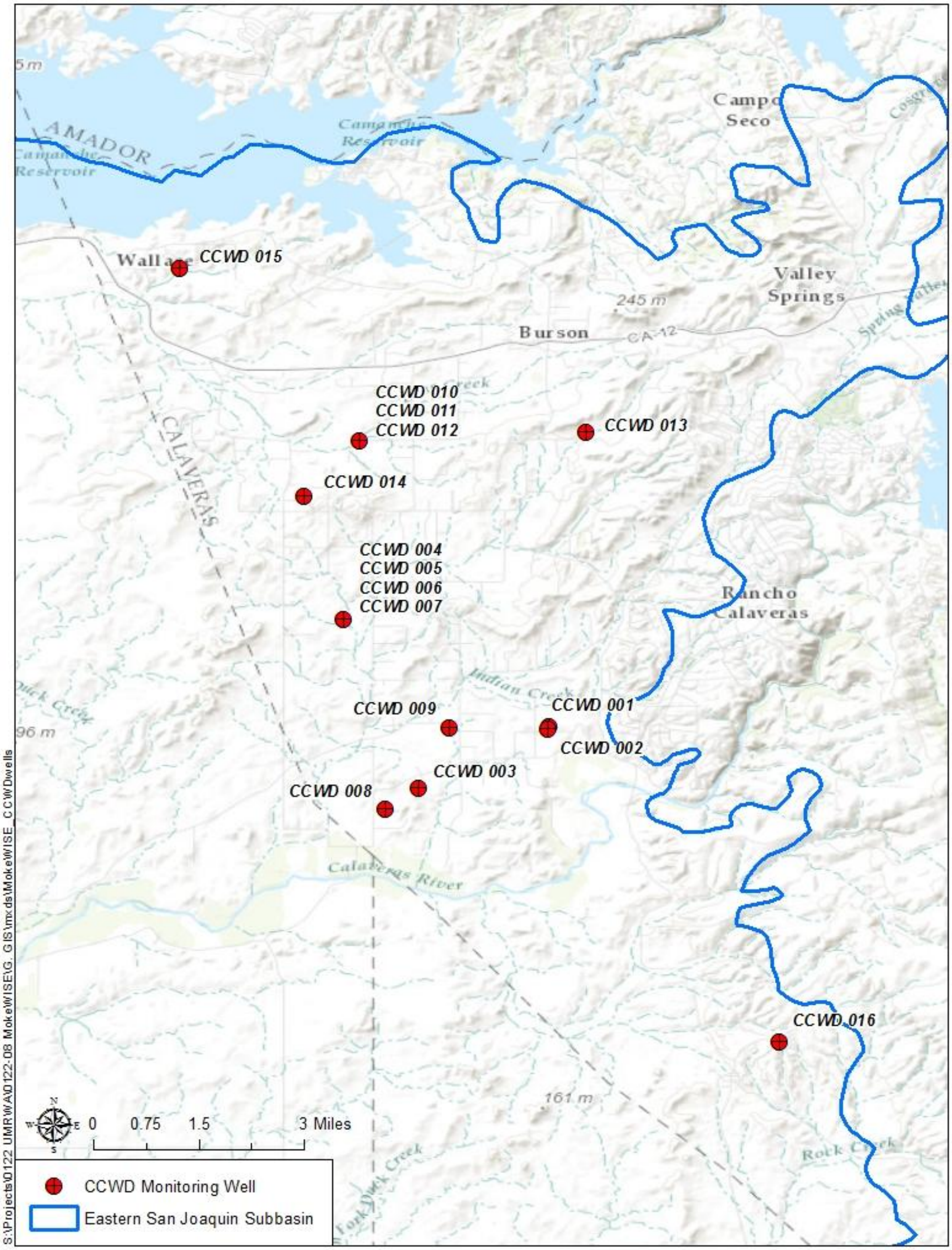
Estimating the age of groundwater is a tool often used to determine the recharge capabilities of a groundwater basin. To estimate the age of groundwater within the Calaveras County portion of the Easton San Joaquin Groundwater Subbasin, samples were collected from a number of monitoring wells for field parameters such as temperature, pH, and dissolved oxygen, as well as age-dating constituents including tritium and carbon-14 (see Figure 2). Tritium is naturally occurring radioactive isotope of hydrogen that is anthropogenic, short-lived (half-life of 12.3 years) and can be used to identify relatively young (post-1952) groundwater. Tritium detected in groundwater can often be attributed to thermonuclear weapons testing from 1952 to 1962. Tritium was detected in only one of six wells, indicating that groundwater recharge in the study area is small or requires a long time to infiltrate through the unsaturated zone to the water table.

Carbon-14 is a naturally occurring radioactive isotope of carbon that is long-lived with a half-life of 5,730 years. It allows for identification of groundwater up to 30,000 years old. Results from the six monitoring wells indicate the water ranges in age from 2,200 to 13,400 years old, becoming progressively older with depth. This indicates that: (1) extensive chemical reactions alter carbon-14 activities, (2) groundwater recharge is limited (which is consistent with the absence of tritium), or (3) groundwater requires a long time to infiltrate to the groundwater table (USGS 2012, 10-11). The well with the youngest groundwater was also the well with detected levels of tritium, which suggests more recent recharge. In order to confirm and augment the USGS study, CCWD prepared and implemented a groundwater sampling plan (Dunn Environmental 2012). The sampling effort had the following objectives:

- Collect additional water quality data to substantiate past findings.
- Collect additional age dating data to confirm and augment tritium and carbon-14 results from the USGS study.
- Assess potential groundwater recharge throughout the County portion of the subbasin.

While there may be localized areas suitable for groundwater recharge in the Calaveras County portion of the Eastern San Joaquin Groundwater Subbasin, based on the USGS study, natural recharge opportunities are limited and additional groundwater storage may not be available. While the feasibility and effect of using injection wells for recharge has not been extensively studied in the ESJ basin, there may be potential for their use.

Figure 2: CCWD Monitoring Well Network



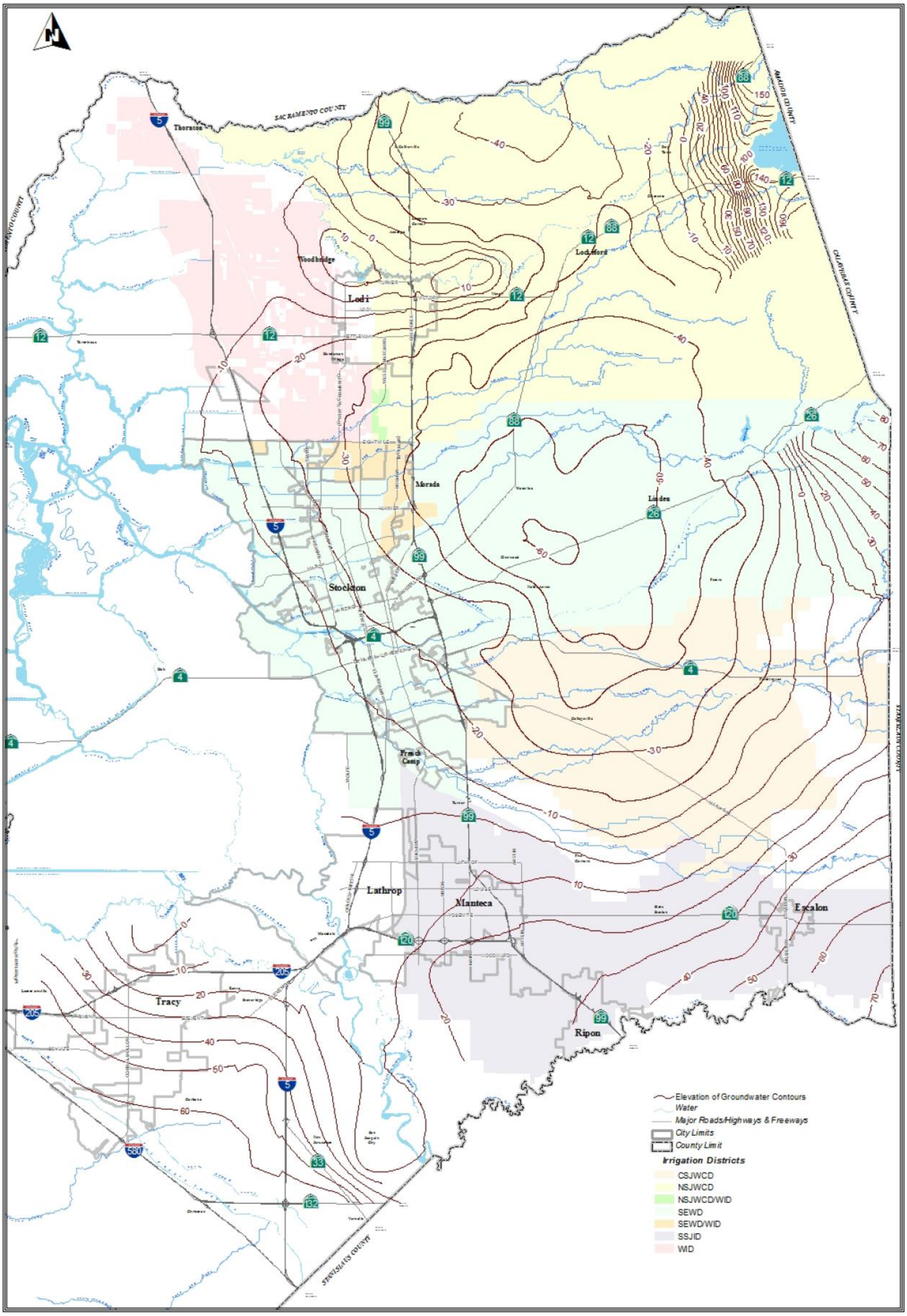
Groundwater in the Lower Watershed

Groundwater measurements taken in Eastern San Joaquin County dating back to the 1960s show a fairly continuous decline in groundwater levels, with elevations dropping as much as 100 feet in some areas. Based on land use and population, total agricultural and municipal groundwater pumping in Eastern San Joaquin County is estimated to have averaged 870,000 AFY since the 1970s, which has resulted in the groundwater subbasin being overdrafted and reducing the volume of water stored in the basin by as much as 2 million acre-feet (AF) (DWR 2006b, 3). Over the last century, irrigated agriculture in the Central Valley has grown from less than 1 million acres to an estimated 7 to 8 million acres. Water demand in San Joaquin County is approximately 1.6 million AFY. The County currently relies on groundwater for 60 percent of its supplies, with surface water meeting the remaining 40 percent of demands. The Eastern San Joaquin groundwater subbasin is currently overdrafted at a rate of 150,000 to 160,000 AFY (GBA 2004, 69). Between 140,000 and 160,000 AFY of water is anticipated to be needed by 2030 to reverse overdraft conditions and stabilize the groundwater basin at target levels, assuming an estimated 2030 level of development as specified in either adopted or draft general planning documents (GBA 2007, ES-27).

As shown in Figure 3, as of spring 2014, groundwater was significantly overdrafted throughout the subbasin, with the greatest depression east of the City of Stockton with elevations as low as 60 feet below ground surface. Long-term groundwater overdraft has dramatic effects on groundwater levels and water quality. Portions of the subbasin have exhibited groundwater levels declining by as much as 2 feet per year, up to 90 feet below sea level (GBA 2007, 1-2). Groundwater level declines have resulted in steep gradients from the west, causing intrusion of highly saline groundwater. Degradation of water quality due to saline migration threatens the long-term sustainability of the groundwater basin in the long term. In the near term, users face failing groundwater wells, reduced pumping rates, and poor water quality. Salt intrusion in the groundwater basin has rendered supplies unusable for urban drinking water needs and crop irrigation in some locations. Studies and monitoring to determine the potential sources and extent of the saline front are limited. Results of a USGS Joint Salinity Study (USGS 2006) indicated several possible sources of saline water including surface water infiltration, dissolution of salts near the Delta margin, contributions from underlying deposits, and possible irrigation return flow. Saline intrusion is discussed in more detail in the Desalination section. Even with conservation and recycled water programs in place, reversing groundwater overdraft will require a substantial amount of supplemental water (GBA 2007).

There are seven incorporated cities within San Joaquin County: Escalon, Lathrop, Lodi, Manteca, Ripon, Stockton, and Tracy. Escalon and Ripon are entirely dependent on groundwater for all potable and non-potable demands. However, these cities are taking steps to diversify supplies with surface water.

Figure 3: Spring 2014 Groundwater Levels in the Eastern San Joaquin Groundwater Subbasin



Source: SJCFCWCD 2014.

Recent studies suggest that while groundwater levels in some parts of the subbasin may have begun to recover, most areas continue to reflect declining conditions. Hydrographs from the spring 2014 Groundwater Report published by the San Joaquin County Flood Control and Water Conservation District (SJCFCWCD) indicate that groundwater surface elevations in many of the wells throughout San Joaquin County were in decline from the beginning of the period of record (~1958) through today. Fluctuations in levels have been observed throughout the years, with some wells exhibiting increasing levels in recent years or somewhat constant levels. However, most wells have exhibited a constant decline (SJCFCWCD 2014). The 2014 *Groundwater Resources Management Report* (Wagner & Bosignore 2014, 22) recommends identification and assessment of risks to the groundwater basin to determine the resiliency of existing wells and the potential to meet future groundwater demands. Risks include, but are not limited to:

- Reduction of surface water supplies through regulatory actions;
- Increased diversions upstream;
- Reduced conservation storage in area reservoirs;
- Prolonged and/or intense drought periods; and
- Increased future demands.

The report recommends development of a Basin Conceptual Model and ultimately a numerical groundwater model, which would facilitate evaluation of the future risk of overdraft conditions and help aid in the development of water banking criteria, operational limitations for extraction, and the understanding of artificial and natural recharge (Wagner & Bosignore 2014).

As noted above, review of the spring 2014 Groundwater Report published by the SJCFCWD indicates that while the majority of the areas in the basin are declining, some areas of the basin are beginning to stabilize (SJCFCWD 2014). Table 1 provides the average groundwater level change over the previous year by jurisdictional monitoring area. That is, the change noted in Spring 2014 indicates the change in groundwater level from Spring 2013 to Spring 2014. Note that there are a number of wells within each monitoring area and the below numbers represent the average.

Table 1: Average Change in Groundwater Level over Previous Year (in feet to mean sea level)

Year	Central San Joaquin Water Conservation District	North San Joaquin Water Conservation District	Oakdale Irrigation District	Stockton East Water District	South San Joaquin Irrigation District	Woodbridge Irrigation District	Southwest County Areas
Spring 2009	-1.5	-3.0	-2.6	-3.1	-2.7	-1.8	-1.0
Spring 2010	-1.2	-0.9	1.1	-1.2	-0.5	0.2	0.2
Spring 2011	1.8	0.1	0.2	1.9	1.0	1.8	1.3
Spring 2012	0.52	0.4	-0.15	-0.1	1.0	-0.3	0.2
Spring 2013	-4.37	-0.47	-3.53	-1.34	-2.11	-0.86	-0.73
Spring 2014	-1.76	-2.62	-2.20	-2.59	-1.84	-2.38	-0.33

Based on this analysis, it is assumed that no additional groundwater is available from the Eastern San Joaquin Groundwater Basin. However, recent studies including the Eastern San Joaquin Groundwater Basin GWMP (GBA 2004) have shown that the groundwater overdraft may have created an estimated 1 to 2 million AF of groundwater basin storage which could be used in a groundwater banking or conjunctive use development. Groundwater banking and conjunctive use are recognized as key water management options for water agencies to balance water needs. There is interest statewide in implementing a groundwater bank in Eastern San Joaquin County. Interested parties include DWR, United States Bureau of Reclamation (USBR), CALFED Storage, Metropolitan Water District of Southern California, State Water Contractors, East Bay Municipal Utility District (EBMUD), AWA, and CCWD.

Recent legislature has the potential to greatly affect groundwater management within California. Senate Bill (SB) 1739 would require a groundwater sustainability agency to submit a groundwater sustainability plan and would grant that agency the ability to impose fees. SB 1168 would require that each groundwater basin be characterized with a priority and include consideration of adverse impacts on local habitat and local streamflows. SB 1319 would authorize the State Board to designate certain high- and medium-priority basins as probationary basins. Each of these bills has the potential to alter the groundwater landscape within the MokeWISE region. However, because each of these bills was recently signed by the Governor, this analysis cannot include a thorough analysis of their impact.

Summary of Potential Groundwater Supplies

Aside from the groundwater currently used and planned for use, groundwater is not a viable additional water supply in the upper watershed for the MokeWISE program because of limited yield. Based on water age findings, large-scale natural groundwater recharge is unlikely to be viable in the Calaveras County portion of Eastern San Joaquin subbasin. Total agricultural and municipal groundwater pumping in Eastern San Joaquin County is estimated to have averaged 870,000 AFY since the 1970s, which has contributed to overdraft conditions. Continuing current rates of groundwater extraction will further impact groundwater levels, and saline groundwater will continue to migrate east into the basin (GBA 2004, 77). This will continue to impact the availability of groundwater in the future. Conjunctive management strategies (i.e. management of groundwater and surface water resources) and groundwater recharge opportunities may help to mitigate groundwater overdraft conditions.

Challenges with Maximizing Groundwater Use

Challenges associated with maximizing the use of groundwater as a supply in the MokeWISE program are listed below. These challenges should be considered in conjunction with any groundwater projects resulting from the MokeWISE program.

- **Availability.** In the Cosumnes Subbasin within the upper watershed, private wells pump groundwater for use; however, because groundwater availability is limited in the upper watershed, the potential for expanded use of groundwater in the upper watershed is also limited. Additionally, widely, distributed, small capacity wells in fractured rock offer very limited opportunities for coordinated management.

- **Groundwater basin conditions**. Groundwater from the Eastern San Joaquin Groundwater Subbasin is widely used in the lower watershed for agriculture and domestic supplies, but the basin, while recovering, has historically seen declining levels. Balancing the demands of users with the groundwater available is a challenging aspect of using groundwater as a supply.

Opportunities for Maximizing Groundwater Use

The following are potential opportunities for maximizing groundwater use. These examples can be considered when discussing potential MokeWISE projects and programs.

- **Direct/in-lieu banking**. Low groundwater levels provide opportunities for potential banking and conjunctive use projects and programs. Water sources could include unused American, Sacramento, and/or Mokelumne River, stormwater, and/or recycled water supplies.
- **Direct injection**. Water from a variety of sources, including the Mokelumne, stormwater, recycled water, and agricultural drainage water, could be used to stabilize groundwater basin levels through direct injection.

Agricultural Drainage Water

Agricultural drainage water is excess irrigation water collected from agricultural field drainage systems. Traditionally, agricultural drainage water may have been a significant supply source, but due to more efficient agricultural irrigation practices and water quality concerns, it is no longer considered a viable source. In the future, there may be a need to flush agricultural soils to reduce salt build-up, potentially creating agricultural drainage water. However, these practices are not currently being implemented and the quantity and quality of any potentially available water resulting from this use is unknown.

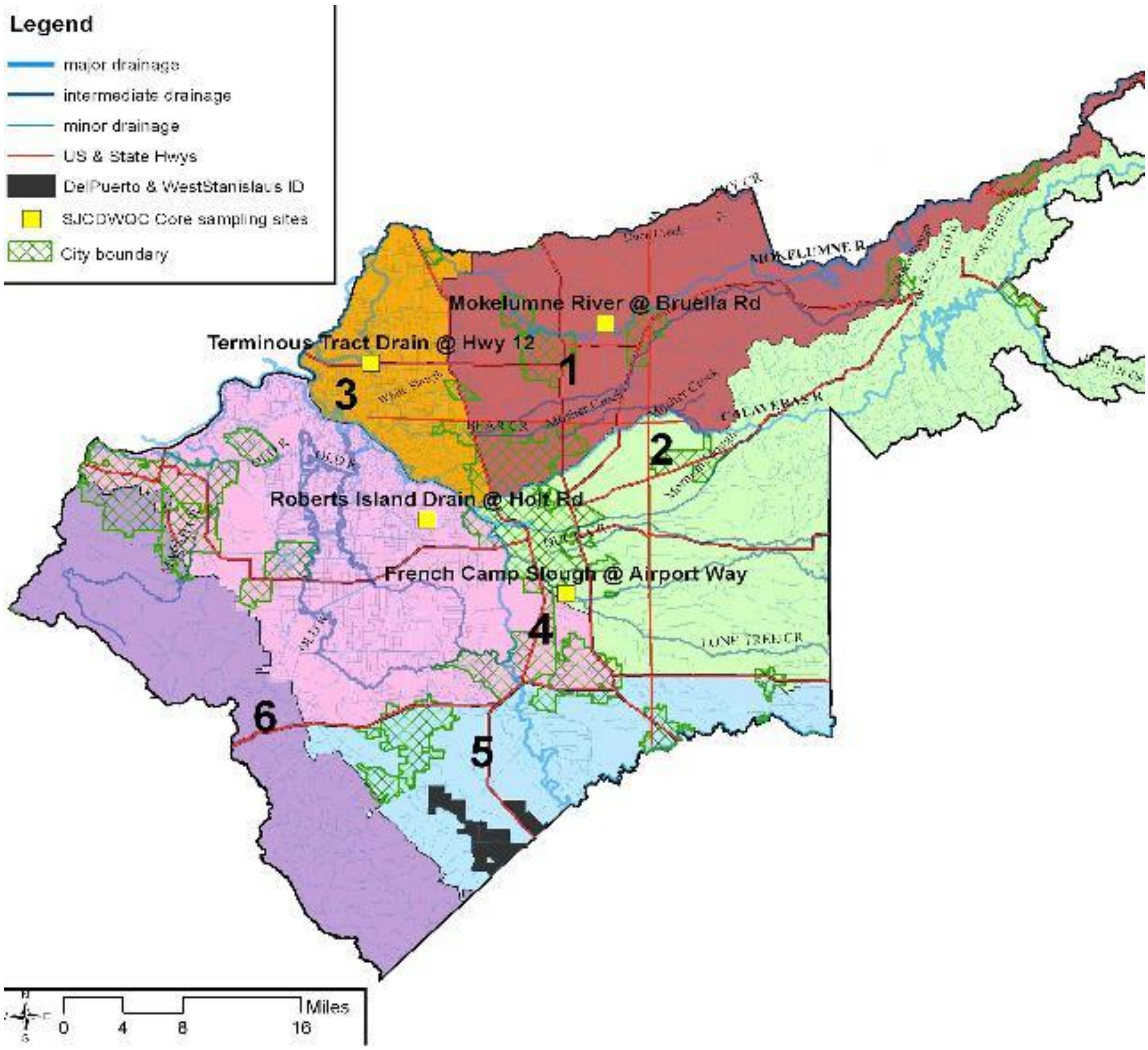
Agricultural drainage supplies were quantified by collecting data from the State Water Resources Control Board (SWRCB) and Regional Water Quality Control Board (RWQCB) to estimate the amount of agricultural drainage water and determine whether it is a viable potential source of supply for the future.

Potential Agricultural Drainage Supplies

Water discharge from agricultural irrigation and operations includes runoff, flows from tile drains, and stormwater runoff. Because these discharges can affect water quality by transporting pollutants such as pesticides, sediment, nutrients, and salts to surface water, the Irrigation Lands Regulatory Program (ILRP) regulates discharges from irrigated agricultural land. Waste discharge requirements (WDRs) or conventional waivers of WDRs (Orders) to growers require water quality monitoring of receiving waters and corrective actions when impairments are found. There are approximately 40,000 growers enrolled in the ILRP encompassing 6 million acres in California (SWRCB 2014a).

The San Joaquin County & Delta Water Quality Coalition was established in response to the ILRP to help meet agricultural water quality requirements in San Joaquin County, Calaveras County, the Delta portions of Alameda and Contra Costa Counties, a portion of Stanislaus County north of the Stanislaus River, and a small portion of Amador County that drains into the Mokelumne River. The ILRP requires growers that irrigate their land and have runoff from that irrigation or rainfall to belong to a coalition or apply for an individual discharge permit from the RWQCB. The Mokelumne River watershed is primarily within Zones 1, 2, 3, and portions of 4 and 5 of the Coalition (see Figure 4). Zones within the Coalition are established for areas with similar characteristics. Water quality monitoring occurs within the zones to identify areas that may be exceeding water quality standards. In March 2014, the Central Valley RWQCB approved a new General Order for the San Joaquin County and Delta Watershed area (San Joaquin County and Delta Water Quality Coalition 2014).

Figure 4: San Joaquin County and Delta Water Quality Coalition Area Zones



Source: San Joaquin County and Delta Water Quality Coalition 2014

Within the Coalition area, the lower reaches of the San Joaquin River drain the eastern and western areas of the Central Valley. Drainage water is exported to the San Francisco Bay through the Delta or conveyed south via the State Water Project and Delta Mendota Canal (San Joaquin County and Delta Water Quality Coalition 2008).

In 2007, the Central Valley RWQCB prepared the *Revised Draft of the 2007 Review of Monitoring Data for the Irrigated Lands Conditional Waiver Program* to assess data collected for the Irrigated Lands Program since its inception in 2003. For the purposes of the report, the Central Valley Region was divided into four zones. Zone 2 includes parts of the San

Joaquin, Contra Costa, Alameda and Calaveras Counties, and the Delta. Participants in Zone 2 include the San Joaquin and Delta Water Quality Coalition, Oakdale Irrigation District, and South San Joaquin Irrigation District. Many growers in Zone 2 utilize an intricate system of conveyance canals for the purpose of returning tail water back to upstream farms, allowing growers to transport and reuse runoff or tail water in upgradient areas (CVRWQCB 2007). Reports and data available from the SWRCB, RWQCB, and the San Joaquin County and Delta Water Quality Coalition provide water quality information, but do not quantify agricultural drainage water.

Summary of Potential Agricultural Drainage Water Supplies

While quantities of agricultural drainage are unknown, it is assumed that they are decreasing due to investments in agricultural irrigation efficiency practices and technologies. As such, it is not recommended that this source be relied upon as a significant source of water. Some local, small-scale applications may be viable for agricultural drainage, but it is not expected to contribute to a viable regional water supply. Additionally, it is important to consider the potential impacts associated with the capture of agricultural drainage, including reductions in water available for downstream environmental, agricultural, and urban uses. Furthermore, use of agricultural drainage water may reduce groundwater recharge. For these reasons, agricultural drainage water is not considered a viable source for the MokeWISE program.

Challenges of Maximizing Agricultural Drainage Water Use

While agricultural drainage water is assumed to be decreasing, its use has the potential to pose challenges for downstream water users. In many cases, downstream users divert agricultural drainage water that was discharged by upstream users. As agricultural efficiencies are realized, this source is naturally decreasing, while potentially increasing the concentrations of contaminants. Capture and reuse of agricultural drainage water would further decrease this source for downstream users, thereby potentially decreasing the supplies available for downstream water users and groundwater users. Additionally, treatment of agricultural drainage water for use would need to be identified and implemented. These challenges should be addressed when considering projects which use agricultural drainage water as a supply.

Opportunities for Maximizing Agricultural Drainage Water Use

The following are potential opportunities for maximizing agricultural drainage water use. These examples can be considered when discussing potential MokeWISE projects and programs.

- **Soil flushing**. Soil flushing is an agricultural practice in which water is applied to decrease the concentration of salts and other constituents that can build up in the soil over time. While some soil flushing occurs now within San Joaquin County, this practice is limited, and the amount of water that could potentially be captured and used is negligible. Additionally, any water that does result from flushing both recharges the groundwater and is potentially used by downstream users. However, water may be available in the future if soil flushing becomes a more common practice implemented at a larger scale.

Recycled Water

Potentially available recycled water was determined by quantifying treated wastewater within the watershed and the volume of recycled water that is currently used or planned for future use. The remaining amount, after considering constraints, may be available for reuse.

Wastewater Flows in the Watershed

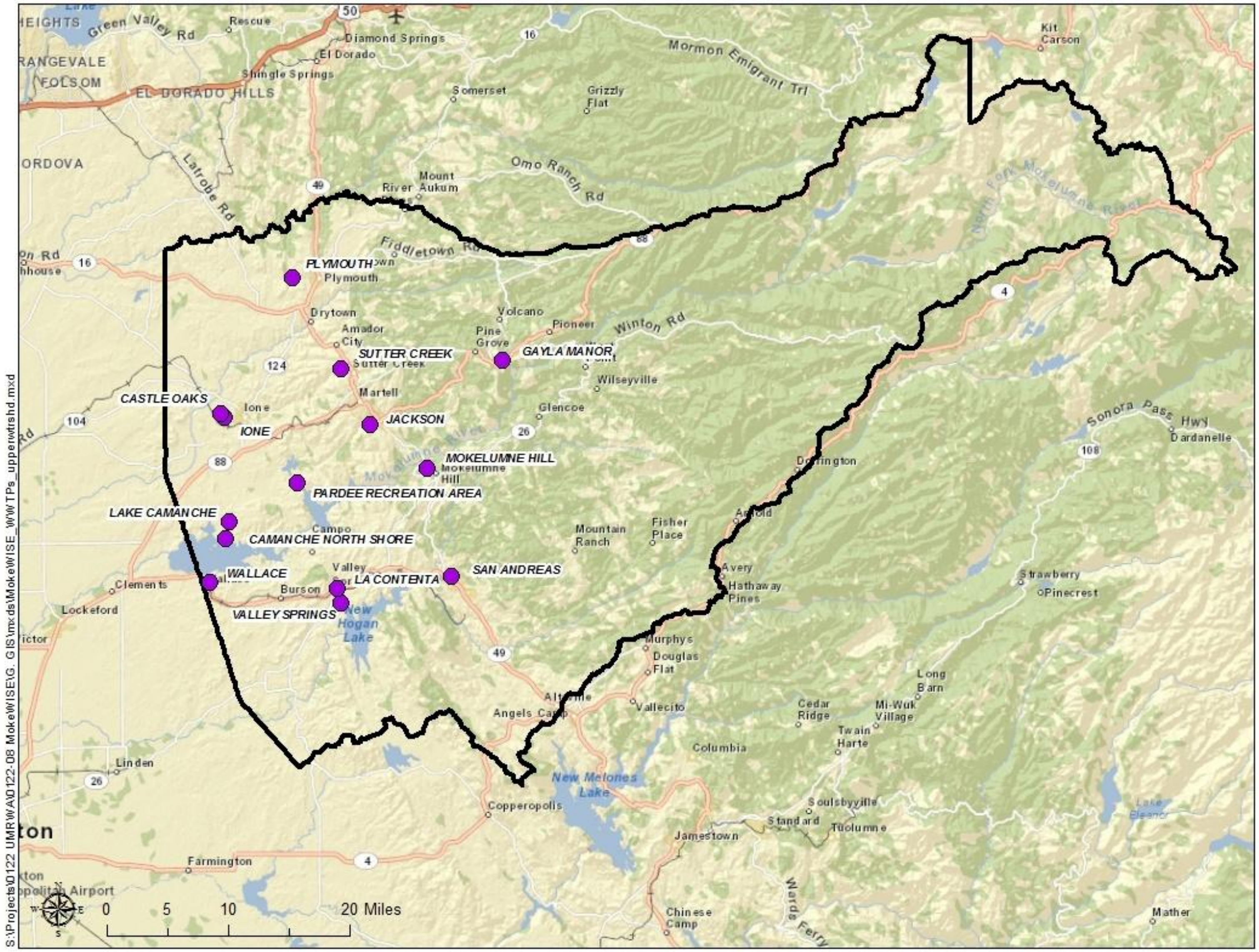
Unless noted, all annual flows were converted from Average Dry Weather Flow (ADWF) reported in million gallons per day (MGD) to acre-feet per year (AFY). This results in a conservative estimate of available supply because it does not include wet weather flows, which are difficult to store for use during dry times. All cited flows are from current, published documents and are based on assumed rates of population growth and buildout population assumptions. It should be noted that there is significant uncertainty associated with projecting future population growth, and the growth rates projected in some of these documents are greater than the rates that have been experienced in the past. If population grows at a slower rate than projected, future wastewater flows will be less than what is cited in this document, thereby decreasing the amount of recycled water that could potentially be available. Conversely, if population growth increases at a rate faster than that assumed by these planning documents, wastewater flows would be expected to be greater than cited, and a greater amount of recycled water may potentially be available in future years.

Upper Watershed

The following agencies own and operate the major wastewater collection and treatment facilities within the upper watershed: AWA, Amador Regional Sanitation Authority (ARSA), City of Sutter Creek, City of Ione, City of Jackson, City of Plymouth, CCWD, EBMUD, Mokelumne Hill Sanitary District (MHSD), San Andreas Sanitation District (SASD), Valley Springs Public Utility District (VSPUD), and Wallace Community Services District (WCSD). Some of these agencies operate more than one facility and some share conveyance and discharge facilities.

The majority of the water treatment facilities in this region serve small, unincorporated areas with wastewater ADWF of less than 600 AFY. Only four wastewater treatment plants (WWTPs), including La Contenta WWTP, Castle Oaks Water Reclamation Plant (COWRP), City of Ione Secondary Treatment Plant, and City of Jackson WWTP, are projected to generate more than 1 MGD (1,120 AFY) at buildout, with a combined flow of approximately 9,000 AFY at buildout. Several agencies currently use recycled water to meet part of their water demands, as discussed in a subsequent section. Each of the agencies and the wastewater treatment facilities they operate are described in detail below. All flows associated with the upper watershed are captured in Table 2. Figure 5: Wastewater Treatment Facilities in the Upper Watershed identifies the location of each of the treatment plants discussed in the following sections.

Figure 5: Wastewater Treatment Facilities in the Upper Watershed



Amador Water Agency

AWA owns and operates ten wastewater systems within the MAC region. The Lake Camanche WWTP and the Gayla Manor WWTP are the only two treatment plants and provide secondary treatment with disinfection and spray irrigation for disposal. The other eight systems are community leach fields that serve the communities of Eagles Nest, Fairway Pines, Jackson Pines, Mace Meadows, Pine Grove, Surrey Junction, Tiger Creek Estates, Viewpoint, and Wildwood Estates. These leach field systems dispose of primary treated wastewater through subsurface drains and produce such limited quantities of wastewater or are so geographically distant from potential users that reuse would be inefficient and cost-prohibitive (AWA 2011). In total, AWA collects and treats approximately 110 AFY of wastewater in the MAC region, but only the flows from the Lake Camanche WWTP and the Gayla Manor WWTP are feasible for recycled water use because these are the only two facilities which produce significant amounts of secondary treated water. The combined existing flow from these two treatment facilities is just over 60 AFY, with flows reaching a combined 132 AFY in the future.

Amador Regional Sanitation Authority: City of Sutter Creek/City of Amador City/Martell

The City of Sutter Creek owns and operates the Sutter Creek Wastewater Treatment Plant (SCWWTP), which serves the cities of Sutter Creek, Amador City, and the community of Martell (Aegis 2013, 4-9). SCWWTP expansion capacity is limited to approximately 1 MGD due to its location; however, an adjacent site has been identified for a future WWTP. Secondary effluent produced by the SCWWTP is chlorinated and discharged to the Amador Regional Sanitation Authority (ARSA) system for storage and reuse or disposal.

The ARSA Regional Outfall originates at the City of Sutter Creek WWTP, and allows effluent to be routed either to the City of Ione's tertiary level COWRP, or to the City of Ione's Secondary Treatment Plant (ponds) south of the Sutter Creek streambed. Along the ARSA pipeline, a portion of the treated effluent is used for pasture grass application at Bowers Ranch and Hoskins Ranch. The City of Ione accepts from ARSA and the California Department of Corrections and Rehabilitation (CDCR) a combined total of 650 AFY of secondary-treated wastewater for disposal (Aegis 2013, 4-3).

Buildout flows are planned to be 0.913 MGD or 1,023 AFY based on the ARSA Wastewater Master Plan (WWMP) (HydroScience 2012, 5). Other studies provide alternate projections of future buildout flows. Future recycled water use is anticipated to be roughly 1,000 AFY.

Calaveras County Water District

CCWD operates five larger wastewater treatment facilities (>0.1 MGD) and nine smaller systems serving approximately 5,000 wastewater connections in total. The effluent produced by the treatment facilities is disposed of in three principal ways: community leach field systems, spray disposal, and irrigation. Three of the plants contain facilities to recycle wastewater for golf course irrigation (CCWD 2011, 5-1).

Wastewater treatment facilities treating less than 0.1 MGD are located in the following communities: Douglas Flat/Vallecito, West Point, Wilseyville Camp, Country Houses, Indian Rock, Millwoods, Sequoia Woods, and Southworth. The Country Houses, Sequoia Woods and Southworth communities are near buildout, and additional connections are not anticipated. Flows at the other facilities are gradually approaching capacity, and the agencies will need to begin making plans for treatment capacity expansions (Calaveras LAFCO 2012, 75). While the Arnold wastewater treatment facility treats 0.1 MGD or 118 AFY of wastewater, it currently only treats to primary standards and is therefore not discussed further below. Copper Cove, Forest Meadows, and Douglas Flat/Vallecito treatment plants, while owned by CCWD, are not hydrologically connected to the Mokelumne River. In other words, any recycled water use connected to these facilities would not offset Mokelumne River water. As such, these wastewater treatment facilities are also not discussed below

Tertiary-treated effluent from the La Contenta wastewater treatment facility is stored and used for golf course irrigation. The La Contenta Golf Course uses the plant effluent as its primary irrigation supply source, and uses raw water from New Hogan Reservoir to meet its supplemental water supply needs. CCWD intends to incorporate additional wastewater recycling programs in other areas, such as parks, landscape, and highway medians once effluent volumes exceed current irrigation demands. Without these alternatives, CCWD would dispose of additional effluent through dedicated land application (CCWD 2011, 5-3). Current wastewater flows are 225 AFY and are expected to increase to 1,636 AFY by 2040.

East Bay Municipal Utility District

EBMUD operates two wastewater facilities that serve the Camanche North Shore Recreation Area and Pardee Recreation Area in Amador County, which treat a combined 3.3 AFY. EBMUD has discussed development of a regional wastewater treatment facility with local jurisdictions to treat wastewater from these two facilities (Amador County Municipal Service Review 2014).

City of Ione

The City of Ione operates the COWRP tertiary treatment facility and a secondary wastewater treatment plant. The City provides wastewater collection, treatment and disposal services to 1,715 connections, treatment for ARSA wastewater discharges, and recycled water to a local golf course.

- **City of Ione WWTP –** The City of Ione owns and operates a WWTP that collects and treats wastewater for property within its corporate city limits. Wastewater is treated to secondary standards using treatment ponds and then disposed of through percolation/evaporation ponds (KSD 2012). The City needs to expand the storage and disposal capacity of its wastewater operations to accommodate future development beyond its existing commitments made through development agreements. Plans include modification of current pond systems and the addition of spray irrigation. ADWF for 2013 was 0.42 MGD or 471 AFY and is expected to expand to 1.34 MGD or 1,505 AFY by 2025 (Amador LAFCO 2014, 75). The City anticipates that 436 AFY of recycled water from this facility will be used in the future, leaving 1,069 AFY of potentially available recycled water in the future.

- **Castle Oaks Water Reclamation Plant –** The City also owns and operates COWRP, which accepts secondary effluent from ARSA and the Mule Creek State Prison and produces a disinfected tertiary Title 22 effluent suitable for unrestricted reuse to irrigate the golf course at the Castle Oaks residential development within the Ione city limits (RMC 2013). The Ione WWTP and COWRP are hydraulically connected with the Ione WWTP accepting backwash and drain water from COWRP and taking secondary effluent from ARSA and Mule Creek when this flow exceeds the irrigation demand of the golf course (Amador LAFCO 2014, 81). Annual wastewater flows for COWRP are currently 462 AFY and are projected to increase to 1,476 AFY in the future. The COWRP currently recycles and uses the entire 462 AFY and has plans to expand recycled water use with wastewater flow increases. As such, no additional recycled water is anticipated being available from this plant in the future.

City of Jackson

The City of Jackson owns and operates a WWTP which discharges secondary-treated effluent to Jackson Creek. The WWTP has a capacity of 796 AFY and currently treats 527 AFY of wastewater (Aegis 2013, 4-7). Development in the greater Jackson area is projected to result in a need to treat and dispose of 753 AFY of municipal wastewater by 2025, but flows are not expected to exceed plant design capacity before 2035 (Amador LAFCO 2014, 119). The City of Jackson does not currently use recycled water, nor does it have plans to in the future.

The WWTP, as noted above, discharges the treated effluent into Jackson Creek, which flows to Lake Amador, Jackson Valley Irrigation District's (JVIDs) water supply reservoir. The Regional Water Quality Control Board and Department of Public Health have expressed concerns that this may result in concentrations of treated wastewater higher than 5 percent of flows in Jackson Creek (Jackson 2012). As a result, the City of Jackson has been directed to upgrade their WWTP to full tertiary status by March 2018 (Central Valley RWQCB 2013). While the capacity of the plant will not change, the increased treatment will allow for a wider variety of uses (Jackson 2012).

City of Plymouth

The City of Plymouth's wastewater facility provides primary wastewater treatment prior to discharging the treated effluent through land disposal. Total current effluent flows at this facility are 135 AFY and are expected to grow to 909 AFY in the future. Plymouth is authorized to discharge the effluent to 125 acres of spray fields for disposal, of which 85 acres are usable for disposal (Amador LAFCO 2014, 161). It is estimated that this uses roughly 90 AFY of recycled water, which Plymouth will continue to use in the future. This leaves 819 AFY of potentially available recycled water in the future.

Currently, the City is working with Bella Victoria Family Vineyard on a program to supply recycled water to their vineyards adjacent to the City's wastewater treatment facility. The first phase of the project, at a cost of roughly $1.6 million, will supply 200 acres with secondary treated recycled water (City of Plymouth 2014, personal communication). The second phase will serve an additional 200 acres and is anticipated to cost between $600,000-700,000. This program will require the City of Plymouth to upgrade its treatment plant to secondary standards and would absorb the effluent associated with growth for the next 40 years (City of Plymouth 2014, personal communication). As such, there is not anticipated to be any secondary treated recycled water available from the City of Plymouth in the future, beyond what it planned to be provided for local agricultural use.

Mokelumne Hill Sanitary District

MHSD provides wastewater collection, treatment and disposal services to the unincorporated community of Mokelumne Hill (RMC 2013). The MHSD wastewater treatment plant treats to secondary standards and has an ADWF of 0.04 MGD or approximately 45 AFY, with an expected 56 AFY by 2035 (MWH 2009, 43). Treated effluent is currently stored in the storage pond until summer, when it is used to irrigate the spray disposal field which is used for cattle grazing. Recycled water is expected to be used for irrigation purposes in the future, so no additional available recycled water is anticipated in the future.

San Andreas Sanitation District

SASD provides wastewater collection, treatment and disposal services to the community of San Andreas and neighboring areas. The plant treats wastewater to secondary levels and polishes the resulting effluent in three post-secondary treatment ponds. SASD is capable of discharging up to 1,681 AFY by land disposal and discharge into San Andreas Creek, which ultimately flows into the North Fork of the Calaveras River (MWH 2009, 42). SASD treats and discharges approximately 340 AFY of effluent, which is projected to reach 482 AFY in 2035 (MWH 2009). SASD does not currently use recycled water, nor does it have any plans to do so in the future.

Valley Springs Public Utility District

VSPUD provides wastewater collection, treatment and disposal services to the unincorporated Valley Springs. VSPUD's treatment process includes the use of a treatment plant, pond processing, and disposal through evaporation and spray fields. The plant currently treats and discharges 67 AFY of wastewater to secondary standards, which is expected to expand to 187 AFY by 2025. Current discussions on future disposal methods include application for discharge permits and creation of a trench system for the spray fields (MWH 2009, 44-45). VSPUD does not currently use recycled water, nor does it anticipate using recycled water in the future.

Wallace Community Services District

WCSD provides wastewater collection, treatment and disposal services to the gated community of Wallace Lake Estates and the unincorporated town of Wallace, but contracted with CCWD in 2009 for operation and maintenance of WCSD wastewater facilities (RMC 2013). The WCSD's wastewater treatment system operates at the tertiary treatment level treating an ADWF of 0.019 MGD or 21 AFY, reaching 179 AFY of wastewater treatment due to growth by 2035. WCSD does not currently use recycled water; currently, all treated effluent, which is roughly 20 AFY, evaporates, transports, or percolates into the soil from the storage reservoir (MWH 2009, 46). In the future, 179 AFY of recycled water is considered potentially available for use.

Overall Upper Watershed Wastewater Flows

Based on the above data, the total amount of wastewater collected and treated currently by the agencies listed above is approximately 2,710 AFY. Of this, approximately 1,250 AFY is reclaimed and treated for use as an irrigation resource. The agencies above are projected to collect and treat approximately 8,300 AFY at build-out, which is around 2035 for most agencies, of which 4,745 AFY will be treated and utilized for irrigation and other recycled water uses. As shown in Table 2 below, this leaves approximately 3,600 AFY of recycled water that may be theoretically available in the future. Based on feasibility, cost, and other local considerations, roughly 3,500 AFY of recycled water is assumed to be available in the future, which includes 2,557 AFY of secondary treated effluent and 932 AFY of tertiary treated effluent. While small wastewater treatment plants are unable to provide the widespread benefits of larger wastewater treatment plants, they would provide opportunities for small scale projects through partnerships between local businesses and other local recycled water users.

Table 2: Wastewater Flows and Potential Recycled Water in the Upper Watershed

Agency	WWTP	Treatment Level*	Disposal Method**	Current*** WW ADWF (AFY)	Current† Recycled Water (RW) Use (AFY)	Future†† WW ADWF (AFY)	Future†† RW Use (AFY)	Future†† Available WW (AFY)
AWA	Lake Camanche WWTP	Secondary	Spray	56	56	110	110	0
AWA	Gayla Manor WWTP	Secondary	Subsurface and Spray	5.5	0	22	0	(theoretical) 22 (assumed) 0
ARSA (City of Sutter Creek)	City of Sutter Creek WWTP	Secondary	ARSA	***355***	151	1,023 (650 to Ione)	968 (650 to Ione)	(theoretical) 55 (assumed) 0
CCWD	La Contenta	Tertiary (Title 22)	Reclaimed	***225***	173	1,636	1,610	(theoretical) 26 (assumed) 0
EBMUD	Lake Camanche North Shore	Secondary	Spray	1.6	0	1.6 ^	0 ^	(theoretical) 1.6 (assumed) 0
EBMUD	Pardee Recreation Area	Secondary	Spray	1.7	0	1.7 ^	0 ^	(theoretical) 1.7 (assumed) 0
City of Ione	Secondary Treatment Plant	Secondary	Ponds	471	278	1,505	436	1,069
City of Ione	Castle Oaks Reclamation Plant (COWRP)	Tertiary (Title 22)	Reclaimed	462	462	1,476	1,476	0

Table 2: Wastewater Flows and Potential Recycled Water in the Upper Watershed

Agency	WWTP	Treatment Level*	Disposal Method**	Current*** WW ADWF (AFY)	Current† Recycled Water (RW) Use (AFY)	Future†† WW ADWF (AFY)	Future†† RW Use (AFY)	Future†† Available WW (AFY)
City of Jackson	City of Jackson WWTP	Tertiary (currently Secondary)	NPDES	527	0	753	0	753
City of Plymouth	City of Plymouth WWTP	Secondary	Spray	***135***	90 ˆ	909	90 ˆ	819
MHSD	Mokelumne Hill WWTP	Secondary	Reclaimed	***45***	45	56	56	0
SASD	San Andreas WWTP	Secondary	Spray & NPDES	***336***	0	482	0	482
VSPUD	Valley Springs WWTP	Secondary	Spray	***67***	0	187	0	187
WCSD	Wallace WWTP	Tertiary	Evaporation & Spray	***21***	0	179	0	179
Total Upper Watershed				**2,709**	**1,255**	**8,341**	**4,764**	**(theoretical) 3,595 (assumed) 3,489**

* Secondary = Secondary Level Treatment for Land Disposal, Tertiary = Tertiary Level Treatment for Land Disposal

** NPDES = Disposal to surface water via an NPDES permit, Reclaimed = Disposal of effluent via permitted reclaimed water uses, Spray = Disposal of effluent to above ground spray fields

*** Current volumes are from the year 2013. Italicized and bolded entries are from the years 2010 and 2011 or projected to 2013.

† Current volumes are based on the most recent available information.

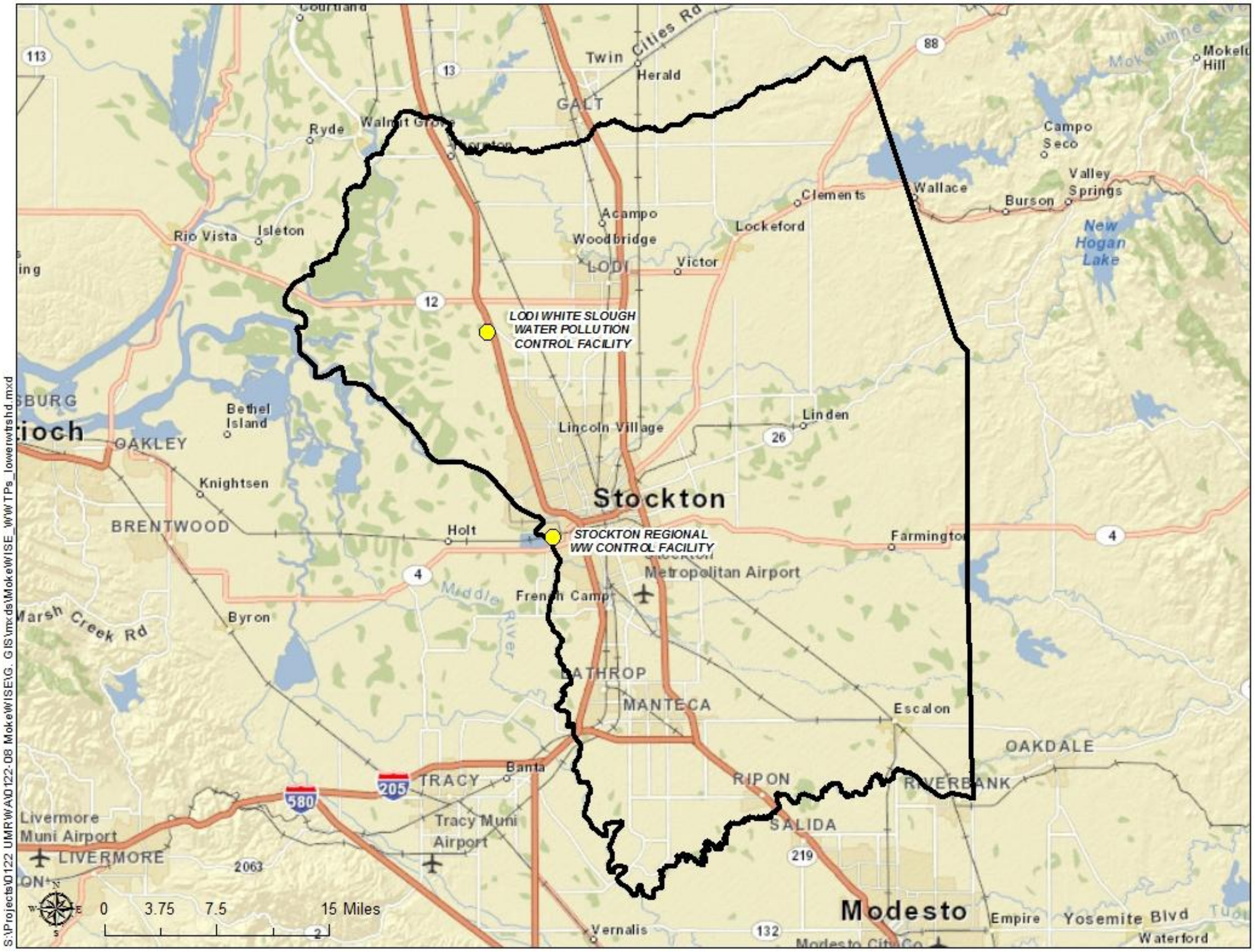
†† Future volumes vary among entities and range from the years 2025 to 2040.

ˆ Estimated number based on available information.

Lower Watershed

The following agencies own and operate the major wastewater collection and treatment facilities in the lower watershed: the City of Stockton and the City of Lodi. Both cities operate tertiary treatment facilities and discharge some, if not all, of the treated effluent to surface water. Together, the facilities collect and treat approximately 37,000 AFY of wastewater, which is projected to increase to 58,892 AFY in 2035. Total planned recycled water use is projected to amount to 2,842 AFY in 2035, with the remaining 56,050 AFY of tertiary-treated recycled water planned to be discharged to surface waters. The two wastewater treatment plants that lie within this area are described in greater detail below. All flows associated with the lower watershed are summarized in Table 3. Figure 6 identifies the location of each of the treatment plants discussed in the following sections.

Figure 6: Wastewater Treatment Facilities in the Lower Watershed



City of Lodi

The City of Lodi operates the White Slough Water Pollution Control Facility (WSWPCF) which currently treats approximately 7,100 AFY of wastewater, of which 1,642 AFY is used in the vicinity of WSWPCF for agricultural, aquacultural, and industrial uses. WSWPCF is capable of treating all wastewater flows to Title 22 tertiary standards and recently completed an upgrade which expanded capacity to 8.5 MGD (9,592 AFY) and allows the plant to meet future NPDES permit limits and long-term land management needs. The City currently discharges all wastewater effluent that is not used for recycled water into Dredger Cut, a slough flowing into the Delta (Lodi 2011, 23). It is anticipated that the City will use 2,842 AFY of recycled water in the future, which would theoretically leave 6,750 AFY of treated effluent available for reuse.

The City is considering an agricultural reuse project as part of its 2008 Reclaimed Water Master Plan. The project would provide approximately 3,700 AFY to agricultural and industrial customers adjacent to the WSWPCF (Lodi 2011,25). Therefore, of the 6,750 AFY of treated effluent that would theoretically be available in the future, 3,050 AFY is assumed to be available, after accounting for the agricultural reuse project.

City of Stockton

The City of Stockton owns and operates the Regional Wastewater Control Facility (RWCF), which provides tertiary treatment year round and was upgraded in May 2006. The RWCF currently treats 29,950 AFY of wastewater and until recently provided approximately 100 AFY of recycled water for agricultural purposes nearby. Future increases in wastewater flows are expected to approximately follow the population growth rate and projected water use of the City of Stockton Municipal Utilities Department (COSMUD) service area, reaching an estimated 49,300 AFY in 2035 (Stockton 2011, 4-15).

The City of Stockton holds a Section 1485 water right, which allows any municipality that disposes of treated wastewater into the San Joaquin River to seek a water right to divert a similar amount of water, less losses, from the San Joaquin River or the Delta, downstream of the wastewater discharge point. Because of this water right, the City's water supply is connected to their wastewater discharge. While 49,300 AFY of treated effluent is theoretically available in the future, because this amount is being reused as part of the City's water right, none would be available for use in a recycled water project.

Overall Lower Watershed Wastewater Flows

The total amount of wastewater collected and treated currently by the Cities of Lodi and Stockton is approximately 37,000 AFY. Of this, approximately 1,650 AFY is recycled for use. The cities are projected to collect and treat approximately 58,900 AFY at build-out, of which 2,842 is reasonably expected to be recycled. As shown in Table 3 below, this leaves approximately 56,050 theoretically available for recycling. However, based on currently planned projects and water right issues, 3,050 AFY of recycled water is assumed to be available in the future.

Table 3: Wastewater Flows and Potential Recycled Water in the Lower Watershed

Agency	WWTP	Treatment Level*	Disposal Method**	Current*** WW ADWF (AFY)	Current† Recycled Water (RW) Use (AFY)	Future†† WW ADWF (AFY)	Future†† RW Use (AFY)	Future†† Available WW (AFY)
City of Lodi	White Slough Water Pollution Control Facility (WSWPCF)	Tertiary (Title 22)	Reclaimed & NPDES	7,095	1,642	9,592	2,842	(theoretical) 6,750 (assumed) 3,050
City of Stockton	Regional Wastewater Control Facility (RWCF)	Tertiary (Title 22)	NPDES	29,950	0	49,300	0	(theoretical) 49,300 (assumed) 0
Total Lower Watershed				**37,045**	**1,642**	**58,892**	**2,842**	**(theoretical) 56,050 (assumed) 3,050**

* Secondary = Secondary Level Treatment for Land Disposal, Tertiary = Tertiary Level Treatment for Land Disposal
** NPDES = Disposal to surface water via an NPDES permit, Reclaimed = Disposal of effluent via permitted reclaimed water uses
*** Current volumes are from the year 2013. Italicized and bolded entries are from the years 2010 and 2011 or projected to 2013.
† Current volumes are based on the most recent available information.
†† Future volumes vary among entities and range from the years 2025 to 2040.

EBMUD Service Area

The final area covered in this study is the group of wastewater collection service areas that lie within the EBMUD water service area, which together serve 1.34 million people (EBMUD 2011, 1-2). This area includes the following wastewater purveyors: EBMUD Special District Number 1 (SD-1), City of San Leandro, Dublin San Ramon Services District (DSRSD), Central Contra Costa Sanitary District (CCCSD), the Cities of Pinole and Hercules, Richmond Sanitary District, West County Wastewater District (WCWD), Rodeo Sanitary District (RSD), Oro Loma Sanitary District (OLSD), and Crockett Community Services District (CCSD). While these agencies are not within the watershed, if any of these agencies generated recycled water that offset demands which would otherwise be met through EBMUD potable water supplies, EBMUD demand for Mokelumne supply could potentially be reduced, freeing up additional Mokelumne supply for other uses.

Some of these districts, such as EBMUD SD-1, DSRSD, and Oro Loma Sanitary District operate and maintain intercepting sewers that receive and transport wastewater from collection systems that are owned and operated by communities within these districts. Alternatively, the communities of San Leandro, Pinole, Hercules, Richmond, and Rodeo own and maintain both the collection systems and the interceptor systems within their respective jurisdictions. Treated wastewater produced by wastewater treatment plants within the EBMUD water service area that is not recycled is discharged through pipelines or outfalls to San Francisco Bay, Suisun Bay, or San Pablo Bay and also provides a supply for recycled water programs.

Wastewater treatment flows in these WWTPs range from ADWF of 0.55 MGD to 74 MGD, with most treating less than 15 MGD or about 16,800 AFY. All of the wastewater treatment plants treat to secondary levels with some treating a portion of their flows to Title 22 tertiary standards for recycling purposes. Recycled water use is assumed to be the different between the wastewater produced and the non-recycled wastewater treated and discharged (EBMUD 2011, 5-3, 5-4). Each of these agencies is described below and summarized in Table 4. Figure 7 identifies the location of each of the treatment plants discussed in the following sections.

Figure 7: Wastewater Treatment Facilities in EBMUDs Service Area*

* CCCSD and DSRSD WWTPs, while outside of EBMUDs service area, are owned by agencies whose potable water needs are served by EBMUD.

Central Contra Costa Sanitary District

Located in Martinez, CCCSD operates a wastewater facility that treats wastewater to a secondary level before discharging the majority of the treated effluent to Suisun Bay. A portion of the secondary effluent is treated to a tertiary level and reused for landscape irrigation, industrial processes, and plant operations (CCCSD 2014). The plant currently treats 41,474 AFY of wastewater to secondary levels and 1,841 AFY of treatment to tertiary levels. The plant is projected to treat 56,045 AFY of wastewater to secondary levels and 785 AFY to tertiary levels in 2040 (EBMUD 2011, 5-3). Future recycled water use is anticipated to be 785 AFY, leaving 55,260 AFY of potentially available recycled water.

Cities of Pinole and Hercules

The Pinole/Hercules Water Pollution Control Plant (WPCP) treats wastewater from the cities of Pinole and Hercules. The WPCP has been upgraded from a primary to a secondary treatment facility (City of Pinole 2014). The majority of flows are treated to secondary levels; however, flows in excess of 10.3 MGD do not receive secondary treatment and are blended with secondary effluent, disinfected and discharged to San Pablo Bay via Rodeo Sanitary District's outfall and its own Emergency Outfall (HDR 2013, 1). Currently, the WPCP treats 3,923 AFY of wastewater and is projected to treat 4,484 AFY by 2040. The cities anticipate that 4,147 AFY will be used as recycled water, leaving 337 AFY of potentially available recycled water.

Richmond Sanitary District

The Richmond WWTP treats water to secondary levels and then discharges to the San Francisco Bay through a joint outfall with WCWD (Contra Costa LAFCO 2014). This WWTP currently treats 9,528 AFY of wastewater and does not currently recycle water nor have plans to expand or update the plant for tertiary treatment (EBMUD 2011, 5-3).

City of San Leandro

The San Leandro Water Pollution Control Plant (WPCP) cleans 5 MGD of wastewater to a secondary level and disposes of this flow to the San Francisco Bay (San Leandro 2014). A portion of the wastewater is treated to tertiary standards and used for golf course irrigation. As of 2010, the plant was treating approximately 5,605 AFY of wastewater and is expected to treat 7,846 AFY by 2040 (EBMUD 2011, 5-3). The City anticipates using 5,885 AFY of recycled water in the future, leaving 1,961 AFY of recycled water potentially available for use (EBMUD 2011, 5-3).

Crockett Community Services District

CCSD has two Sanitary Departments which have separate wastewater systems and serve the unincorporated Crockett and Port Costa communities. The Crockett Sanitary Department (CSD) is responsible for the collection system in the town of Crockett and issues related to the Philip F. Mead Treatment Facility, which is jointly used with the C&H Sugar Company. The plant treats wastewater generated in the sugar refining process and pretreated domestic wastewater. Secondary treated effluent is discharges into the Carquinez Strait tributary to the San Francisco Bay (Contra Costa LAFCO 2014, 171172). The current ADWF is 0.7 MGD or 785 AFY, and is projected to remain constant through 2040. Recycled water is not currently used, nor are there plans for use in the future.

Dublin-San Ramon Sanitary District

DSRSD owns and operates a regional WWTP, which treats wastewater from Dublin, South San Ramon, and Pleasanton. The wastewater treatment plant includes conventional secondary treatment facilities. A portion of the secondary effluent from the WWTP is treated further to produce Title 22 disinfected tertiary recycled water. Wastewater that is not recycled is discharged into the San Francisco Bay through a pipeline owned by the Livermore-Amador Valley Water Management Agency (LAVWMA). In 2010, DRSRSD measured 16,309 AFY of treated effluent, of which 2,977AFY was reused (DSRSD 2011, 98). DSRSD projects that by 2035, the treatment plant will treat approximately 21,000 AFY of wastewater, all of which is anticipated to be recycled, and thus, not considered available for use by the MokeWISE program.

EBMUD

EBMUD's wastewater service district (known as SD-1) provides primary and secondary wastewater treatment, followed by disinfection, dechlorination, and discharge via a deep-water outfall one mile off the East Bay shore into San Francisco Bay (EBMUD 2011, 5-7). The EBMUD Main WWTP currently treats an ADWF of approximately 83,000 AFY and is projected to maintain this level of treatment and discharge through 2040. EBMUD anticipates that 7,510 AFY of recycled water from this facility will be used in the future, leaving 75,437 AFY of recycled water potentially available for use in the future.

Oro Loma Sanitary District

The Oro Loma WWTP is jointly owned by OLSD and Castro Valley Sanitary District and treats wastewater to a secondary level. Treated effluent is disposed of through a collectively-owned discharge pipe into the deep waters of San Francisco Bay (Oro Loma 2013). A portion of the secondary treated effluent is sent to the Sky West Golf Course and used for irrigation purposes. In total, the Oro Loma WWTP treats 15,132 AFY of wastewater and is expected to treat 19,055 AFY by 2040 (EBMUD 2011, 5-7). The City currently uses 291 AFY of recycled water, which it is expected to maintain in the future (EBMUD 2011).

Rodeo Sanitary District

The RSD Wastewater Treatment Facility treats wastewater to secondary levels and discharges treated effluent to San Pablo Bay via a joint outfall with the Pinole-Hercules WPCP (Contra Costa LAFCO 2014). The RSD treatment facility currently treats 615 AFY of wastewater and expects to increase wastewater treatment to 785 AFY in the future (EBMUD 2011, 5-3). RSD does not currently use recycled water, nor does it have plans to in the future (EBMUD 2011).

West County Wastewater District

WCWD owns, operates, and maintains a Water Pollution Control Plant (WPCP) with a capacity of 12.5 MGD ADWF. The WPCP treats an average of 6.6 MGD or approximately 7,400 AFY of water to secondary treatment level. WCWD's final effluent is pumped to EBMUD's Richmond Advanced Recycled Expansion (RARE) facility and North Richmond Water Reclamation Plant (NRWRP) for additional treatment and reuse by Chevron's boiler and cooling tower facilities (Carollo 2013, 1). The WCWD WPCP is projected to treat 8,967 AFY of wastewater beginning in 2015 and through 2040, all of which will be recycled (EBMUD 2011, 5-7).

Overall EBMUD Service Area Wastewater Flows

Based on the above data, the total amount of wastewater collected and treated currently by the agencies in the EBMUD water service district is currently 183,718 AFY. Of this, approximately 18,400 AFY is currently used as a recycled water source. The agencies above are projected to collect and treat approximately 211,400 AFY by 2040, of which 48,559 AFY will be treated and utilized as recycled water. As shown in Table 4 below, this leaves 162,857 AFY of treated effluent that is theoretically available as recycled water.

It is understood that the 162,857 AFY that is theoretically available as recycled water in the future is not realistic, largely due to the costs and the regulatory structure required to implement this amount. In 2008, EBMUD developed the Water Supply Management Program 2040 (EBMUD 2012c), which included an assessment of the potential recycled water market. The assessment estimated the recycled water demand as a percentage of average potable water demand, excluding users with potential demands less than 1.5 AFY. The results indicate that the potential future demand associated with existing accounts is approximately 33,500 AFY, comprised of 22,000 AFY for irrigation of public or common areas, 9,500 AFY for indoor industrial use, and 2,000 AFY of indoor commercial use (EBMUD 2012c, 4-8). Due to the lack of available information on projected water demands for future users, recycled water demand estimates for potential future users were not developed. The 33,500 AFY amount has been provided in this document to help benchmark the recycled water use that could potentially be available.

Table 4: Wastewater Flows and Potential Recycled Water in the EBMUD Service Area

Agency	WWTP	Treatment Level*	Disposal Method**	Current*** WW ADWF (AFY)	Current† Recycled Water (RW) Use (AFY)	Future†† WW ADWF (AFY)	Future†† RW Use (AFY)	Future†† Available WW (AFY)
Central Contra Costa Sanitation District	CCCSD WWTP	Secondary Tertiary (Title 22)	Reclaimed & SW Discharge	41,474	1,841	56,045	785	55,260
Cities of Pinole and Hercules	Pinole-Hercules WWTP	Secondary	Reclaimed & SW Discharge	3,923	0	4,484	4,147	337
Richmond SD	Richmond WWTP	Secondary	NPDES	9,528	0	9,528	0	9,528
City of San Leandro	San Leandro Water Pollution Control Plant (WPCP)	Secondary Tertiary (Title 22)	Reclaimed & SW Discharge	5,605	4,203	7,846	5,885	1,961
Crockett Community Services District	Philip F Mead Wastewater Treatment Plant	Secondary	SW Discharge	785	0	785	0	785
DSRSD	Regional Wastewater Treatment Facility	Secondary Tertiary (Title 22)	Reclaimed & SW Discharge	16,309	2,977	20,974	20,974	0
EBMUD SD-1	Main WWTP	Secondary Tertiary (Title 22)	Reclaimed & SW Discharge	82,947	1,681	82,947	7,510	75,437
Oro Loma SD	Oro Loma WWTP	Secondary	Reclaimed & SW Discharge	15,132	291	19,055	291	18,764
Rodeo SD	Rodeo Wastewater Treatment Facility	Secondary	SW Discharge	785	0	785	0	785
West County WD	WCWD WWTP	Secondary Tertiary (Title 22)	Reclaimed & SW Discharge	7,398	7,398	8,967	8,967	0
Total EBMUD Service Area				**183,718**	**18,391**	**211,416**	**48,559**	**162,857 (theoretical) <162,857 (assumed) †††**

* Secondary = Secondary Level Treatment for Land Disposal, Tertiary = Tertiary Level Treatment for Land Disposal
** NPDES = Disposal to surface water via an NPDES permit, Reclaimed = Disposal of effluent via permitted reclaimed water uses
*** Current volumes are from the year 2013. Italicized and bolded entries are from the years 2010 and 2011 or projected to 2013.
† Current volumes are based on the most recent available information.
†† Future volumes vary among entities and range from the years 2025 to 2040.
††† **EBMUDs WSMP** 2040 cites 33,500 AFY as the potential annual recycled water demand (EBMUD 2012c).

Combined Flows in the Upper and Lower Watershed and EBMUD Retail Service Area

Current Recycled Water Use

The amount of wastewater currently being treated and discharged is estimated to be roughly 223,500 AFY, as indicated in Table 5. Of this amount, approximately 21,000 AFY is currently being reused for irrigation, cooling, or other purposes within the EBMUD water service area and the upper and lower watersheds.

Table 5: Recycled Water Currently Used within the Upper and Lower Watersheds and EBMUD's Service Area

Region	Current* WW ADWF (AFY)	Current† Recycled Water (RW) Use (AFY)
Total Upper Watershed	2,709	1,255
Total Lower Watershed	37,045	1,642
Total EBMUD Water Service Area	183,718	18,391
Total	**223,472**	**21,288**

* Current values are based on the most recent available information and range from years 2010 to 2013.
† Current values are based on the most recent available information.

Future Recycled Water Available

Recycled water theoretically available for use in the future is calculated to be 222,511 AFY, as shown in Table 6 below. Due to challenges and constraints as outlined in the following section, the amount assumed available in the future is reduced to approximately 170,000 AFY. These were calculated by taking the difference between projected future treated wastewater treatment effluent and anticipated recycled water use in the future.

Table 6: Recycled Water Assumed Available for the MokeWISE Program

Region	Future†† WW ADWF (AFY)	Future†† RW Use (AFY)	Available WW (AFY)
Total Upper Watershed	8,341	4,746	(theoretical) 3,595 (assumed) 3,489
Total Lower Watershed	58,892	2,842	(theoretical) 56,050 (assumed) 3,050
Total EBMUD Retail Service Area	211,416	48,559	(theoretical)162,857 (assumed) <162,857
Total	**278,649**	**56,147**	**(theoretical) 222,502** **(assumed) <169,396**

††Future values vary among entities and range from 2025 to 2040.

Summary of Potential Recycled Water Supplies

Recycled water potentially available for the MokeWISE program is estimated to be 222,500 AFY. However, due to constraints and challenges associated with treating and delivering recycled water, the total available decreases to approximately 169,400 AFY. This includes an estimated 126,720 AFY in secondary treated recycled water and roughly 42,680 AFY in tertiary treated recycled water available. Future recycled water opportunities within the upper and lower watersheds accounts for roughly 6,500 AFY of the total recycled water potentially available, while the remaining approximately 162,900 AFY is generated in the EBMUD retail service area.

Challenges with Maximizing Recycled Water Use

Challenges associated with the use of recycled water as a supply in the MokeWISE program are listed below. These challenges will limit the ability to implement recycled water as part of the MokeWISE process.

- **Timing and storage**. Recycled water use can be limited by the timing of supply and demand. While supply is available year-round, demand is often limited to the summer months, particularly if the recycled water demand is largely irrigation. Because of this discrepancy in the timing of supply and demand, storage is needed. However, storage can be costly and space for storage limited, particularly in urban areas and in areas with limited groundwater recharge ability.
- **Economic feasibility**. Recycled water projects can be costly, potentially limiting the ability of agencies implement projects and support ongoing operation and maintenance costs. While there are various funding opportunities available to help offset initial capital costs, agencies may reach a point of diminishing returns on recycled water projects. That is, the marginal cost of implementing the last few recycled water projects may be significant and those projects may not be economically feasible. While this point of diminishing returns may change over time as technology advances, some of the recycled water theoretically available for MokeWISE may not be economically feasible.
- **Coordination costs**. Many recycled water projects require multiple agencies to implement. Coordination costs may be significant in large-scale projects that require multiple agencies. For example, while there is roughly 163,000 AFY theoretically available within the EBMUD water service area, only about 75,500 AFY of that is from EBMUD's Main WWTP. Coordination with nine agencies would be required to utilize the 163,000 AFY. This level of coordination may significantly limit the quantity of recycled water that could realistically be achieved.
- **Infrastructure requirements**. In the case of EBMUD, it is difficult to retrofit facilities already using EBMUD potable water. Because infrastructure relies on current demands in established areas, issues may arise if potable demands decrease.

Furthermore, the EBMUD service area is not planned for much growth that could use recycled water, as the majority of planned growth is infill and densification.

- **Benefit allocation.** Increasing recycled water use outside of the Mokelumne River watershed could potentially create issues with how benefits are apportioned within the watershed. For example, recycled water use in southern California has supported additional growth rather than reducing imports from other regions.
- **Market potential**. Recycled water projects can only be implemented if sufficient market demand exists to use the supply. Recycled water is primarily used for nonpotable, outdoor demands, which represent a subset of total demand. While recycled water can also be used to meet potable demands through indirect or direct potable reuse, regulatory requirements for potable reuse are currently evolving in California, adding some uncertainty to the feasibility of implementation, particularly given high costs of treatment to potable quality. Depending on the extent of market potential, the amount of recycled water that can be used within the planning horizon of the MokeWISE program may change.
- **Local considerations**. Each local agency has a unique setting which must be considered prior to implementing recycled water projects. For example, the City of Stockton produces 49,300 AFY of treated effluent that could theoretically be reused. However, due to the structure of the City's water rights, this amount would result in a need to secure additional supplies and would therefore not generate a net increase in available supply. Additionally, some agencies overlap with the EBMUD service area. Recycled water projects would need to be implemented within the overlap with the EBMUD service area to create benefits to the Mokelumne River watershed.
- **Scalability**. Small wastewater treatment plants may provide recycled water that is potentially available in the future. For instance, AWA's leachfields produce small quantities and are not proximate to potential recycled water customers. As such, projects involving recycled water from these leachfields are considered infeasible.
- **Groundwater basin proximity.** Recycled water could potentially be used to recharge the Eastern San Joaquin Groundwater Basin. However, feasibility of a recycled water recharge project may depend on the origin of the recycled water. Because of the proximity to the Eastern San Joaquin Groundwater Basin, recycled water from the lower watershed would likely be the most feasible for use in a recharge project. Because Stockton's assumed available supply is 0 AFY, only the 3,700 AFY of recycled water from Lodi or other valley cities could potentially be used for recharge. While recycled water supplies from EBMUD and the upper watershed could be used for recharge, this supply would only be feasible through an exchange.
- **Downstream impacts**. Recycled water, particularly on the municipal scale, must consider the downstream impacts. As with agricultural drainage water, reuse of recycled water could decrease this source for downstream users, thereby potentially decreasing the amount of water available for downstream users.

Opportunities for Maximizing Recycled Water Use

The following are potential opportunities for maximizing recycled water use. These examples can be considered when discussing potential MokeWISE projects and programs.

- **Non-potable uses.** The use of recycled water for non-potable uses such as irrigation and toilet flushing is becoming increasingly common, and there is likely demand for expanded use of recycled water for these purposes. Use of recycled water for non-potable purposes requires a lower level of treatment than other potential uses of recycled water, such as indirect or direct potable reuse, though infrastructure requirements may be more significant. Dual-pipe systems could be used to support recycled water use in urban and suburban infill areas.
- **Saline intrusion barrier.** There are a number of areas within the San Joaquin Valley that are experiencing or are expected to experience saline intrusion, resulting in degradation of groundwater supplies. Wastewater agencies adjacent to areas experiencing saline intrusion could inject recycled water into the groundwater basin to provide a barrier against saline intrusion.
- **Indirect potable reuse/direct potable reuse**. Regulations are currently in place allowing indirect potable reuse of recycled water via groundwater recharge, and such programs could be implemented to develop this practice within the MokeWISE region. Surface water augmentation regulations for indirect potable reuse and state guidelines for direct potable reuse are expected in 2016, which may enable expanded use of recycled water for potable purposes.
- **Direct injection**. Recycled water could be directly injected into the groundwater basin to help stabilize groundwater levels and offset Mokelumne River water use.

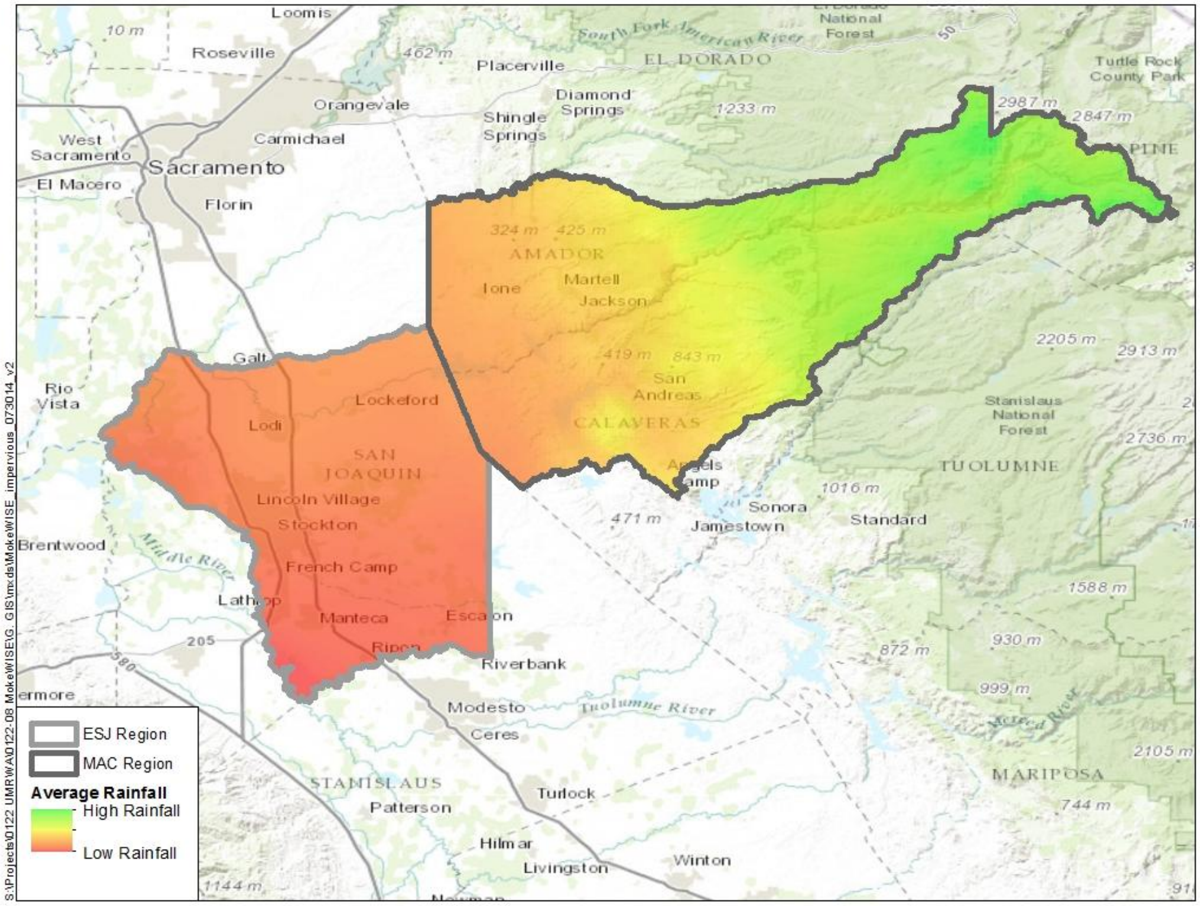
Stormwater

Stormwater is precipitation, including rain, sleet, and melting snow, that runs off impervious surfaces. There is significant rainfall within the Mokelumne watershed, but it is highly variable and seasonal, with most precipitation occurring between November and May and very little occurring from late spring to fall. Greater rainfall typically occurs in the eastern portion of the Mokelumne River watershed (Sierra Foothills), compared to the western portion (San Joaquin Valley), as shown in Figure 8. Stormwater runoff that is not currently captured or infiltrated to groundwater may be available for a MokeWISE project.

In order to identify the potential supply available from stormwater capture, the amount of stormwater runoff that is not captured or infiltrated was estimated. For residential areas in the upper and lower watersheds, this was estimated by identifying impervious areas and estimating the average annual rainfall and snowmelt in those areas and assuming that some residential homes would participate in a rain barrel program. On a large-scale, stormwater from the municipal systems in Lodi and Stockton was estimated; it was assumed that municipal systems in the upper watershed would not contribute a substantial amount of stormwater for the MokeWISE program. As a final step, large-scale and small-scale stormwater capture programs were evaluated and existing stormwater programs in the MAC and ESJ regions were reviewed.

The EBMUD service area is not considered in this analysis because EBMUD is currently embarking on a study that will calculate theoretical stormwater supplies available within the EBMUD service area (see Appendix A for scope of work). EBMUD anticipates dividing the service area into two regions based on rainfall and will estimate monthly rainfall in a variety of year types, taking into account two climate change scenarios. For each region, EBMUD anticipates identifying the number and average property size, as well as the area of municipal open space, to develop an estimate of the amount of stormwater that could theoretically be captured within the EBMUD service area. This study is currently underway and is anticipated to be complete in spring 2015. If possible, results from that study will be incorporated into this analysis as appropriate.

Figure 8: Average Rainfall in the Region



Potential Stormwater Capture

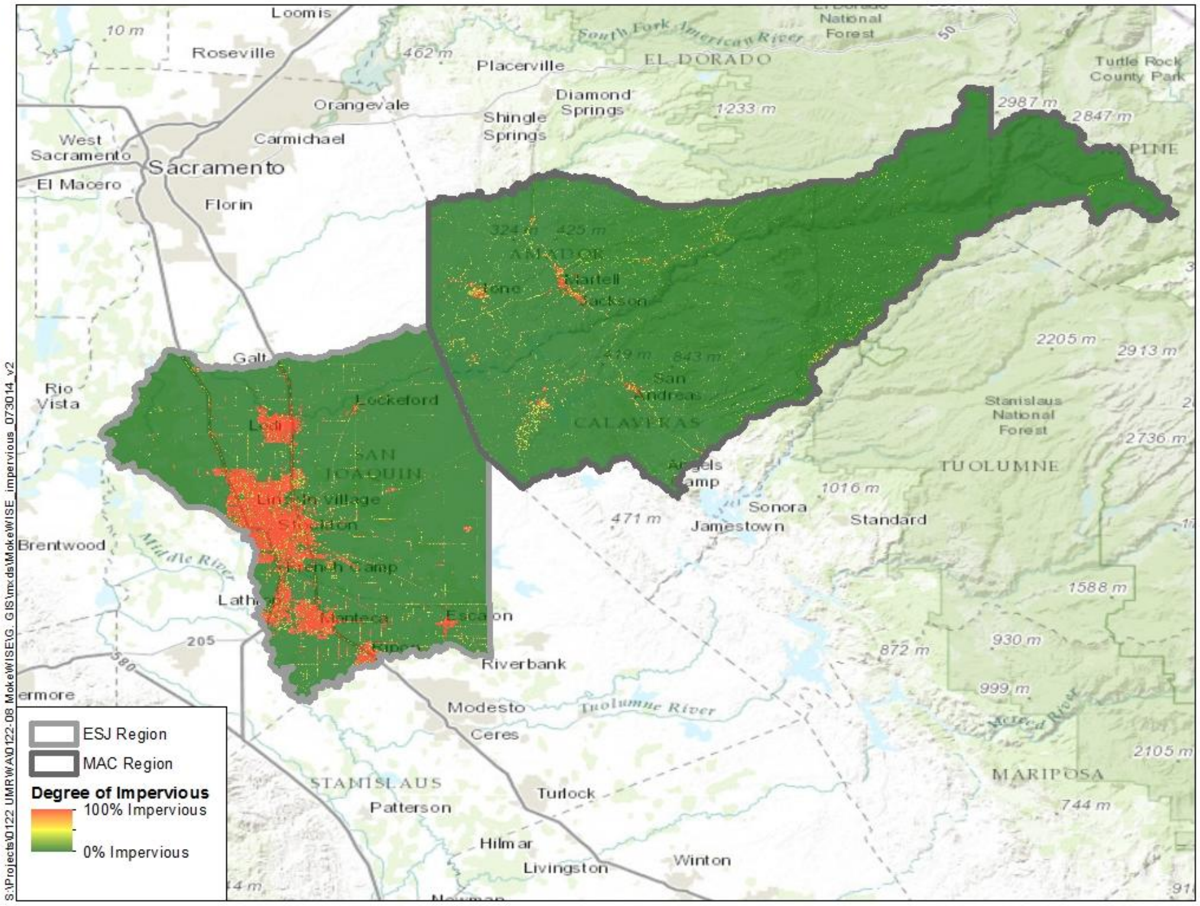
Identification of Impervious Areas

In general, only precipitation that falls on impervious surfaces is available for capture and potential reuse. Impervious areas include streets, roads, parking lots, populated areas, rooftop, and other surfaces. In developed areas, stormwater may be collected and conveyed through a network of storm drains which eventually discharge to local creeks or the river. Rainfall reaching pervious areas tends to infiltrate and supplement the groundwater supply, and could not be readily captured for alternate use. Therefore, areas with the greatest concentrations of impervious surfaces have the greatest potential for stormwater capture and reuse. To determine the extent of impervious area in the region, land use data was acquired from the USGS's 2011 update to the National Land Cover Database (NLCD). The 30 meter resolution dataset displays the impervious land contained within each cell as a percentage. For example, an area designated as 80 percent impervious is, on average, 20 percent pervious area with the remaining area being impervious. Masking the dataset to the MAC and ESJ regions and applying zonal statistics tools in GIS provided the following results.

Total Area of MokeWISE Region: 1,559,235 acres
Average Percent of Impervious Area in the Region: 3.25%
Total Impervious Area in the Region: 50,657 acres

As shown in Figure 9, areas with high concentrations of impervious area tend to be more urban in nature, such as the cities of Stockton, Lodi, and Manteca. These communities have more paved areas, buildings, and developed areas compared to communities that are more rural in nature.

Figure 9: Impervious Areas in the Region



Rainfall in the Region

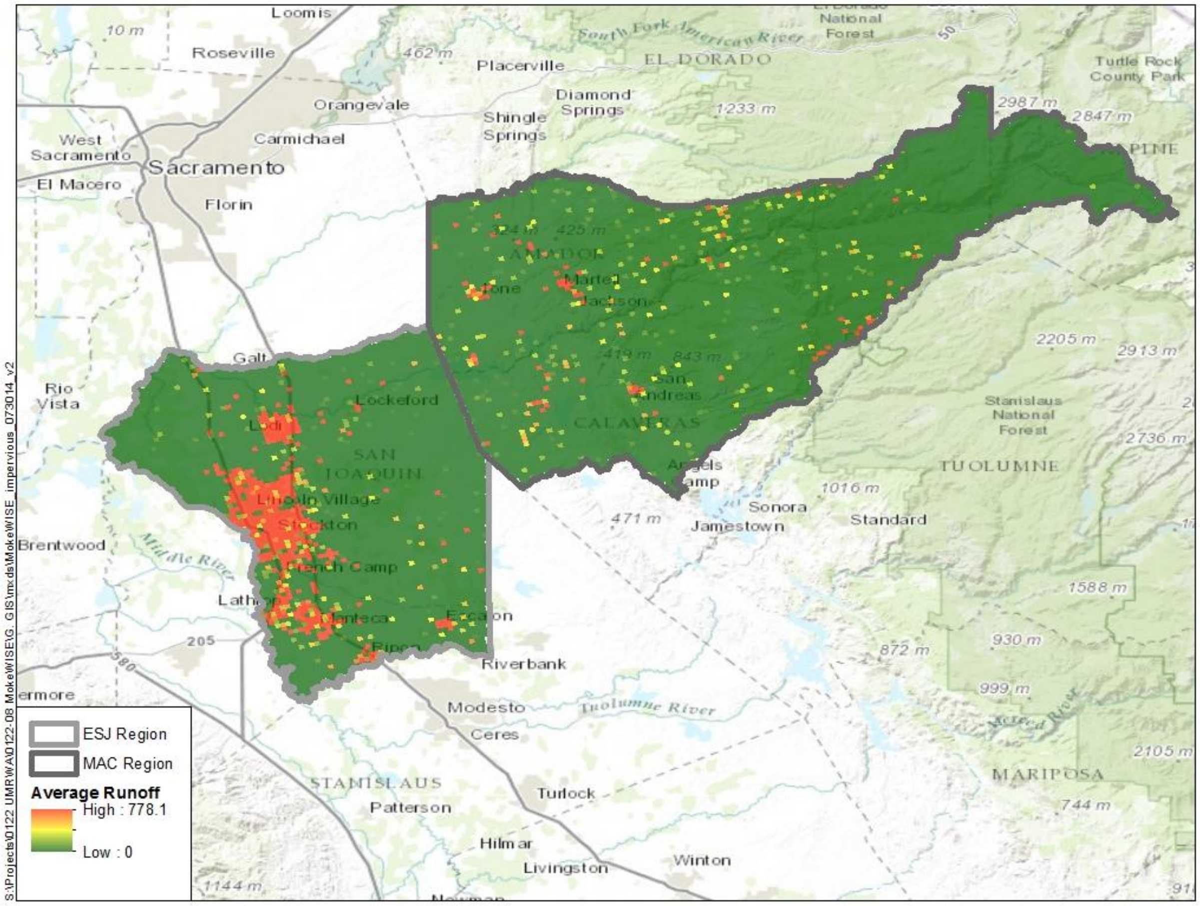
A comprehensive, 30-year dataset from the PRISM Climate group was used to estimate precipitation in the MokeWISE region. This data set provides a long-term representation of potential stormwater capture in the region. CDEC data and data from other sources are incorporated into the PRISM dataset. The PRISM Climate Group gathers climate observations from a wide range of monitoring networks, applies quality control, and develops datasets that represent precipitation (rain and snowmelt) averaged from 1981-2010 with an 800m x 800m cell size. Data sources include Bureau of Reclamation Agricultural Weather Network (AGRIMET), California Data Exchange Center (CDEC), Community Collaborative Rain, Hail and Snow Network (COCORAHS), National Weather Service Cooperative Observer Program (COOP), National Oceanic and Atmospheric Administration Hydrometerological Design Studies Center (NOAA HDSC), U.S. Forest Service and Bureau of Land Management Remote Automated Weather Stations (RAWS), Natural Resources Conservation Service Snowpack Telemetry (SNOTEL), Natural Resources

Conservation Service Snow Course (SNOWCOURSE), Western Regional Climate Center (WRCC), miscellaneous long-term precipitation storage gage stations, and others (NACSE, 2012). Using the PRISM precipitation dataset and the previous evaluation of impervious area in the region, the following rainfall estimates were determined for the region. These values were calculated by multiplying the precipitation raster dataset by the impervious area dataset.

Mean Precipitation per Year in the Region: 3,839,900 acre-feet per year (AFY)
Mean Stormwater Runoff per Year on Impervious Surfaces: 72,964 AFY

As shown in Figure 10, stormwater runoff capture and reuse has greater potential in the more populated areas of the ESJ Region, with some localized areas throughout the MokeWISE region as a whole. Because capturing all of the 72,964 AFY of available stormwater is infeasible, further analysis was conducted to determine the amount of potentially feasible stormwater available to be captured within residential areas and by municipal systems.

Figure 10: Average Stormwater Runoff in the Region



Potential Stormwater within Residential Areas

To determine the amount of stormwater potentially available in residential areas within the watershed, the cities of Jackson and Stockton were assumed to be representative of the upper and lower watersheds, respectively.

Zoning data from these two cities and level of development data from the NLCD was used to determine the percentage of residential developed area. The percentage for Stockton was calculated to be 45.41 percent and the percentage for Jackson was 61.84 percent (see Table 7). These percentages were applied to the total developed area with each watershed to determine the total area of residential developed area within the upper and lower watersheds. Total residential developed area within the upper watershed was calculated to be roughly 3,030 acres and approximately 33,170 acres in the lower watershed (see Table 8).

Table 7: Metrics for Upper and Lower Watershed Representative Cities

Metric	Stockton	Jackson
Area of City (acres)	112,745	2,280
Average Total Area of Residential (acres)	14,436	1,100
Total Area of Developed Area (acres)	31,790	1,790
Percent of Developed Area that is Residential	45.41%	61.84%
Average Residential Parcel Size (acres)	0.13	0.82

Sources: City of Jackson 2008, City of Stockton 2013.

For the purposes of this analysis, it was assumed that 25 percent of all residential parcels would participate in a rain barrel program by installing a barrel or other stormwater capture and reuse system. Based on data from Jackson and Stockton, the average residential parcel size in the upper watershed was estimated to be 0.82 acres and 0.13 acres in the lower watershed (see Table 7). Assuming 25% of the total residential area would participate in a program, 760 acres in the upper watershed and 8,290 acres in the lower would participate in a rain barrel program (see Table 8). Assuming that 10% of a residential parcel is roof space, the total residential acreage in each watershed that would be available to capture stormwater is 829 acres in the lower watershed and 76 acres in the upper watershed.

Table 8: Metrics for Calculating Residential Area in Upper and Lower Watersheds

Metric	Lower Watershed	Upper Watershed
Total Developed Area (acres)	73,030	4,900
Total Area of Developed that is Residential (acres)	33,170	3,030
Total Area of Residential Developed Participating in a Rain Barrel (acres)	8,290	760
Total Area of Roofs within Residential Developed Participating in a Rain Barrel (acres)	829	76

Source: NLCD 2011, City of Jackson 2008, City of Stockton 2013.

Monthly data from two stations located in the upper watershed (Camp Pardee and West Point) and from two stations in the lower watershed (Lodi and Stockton Fire Station 4) were averaged to obtain the average monthly rainfall for the upper and lower watersheds. To determine the amount of stormwater that could potentially be captured in irrigation months through residential rain barrels or other rainwater capture and reuse systems, the average monthly rainfall was obtained from CDEC (see Table 9).

Table 9: Average Monthly Rainfall in Upper and Lower Watersheds

	Average Rainfall (inches)	
Month	**Lower Watershed**	**Upper Watershed**
January	3.25	5.47
February	2.69	4.71
March	2.30	4.35
April	1.41	2.64
May	0.44	1.01
June	0.12	0.33
July	0.05	0.09
August	0.06	0.12
September	0.23	0.34
October	0.74	1.52
November	1.84	3.37
December	2.87	4.70
Total	**16.00** **1.33 (feet)**	**28.65** **2.39 (feet)**

Source: CDEC 2014

To determine the amount of stormwater that could potentially be captured all year, assuming adequately-sized rainwater capture and reuse systems and sufficient demand for captured supplies, the average yearly rainfall was used (Table 9). Multiplying the average yearly rainfall by the acreage of the residential developed roofing area that would participate in a rain barrel program yields the stormwater that could potentially be captured in the upper and lower watersheds.

Upper Watershed: <u>180 AFY</u>
Lower Watershed: <u>1,103 AFY</u>

Assuming 50 percent losses due to evaporation, transpiration, and minimal recharge, the total amount of stormwater available to be captured and reused in residential areas within the watershed is approximately:

Upper Watershed: 90 AFY
Lower Watershed: 551.5 AFY
Total: 641.5 AFY

Potential Stormwater from Municipal Systems

City of Stockton

The City of Stockton monitors the quality of its stormwater, but does not have a system for measuring quantity (City of Stockton 2014a personal communication). To estimate the amount of stormwater discharged through the municipal system and therefore potentially available to be used, the acreage of developed commercial and industrial land was determined and multiplied by the average annual rainfall in the City of Stockton. The precipitation gage at the Stockton Fire Station 4 indicates that the average annual rainfall is 15.67 inches, or 1.31 feet. There are roughly 17,400 developed acres within the City of Stockton that are dedicated to commercial and industrial uses. This yields approximately 22,700 AFY of stormwater potentially available to the municipal system. Assuming 50 percent losses, the total potential amount of stormwater that is discharged through the City of Stockton's municipal system and that could be captured and reused is 11,370 AFY.

City of Lodi

The City of Lodi discharges all of its stormwater through 18 outlets with pipes ranging in diameter from 8 to 72 inches (Black and Veatch 2003, 5-23). While some of the stormwater is discharged in Lodi Lake, the majority is discharged into the Woodbridge Canal, per the Storm Drainage Discharge Agreement between the two entities. This agreement allows the City to discharge a total maximum of 160 cubic feet per second (cfs), not to exceed 60 cfs per discharge site, during the winter (Black and Veatch 2003, 5-23). These rates are reduced to 40 cfs and 20 cfs, respectively, during the summer. Woodbridge Irrigation District (WID) charges the City of Lodi annually for discharging its stormwater. These rates are determined by multiplying the amount of rainfall per a given year by the area of the City (Woodbridge Irrigation District 2014, personal communication).

The City of Lodi is roughly 14 square miles, or 8,845 acres. The City's average annual rainfall from 2000-2010 was 16.97 inches, or 1.47 feet (NOAA 2014). This yields approximately 13,000 AFY of stormwater potentially discharged from the City of Lodi. However, because a portion of this amount is already considered in the residential analysis, the residential developed areas must be removed from the total acreage of the City. The total acreage of commercial and industrial areas within the City is roughly 4,830 acres, which yields a discharge of 7,100 AFY. Assuming 50 percent losses due to evaporation, transpiration, and minimal recharge, the total potential amount of stormwater that is discharged through the City of Lodi's municipal system and that could be captured, treated, and reused is 3,550 AFY.

Existing and Potential Stormwater Programs

Existing Stormwater Programs

Most stormwater drainage systems are designed to capture and convey water away from people and property rather than for beneficial use. As stormwater flows across the ground, it picks up contaminants such as fertilizers, pesticides, dirt, and motor oil. Since stormwater can be a source of surface water and groundwater contamination, cities must comply with total maximum daily load (TMDL) implementation plans and applicable National Pollutant Discharge Elimination System (NPDES) requirements. To comply with state and federal requirements, cities typically develop Stormwater Management Programs to help protect rivers, both water supplies and valuable habitat areas.

For example, the City of Lodi published a Stormwater Development Standards Plan in 2008 to assist in the overall management and infrastructure planning for handling of stormwater runoff. The plan, which supplements the City's Stormwater Management Program from 2003, includes Best Management Practices (BMPs) in six program areas: public education and outreach, illicit discharge detection, public participation/involvement, construction site runoff control, post-construction runoff control, and pollution prevention (B&V 2003). The City has teamed with the local community under its Storm Drain Detectives program. A group of teachers, students, and community members, in partnership with the City of Lodi, monitor the effects of storm drain runoff that flows from streets and drains into Lodi Lake and the Mokelumne River. The City discharges some of its stormwater into the Mokelumne River and the WID Canal, and retains the rest of the stormwater in DeBenedetti Park and Pixley Park detention basins. The stormwater flow directed to the detention ponds is allowed to dissipate by evaporation and percolation (City of Lodi 2008). Because some of the water is allowed to percolate, there are groundwater recharge benefits which may be realized. As such, utilizing a portion of this water could decrease the amount of recharge that is currently occurring.

Similarly, the City of Stockton operates five detention basins that were initially designed for flood control and three additional detention basins maintained for water quality and flood control. The City, along with the urbanized areas of San Joaquin County, updated its Stormwater Management Plan in 2009 to comply with new federal regulations to eliminate or control the discharge of pollutants. The program includes volume reduction measures, which arose from the volume reduction requirement that specifies the use of low impact development (LID). The volume reduction measures are BMPs that can be used to direct, retain, reuse and/or infiltrate stormwater runoff (LWA 2009). These detention basins are being used for recharge, similarly to how the City of Fresno and the Fresno Irrigation District use Leaky Acres.

Many cities are evaluating potential LID principles and techniques which can be used to design and construct sites that minimize soil compaction and imperviousness, preserve natural drainages, and result in improved water quality. For example, the City of Manteca has included LID recommendations in its 2013 Stormwater Management Plan. It anticipates LID principles will be required in all new development after updates to the statewide stormwater NPDES Phase II permit.

In the MAC Region, the City of Ione has an inadequate storm drainage system. According to the 2009 City of Ione General Plan, in older section of the City, there are limited or no storm drainage facilities, requiring the City to place temporary storm drainage structure to contain runoff. The City intends to correct these deficiencies. This could provide an opportunity for the implementation of LID measures or local, small-scale stormwater runoff capture and reuse.

Based on research of existing documents, there are currently no existing or planned stormwater capture, treatment and reuse programs occurring in the MokeWISE region.

Potential Programs

Stormwater could potentially be captured through large-scale capture and treatment projects and/or small-scale onsite capture programs (such as rain barrels).

Small-scale programs could include utilizing low impact development (LID) principles and implementing onsite systems such as rain barrels and cisterns. LID could be used to recharge upper aquifers, but its primary benefit is in reducing peak attenuations of storm flows and improving runoff quality. Onsite rain barrels at the residential level could be widely implemented if incentives were offered to property owners.

Groundwater storage and/or recharge are potential uses of collected municipal stormwater within the lower watershed. Stormwater could be banked within the groundwater basin during the wet months and extracted during the dry months. Partnerships between local entities could help facilitate localized transfers between banked groundwater and surface water. In addition to the recharge infrastructure required, storage and conveyance infrastructure would be necessary to deliver the collected stormwater to any recharge sites.

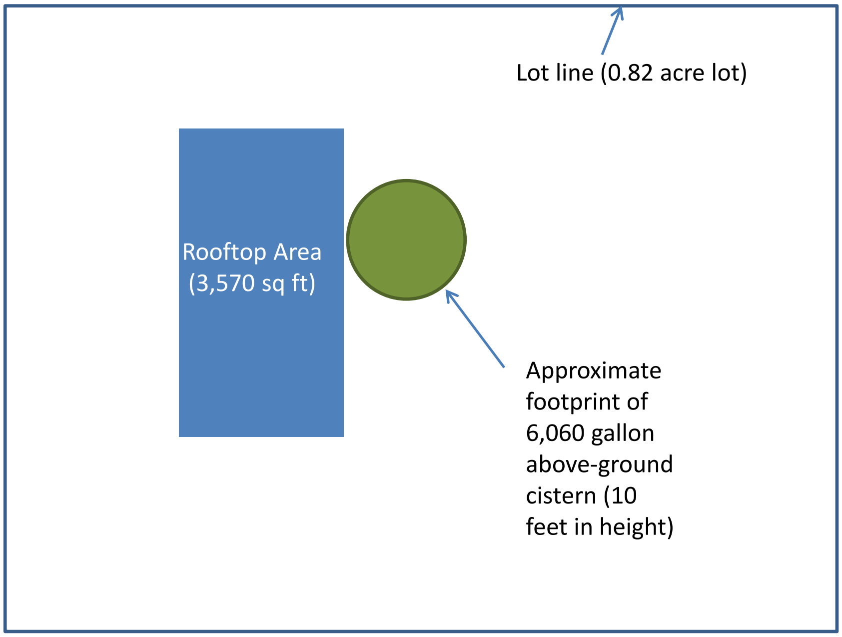
The upper watershed is more rural residential in nature. As such, it is anticipated that onsite rainwater capture and use by individual residences would be the primary mechanism for rainwater capture and reuse in the upper watershed.

Captured rainwater can be used for outdoor irrigation and some indoor nonpotable uses. Indoor use of rainwater is typically regulated by the local health department, and allowable uses vary, with approvals often occurring on a case-by-case basis. In California, rainwater has been used for indoor purposes such as toilet flushing and clothes washers. According to a 2011 study, the average single family home in northern California uses 295 gallons per household per day (gphd) (Aquacraft 2011, 128). Roughly 42% (125 gallons) of this total is for outdoor uses and 58% (171 gallons) is for indoor uses. Typically, approximately 20% of indoor use is for toilet flushing and 18% of indoor use is for clothes washing (Aquacraft 2011, 134). Assuming that a non-potable supply, such as rainwater, could be used for outdoor irrigation, toilet flushing, and clothes washing, the average single family northern California home could offset 190 gallons of potable water per day with rainwater if sufficient supplies and storage were available. Over the course of a year, this equates to approximately 69,350 gallons (0.2 AF).

As described previously, a typical residential parcel in the Jackson area is estimated to be 0.8 acres. It was assumed that approximately 10% of this area would be roof space; this corresponds to 0.082 acres, or 3,570 square feet. Assuming approximately 2.39 feet of precipitation falls in the upper watershed in an average year, and accounting for 50 percent losses, approximately 31,910 gallons (0.10 AF) of rainwater could be captured from a 3,570 square foot rooftop over the course of a year. This equates to 46 percent of estimated annual demand for non-potable supplies. This is a conservative estimate, as rooftop capture could have losses less than 50 percent. If rooftop systems were constructed on residential homes, water capture would likely be higher and annual water savings could be greater.

The wettest month is January, when irrigation needs are at their lowest. Of the 31.910 gallons of water available for capture over the course of the year, 19%, or 6,060 gallons (0.02 AF), falls in January. Assuming storage capacity would need to be sufficient to capture the quantity of rainfall experienced in January alone, a 6,060 gallon cistern would be required (Figure 11). Depending upon the desired configuration, this level of storage could be achieved with an above-ground cistern that is 28 feet in diameter and 10 feet in height.

Figure 11: Approximate Dimensions of Required Storage



Summary of Potential Stormwater Supplies

Stormwater potentially available for the MokeWISE program comes from both residential areas and from municipal systems in Stockton and Lodi. Total stormwater potentially available for reuse within the upper and lower watersheds from both sources is estimated to be roughly 15,100 AFY. Stormwater that could potentially be captured and reused within residential areas is estimated to be 640 AFY. Stormwater capture from municipal systems is estimated to be 14,920 AFY. Residential areas within the upper watershed could potentially capture up to 90 AFY, while residential areas in the lower watershed could potentially capture 550 AFY, assuming rainwater capture occurs all year long. The cities of Stockton and Lodi potentially discharge 11,370 AFY and 3,550 AFY of stormwater within their municipal systems, respectively. These amounts could potentially be captured and reused.

Challenges with Maximizing Stormwater Use

Challenges associated with maximizing the use of stormwater as a supply in the MokeWISE program are listed below. These challenges should be considered when discussing stormwater projects within the MokeWISE program.

- **Storage and timing of demand**. Challenges associated with storage and timing of demand are particularly relevant to small-scale residential stormwater reuse. Demand for reuse in residential areas is high in the summer irrigation months when precipitation is low, while precipitation is high during times when demand is low. While theoretically possible to capture all stormwater falling on residential property, building the storage necessary to allow for year-round use of stormwater on a small scale is not realistic and inconsistent with the use of a typical rain barrel system.

- **Downstream impacts**. Stormwater reuse, particularly on the municipal scale, must consider the downstream impacts. As with agricultural drainage water, reuse of stormwater could decrease this source for downstream users, thereby potentially decreasing the amount of water available for downstream users.
- **Rain barrel requirements.** Residential stormwater capture is limited to rain barrel or cistern utilization, which has very specific use and specification requirements for capturing rooftop runoff. Due to the long dry season in California and the limited yield expected, implementing a program to maximize stormwater use on a residential scale can be space intensive and costly. Because of these challenges, typical rain barrel systems are small and very localized.
- **Treatment and conveyance for large-scale systems.** Stormwater can have a wide range of pollutants that make it unavailable for immediate use. Treatment of stormwater is often required prior to its reuse for certain activities. Designing and constructing a treatment system, or connecting drains to existing treatment systems, can provides challenges to large-scale stormwater reuse. Additionally, conveyance of treated stormwater may require modifications to existing conveyance infrastructure, or construction of new infrastructure.
- **Groundwater recharge.** Currently, some stormwater is likely helping to recharge the groundwater basin. Diverting this supply for another use aside from recharge could further impact the condition of the basin.

Opportunities for Maximizing Stormwater Use

The following are potential opportunities for maximizing stormwater use. These examples can be considered when discussing potential MokeWISE projects and programs.

- **Large-scale detention basins**. Large-scale detention bases can be used to store municipal and/or residential runoff that can be treated and conveyed for other uses. Additionally, these basins can have flood control capabilities, which could allow supplies to be pumped and recharged, offsetting use of surface supplies.
- **Low impact development**. On a smaller scale, low impact development implemented in parking lots, office and residential complexes, and along roadsides can help stormwater infiltrate the groundwater basin. Agencies and local governments can redesign or require that new parking areas, parks, and playfields be used for recharge or have some recharge features and capabilities beyond what is currently required in stormwater discharge permits. Low-impact developments elements could be required, recommended, or supported in local general plans and/or zoning ordinances.

- **Land purchases**. There may be opportunities to purchase land within areas experiencing frequent flooding or stormwater management issues for the purpose of groundwater basin recharge with stormwater.
- **Formal on-site reuse programs**. There may be opportunities to implement onsite stormwater reuse programs similar to existing programs in other areas around the state. For example, Los Angeles County has developed a local ordinance promoting stormwater capture, and the City of San Francisco has developed treatment standards for stormwater that are partially determined by end use.
- **Offset surface water**. Depending on the level of treatment, stormwater could be used to offset potable supplies in the future. While no regulations currently govern potable reuse of stormwater reuse, future regulations could allow stormwater to be used to offset Mokelumne or other surface water supplies. For instance, golf courses and other large water users could be mandated or encouraged to supplement potable supplies with stormwater for irrigation and other onsite uses.

Conservation and Efficiency

Cities, agencies and districts throughout the project area are implementing aggressive conservation and efficiency programs as outlined in their 2010 UWMPs and Agricultural Water Management Plans (AWMPs). By reducing demands, conservation provides a direct one-to-one offset of potable or non-potable supplies, providing a valuable water supply management strategy with a potential benefit to Mokelumne River flows.

While conservation technically reduces water demands, for the purposes of the MokeWISE program, it is being treated as a potential supply option. As such, the following discussion refers to the amount of water available through conservation as opposed to the demand reduction achievable through conservation. Throughout the water industry, conservation is at times referred to as a demand reduction and at times as a supply; both are considered correct based on industry standards.

The amount of supply potentially available through conservation was determined by quantifying water that could be conserved through the expansion of conservation programs within the MokeWISE region, after accounting for those measures that are currently being implemented or are planned for implementation. While some of these programs in their current form are unfunded or underfunded, this analysis does not consider cost as a factor in expanding conservation programs. However, funding and monetary costs are recognized as a challenge.

To estimate the potential for water savings through conservation, first, the amount of water being conserved through implementation of ongoing and planned conservation BMPs was estimated. As previously described, water conservation and demand management projects which are already planned will be noted, as these projects will not create additional water available in the future for beneficial use.

Next, additional opportunities to maximize conservation were identified. BMPs not being implemented were reviewed and a basic feasibility determination was made based on cost-effectiveness and implementability considerations. The potential volume of conservation achievable through each non-implemented BMP was then estimated. Appendix B provides the methodology and assumptions for this analysis.

Existing and Future Conservation Measures

UWMPs and AWMPs for water agencies and districts within the upper and lower Mokelumne River watershed (approximated as the MAC and ESJ regions) were reviewed to determine existing conservation measures already underway and planned for implementation in the future. Additionally, since EBMUD relies significantly on water resources in the Mokelumne watershed, its existing and planned conservation measures were also reviewed. The conservation measures being implemented or planned to be implemented by these agencies and districts are described in the following sections. Additional BMP implementation levels are also identified and the savings associated with these expanded programs are calculated. The expanded 2040 implementation program assumes current levels (projected to 2040) are doubled and quadrupled; these savings are presented in a range. The theoretical maximum implementation level assumes that the gallons per capita per day (gpcd) for each agency is reduced to 85 gpcd, which assumes 55 gpcd for indoor use and 30 gpcd for outdoor use[1].

Typically, the conservation measures implemented by urban suppliers, also referred to as BMPs or Demand Management Measures (DMMs) are described in UWMPs according to standards established by the California Urban Water Conservation Council (CUWCC). In September 2011, the CUWCC amended its *Memorandum of Understanding (MOU) Regarding Urban Water Conservation in California* (CUWCC 2011). The CUWCC signatory agencies first adopted the MOU in 1991 to expedite implementation of reasonable water conservation measures in urban areas by outlining fourteen BMPs that could be implemented to reduce long-term urban demands. A December 2008 amendment to the MOU restructured the fourteen BMPs into five BMP categories. Urban water suppliers typically use the original fourteen BMPs and associated numbers, consistent with the DWR UWMP Guidelines. Urban suppliers describe the fourteen BMPs and their compliance status in their UWMPs. The CUWCC MOU provides water savings assumptions for some of the BMPs which can be used to estimate potential water savings from implementation. Water savings assumptions from the CUWCCC MOU are summarized in Table 10 and Table 11.

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1 According to the SWRCB, 55 gpcd is considered the performance standard for indoor use (SWRCB 2014c, 14). Research shows that more than half of Australia's residential water savings is a result of reduced outdoor water use. It is assumed that the maximum theoretical outdoor use that could be achieved in California would match that of Australia's, which is roughly 30 gpcd (Lund et. al 2011).

Table 10: BMP Naming Changes in the CUWCC MOU and Water Savings Assumptions

Original BMP Number and Name	New BMP Category in the CUWCC MOU	Water Savings Assumption
1. Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers	Programmatic: Residential	Water savings assumptions will be based on the type and number of actions implemented.
2. Residential Plumbing Retrofit	Programmatic: Residential	Water savings assumptions will be based on the type and number of actions implemented.
3. System Water Audits, Leak Detection and Repair	Foundational: Utility Operations – Water Loss Control	To Be Determined
4. Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections	Foundational: Utility Operations – Metering	Assume meter retrofits and volumetric rates combined will result in a 20% reduction in demand for retrofitted accounts.
5. Large Landscape Conservation Programs and Incentives	Programmatic: Landscape	Assume landscape BMP will result in a 15% to 20% reduction in demand for landscape irrigation by affected accounts.
6. High-Efficiency Clothes Washing Machine Financial Incentive Programs	Programmatic: Residential	Water savings assumptions will be based on the type and number of actions implemented.
7. Public Information Programs	Foundational: Education – Public Information Programs	Not Quantified
8. School Education Programs	Foundational: Education – School Education Programs	Not Quantified
9. Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts	Programmatic: Commercial, Industrial, and Institutional	See MOU Compliance Policy CII Water Savings Assumptions
10. Wholesale Agency Assistance Programs	Foundational: Utility Operations – Operations	Not Quantified
11. Retail Conservation Pricing	Foundational: Utility Operations – Pricing	Not Quantified

Table 10: BMP Naming Changes in the CUWCC MOU and Water Savings Assumptions

Original BMP Number and Name	New BMP Category in the CUWCC MOU	Water Savings Assumption
12. Conservation Coordinator	Foundational: Utility Operations – Operations	Not Quantified
13. Water Waste Prohibition	Foundational: Utility Operations – Operations	Not Quantified
14. Residential Ultra-Low-Flow Toilet (ULFT) Replacement Programs	Programmatic: Residential	Water savings assumptions will be based on the type and number of actions implemented.

Source: CUWCC 2011.

Table 11: Commercial, Industrial, Institutional Water Savings Assumptions

Measure	Average Annual Savings (AFY)	Units	Measure Life (years)
Hi-Efficiency Toilets	0.041748	Per toilet	25
Hi-Efficiency Urinals	0.069086	Per urinal	25
Ultra Low Volume Urinals	0.080603	Per urinal	25
Zero Consumption Urinals	0.0921146	Per urinal	25
Commercial High-Efficiency Single Load Clothes Washers	0.116618	Per clothes washer	10
Cooling Tower Conductivity Controllers	1.032250	Per cooling tower	5
Cooling Tower pH Controllers	3.981543	Per cooling tower	5
Connectionless Food Streamers	0.25	Per food steamer compartment	10
Medical Equipment Steam Sterilizers	1.538	Per steam sterilizer	20
Water-Efficient Ice Machines	0.834507	Per ice machine	10
Pressurized Water Brooms	0.1534	Per water broom	5
Dry Vacuum Pumps	0.64	Per vacuum pump	7

Source: CUWCC MOU Compliance Policies.

The Water Conservation Act of 2009 (SBx7-7, or 20x2020), which was passed in 2009, requires an evaluation of baseline per capita water use and identification of interim and 2020 per capita water use targets to achieve a 20% per capita water use reduction by 2020. Only water conservation and recycled water can be used to achieve the 2015 and 2020 targeted demand reductions. The Act modified Division 6 of the California Water Code (CWC) which also requires agricultural water suppliers delivering water to 2,000 or more irrigated acres (excluding recycled water) to prepare AWMPs and implement efficient water management practices (EWMPs). Specific EWMPs that must be implemented include:

- Measure the volume of water delivered to customers
- Adopt a pricing structure for customers based at least in part on quantity delivered.

Conservation in the Upper Watershed

The primary water purveyors in the upper watershed are AWA, CCWD, Calaveras Public Utility District (CPUD), and JVID. 20x2020 per capita water use targets for AWA and CCWD are 166 gallons and 172 gallons, respectively (AWA 2011, 3-15; CCWD 2011, 3-10). These are higher than established targets for other parts of California.

Amador Water Agency

As shown in Table 12, it is estimated that AWA saved 4.8 AFY in 2010 through implementing the quantified BMPs. Assuming 2010 implementation levels in 2040, AWA could save 17.0 AFY in 2040. If current implementation levels were doubled, AWA could potentially save 61.8 AFY in 2040; if current levels were quadrupled, AWA could potentially save 14.1 AFY in 2040. Thus, AWA could potentially save between 44.9 AFY and 97.2 AFY in 2040 under an expanded conservation program.

Gallons per capita per day (gpcd) in the AWA service area is projected to be 166 gpcd in 2020, as a result of 20% by 2020 requirements. If gpcd were reduced to 85 gpcd in 2040, AWA could potentially save 4,030.7 AFY[2]. Methodology and assumptions for calculating these numbers are presented in Appendix B.

[2] This gpcd number is presented to provide a theoretical maximum of estimated conservation savings. It is understood that to achieve 85 gpcd, significant funding and public outreach and education would be needed.

Table 12: AWA Estimated Future Savings Potential Associated with Conservation BMPs

Conservation Scenario*	BMP Number														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Amount Conserved in 2010 based on UWMP (AFY)	3.9	0	NQ	NQ	0	0	NQ	NQ	0	NQ	NQ	NQ	NQ	0.9	4.8
Amount Conserved in 2040 if BMP Maintained at Current (2010) Implementation Level (AFY)	6.7	9.4	NQ	NQ	0.0	0.0	NQ	NQ	0.0	NQ	NQ	NQ	NQ	0.9	17.0
Amount Conserved in 2040 (Expanded BMP) (AFY)	13.3 – 26.7	9.4	NQ	NQ	11.7 – 23.4	13.8 – 27.5	NQ	NQ	10.4 – 20.8	NQ	NQ	NQ	NQ	3.2 – 6.4	61.8 – 114.1
Additional Conservation Anticipated under Expanded 2040 Program*	6.7 – 20.0	0.0	NQ	NQ	11.7	13.8 – 27.5	NQ	NQ	10.4 – 20.8	NQ	NQ	NQ	NQ	2.3 – 5.5	44.9 – 97.2
Additional Conservation Anticipated under Maximum Theoretical 2040 Program***	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4,030.7

* NQ = not quantified
** Calculates the difference between the estimated future savings in 2040 at expanded levels of conservation and the estimated future savings in 2040 at current levels of conservation.
*** Calculated based on assumed 85 gpcd compared to 166 gpcd (2020 estimated gpcd). It is understood that to achieve 85 gpcd, significant amounts of grant funding and extensive public education would be required.

Calaveras County Water District

As shown in Table 13, it is estimated that CCWD saved 0 AFY in 2010 through implementing the quantified BMPs. Because CCWD submitted exemption reports and is not currently implementing any conservation measures, if 2010 implementation levels are assumed in 2040, CCWD is estimated to save 0 AFY in 2040. If conservation programs are expanded to what CCWD indicates in their exemption reports, CCWD could potentially save 1,385 AFY in 2040. If CCWD doubles the implementation of this expanded program, CCWD could save 1,485.4 AFY[3]. Thus, CCWD could potentially save between 1,385 AFY and 1,485.4 AFY in 2040 under an expanded conservation program. While it is anticipated that some of these savings will be attributed to meeting requirements for future water use reductions, additional conservation savings are likely to contribute to available water for the MokeWISE program.

CCWD plans to reduce its per capita water use from its current rate of 217 gpcd to 172 gpcd by 2020. This translates to an annual savings of 268 AFY. For the purposes of this study, it is assumed that this will all be met through implementation of future conservation measures. If gpcd were reduced to 85 gpcd in 2040, CCWD could potentially save 5,106.9 AFY[4]. Methodology and assumptions for calculating these numbers are presented in Appendix B.

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[3] This figure is not quadruple the double expanded program as BMP 14 is expected to be fully implemented after the double expansion.

[4] This gpcd number is presented to provide a theoretical maximum of estimated conservation savings. It is understood that to achieve 85 gpcd, significant funding and public outreach and education would be needed.

Table 13: CCWD Estimated Future Savings Potential Associated with Conservation BMPs

Conservation Scenario*	BMP Number														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Amount Conserved in 2010 based on UWMP (AFY)	0.0	0.0	NQ	NQ	0.0	0.0	NQ	NQ	0.0	NQ	NQ	NQ	NQ	0.0	**0.0**
Amount Conserved in 2040 if BMP Maintained at Current (2010) Implementation Level (AFY)	0.0	0.0	NQ	NQ	0.0	0.0	NQ	NQ	0.0	NQ	NQ	NQ	NQ	0.0	**0.0**
Amount Conserved in 2040 (Expanded BMP) (AFY)	30.3 – 60.4	63.6 – 126.6	NQ	NQ	2.8 – 5.3	3.3 – 6.5	NQ	NQ	1.3 – 2.9	NQ	NQ	NQ	NQ	1,283.7	**1,385.0 – 1,485.4**
Additional Conservation Anticipated under Expanded 2040 Program**	30.3 – 60.4	63.6 – 126.6	NQ	NQ	2.8 – 5.3	3.3 – 6.5	NQ	NQ	1.3 – 2.9	NQ	NQ	NQ	NQ	1,283.7	**1,385.0 – 1,485.4**
Additional Conservation Anticipated under Maximum Theoretical 2040 Program***	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**5,106.9**

* NQ = not quantified

** Calculates the difference between the estimated future savings in 2040 at expanded levels of conservation and the estimated future savings in 2040 at current levels of conservation.

*** Calculated based on assumed 85 gpcd compared to 172 gpcd (2020 estimated gpcd). It is understood that to achieve 85 gpcd, significant amounts of grant funding and extensive public education would be required.

Calaveras Public Utility District

CPUD serves Mokelumne Hill, San Andreas, and outlying areas. In 2013, CPUD supplied approximately 1,120 AFY to its customers (CPUD 2014a). Because CPUD supplies less than 3,000 AFY and has less than 3,000 customers it is not required to prepare an UWMP or develop 20x2020 water use targets. Due to the ongoing drought, in July 2014, CPUD adopted an ordinance to establish a water conservation plan to reduce water consumption through conservation. The ordinance includes a prohibition against waste that will always be in effect, regardless of a drought or water supply shortages. The water waste prohibition includes no excessive water flow or runoff, customer obligation to fix leaks and breaks, recirculating water requirement for decorative water fountains, limits on washing vehicles, recirculating water at commercial car washes, and other restrictions and requirements. The ordinance also outlines conservation requirements during increasingly severe stages of drought.

Information on existing conservation program success and potential for future programs is not currently available. While estimating the potential savings achieved through addressing leaking infrastructure is theoretically possible, CPUD does not currently have information about the potential system losses so these savings cannot be calculated at this time (CPUD 2014b). However, because CPUD's water use is a relatively small percentage of the MokeWISE Region demand, supply from potential future conservation within the CPUD service area was considered to be negligible compared to other potential future supplies.

CPUD had 1,898 connections in its service area in 2008. The District's Water System Master Plan assumes an annual growth rate of 2%, compounded annual through 2030 (CPUD 2008, 13). Assuming this annual growth rate continues through 2040, the total number of connections in 2040 is projected to be 3,577. In 2014, CPUD projected 2,137 connections in its service area. The CPUD service area population is roughly 5,000, which calculates to roughly 2.3 people per connection. Assuming this people per connection in 2040, the population of the CPUD service area is calculated to be 8,367. As stated above, water use is 1,120 AFY. Assuming a current population of 5,000, this is equivalent of 200 gpcd. If 200 gpcd is assumed in 2040, CPUD will use 1,874.2 AFY in 2040. If CPUD reduced its gpcd to 85 gpcd in 2040, it would use 797.2 AFY in 2040. This results in a savings of 1,077.1 AFY in 2040.

Jackson Valley Irrigation District

JVID provides irrigation water to farms and ranches in Jackson Valley, as well as homes, mobile home parks, and a biomass energy plant which opened in 2012. The 2008 Municipal Service Review (MSR) for Amador County states that JVID's surface water use averages 2 acre-feet per year (note that this does not include the biomass energy plant, which contracts with JVID for approximately 400 AFY) (JVID 2014 personal communication). JVID has implemented the following measures in response to the drought:

- Started a water allotment to farmers, which was based on the amount of water individual crops needs and the amount of land irrigated. Due to this allotment, some farming practices were reduced by 50 percent.
- Doubled existing water rate to balance budget because lack of expected water sales.
- Implemented water conservation on smaller residential users.
- Installed meters and created a program within a 2 month time period for 60 users.

Most recently, the JVID Board of Directors established a Drought Committee which meets twice monthly to address drought impacts and water conservation efforts. The JVID Board created and adopted its Water Shortage/Drought Policy and encourages water conservation in its service area through the distribution of public education materials regarding both the drought and ways to save water. JVID has instituted a water allotment system as shown in the JVID Decision Tree for Water Allocation and Billing. All agricultural water users that irrigate an acre of land or more are being required to install water meters to monitor water use. Smart irrigation scheduling and shifting from flood and spray irrigation to drip irrigation can result in significant savings; savings associated with both of these agricultural BMPs are quantified in the agricultural conservation and efficiency section below.

To encourage water use efficiency, JVID has also doubled the irrigation water rate from $12/AF to $24/AF. Significant water savings are being achieved. Historically, average crop irrigation in May is approximately 2,000 AF, but in May 2014 water use for crop irrigation was 600 AF. In 2013 JVID delivered 16,000 AF to users; this year JVID staff estimates demands will be closer to 8,500 AF due to increases in water rates and implementation of water allotments. In order to implement a water metering program and a conservation project, the Amador County Board of Supervisors approved a loan request of $180,000 from JVID, which will help them further conserve water in response to the ongoing drought.

JVID's distribution system includes a canal (Jackson Creek) and a pipeline system, with 50 percent of the District's water traveling through the canal system and 50 percent traveling through the pipeline system. There is currently a 20 percent loss associated with the canal system; however, because Jackson Creek serves as the canal, no lining or other efficiencies can be installed to decrease losses (JVID 2014 personal communication). JVID has reduced pipeline distribution losses from 25 percent to roughly 10 percent, due to recent valve replacements and other efficiency measures (JVID 2014 personal communication). Assuming JVID will deliver roughly 8,500 AFY in the future and pipeline losses were decreased to 5 percent, the District could potentially conserve 212.5 AFY.

Conservation in the Lower Watershed

Urban water suppliers in the lower watershed include the Cities of Lodi, Stockton, Manteca, Ripon, and Lathrop, Escalon, Stockton East Water District (SEWD), and California Water Service Company. Agricultural water suppliers include Central Delta Water Agency, North

San Joaquin Water Conservation District (NSJWCD), WID, SEWD, Central San Joaquin Water Conservation District, Oakdale Irrigation District, and South San Joaquin Irrigation District. Only the suppliers that rely on Mokelumne River as a water supply source are included in this evaluation. These include the City of Lodi, City of Stockton, NSJWCD, and WID (see Table 14).

Table 14: Primary Water Supply Sources in the Lower Watershed

Supplier	Primary Surface Supply Source(s)
City of Stockton	***San Joaquin River, Mokelumne River***
City of Lodi	***Mokelumne River***
City of Tracy	Stanislaus River, Delta
City of Manteca	Stanislaus River
City of Ripon	None (all groundwater)
City of Lathrop	Stanislaus River
City of Escalon	Stanislaus River
Stockton East Water District	Calaveras River, Stanislaus River
California Water Service Company	Calaveras River, Stanislaus River
Central Delta Water Agency	Delta
North San Joaquin Water Conservation District	***Mokelumne River***
Woodbridge Irrigation District	***Mokelumne River***
Central San Joaquin Water Conservation District	Stanislaus River
Oakdale Irrigation District	Stanislaus River
South San Joaquin Irrigation District	Stanislaus River

City of Stockton

Based on a combination of the City of Stockton water savings assumptions and CCWD's water savings assumptions, it is estimated that the City of Stockton saved 321.4 AFY in 2010 through implementing the quantified BMPs (Table 15). Assuming 2010 implementation levels in 2040, the City is estimated to save 495.9 AFY in 2040. If implementation levels were doubled in 2040, Stockton could potentially save 1,083.6 AFY in 2040; if implementation levels were quadrupled, Stockton could potentially save 2,167.2 AFY. Thus, the City could potentially save between 587.7 AFY and 1,671.3 AFY under an expanded conservation program. While it is anticipated that some of these savings will be attributed to meeting requirements for future water use reductions, additional conservation savings are likely to contribute to available water for the MokeWISE program.

The City plans to reduce its per capita water use from its current rate of 195 gpcd to 165 gpcd by 2020, which is higher than some other portions of California. This translates to a savings of 170 AFY[5]. This reduction will be achieved through a combination of conservation and recycled water. For the purposes of this study, it is assumed that this will all be met through implementation of future conservation measures. If gpcd were reduced to 85 gpcd in 2040, Stockton could potentially save 23,508.2 AFY[6]. Methodology and assumptions for calculating these numbers are presented in Appendix B.

[5] This figure was calculated by multiplying the current gpcd by the population of Stockton in 2010 and the future gpcd by the population in 2020 to get the total gallons per day in 2010 and 2020. These numbers were converted to AFY and the difference between the two numbers, 170 AFY, is the calculated savings between 2010 and 2020.

[6] This gpcd number is presented to provide a theoretical maximum of estimated conservation savings. It is understood that to achieve 85 gpcd, significant funding and public outreach and education would be needed.

Table 15: City of Stockton Estimated Future Savings Potential Associated with Conservation BMPs

Conservation Scenario*	BMP Number														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Amount Conserved in 2010 based on UWMP (AFY)	0.0	25.0	NQ	NQ	0.0	24.5	NQ	NQ	252.9	NQ	NQ	NQ	NQ	19.0	**321.4**
Amount Conserved in 2040 if BMP Maintained at Current (2010) Implementation Level (AFY)	0.0	38.6	NQ	NQ	0.0	37.8	NQ	NQ	390.1	NQ	NQ	NQ	NQ	29.4	**495.9**
Amount Conserved in 2040 (Expanded BMP) (AFY)	54.2 – 108.4	77.1 – 154.2	NQ	NQ	5.3 – 10.2	83.5 – 167.4	NQ	NQ	780.2 – 1,560.4	NQ	NQ	NQ	NQ	83.3 – 166.6	**1,083.6 – 2,167.2**
Additional Conservation Anticipated under Expanded 2040 Program**	54.2 – 108.4	38.5 – 115.6	NQ	NQ	5.3 – 10.2	45.7 – 129.6	NQ	NQ	390.1 – 1,170.3	NQ	NQ	NQ	NQ	53.9 – 137.2	**587.7 – 1,671.3**
Additional Conservation Anticipated under Maximum Theoretical 2040 Program***	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**23,508.2**

* NQ = not quantified

** Calculates the difference between the estimated future savings in 2040 at expanded levels of conservation and the estimated future savings in 2040 at current levels of conservation.

*** Calculated based on assumed 85 gpcd compared to 165 gpcd (2020 estimated gpcd). It is understood that to achieve 85 gpcd, significant amounts of grant funding and extensive public education would be required.

City of Lodi

As shown in Table 16, it is estimated that the City of Lodi did not achieve any water savings in 2010 through implementation of the quantified BMPs. Assuming 2010 implementation levels in 2040, the City is estimated to save 730.1 AFY in 2040[7]. If implementation levels doubled in 2040, the City of Lodi could potentially save 1,031.7 AFY in 2040; if implementation levels were quadrupled, the City could potentially save 1,333.6 AFY[8]. Thus, Lodi could potentially save between 301.6 AFY and 603.5 AFY under an expanded conservation program. While it is anticipated that some of these savings will be attributed to meeting requirements for future water use reductions, additional conservation savings are likely to contribute to available water for the MokeWISE program.

The City plans to reduce its per capita water use from its current rate of 248 gpcd to 199 gpcd by 2020, which is higher than some other portions of California. This translates to a savings of 2,006 AFY[9]. This reduction will be achieved through a combination of conservation and recycled water. For the purposes of this study, it is assumed that this will all be met through implementation of future conservation measures. If gpcd were reduced to 85 gpcd in 2040, Lodi could potentially save 10,945.0 AFY[10]. Methodology and assumptions for calculating these numbers are presented in Appendix B.

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7 This is due to a currently planned BMP which was not implemented in 2010, but will be fully implemented by 2040.

8 These figures are not double and quadruple the current conservation savings as some of the BMPs are expected to be fully implemented prior to expansion.

9 This figure was calculated by multiplying the current gpcd by the population of Lodi in 2010 and the future gpcd by the population in 2020 to get the total gallons per day in 2010 and 2020. These numbers were converted to AFY and the difference between the two numbers, 2,006 AFY, is the calculated savings between 2010 and 2020.

10 This gpcd number is presented to provide a theoretical maximum of estimated conservation savings. It is understood that to achieve 85 gpcd, significant funding and public outreach and education would be needed.

Table 16: City of Lodi Estimated Future Savings Potential Associated with Conservation BMPs

Conservation Scenario*	BMP Number														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Amount Conserved in 2010 based on UWMP (AFY)	0.0	0.0	NQ	0.0	0.0	0.0	NQ	NQ	0.0	NQ	NQ	NQ	NQ	0.0	**0.0**
Amount Conserved in 2040 if BMP Maintained at Current (2010) Implementation Level (AFY)	0.0	0.0	NQ	730.1	0.0	0.0	NQ	NQ	0.0	NQ	NQ	NQ	NQ	0.0	**730.1**
Amount Conserved in 2040 (Expanded BMP) (AFY)	9.6 – 19.3	13.9 – 27.8	NQ	730.1	2.4 – 4.8	4.7 – 0.4	NQ	NQ	262.2 – 524.5	NQ	NQ	NQ	NQ	8.8 – 17.7	**1,031.7 – 1,333.6**
Additional Conservation Anticipated under Expanded 2040 Program**	9.6 – 19.3	13.9 – 27.8	NQ	0.0	2.4 – 4.8	4.7 – 0.4	NQ	NQ	262.2 – 524.5	NQ	NQ	NQ	NQ	8.8 – 17.7	**301.6 – 603.5**
Additional Conservation Anticipated under Maximum Theoretical 2040 Program***	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**10,945.0**

* NQ = not quantified

** Calculates the difference between the estimated future savings in 2040 at expanded levels of conservation and the estimated future savings in 2040 at current levels of conservation.

*** Calculated based on assumed 85 gpcd compared to 199 gpcd (2020 estimated gpcd). It is understood that to achieve 85 gpcd, significant amounts of grant funding and extensive public education would be required.

Woodbridge Irrigation District

WID currently implements the latest in agricultural conservation practices. Additional water use savings may be achievable through enhanced conservation programming and incentives. Because detailed information on individual customer water use patterns is not available, potential savings could not be quantified. Savings associated with agricultural efficiencies within the WID service area are captured in the Agricultural Conservation and Efficiency section below. Additional information on WID is presented in Appendix B.

North San Joaquin Water Conservation District

NSJWCD currently does not implement agricultural conservation practices. Additional water use savings may be achievable through implementation of conservation programming and incentives. However, because information on individual customer water use patterns is not available, potential savings could not be quantified. Savings associated with agricultural efficiencies within the NSJWCD service area are captured in the Agricultural Conservation and Efficiency section below. Additional information on NSJWCD is presented in Appendix B.

Agricultural Conservation and Efficiency

A report published in 2008 by the Pacific Institute studied the effects of four scenarios for increasing agricultural water use efficiency (Cooley, et al. 2008). The four scenarios evaluated were:

- Modest crop shifting – shift 25 percent of irrigated field crop acreage to irrigated vegetable crop acreage
- Smart irrigation scheduling – use irrigation scheduling information to help farmers more precisely irrigate to meet crop water needs and boost production
- Advanced irrigation management – apply regulated deficit irrigation to almonds, pistachios, citrus trees, and vines during stress-tolerant growth stages
- Efficient irrigation technology – shift a fraction of the crops irrigated using flood irrigation to sprinkler and drip systems

Water use under each of these four scenarios was compared against baseline agricultural water use for the Sacramento River, San Joaquin River, and Tulare Lake hydrologic regions to achieve a percent reduction in agricultural water use. Results for the San Joaquin River hydrologic region indicate that modest crop shifting could result in a 3 percent decrease in agricultural water use, smart irrigation scheduling could yield a 13 percent reduction in agricultural water use, advanced irrigation management could generate a 6 percent decrease in agricultural water use, and efficient irrigation technology could result in a 3 percent reduction in agricultural water use.

The San Joaquin IRWMP estimated that the ESJ Region used approximately 1,070,017 AFY for agricultural irrigation in 2005, which is projected to decrease to 911,072 AFY by 2030 (GBA

2007). As shown in Table 17, if the percent savings for each of the four scenarios are applied to ESJ Region's estimated agricultural water use in 2005 and 2030, the following savings may be achieved.

Table 17: Potential Agricultural Water Savings from Four BMPs

BMP Scenario	2005 Savings (AFY)	2030 Savings (AFY)
Modest Crop Shifting	32,101	27,332
Smart Irrigation Scheduling	139,102	118,439
Advanced Irrigation Management	64,201	54,664
Efficient Irrigation Technology	32,101	27,332
TOTAL	**267,504**	**227,768**

The potential savings associated with each of these strategies assumes that there has been no prior implementation. Because water saving strategies are already being implemented in parts of the San Joaquin Valley, the actual savings that could be achieved is likely lower. If 25 percent% of farmers have already implemented the conservation strategies, then 170,826 AFY of savings could potentially be generated in 2030.

Conservation in the EBMUD Service Area

EBMUD is an original signatory of the CUWCC MOU and maintains compliance with the MOU. EBMUD implements all fourteen BMPs, as well as additional conservation measures not included in the CUWCC MOU. EBMUD has self-certified that its water conservation achievements are on-track, ahead of schedule or have reached 100 percent completion for all established BMP, Flex Trak, or gpcd coverage requirements. It plans to continue to implement conservation measures to meet its water conservation goals, provide a reliable water supply, and help meet its future water use reduction targets. EBMUD adopted a Water Conservation Master Plan (WCMP) in 1994 addressing both supply-side (water supplier) and demand-side (customer) measures. In 2011 EBMUD updated its WCMP to meet long-term water conservation planning goals to 2040. The WCMP presents a phased implementation of measures based on water production and customer demands to achieve a cumulative water savings of 62 MGD by 2040. Approximately 100 conservation measures were considered for implementation and 53 were selected. Since adoption of the WCMP in 1994, EBMUD has achieved a water savings of 26 MGD through 2010.

Because EBMUD is currently fully implementing and/or exceeding CUWCC targets for all BMPs, it has been assumed that no additional water conservation potential is available in the EBMUD service area.

EBMUD plans to reduce its per capita water use from its current rate of 175 gpcd to 151 gpcd by 2020. This translates to an annual savings of 2,534 AFY. This reduction will be achieved through a combination of conservation and recycled water. For the purposes of this study, it is assumed that this will all be met through implementation of future conservation measures. If EBMUD reduced its gpcd to 85 gpcd in 2040, it could potentially save 135,263.0 AFY in 2040[11].

Summary of Potential Conservation Savings

Table 18 provides a summary of the future potential water savings.

Table 18: Potential Additional Future Supply Available through Expanded Conservation Programs*

Agency	Total Savings Achievable (AFY) under Expanded Program	Total Savings Achievable (AFY) under Theoretical Maximum (85 gpcd)
AWA	44.9 – 97.2	4,030.7
CCWD	1,385.0 – 1,485.4	5,106.9
CPUD	Not quantified	1,077.1
JVID	212.5	Not quantified
City of Stockton	587.7 – 1,671.3	23,508.2
City of Lodi	301.6 – 603.5	10,945.0
WID	Not quantified	Not quantified
NSJWCD	Not quantified	Not quantified
EBMUD	--	135,263.0
Agricultural	170,826	170,826.0**
Total	**173,357.7 – 174,895.9**	**350,756.9**

* The numbers presented reflect expanded implementation of the BMPs discussed earlier in the section. They do not include BMPs that could not be quantified due to limited available data.

** This figure does not reflect 85 gpcd. It is assumed here that this agricultural program would be implemented in both the expanded program scenario and the theoretical maximum program scenario.

[11] Assuming 151 gpcd in 2040, EBMUD would use 309,403.6 AFY in 2040, with an estimated 2040 population of 1,828,044. If EBMUD were to achieve 85 gpcd in 2040, it would use 174,167.6 AFY in 2040, resulting in a savings of 135,263.0 AFY. It is understood that to achieve 85 gpcd, significant funding and public outreach and education would be needed.

Challenges with Maximizing Conservation

Challenges associated with maximizing conservation as a supply in the MokeWISE program are listed below. These challenges should be considered when discussing conservation projects in the MokeWISE program.

- **Downstream impacts**. Indoor conservation, while decreasing the demand on supplies, can also decrease the amount of water being discharged from wastewater treatment plants. As a result, indoor conservation can potentially impact downstream users. When discussing indoor conservation programs within the MokeWISE process, this challenge should be considered.
- **Growth impacts**. Increased conservation may not necessarily decrease the demand on supplies, but rather reduce the need for additional supplies to meet growth. For example, southern California water utilities have seen that water saved from conservation activities merely postpones the need to import additional water instead of deceasing demand on supplies. Furthermore, agricultural areas may develop extensive and expensive water use efficiency measures to increase crop production. However, these investments may not necessarily reduce water use if additional acreage is planted.
- **Economic feasibility**. Conservation projects and programs can be costly, potentially limiting the ability of agencies implement projects and support ongoing overhead costs. While there are funding opportunities available to help offset start-up costs, agencies may reach a point of diminishing returns on conservation programs. For example, the marginal cost of replacing the last few toilets may be significant and may not be economically feasible. While this point of diminishing returns may change over time as technology advances, some of the conservation theoretically available for MokeWISE may not be economically feasible.

Opportunities for Maximizing Conservation

The following are potential opportunities for maximizing conservation. These examples can be considered when discussing potential MokeWISE projects and programs.

- **Further implementation of BMPs**. Enhanced implementation of conservation BMPs beyond current levels could result in substantially higher levels of savings, provided sufficient funding is available. Reducing water use could potentially free up Mokelumne River supplies for alternative uses.
- **Implementation of additional BMPs**. Additional savings could be achieved by implementing additional BMPs that are not quantified in this study. For instance, water neutral development requirements may increase conservation levels by shifting cost of conservation programs to new developments and away from ratepayers.

- **Infrastructure improvements.** Losses associated with the conveyance of water supplies can be significant depending on the type of conveyance and the amount of water being conveyed. Leak detection programs can be implemented to improve efficiency in pipeline systems and pipelines can be installed to reduce losses associated with open canals. For systems conveying water in streams, shade trees can be planted which could help reduce evaporative losses.
- **Altering rate structures.** Raising water rates could encourage more efficient water use. Potential rate structures may include seasonal, block, time of use, surcharges, or use of water budgets.

Desalination

While the upper and lower watersheds are not near the ocean, allowing for typical desalination opportunities, demineralization of high salinity groundwater or exchange opportunities from coastal desalination efforts may provide potential supply options. Groundwater demineralization (which uses desalination plant technology to decrease salinity in groundwater supplies) was assessed for feasibility within the watershed. Additionally, a regional desalination project has been initiated in the Bay Area, which may present an opportunity for collaboration and potential water supply through exchange.

In order to assess potential desalinated supplies for the MokeWISE program, the following methodology was applied:

- Identify potential groundwater demineralization opportunities.
- Assess potential exchange opportunities for desalinated water from the Bay Area Regional Desalination Project.
- Quantify potential supplies from groundwater demineralization and desalination by analyzing other demineralization projects in California and reviewing Bay Area Regional Desalination Project reports to estimate potential for exchange.

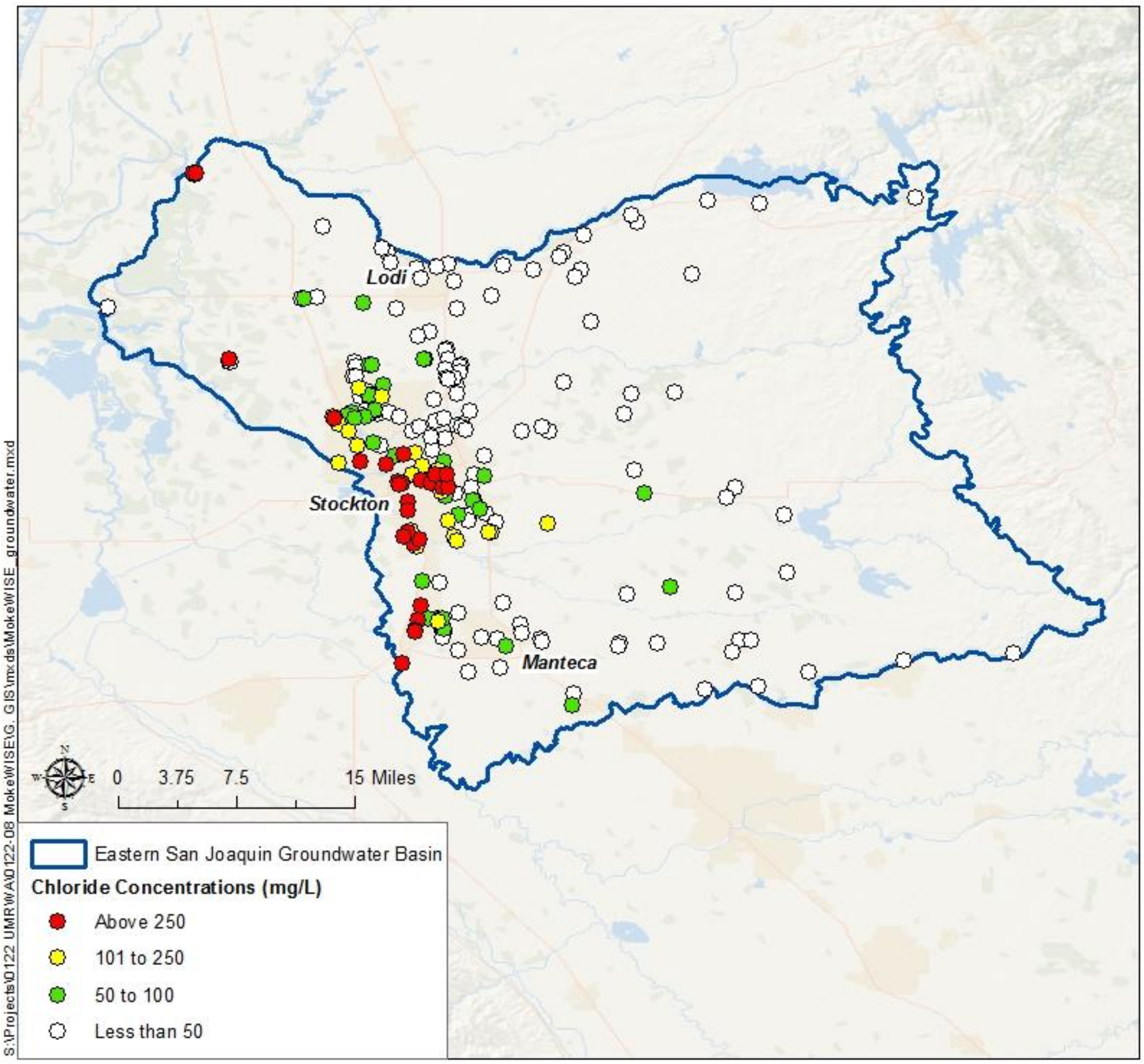
As discussed in the Groundwater section, groundwater is limited within the upper watershed; therefore, the analysis of potential groundwater demineralization opportunities focused on potential groundwater demineralization opportunities in the lower watershed. The San Joaquin Valley Groundwater Basin, which underlies portions of the upper and the lower watershed, includes multiple subbasins as shown in Figure 1.

As detailed in the Groundwater section, the Eastern San Joaquin Groundwater Subbasin is "critically overdrafted," indicating the rate of groundwater pumping exceeds the rate of recharge. Groundwater level declines have resulted in steep gradients from the Delta, causing intrusion of highly saline groundwater. Salt intrusion in the groundwater basin results in water quality impacts that render the supply unusable for meeting drinking water needs and for irrigating crops. Municipal supply wells in the City of Stockton and irrigation wells in the areas surrounding the City have been abandoned due to elevated salt levels.

In 2003, USGS, the GBA, and DWR undertook a 5-year, $2.7 million study of saline intrusion in Eastern San Joaquin County. The purpose of the study was to quantify the source, extent, and vertical distribution of high-chloride groundwater. USGS compiled an extensive groundwater level and water quality Geographic Information Systems (GIS) database consisting of more than 4,000 wells throughout the lower watershed.

Figure 12 shows the chloride concentrations of wells in the Eastern San Joaquin Subbasin based on historic data from 1984 to 2004. The red dots indicate wells with chloride concentrations greater than 250 mg/L, the U.S. Environmental Protection Agency (EPA) Secondary Maximum Contaminant Level (SMCL) for chloride. Some of these wells have been removed from service.

Figure 12: Chloride Concentrations of Wells in the Eastern San Joaquin Subbasin (1984 to 2004)

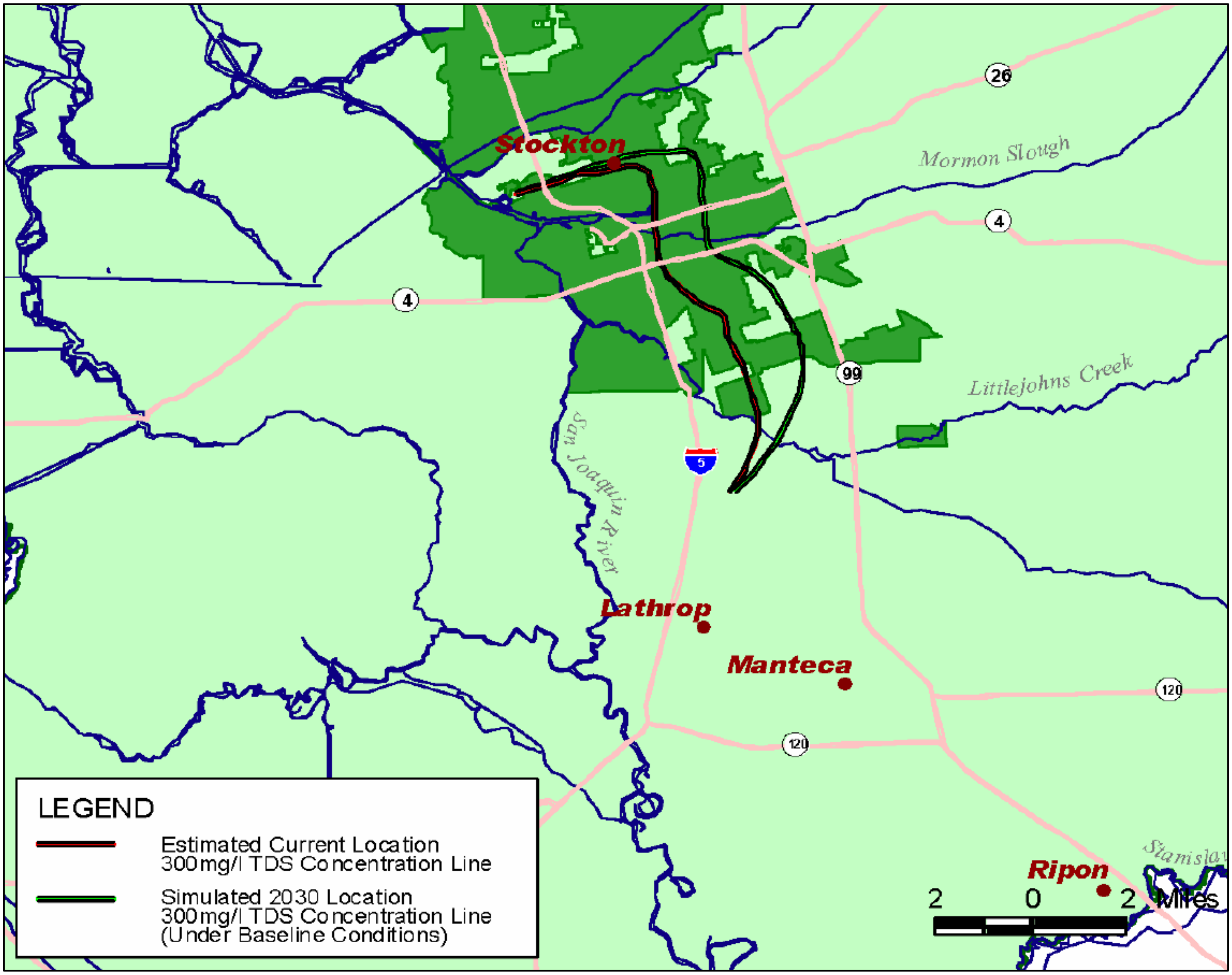


Source: 2007 ESJ IRWMP, Page 4-56 (GBA, 2007).

At chloride concentrations of 300 mg/L, water becomes unsuitable for most uses. The 300 mg/L isochlor, as measured in 2000 and described in the ESJ IRWMP, is shown in Figure 13. Also shown is the estimated 300 mg/L isochlor in 2030 if no actions are taken to remediate the basin are taken. As shown, chloride concentrations exceeding 300 mg/L extend eastward almost to Highway 99 in southwestern Stockton. Projections indicate that the rate of eastward migration of the saline front is approximately 150 to 250 feet per year. Results of this study indicate several sources of saline water including surface water infiltration, dissolution of salts near the Delta margin, contributions from underlying deposits, and possible irrigation return flow. The study also concluded that, despite increased precipitation in the 2005-2006 winter, the saline front underlying the City of Stockton has encroached further eastward and the groundwater basin underlying the City experienced water quality degradation. Preliminary results showed that water from wells near the San Joaquin River Delta had chloride concentrations as high as 1,800 mg/L (GBA 2007).

It is assumed that groundwater found in the locations shown in Figure 12 and Figure 13 with chloride concentrations exceeding 300 mg/L result in groundwater that is unsuitable for potable uses. This supply could be treated with reverse osmosis (RO) at a demineralization plant to reduce salinity and make the supply useable for potable and/or irrigation purposes. The RO treatment process results in a treated water effluent with lower TDS that can be used for agricultural and urban water uses or blended with other water supplies for use. Reverse osmosis generates a brine stream that must be disposed of, presenting a significant constraint, particularly for inland applications. Pumping and treating saline groundwater could increase the rate of localized saline intrusion. Additionally, because the Eastern San Joaquin Groundwater Basin is already in a state of overdraft and is experiencing saline intrusion, enabling groundwater that is not currently useable to be pumped and used for irrigation and domestic purposes could result in a net increase in groundwater withdrawals, exacerbating these issues.

Figure 13: Estimated 2000 and Projected 2030 Saline Front



Source: 2007 ESJ IRWMP, Figure 4-38 (GBA, 2007).

Regional Desalination Partnerships

Five Bay Area water agencies, Contra Costa Water District, EBMUD, San Francisco Public Utilities Commission (SFPUC), Santa Clara Valley Water District (SCVWD), and Zone 7 Water Agency (Zone 7) are jointly exploring the development of regional desalination facilities that could benefit the 5.4 million Bay Area residents and businesses served by these agencies. The concept for the Bay Area Regional Desalination Project (BARDP) has changed over time since it was initially conceptualized in 2003. Initially, a 120 MGD plant was conceptualized to help the agencies during major facilities outages and emergencies. The concept has evolved to a 10 to 20 MGD plant in eastern Contra Costa County to treat brackish water, creating a drought-proof drinking water supply for the agencies.

In 2003, Contra Costa Water District, EBMUD, and SCVWD entered into an MOU to explore the initial viability of the BARDP through completion of a pre-feasibility analysis. The pre-feasibility analysis evaluated permit requirements and desalinated water quality, and included a siting study. This analysis ultimately concluded that a regional desalination facility in the Bay Area may be feasible. In 2007, the BARDP Feasibility Study was completed, in which the agencies revisited their respective needs for desalinated water. The 2007 Feasibility Study also identified three potential locations for the facility and developed preliminary design for two potential desalination plant configurations (a 20 MGD seawater RO plant and a 65 MGD brackish water RO plant) (URS 2007, ES-6). Desalination generally would provide a highly reliable new water supply in all water year types. A six-month pilot test was completed in April 2009 at Contra Costa Water District's Mallard Slough Pump Station (MSPS) which confirmed the technical viability of the project. The MSPS site had several benefits including accessibility to Suisun Bay (a potential water source) proximity to power and related utilities, and ease of operations and site use, since the site is owned by Contra Costa Water District.

In 2010, Zone 7 joined the four other agencies to evaluate the project, and in 2011, the five agencies signed an MOU to fund site-specific analyses. In January 2014, Contra Costa Water District completed a site-specific analysis that describs the BARDP as drawing water from the MSPS with a maximum pumping capacity of 25 MGD (CCWD 2014a, 73).

The partner agencies need to establish the necessary formal agreements for defining roles, responsibilities, and obligations. Issues such as ownerships of the desalination plant and conveyance facilities, operational responsibilities, and the transfer of treated water will need to be resolved (MWH 2010). The exact amounts of desalinated water that would be delivered to each partner agency has not yet been determined. If supply were to exceed demand, or if EBMUD were to purchase supply allowing sale or exchange of Mokelumne supply, there may be potential supply benefit to the Mokelumne River watershed and MokeWISE partners. As currently envisioned, the desalination plant would operate under all hydrologic conditions (every year), serving the needs of the SFPUC and Zone 7 and banking the excess production for the agencies' dry year needs (BARDP 2014). An alternative operating approach would be necessary to provide potential supply to the Mokelumne River watershed.

Potential Supplies from Demineralization/Desalination

Groundwater Demineralization

Groundwater demineralization has been implemented outside of the Central Valley for decades. Since 1990, the Santa Ana Watershed Project Authority (SAWPA) has been operating groundwater desalters. They began operation of a 9 MGD groundwater desalter in the Chino Groundwater Basin in 2000 and added another desalter in 2004. SAWPA's goal is to have 40 MGD of groundwater desalting capacity by 2020. Other desalters include the City of Corona's Temescal Basin Desalter, which has been operating since 2002, and Eastern Municipal Water District's Sun City Desalter, which was implemented in 2003 (CVRWQCB 2006, 68). Raw water from the Chino Groundwater Basin has TDS that ranges from 600 mg/L to 1,000 mg/L.

As an example of groundwater deminerlization, the Mocho Groundwater Demineralization Plant, operated by Zone 7, is adjacent to both the upper and lower Mokelumne watersheds. Zone 7 provides potable water supplies to Pleasanton, Livermore, Dublin, and Dougherty Valley in the San Francisco Bay Area. The Mocho Groundwater Demineralization Plant began operating in 2009 with the primary goal of decreasing the buildup of salts and minerals in the Livermore Valley Main Groundwater Basin. The plant has 7.7 MGD of RO capacity, which allows Zone 7 to produce 6.1 MGD of demineralized water. The demineralized water is then blended with other supplies, such as surface water, prior to delivery to customers. The remaining 1.6 MGD of mineral concentrate (or brine) is discharged to San Francisco Bay via the DSRSD brine sewer line. Exporting brine out of Livermore Valley to the Bay reduces the amount of salts and minerals re-entering the groundwater basin (Zone 7 2009, 1-3). Influent groundwater hardness (as calcium carbonate) averages 474 mg/L, and total dissolved solids (TDS) averages 692 mg/L. The treated water averages 204 mg/L hardness and 311 mg/L TDS (Witham 2012, 11). Total storage capacity of the Livermore Valley Groundwater Basin is estimated to be approximately 500,000 AF. The groundwater budget is essentially in balance between supply and demand (DWR 2006a, 2). The Eastern San Joaquin Groundwater Subbasin is much larger, and unlike the Livermore Valley Groundwater Basin, it is not in balance from a supply standpoint. The total net outflow of the Eastern San Joaquin Subbasin system exceeds the estimated safe yield of 618,000 AFY, resulting in groundwater overdraft conditions (DWR 2006b, 3). As such, although localized groundwater demineralization opportunities may exist, additional groundwater withdrawal from the basin would further impact the existing overdraft condition and is generally not recommended.

Desalination Exchange

SFPUC and Zone 7 anticipate needing BARDP supplies every year, creating a minimum BARDP partner demand of 15,700 AFY in all years. EBMUD, SCVWD, and Contra Costa

Water District demands for BARDP water would occur less frequently, creating a maximum demand of up to 51,500 AFY in some dry years. BARDP production is 20,900 AFY. In order to make all partners whole, SFPUC and Zone 7 demands would likely be met in all non-drought years, and BARDP water that is not needed during non-dry years would be stored in Los Vaqueros Reservoir for use during dry years. The analysis completed in the 2014 Site Specific Analyses Final Report assumes that up to 5,200 AFY will be produced by the BARDP in excess of partner demands. It also assumes this amount would be available to store in the reservoir for use during droughts (CCWD 2014a, 115). BARDP is currently sized based on existing and potential demands within the partner agency service areas. As such, no supplemental supply is currently expected to be available from the BARDP. The project capacity and operations would need to be modified to allow additional supply to be produced for exchange with MokeWISE partners.

Summary of Potential Desalination/Demineralization Supply

Because groundwater within the Eastern San Joaquin Groundwater Basin is considered "critically overdrafted," groundwater demineralization is not considered a viable supply. While small-scale, local opportunities may exist, additional withdrawal from the groundwater basin would likely exacerbate the groundwater conditions. As such, groundwater demineralization is not anticipated to provide a long-term, regional supply for the MokeWISE program.

Desalination exchange could potentially be a viable water supply in the future. Currently, however, the BARDP is designed to meet the needs of all current partners; any additional partners would require a modification of the design capacity. At this time, desalination exchange is not considered a viable supply alternative.

Challenges with Maximizing Desalination/Demineralization Supply

Challenges associated with desalination/demineralization as a supply in the MokeWISE program are listed below. These challenges should be considered when discussing desalination or demineralization projects in the MokeWISE program.

- **Institutional challenges**. Large-scale desalination would likely require regional partnerships which can be difficult, expensive, and time-intensive to identify and develop.
- **Groundwater basin conditions**. Demineralization requires uptake of groundwater, which has the potential to exacerbate groundwater overdraft conditions. As mentioned previously, the Eastern San Joaquin Groundwater Basin, while recovering, has historically been overdrafted. Demineralization would allow use of groundwater that has historically been too saline for beneficial use. This additional use of groundwater could potentially exacerbate basin overdraft conditions.
- **Waste stream**. Desalination and demineralization projects produce waste streams. Depending on the scale of the project, this waste stream could present disposal

challenges. For example, the Final EIR for the Davis-Woodland Water Supply Project states that saline water disposal from potential desalination of local groundwater is infeasible due to extremely high costs and other factors related to physical feasibility (Davis 2007).

Opportunities for Maximizing Desalination/Demineralization Supply

The following are potential opportunities for maximizing desalination and demineralization supply. These examples can be considered when discussing potential MokeWISE projects and programs.

- **Use of saline supplies.** As saline intrusion causes groundwater supplies to become more saline over time, desalination may become necessary to allow supplies to continue to be used for irrigation and potable purposes, despite water quality degradation.
- **Solar desalination**. A number of saline supplies, including groundwater and agricultural drainage water, could be treated by solar desalination. Solar desalination removes salts and other impurities from water using solar energy.

Mokelumne River

Background

Previous efforts have evaluated the possibility of expanding use of Mokelumne River supplies through arrangements such as an in-river exchange or banking Mokelumne supplies in the Eastern San Joaquin Groundwater Basin. Before such opportunities can be explored, potential unallocated water from the Mokelumne River must be quantified[12]. The proposed methodology to quantify and assess potentially unallocated water is described below.

Unallocated water, as it is used in MokeWISE, is defined as that quantity of water in the Mokelumne River that is not diverted pursuant to a riparian or appropriative water right and that is not required to be in the river pursuant to a prescribed pre-1914 regulatory requirement. This differs from the original MokeWISE Work Plan, which indicated that the Water Availability Analysis would quantify "available water." Task 4 of the MokeWISE work plan is provided below.

> *TASK 4: WATER SUPPLY AVAILABILITY ANALYSIS*
>
> *In order to accurately develop a program that optimizes water supply, water quality, and environmental stewardship on an interregional conjunctive management basis, key background information must first be developed. A critical piece of information to be determined is the amount of water that is potentially available in wet years from the Mokelumne River and from other potential sources.*
>
> *Available water supply for conjunctive management will be precisely determined through inter-related investigations of water rights, Mokelumne River hydrology, existing regulatory constraints, and evaluation of potential expansion of surface water storage. The intent is to define potentially available water supply in terms of water rights holders (or potential for acquiring additional rights) and associated volume, timing, and reliability. To conduct hydrologic analysis, the Mokelumne-Calaveras River Simulation Model (MOCASIM) and/or EBMUDSIM simulation models may be used.*
>
> *A Water Supply Availability Analysis methodology will be developed, discussed, and approved by the stakeholder groups.*

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[12] This analysis has been performed at a feasibility level as part of the MokeWISE Program. It is not designed, nor is it intended to, serve as the basis for a water rights proceeding. Any future water rights application must undergo a separate water availability analysis.

The methodology will:

• Clearly define modeling assumptions and proposed approach to hydrologic modeling;

• Propose a mutually-agreeable definition of "available water," which will take into account human and environmental demands, water rights, and other regulatory constraints;

• Identify an approach to analyzing of the potential benefits from high flood flows in wet years, any potential detrimental impacts to the environment from reduced river flows, and the availability of alternative water supply sources

The following is an excerpt from the work plan for the MokeWISE program, as submitted in the grant application to DWR.

A key aspect of defining the methodology will be developing a mutually agreeable definition of "available water." For example, this could be any water above and beyond human and environmental demands, or it could be water above and beyond existing water rights and other regulatory constraints.

The following section summarizes MCG discussions relating to the above excerpted sections from the scope of work and work plan.

Mokelumne Collaborative Group

As indicated above, MCG members were tasked with developing a definition of "available water." The MCG struggled to develop a definition of available water that could be mutually agreed upon. After lengthy discussions among the MCG, the Modeling Workgroup, and between entities offline, the MCG ultimately decided to quantify unallocated water within the Mokelumne River in lieu of defining available water at this point in the process. Unallocated water, as it is used in this discussion, is defined as that quantity of water in the Mokelumne River that is not diverted pursuant to a riparian or appropriative water right and that is not required to be in the river pursuant to a prescribed pre-1914 regulatory requirement. Several MCG members do not consider all unallocated water to be available for a project.

In the past, consultants to the Mokelumne River Water and Power Authority have advocated that unallocated, or unappropriated, water is available for appropriation (HDR 2004). Because this assumes that JSA and other riparian flows are sufficient for the health of the river and its ecosystem, a number of Mokelumne River stakeholders have disputed this claim.

To provide a more holistic view of available water in the Mokelumne River, MCG members have proposed to consider adjusting the following variables in conjunction with projects which would divert water from the river or modify its flow.

1. An environmental flow preservation block of water that maintains a defined amount of water above and beyond channel losses, diversions, and instream flow requirements established by the Lodi Decrees and Joint Settlement Agreement (JSA) to be left in the river (or made available for a specific environmental restoration project).

2. An environmental flow preservation percentage that maintains a defined percentage of water in the river after accounting for channel losses, instream flow requirements, baseline diversions, and the flow preservation block of water.

These two variables will be analyzed in conjunction with projects that would either divert water or otherwise modify river flows. The value of each variable may be adjusted iteratively to optimize the environmental and developmental benefits of each given project or portfolio. The final recommendation for water available to a project that diverts water or modifies flow, and the defined flow preservation block of water and percentage values (if any) to be applied, would be determined by the full MCG following iterative model runs.

The optimal application of these variables will vary based on the project being considered. For instance, these variables may be applied in conjunction with the San Joaquin Groundwater Banking and Exchange project concept currently being considered. Analysis of this project concept may include varying levels of each variable to better understand what water may be available and how that definition may affect the Mokelumne River. As stated above, the final recommendation for water available to this project, or any other project in which the variables would be applied, would be determined by the full MCG.

The variables can only be applied when projects are developed thoroughly enough to allow the changes to Mokelumne River flow to be analyzed using the MOCASIM model. Where projects are not defined in sufficient detail to quantify potential changes to Mokelumne River flows, the variables cannot be applied.

It should be noted that these variables are not incorporated in the presented analysis of unallocated Mokelumne River water. They are designed to be incorporated alongside projects. They are mentioned here to capture the history of the MCG discussions regarding unallocated and available water. Quantities of unallocated water in the river were analyzed to understand sensitivity to hydrologic conditions (see Tables 2 through 7).

Regulatory Setting

Surface water rights in the Mokelumne River Watershed basin consist of riparian and pre- and post-1914 appropriative rights. Riparian rights always have priority over appropriative rights, and pre-1914 appropriative rights have priority over post-1914 appropriative rights (WRIME 2007). The following sections summarize the major decisions and orders affecting the management and distribution of Mokelumne River water.

Decision 100 (1927)

Issued by the State in 1927, Decision 100 approved EBMUD's appropriation application for the Pardee Project and a permit was subsequently issued (WRIME 2007). The SWRCB issued License 11109 to EBMUD for its Pardee Project in 1981.

Decision 858 (1956)

Decision 858 was issued in 1956 by the State Engineer and had several implications for the Mokelumne River (WRIME 2007). The Decision declared that a permit by a municipality for domestic purposes be considered first in right, regardless of whether it is first in time. EBMUD was declared a municipality. Because CCWD and NSJWCD delivered large portions of their water to agricultural users, they were not declared municipalities. The Decision granted rights to EBMUD to store water in either Camanche and/or Pardee Reservoirs and to directly divert water from the Mokelumne River during December 1 through July 1 for municipal purposes. CCWD was granted the opportunity to develop their water rights as a county of origin, but applications could not exceed 20,000 AFY[13]. Under Application 12842, NSJWCD was granted temporary appropriation of the excess water not used by EBMUD under its Application 13156.

Decision 1490 (1979)

Decision 1490, issued by the SWRCB in 1979, reduced JVID's diversion under Permit 12167 5,000 AFY to 3,850 AFY. AWA was granted direct diversion rights to 1,150 AFY from the North Fork of the Mokelumne River and 279 AFY from Antelope Creek, and storage rights to 1,600 AFY in Bear Reservoir. However, the maximum diversion that AWA could take from all sources was set at 1,150 AFY (WRIME 2007).

Decision 1527 (1979)

Also in 1979, the SWRCB issued Decision 1527, which related to an application from El Rio Vineyards for appropriation of 49 AF of water and flow of 11.14 cfs for storage and crop use. While the SWRCB found that water was not available for appropriation from March 1 through July 1 of each year, there was surplus water available from December through February. As such, the SWRCB allowed El Rio Vineyards to divert water to storage (49 AFY) from December to February. Furthermore, El Rio Vineyards had riparian rights to water in the Mokelumne River, so there was no need for a permit to divert water for crop usage during

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[13] County of origin rights are administered by the SWRCB, but were originally filed by the State Department of Finance in 1927 under "state filings" No. 5647 and 5648. These "reserved" rights are intended to ensure that projects exporting water from the county would not deprive the county of origin of water necessary for the development of the county. These reservations are not forfeitable and are held in perpetuity until released by the SWRCB for use in the county of origin (WRIME 2007).

the growing season; riparian holders were already factored into the releases from Camanche under the agreements between EBMUD and WID (WRIME 2007).

Water Rights Order 98-08 (1998)

In a declaration established in Water Rights Order 91-07, the SWRCB had declared that the season of unavailability for appropriation in the Mokelumne River includes the months of June through November (WRIME 2007). In WRO 98-08, the SWRCB added the months of March through June to the season of unavailability. The WRO states that the Mokelumne River is fully appropriated March to November from Woodbridge Dam upstream[14]. Additionally, the WRO declares that the Mokelumne River is fully appropriated July to September from the confluence with the San Joaquin River upstream to the Woodbridge Dam, including all tributaries within this reach where hydraulic continuity exists. The following three exceptions exist to the above declarations of appropriation:

- Due to the occasional availability of unappropriated water in the Mokelumne River during the months of March through June, the declaration does not apply to proposed conjunctive projects which are not dependent upon unappropriated water being available in most years but which could utilize unappropriated water when it is available.
- The order does not apply to State Applications 5647 and 5648 and related assignments.[15]
- Applications 29835 and 29855 should be processed normally, pursuant to Title 23 CCR Section 873(b) (5).[16]

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[14] California Water Codes sections 1205 through 1207 establish a procedure for the SWRCB to declare state water systems fully appropriated either year-round or during certain months. Section 1205(b) states that a such a declaration include "previous water rights decisions [that] have determined that no water remains available for appropriation" (Water Code §1205(b)). Decision 1527 provides the SWRCB with the support needed to declare the Mokelumne fully appropriated.

[15] Filed by the State of California on July 30, 1927. Both applications reserve water for future appropriation from tributaries of the Mokelumne River for domestic and irrigation uses. A portion of Application 5648 was assigned to JVID in 1959 under Permit 12167 and a portion of Application 5647 was assigned to AWA in 1979 under Permit 17579.

[16] These applications were submitted by the Mokelumne River Water and Power Authority. Application 29835 is currently being pursued by San Joaquin County. Title 23 CCR Section 873(b)(5) states that applications determined by the Chief to be consistent with a revised or additional declaration shall be processed normally. If an application is deemed to be inconsistent with the conditions of the revised declaration, the Chief shall provide the applicant a notice which specifies a reasonable time within which the applicant may provide information to show that hydrologic circumstances have changed within the system declared to be fully appropriated, or that other circumstances exist which justify the continued processing of the application.

Decision 1641 (1999)

The primary purpose of Decision 1641, issued December of 1999, was to address the water quality objectives of the Bay-Delta Water Quality Control Plan, as well as changing points of diversion, place of use, and purpose of use for the State Water Project and the Central Valley Project (WRIME 2007). As part of the discussions on Bay-Delta Plan water quality objectives, EBMUD and a number of other agencies argued that the flows being released under the JSA were sufficient to meet the objectives. Decision 1641 affirms that the JSA releases by EBMUD and WID are sufficient to meet the Bay-Delta Plan water quality objectives. Accordingly, this Decision establishes that both EBMUD and WID are responsible for helping meet Bay-Delta Plan water quality objectives through compliance with the JSA and amends WID's water right licenses to require that WID bypass JSA released flows below Woodbridge Dam, as defined in the JSA (WRIME 2007).

In 2010, the SWRCB released the Delta Flow Criteria Report which determines new flow criteria for the Sacramento-San Joaquin Delta ecosystem necessary to protect public trust resources. Prompted by this Report, the SWRCB is currently updating the Bay-Delta Plan. A draft Substitute Environmental Document has been released, which indicates that the SWRCB is preparing to require additional flow from many tributaries to the San Joaquin River and the Delta, representing an increase in the amounts required by Decision 1641 (SWRCB 2012). It is not known at this time how continued updates to the Bay-Delta Plan will affect the Mokelumne River and Decision 1641.

Water Rights Order 2000-02 (2000)

WRO 2000-02 was issued by the SWRCB to clarify Decision 1641. In this order, the SWRCB stated that "the Watershed Protection Act [...] does not apply to EBMUD's water rights because EBMUD's project is not part of the Central Valley Project (SWRCB 2000)." In the process of hearings prior to D1641 being issued, NSJWCD argued that they were unfairly denied water rights under D858. WRO 2000-02 stated that "D1641 is not the proper proceeding for the SWRCB to make the kind of change [reversal of the water rights priority set in D858] NSJWCD is requesting (SWRCB 2000)." As such, the SWRCB did not change the priority of the rights established in Decision 858.

The declarations made in WRO 2000-02 were subsequently litigated. In an appellate decision, the court upheld the SWRCB's declaration in Decision 1641 to approve the JSA flows (WRIME 2007). The court also found that Water Code section 11460 does not determine a preference for any particular type of use over another within an area of origin, nor does the section require explanation of why a particular beneficial need for water exists within the area of origin.

Protest Dismissal Agreement (2014)

Since 1990, San Joaquin County (SJC), North San Joaquin Water Conservation District (NSJWCD), Stockton East Water District (SEWD), Central Delta Water Agency (CDWA), South Delta Water Agency (SDWA) and EBMUD have at various times filed petitions with the State Water Board regarding applications, change petitions and protests related to water rights along the Mokelumne River. These petitions and protests have been pending before the State Water Board. In the settlement agreement approved in December of 2014, the parties agreed to work jointly to improve the health and sustainability of the Eastern San Joaquin groundwater basin and to set aside their respective protests and to petition the SWRCB to dismiss their pending protests. The settlement lays out specific agency commitments which could affect the timing and quantity of water available on the Mokelumne. However, due to the timing of its approval, the provisions of the agreement were not incorporated into the modeling results presented herein.

Overview of Results

Unallocated Mokelumne River water was simulated using the Mokelumne-Calaveras Simulation Model (MOCASIM), which simulates in-river flow conditions over the period of record (1953-2010) under specific diversion assumptions. Channel losses and instream flows required by the FERC requirements for Project 137, Lodi Decrees and Joint Settlement Agreement (JSA) are automatically accounted for by the model logic based on hydrologic and storage conditions. Diversions are included as a primary input to the model. Appendix B presents additional information on the MOCASIM model, including how the diversions and flow requirements are prioritized.

Mokelumne River flows and unallocated water were simulated for current (2010) and projected future (2040) baseline levels of diversion. The current baseline was used to approximate in-river flows under current diversion levels and the future baseline was used to approximate in-river flows under future projected levels of diversion based on existing planning documents. Diversions associated with two baseline cases are presented in Table 19 and have been approved for use in MokeWISE by the MCG and the respective entities.

Table 19: Diversion Assumptions for Current (2010) and Future (2040) Baselines

Agency	2010 Baseline Diversions (AFY)	2040 Baseline Diversions (AFY)
Amador Water Agency (AWA)[1]	8,155	13,925
Calaveras County Water District (CCWD)[2]	2,030	2,030
Calaveras Public Utility District (CPUD)[3]	1,299	2,542
East Bay Municipal Utility District (EBMUD)[4]	241,920	257,600
Jackson Valley Irrigation District (JVID)[5]	3,850	2,800
North San Joaquin Water Conservation District (NSJWCD)[6]	3,021	20,000
Woodbridge Irrigation District (WID)[7]	72,000	72,000
TOTAL	**332,275**	**370,897**

1 2010 diversions reflect 97% of historic and projected reported total water use in the AWA 2010 Urban Water Management Plan (UWMP), as 97% of supply is surface water from the Mokelumne River. Projected 2040 diversions are extrapolated from the AWA 2010 UWMP, which reports projected demands through 2030. It is understood that demand may differ in the future from what is presented here depending on actual growth and water use in the AWA service area.

2 Historic and projected diversions reflect actual and projected data presented in the CCWD 2010 UWMP. It should be noted that projected 2040 use could change significantly in future years, and projections are expected to increase in the 2015 UWMP. However, these are the best currently available projections.

3 CPUD diversions are confirmed by CPUD and are based on the 2008 Master Plan and 2008-2013 usage summary.

4 EBMUD 2010 and 2040 diversions based on information provided by the EBMUD Water Resources Division for Mokelumne Supplies.

5 JVID shares a 5,000 AF right under the Central Amador Water Project (CAWP) with AWA and can currently take up to 3,850 AF. AWA anticipates increasing their portion of the right from 1,250 AF to 2,200 AF, which will decrease JVID's portion to 2,800 AF by 2040.

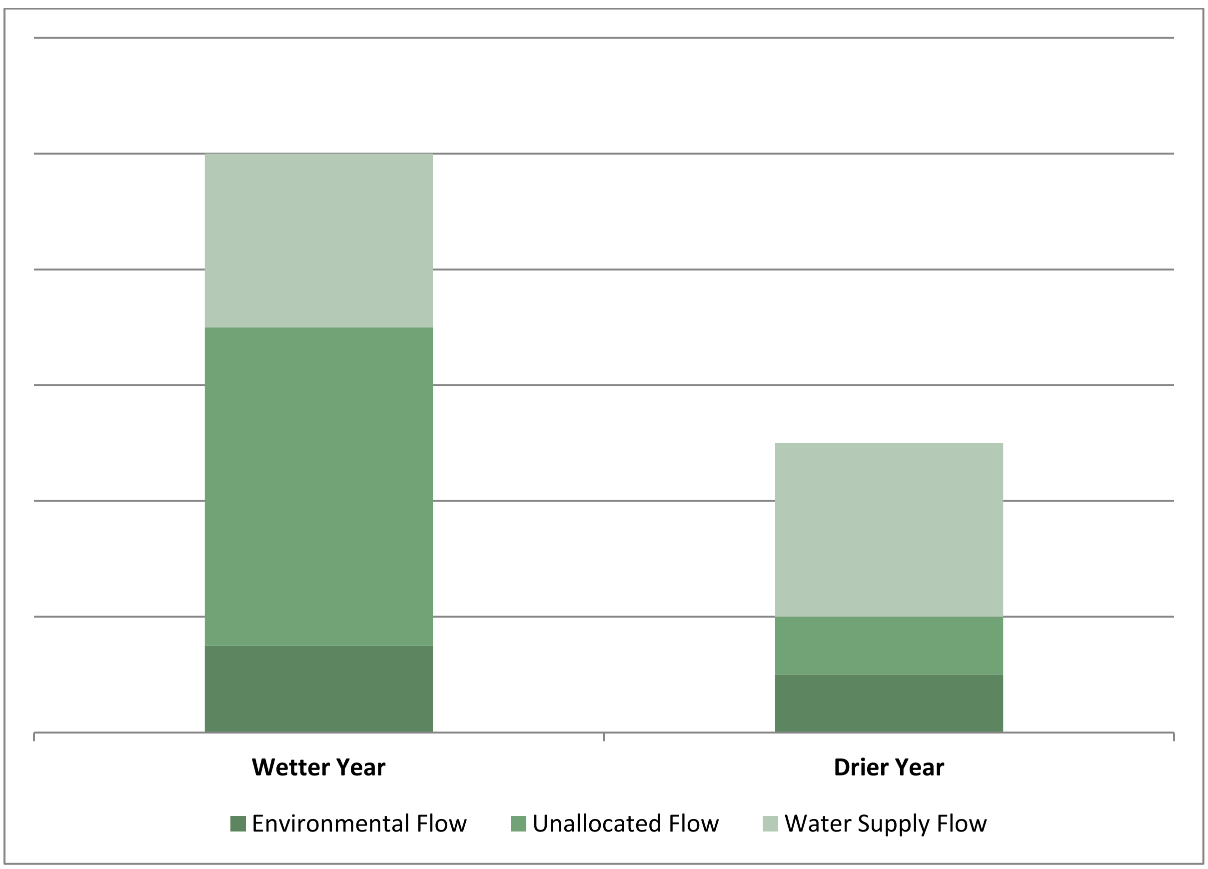
6 NSJWCD 2010 diversion reflects actual diversions in 2010. Projected 2040 diversions based on capacity and projected demand.

7 WID can currently take 60,000 AFY, plus additional spill (which is used for irrigation). In recent years, WID has reported diverting 72,000 AFY. The additional spill is obtainable under WID's combined pre 1914 water rights (1886) and the State Water Resources Control Board (SWRCB) licenses 5945 and 8214. WID's simultaneous diversion under License 5945 and the pre-1914 right may not exceed 300 cfs. WID's water right under License 8214 allows 114 cfs to be diverted from the Mokelumne. All combined, diversions cannot exceed 414.4 cfs.

Mokelumne River total in-stream flow and the portion of that flow that is considered to be unallocated were simulated at four locations: (1) below Camanche Reservoir, (2) below Highway 99, (3) below the Woodbridge Diversion Dam, and (4) below Interstate 5 (this location is assumed to be downstream of the last riparian diversion and therefore approximates Mokelumne River inflow into the Delta).

Mokelumne River flow generally consists of several components, including water supply flows, environmental flows, and unallocated flows (see Figure 14). Water supply flows are flows allocated to water users according to existing water rights; in very dry years, some users do not receive all or a portion of their allocation. Environmental flows, including Joint Settlement Agreement (JSA) flows and flows required pursuant to the FERC license for PG&E's project #137, are required at certain regulatory points along the river to ensure a minimum flow for fish and other aquatic wildlife. Unallocated water, as described at the beginning of this chapter, is the water remaining after water supply and environmental flows are accounted. In wetter years when there is more river flow, there is generally more unallocated water; in drier years when there is less river flow, there generally less unallocated water.

Figure 14: Mokelumne River Flow Components*



* This figure is provided as an example to show components of Mokelumne River flow and does not represent actual modeling results.

MOCASIM modeling results, presented in the appendices, present results for both the 2010 and 2040 baselines.

Summary of Mokelumne River Supply

The amount of unallocated Mokelumne River water is highly variable depending on the location along the River and the hydrologic year type. Generally, there is more unallocated water downstream and less upstream and generally more in normal and below normal years than in dry and critically dry years. Additionally, under both the 2010 and 2040 base case, more water is being released than is required as part of the JSA. There is also generally less unallocated water in the 2040 baseline than in the 2010 baseline, due to the increases in diversions as shown in Table 19.

Challenges with Optimizing Mokelumne River Water Supply

Challenges associated with optimizing the use of Mokelumne River water as a supply in the MokeWISE program are listed below. These challenges should be considered in conjunction with any MokeWISE projects or programs that include the use of Mokelumne River water.

- **Balancing competing interests**. There are a number of competing interests for Mokelumne River water. Optimizing consumptive use of Mokelumne River water would likely leave less in the river for fish, geomorphic work, ecosystem health, and other wildlife, while maximizing flows within the Mokelumne River would likely leave less for consumptive use. Balancing these competing interests is an inherent challenge when discussing potential uses of Mokelumne River water.
- **Variable flow**. The Mokelumne River is subject to both flood and drought, which results in flows that vary from year to year. This inherent variability of supply has the potential to make optimizing the use of Mokelumne River water challenging.
- **New diversions.** Current facility limitations at existing diversions, such as North San Joaquin Water Conservation District, may limit the ability to divert unallocated water. Permitting new diversions is a significant challenge associated with optimizing consumptive Mokelumne River water.
- **Banking.** Banking of Mokelumne River water could result in challenges associated with the management of withdrawals, particularly regarding monitoring and reporting.
- **Regulatory requirements.** The Joint Settlement Agreement and other regulatory agreements governing the Mokelumne River are not static and are subject to change. Any increase in required flows would likely decrease the amount of unallocated water available.

Opportunities for Optimizing Mokelumne River Water Supply

- **Supply source for direct/in-lieu banking**. As mentioned in the Groundwater Opportunities section, Mokelumne River water could potentially be used as a source for a direct or in-lieu groundwater banking project or program. In wet or above normal years, unallocated Mokelumne River water could be banked for use in dry years.
- **Ecosystem/wildlife benefits**. Maximizing other sources of water for consumptive or conjunctive use and foregoing the use of Mokelumne River water for additional consumptive use could potentially provide ecosystem and wildlife benefit opportunities, including fishery benefits.

Other Surface Water

Surface water supplies throughout California are currently heavily subscribed. However, short-term and long-term transfer opportunities may be available through other agencies to assist in meeting needs within the Mokelumne River watershed.

Water transfers involve one agency purchasing supply from another agency. Surface water transfers require a seller to either release additional supply from storage to be used by the buyer, or for a seller to forego use of a portion of its supply such that it may be used by the buyer in a direct diversion. Water transfers may be either short-term, or long-term. For the purposes of this study, short-term transfers are those transfers that are in effect for one year or less, while long-term transfers are transfers that occur for more than one year. Because the MokeWISE program seeks a long-term water supply solution, short term transfers are generally not expected to be desirable. However, some short-term transfers may evolve into long-term transfers over time.

The following sections summarize non-Mokelumne River surface water supplies that could potentially be available to a MokeWISE program project. Due to the significant conveyance and permitting requirements associated with transferring water from users south of the Delta to the MAC and ESJ regions, this section focuses on opportunities to receive water transfers from watersheds north of the Delta. In addition, it should be noted that water transfers that involve conveying water through the Delta are subject to significant carriage losses and permitting hurdles. Existing Freeport facilities could potentially be utilized through an agreement with EBMUD to transfer supplies from north of the Delta to the MAC or ESJ IRWM Regions, as could new conveyance facilities that have not been conceptualized or constructed as part of this study. While Freeport facilities have the benefit of already being in place, capacity and cost limitations and potential institutional hurdles associated with using these facilities should be considered in assessing future transfer opportunities.

Transfer Opportunities

Water transfers are implemented throughout California each year on a wide scale. Water transfers are regulated by several entities, depending on the details of the transfer. The State Water Resources Control Board (SWRCB) regulates transfers involving any surface water rights established after 1914 that involve changes in purpose, place of use, or point of diversion (PPIC 2012a). The Department of Water Resources, California Department of Fish and Wildlife, US Bureau of Reclamation, US Fish and Wildlife Service, and the National Marines Fisheries Services are also involved in approving and managing transfers in California (DWR 2014).

The SWRCB tracks recent water transfers. Figure 15 shows the location of agencies engaged in recent transfers in relation to the MAC and ESJ IRWM Regions. Table 20 provides a summary of water transfers approved by the SWRCB between 2012 and 2014. As shown in this table, a variety of agencies have transferred supplies in recent years. These examples are presented to provide a snapshot of recent transfer activities.

Transfer activity varies significantly over time. For the purposes of this study, transfers may be most attractive during wet and normal years, when supplies could potentially be stored for use in dry years through a conjunctive use arrangement. Transfers are generally in greater demand in dry years than normal and wet years; as such, reviewing recent transfers may provide an inaccurate picture of what may actually be available in wet and normal years. Conversely, dry year transfer contract agreements (which are generally more valuable due to supply pressures) may limit the ability of suppliers to provide wet- or normal- year transfers due to the need to store supplies to meet dry year obligations.

It should be noted that the actual quantity of available supply is assumed to be significantly greater than what is shown in the following sections. However, potential impacts associated with transfers and the complexity of conveying and permitting transfers increases significantly with quantity. Additional coordination with potential partner agencies would be required to determine the exact amount of transfer water potentially available and associated permitting, conveyance, and institutional requirements.

Figure 15: Examples of Recent Water Transfers in Relation to the MAC and ESJ Regions

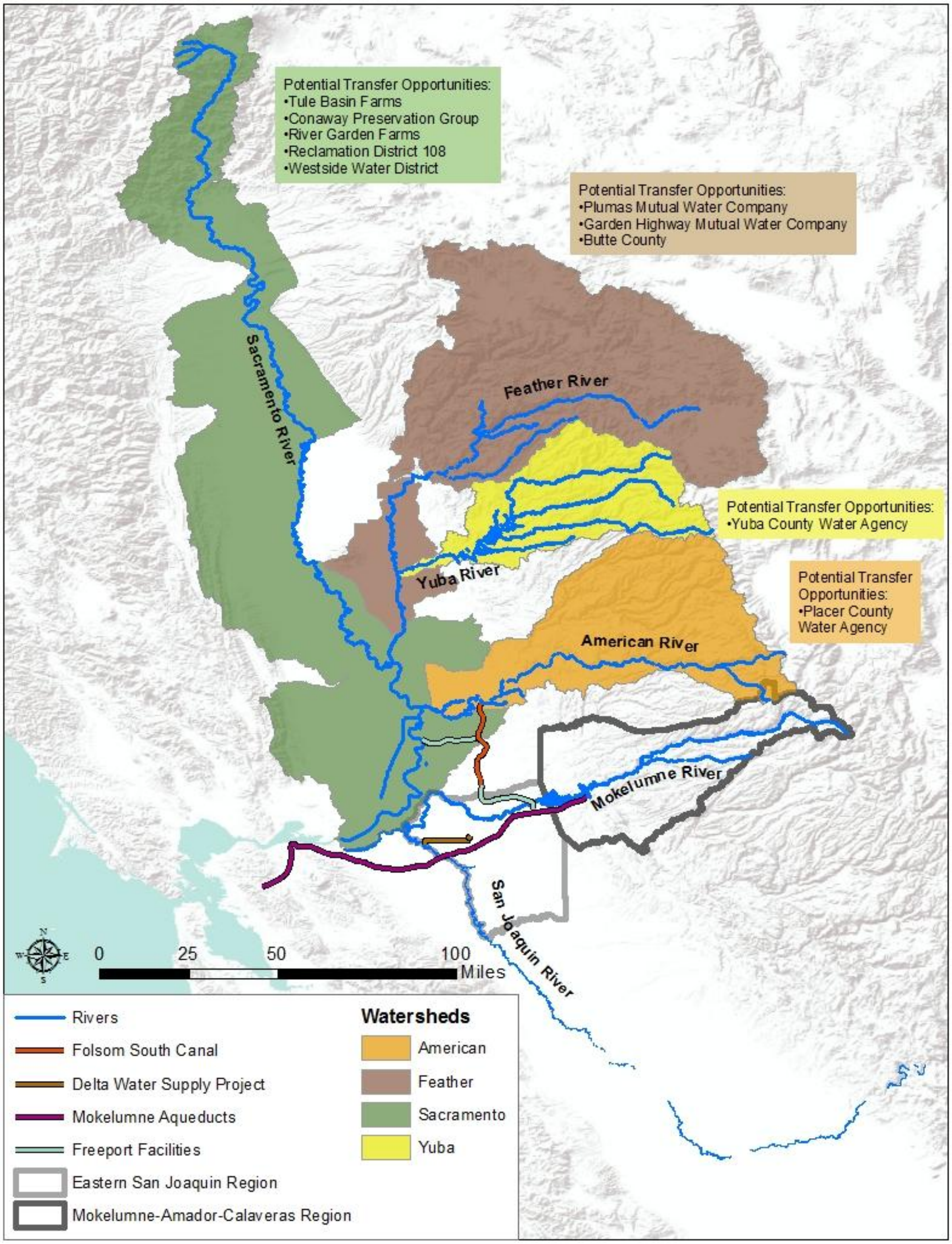


Table 20: Recent Water Transfers[1]

Transferring Agency	Receiving Agency(ies)	Source Watershed	Transfer Amount (AFY)	Begin Date	End Date
DWR/USBR	Santa Clara Valley Water District, Oak Flat Water District/Del Puerto Water District, Kern County Water Agency/Kern Tulare Water District	Trinity/Delta/San Joaquin	52,320	10/24/2012	10/23/2013
Merced Irrigation District	U.S. Bureau of Reclamation	Merced	180,000	effective April/May of 2012 and 2013	6/1/2013
U.S. Bureau of Reclamation on behalf of Arvin-Edison Water Storage District	Metropolitan Water District of Southern California	San Joaquin River, American River, Old River, Sacramento River, Trinity River, Clear Creek, Rock Slough	100,000	4/2/2012	4/1/2013
Placer County Water Agency	Westlands	Sacramento	20,000	6/27/2013	6/26/2014
Department of Water Resources	Santa Clara, Metropolitan	Trinity/Delta	196,000	7/1/2013	6/30/2014
Tule Basin Farms	Kern County, Dudley Ridge, Empire West Side	Sutter Bypass	3,520	7/1/2013	6/30/2014

[1] 2012, 2013, and 2014 water transfers under Water Code Section 1725, reported by the SWRCB

Table 20: Recent Water Transfers[1]

Transferring Agency	Receiving Agency(ies)	Source Watershed	Transfer Amount (AFY)	Begin Date	End Date
Garden Highway Mutual Water	Kern County, Dudley Ridge	Feather River	5,000	7/1/2013	6/30/2014
Eastside Mutual Water Co	San Luis & Delta Mendota	Sacramento	1,100	7/1/2013	6/30/2014
Reclamation District No. 1004	San Luis & Delta Mendota	Sacramento	7,175	7/1/2013	6/30/2014
Pleasant Grove-Verona Mutual Water Company	San Luis & Delta Mendota	Sacramento	2,000	7/1/2013	6/30/2014
Conaway Preservation Group	San Luis & Delta Mendota	Sacramento	8,000	7/1/2013	6/30/2014
David & Alice te Velde Revocable Family Trust	San Luis & Delta Mendota	Sacramento	1,320	7/2/2013	7/1/2014
City of Sacramento, Sac Suburban Water District	Dudley Ridge Water District, Empire-West Side Irrigation District, Kern County Water Agency	American River	3,658	7/3/2013	7/2/2014
Walker River Irrigation District	Instream flow dedication to Walker Lake (not drought related)	Walker River	25,000	2/21/2014 - Transfer begins upon federal District Court approval	One year from federal District Court approval

Table 20: Recent Water Transfers[1]

Transferring Agency	Receiving Agency(ies)	Source Watershed	Transfer Amount (AFY)	Begin Date	End Date
Department of Water Resources/U.S. Bureau of Reclamation(joint petition)**	Santa Clara Valley Water District, Oak Flat Water District, Del Puerto Water District, Kern County Water Agency, Kern Tulare Water District, Arvin-Edison Water Storage District , Metropolitan Water District of Southern California, Westlands Water District, Dept. of Veterans Affairs - San Joaquin Valley National Cemetery, Musco Olive Products, Inc.	Trinity/Delta/San Joaquin -- No North of Delta Water - Therefore, No Fishery Assistance	277,863	approved 3/28/2014 transfer begins 4/1/2014	5/1/2015
Placer County Water Agency	East Bay Municipal Utility District	American River -- Assists with Lower American River Flows Beginning 4/2/2014	20,000	4/2/2014	5/2/2014
Reclamation District 756	Semitropic Water Storage District, Kern County Water Agency, Alameda County Water District, Zone 7 Water Agency, Santa Clara Valley Water District	San Joaquin River -- In Delta Transfer, No Fishery Assistance	11,603	5/12/2014	9/30/2014

Table 20: Recent Water Transfers[1]

Transferring Agency	Receiving Agency(ies)	Source Watershed	Transfer Amount (AFY)	Begin Date	End Date
Delta Farms Reclamation District 2026	Semitropic Water Storage District, Kern County Water Agency, Alameda County Water District, Zone 7 Water Agency, Santa Clara Valley Water District	San Joaquin River -- In Delta Transfer, No Fishery Assistance	9,131	5/12/2014	9/30/2014
Merced Irrigation District	San Luis and/or Santa Clara Valley	Merced River -- Yes, Pulse Flow for Fishery Assistance April 2014	5,000	4/22/2014	10/19/2014
Garden Highway Mutual Water Company	San Luis & Delta-Mendota Water Authority	Feather River - No Identified Fishery Component	7,500	Transfer Denied Because Water Right Curtailed 6/10/2014	
Plumas Mutual Water Company	Feather River - No Identified Fishery Component	State Water Contractor Agencies (County of Kings, Dudley Ridge Water District, Kern County Water Agency, Oak Flat Water District, Napa County FCWCD)	5,000	Transfer Denied Because Water Right Curtailed 6/10/2014	
Department of Water Resources	Westlands Water District	Feather River - No Identified Fishery Component	15,225	6/9/2014	9/30/2014

Table 20: Recent Water Transfers[1]

Transferring Agency	Receiving Agency(ies)	Source Watershed	Transfer Amount (AFY)	Begin Date	End Date
South Sutter Water District	State Water Contractor Agencies (County of Kings, Dudley Ridge Water District, Kern County Water Agency, Oak Flat Water District, Napa County FCWCD)	Bear River - No Identified Fishery Component	10,000	7/7/2014	9/30/2014
Placer County Water Agency	Westlands Water District	American River -- Assists with Lower American River Flows	35,000	7/8/2014	7/8/2015
U.S. Bureau of Reclamation/ Contra Costa Water District	Alameda County Water District	Old River/ Middle River - No Identified Fishery Component	5,000	7/11/2014	9/30/2014
Department of Water Resources	San Luis & Delta-Mendota Water Authority	Feather River - No Identified Fishery Component	6,600	7/11/2014	7/11/2015
U.S. Bureau of Reclamation/ Contra Costa Water District	Byron-Bethany Irrigation District	Old River/ Middle River - No Identified Fishery Component	4,000		

As seen in the previous table, several agencies are currently involved in the transfer market that may have supplies available for transfer. Examples of recent transfers are summarized below.

Example Recent Short-Term Transfers

Placer County Water Agency

Placer County Water Agency (PCWA) began transferring water in 2000 with the formation of the Sacramento Water Forum Agreement. This agreement states that PCWA will release water from its reservoirs in dry years only, if there is a willing buyer downstream of the confluence of the Sacramento and American Rivers (EBMUD 2012a). Based on preliminary discussions, up to 47,000 AF per year of dry-year transfer water may be available through this opportunity. This is an opportunity that is currently being pursued by EBMUD, though PCWA has been receptive to EBMUD partnering with other agencies (EBMUD 2013, 10).

PCWA is currently engaged in a short-term transfer with Westlands Water District (SWRCB 2014b). This 35,000 AF transfer assists with Lower American River Flows, in addition to providing water to Westlands. The transfer began on July 8, 2014 and terminates July 8, 2015, at which point all or a portion of this water may become available on the open market. PCWA also initiated a one-month transfer with EBMUD in April of 2014 for 20,000 AF (SWRCB 2014b).

Garden Highway Mutual Water Company (GHMWC)

In 2010, GHMWC sold 5,802 AF to a number of agencies including Kern County, Metropolitan Napa County Flood Control and Water Conservation District, and Dudley Ridge (SWRCB 2010a). In 2013, GHMWC sold 5,000 AF to Kern County, Dudley Ridge, and Empire-West Side in a short-term transfer agreement that terminated on June 30, 2014 (SWRCB 2013, 1-2).

In 2014, the Garden Highway Mutual Water Company (GHMWC) attempted to enter into a short-term transfer agreement with San Luis and Delta-Mendota Water Authority for 7,500 AF. This transfer was ultimately denied because the water right was curtailed on June 10, 2014 (SWRCB 2014b).

Conaway Preservation Group

In 2013, the Conaway Preservation Group entered into an agreement with San Luis and Delta Mendota Water Authority for a transfer of 8,000 AF, which terminated on June 30, 2014 (SWRCB 2013).

Tule Basin Farms

In 2010, Tule Basin Farms (TBF) sold 3,520 AF to a number of agencies, including Antelope Valley-East Kern, Dudley Ridge, and Kern County (SWRCB 2010a). This short-term transfer lasted for three months and ended on September 30, 2010. This same amount of water was transferred again in 2013 to Kern County, Dudley Ridge, and Empire-West Side (SWRCB 2013, 1-2). This transfer agreement was executed on July 1, 2013 and ended on June 30, 2014.

Plumas Mutual Water Company

In 2014, Plumas Mutual Water Company (MCWP) attempted to enter into a short-term transfer agreement for 5,000 AF of Feather River water with a number of State Water Contractor agencies, including Kings County, Dudley Ridge Water District, Kern County Water Agency, and Oak Flat Water District. This transfer was ultimately denied because the water right was curtailed on June 10, 2014 (SWRCB 2014b).

Reclamation District 108

In 2009, Reclamation District 108 transferred 2,805 AF of water in a short-term transfer to the 2009 Drought Water Bank. This was a three month transfer that ended on September 30, 2009 (SWRCB 2009).

River Garden Farms

In 2009, River Garden Farms initiated a short-term transfer of 3,500 AF to the 2009 Drought Water Bank (SWRCB 2009). This was a 3-month transfer that ended on October 31, 2009.

Example Recent Long-Term Transfers

Yuba County Water Agency

Yuba County Water Agency (YCWA) has been engaging in water transfers since 1987. In 2008, the Lower Yuba River Accord initiated a long-term transfer for the environment and state and federal water contractors, totaling 60,000 AF per year (EBMUD 2012b; EBMUD 2014; YCWA *nd*). This transfer agreement terminates in 2025.

Butte County

In 2012, Butte County, a long-time State Water Project contractor, entered into two long-term transfer agreements, both lasting for two years (PPIC 2012b, 25). The first, for 24,832 AF, involved sales to a number of agencies within the San Joaquin Valley region, including Dudley Ridge Water District, Belridge Water Storage District, and Berrenda Mesa Water District. The second was for 10,429 AF and served Palmdale Water District in Southern California (PPIC 2012b, 25). Both of these transfers ended in 2014.

Westside Water District

In 1998, Westside Water District entered into a 25-year transfer agreement with Colusa County Water District, selling 25,000 AFY (PPIC 2012b, 23). Because this agreement was initiated in 1998 with a 25-year lifespan, this water would not be available until 2023.

Delta Supplies

While the Delta is fully appropriated, there may be additional water available in the Delta during flood flows. Utilization of flood flows for a MokeWISE project would require a new water right to be secured, which would involve a significant regulatory and permitting process.

In August 2010, the SWRCB identified potential new Delta flow criteria (SWRCB 2010b). Analysis using CalSimII indicates that there may be surplus Sacramento River and Delta supplies if the identified flow criteria were to be adopted as new flow requirements (Bourez 2010a). Table 21 shows the percentage of time during each month when surpluses would be present (Bourez 2010b).

Table 21: Percent of Time Surplus can be Expected to be Available if SWRCB Adopts Delta Flow Criteria as Flow Requirements

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
0%	4%	21%	34%	29%	13%	2%	0%	0%	0%	0%	0%	61%

Based on this analysis, if the new flow criteria were adopted, water could be reasonably expected to be available in November through April. This water is not currently available, but could become available in the future should the SWRCB modify current Delta flow requirements.

Flood flows that reach the Delta may also be available for transfer. While estimating the average potential amount available during flood flows is difficult, it can generally be assumed that flood flows on the magnitude of what has been observed historically could potentially be captured and put to beneficial use. Furthermore, if the flow criteria identified by the SWRCB in 2010, or any more stringent requirements were to be adopted, flood flows would still be expected to be available for use (Bourez 2010a). Again, it should be noted that utilization of flood flows for a MokeWISE project would require a new water right to be secured, which would involve a significant regulatory and permitting process.

Transfer Conveyance Alternatives

Depending upon the location and type of transfer, various conveyance alternatives may be considered. Existing Freeport Regional Water Project Facilities may provide the most feasible alternative for conveying a north of Delta transfer to the MAC or ESJ Region. Potential conveyance alternatives and related constraints are discussed below.

Freeport Regional Water Project Facilities

The Freeport Regional Water Project is a jointly owned intake facility on the Sacramento-San Joaquin River Delta. A cooperative effort between EBMUD and the Sacramento County Water Agency (SCWA), Freeport serves surface water supplies from the Sacramento River to customers in both Sacramento County and the East Bay (Freeport Regional Water Authority [FRWA] 2008). The facility can convey roughly 185 million gallons per day (mgd), with SCWA receiving 85 MGD in all years and EBMUD receiving 100 MGD in dry years only (San Joaquin County 2009, ES-1). While Freeport is operated at capacity in dry years, conveyance capacity is expected to be available during wet and normal years, which are expected to occur in two of every three years, on average (San Joaquin County 2009, ES-1; EBMUD 2014 personal communication). Unassigned EBMUD capacity within Freeport facilities could potentially be utilized to facilitate through-Delta transfers.

As defined by EBMUD, unassigned capacity is any capacity dedicated to EBMUD remaining in Freeport facilities after meeting all EBMUD needs (EBMUD 2005). Third parties interested in utilizing this unassigned capacity must meet one or more of the four objectives outlined by EBMUD:

1. Deliver water to improve reliability for EBMUD customers;
2. Deliver water as an alternate supply to facilitate maintenance of Mokelumne facilities;
3. Protect and restore or enhance the environment of the Delta and its tributaries, and mete water conservation and recycling objectives as defined by the Bay-Delta program;
4. Minimize EBMUD capital and operation cost for the Freeport Regional Water Facility Project (EBMUD 2005).

Third parties utilizing EBMUD unassigned capacity would be required to enter into an agreement with EBMUD, which would include obtaining advance permit approvals and securing funding for the use of Freeport facilities. As such, unassigned capacity may be determined to meet the fourth objective.

Costs associated with the use of Freeport facilities would be expected to range from $400-500 per AF if supplies are not mized with EBMUD Mokelumne supplies, or $800-$900 if the transfer water were combined with Mokelumne River water (EBMUD 2014 personal communication). These costs would increase the overall unit cost of the transfer water accordingly.

Delta Water Supply Project Facilities

The Delta Water Supply Project (DWSP) is owned and operated by the City of Stockton and serves customers with water from the San Joaquin River. The intake is located at the southwestern tip of Empire Tract on the San Joaquin River and has a capacity of 33,600 AFY (30 MGD) (Stockton 2011, 4-2). The City of Stockton has planned to use the full capacity of the DWSP; however, records indicate that the City typically only utilizes 11 MGD of capacity (Stockton 2011; Stockton 2014b). While the City of Stockton may increase its capacity use in the future, this facility could provide an opportunity for use in transfer agreements. The cost of raw water delivery through DWSP facilities is significantly lower than Freeport, estimated at roughly $200 per AF (Stockton 2011, 127).

Contra Costa Canal Facilities

The Contra Costa Canal is owned and operated by the Contra Costa Water District to draw water from the Delta under a contact with the Central Valley Project (CVP). Contra Costa is the CVP's largest urban contractor. Part of the CVP, the canal is a 48-mile long aqueduct that begins at Rock Slough in East Contra Costa County and ends at the Terminal Reservoir in the City of Martinez (CCWD 2014b). Water is diverted from both Rock Slough and Old River near Discovery Bay. Water diverted at Rock Slough travels through 4 miles of unlined channel before reaching the concrete-lined canal (CCWD 2014b). Water diverted at Old River can either be delivered to Los Vaqueros Reservoir or to the Contra Costa Canal. There may be some capacity in the Contra Costa Canal in certain hydrologic year types that could be purchased for use.

Summary of Potential Other Surface Water Supply

Transfer potential is estimated based on a review of transfers tracked by the SWRCB in 2012-2014. Of these years, the greatest quantity of transfers was approved on 2014, totaling nearly 412,000 AF in that year. However, conveyance of these supplies would likely present a significant hurdle. If Freeport facilities were to be used for conveyance, potential supply would be limited by capacity constraints of the existing facilities. As such, the potentially available supply from other surface water is assumed to be limited to the conveyance capacity of Freeport facilities. As discussed previously, Freeport facilities can convey roughly 185 MGD, with SCWA receiving 85 MGD in all years and EBMUD receiving 100 MGD in dry years only (San Joaquin County 2009, ES-1). In normal and wet years, if EBMUD's 100 MGD were used for a MokeWISE project, approximately 112,000 AFY could be delivered for a MokeWISE project in normal and wet years.

Challenges with Maximizing Other Surface Water Use

Challenges associated with other surface water as a supply in the MokeWISE program are listed below. These challenges should be considered when discussing transfer or other surface water projects in the MokeWISE program.

- **Conveyance constraints**. Freeport currently provides the biggest potential for infrastructure conveyance of transfers, which potentially limits the amount of water that can be transferred. However, there may be additional infrastructure which can be used to transfer water in the future.
- **Partnership-building**. Transfers require partnership building. Agencies interested in transfers must identify water available on the market and build relationships with those agencies selling water. Identifying these agencies and building the relationships necessary to enter into a transfer agreement can be difficult, expensive, and time-consuming. Relationships also needed for developing in-lieu exchanges of the water diverted and treated at Freeport or Stockton.
- **Economic feasibility**. Transfers and use of other surface water can be expensive. As mentioned above, use of Freeport facilities is costly due to high pumping costs and additional facilities needed to convey it an agency. In dry years, water available on the transfer market will be costly due to high demand. While agencies can partner to realize cost-sharing benefits, this requires partnership-building.
- **Seasonal and yearly conditions.** Additional information on availability of potential transfers under various seasonal conditions and year types is needed to refine the estimates provided.
- **Institutional challenges**. Transfers and use of other surface water would likely require regional coordination and partnerships which can be difficult, expensive, and time-intensive to identify and develop. There may be pumping limitations and other future regulatory constraints which could potentially limit availability. Additionally, storage arrangements to ensure that wet year transfers are available in dry year could be challenging.

Opportunities for Maximizing Other Surface Water Use

The following are potential opportunities for maximizing other surface water use. These examples can be considered when discussing potential MokeWISE projects and programs.

- **Banking programs**. Opportunities may exist to implement banking programs with urban water utilities in adjacent watersheds, improving groundwater levels.
- **Freeport facilities**. Unused capacity within the Freeport facilities could be used, through agreements with EBMUD, to convey transfer supplies to users in the Mokelumne River watershed. These supplies could potentially offset the use of Mokelumne River water.
- **Operational modifications**. Modified operation of existing storage facilities and other infrastructure could potentially free up new water that could be available for transfer or exchange with Mokelumne River users.
- **Storage facility sharing**. Partnerships could be developed among agencies needing to store transfer water and agencies with storage capacity to allow storage facilities to be used in exchange for money or additional water during other times of year.

Summary of Potentially Available Supply

Estimated quantities of supplies potentially available from each of the sources considered, including groundwater, agricultural drainage water, recycled water, stormwater, conservation, desalination, Mokelumne River, and other surface water, are summarized below and shown in Table 22.

Groundwater

- While currently used in the upper watershed, groundwater is not considered a viable additional source in Amador and Calaveras counties due to low yield, unreliability, age of groundwater, and limited storage opportunities.
- The Eastern San Joaquin Groundwater Basin is considered critically overdrafted.
- Groundwater is not considered a viable additional supply source, although conjunctive use and recharge opportunities may be available.

Agricultural Drainage Water

- While quantities of agricultural drainage water are unknown, it is assumed that they are currently minimal and decreasing due to investments in agricultural irrigation efficiency practices and technologies. As such, this is not considered a viable source.
- Some local, small-scale applications may be viable for capturing agricultural drainage, but it is not expected to provide a viable regional water supply.
- It is generally accepted that there is usually a user that will take agricultural drainage water downstream for use.

Recycled Water

- The total quantity of potentially available recycled water is estimated to be 222,500 AFY; however, that amount is reduced to roughly 169,400 AFY after accounting for challenges and constraints associated with the treatment and distribution of recycled water.
- Potential recycled water available in the future within the upper watershed, lower watershed, and EBMUD service area is estimated to be 3,489 AFY, 3,050 AFY, and 162,857 AFY, respectively. However, full use of this supply is not realistic due to monetary costs, coordination costs, and market potential.
- Of the up to 169,400 AFY potentially available, an estimated 126,720 AFY of secondary treated and 42,680 AFY of tertiary treated recycled water is available in the future.

Stormwater

- Total potentially available stormwater within the MokeWISE region is between 14,939 AFY and 15,560 AFY. This amount includes the municipal systems in Lodi and Stockton and the residential areas in both the upper and lower watersheds.
- The municipal system in Lodi could potentially yield 3,550 AFY and the system in Stockton could potentially yield 11,370 AFY, totaling 14,920 from municipal systems.
- Residential areas in the MokeWISE region could potentially yield an estimated 20 AFY, with 3 AFY from the upper watershed and 17 AFY from the lower watershed, assuming rainfall capture occurred from April to October. If rainfall capture occurred all year long, the upper watershed could capture 90 AFY and the lower watershed could capture roughly 550 AFY.

Conservation

- Using water savings assumptions from the CUWCC and the applicable agencies, the estimated quantity of water that could potentially be available in the future under expanded implementation of BMPs is between 173,000 and 175,000 AFY. This number is assumed to be low, as the savings for several BMPs were unable to be determined due to data gaps.
- Under a theoretical maximum conservation program where agencies could reduce to 85 gpcd, anticipated future savings in 2040 would be roughly 350,000 AFY.
- Agricultural efficiency could potentially conserve roughly 170,000 AFY by 2030.

Desalination

- Groundwater demineralization requires additional withdrawal from the groundwater basin, which could exacerbate the existing overdraft condition.
- While desalination exchange could potentially yield available water in the future, the BARDP as currently sized is designed to meet the needs of all current partners. Additional partners would require a modification of the design capacity.
- At this time, neither groundwater demineralization nor desalination exchange are considered viable supplies.

Mokelumne River

- Supply of unallocated water is highly variable based on year type and River location.
- Generally, there is more unallocated water in wet and above normal years than in below normal, dry, and critically dry years.
- Modeling indicates that under both 2010 and 2040 baselines, more water is being released at both JSA compliance points than is required as part of the JSA.

Other Surface Water

- The total estimated quantity of short-term transfers available is 85,325 AFY, while long-term transfers potentially provide an additional 127,261 AFY. However, more information on availability under various seasonal conditions and year types is needed to refine this estimate.
- Other surface water may include unappropriated flood flows or water that may potentially be available under a new flow regime. These quantities, while variable and difficult to determine, may potentially provide additional available water to the MokeWISE program.

Table 22: Summary of Potentially Available Supply by Source

Supply Type	Type of Supply Available	Amount of Supply Available (AFY)	Challenges	Opportunities
Groundwater	N/A	Not quantified	• Availability • Groundwater basin conditions	• Direct/in-lieu banking • Direct injection
Agricultural Drainage Water	N/A	Not quantified	• Downstream impacts • Treatment	• Soil flushing
Recycled Water	• Secondary treated • Tertiary treated	169,499	• Timing and storage • Economic feasibility • Coordination costs • Infrastructure requirements • Benefit allocation • Market potential • Local considerations • Scalability • Groundwater basin proximity • Downstream impacts	• Non-potable uses • Saline intrusion barrier • Indirect potable reuse/direct potable reuse • Direct injection
Stormwater	• Municipal • Residential	14,939	• Storage and timing of demand • Downstream impacts • Rain barrel requirements • Treatment and conveyances for large-scale systems • Groundwater recharge	• Large-scale detention basins • Low impact development • Land purchases • Formal on-site reuse programs • Offset surface water

Table 22: Summary of Potentially Available Supply by Source

Supply Type	Type of Supply Available	Amount of Supply Available (AFY)	Challenges	Opportunities
Conservation	• Municipal • Agricultural	173,357.7 – 350,756.9	• Downstream impacts • Growth impacts • Economic feasibility	• Further implementation of BMPs • Implementation of additional BMPs • Infrastructure improvements • Altering rate structures
Desalination	• Groundwater demineralization • Desalination exchange	Not quantified	• Institutional challenges • Groundwater basin conditions • Waste stream	• Use of saline supplies • Solar desalination
Mokelumne River	Unallocated water	Variable*	• Balancing competing interests • Variable flow • New diversions • Banking	• Supply source for direct/in-lieu banking • Ecosystem/wildlife benefits
Other Surface Water	• Short-term transfers • Long-term transfers • Unappropriated Delta water	212,585**	• Downstream impacts • Growth impacts • Economic feasibility	• Further implementation of BMPs • Implementation of additional BMPs • Infrastructure improvements • Altering rate structures

* Dependent on year type and location on the Mokelumne River.

** Dependent on flood flows, hydrologic year type, and/or amount of water in Delta.

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Appendix A: East Bay Municipal Utility District Stormwater Capture and Use Evaluation Scope of Services

Appendix A presents the scope of work for a stormwater quantification project currently being implemented by EBMUD.

EXHIBIT A

East Bay Municipal Utility District
Stormwater Capture and Use Evaluation

SCOPE OF SERVICES

I. CONSULTANT SERVICES

CONSULTANT shall provide the following:

Contracted Services

Task A. Estimation of Theoretical Stormwater Supplies

Kickoff Meeting - Discussion of EBMUD Goals and Data Availability before starting the Task A work effort, CONSULTANT's project manager and a GIS analyst will meet with EBMUD staff to confirm the project goals, agree upon the number of scenarios to assess, and review available GIS data.

The methodology for estimating theoretical stormwater supplies will be presented to the District's project manager for approval or modification as a deliverable of Task A and may change slightly depending on the District's available GIS data sources. Our proposed methodology is as follows:

1. CONSULTANT will delineate the project area in GIS by masking the five (5) terminal reservoirs out of the EBMUD service area. This will require GIS data from EBMUD (service area and terminal watersheds).
2. CONSULTANT will delineate the relevant watersheds and/or constructed hydrologic divides using GIS data from EBMUD where available, supplemented by the East Bay creek watershed boundaries from the Museum of California, and USGS topographic database for watersheds east of the hills. CONSULTANT will divide the EBMUD service area watersheds into two rainfall areas: east and west of the hills. For each watershed, CONSULTANT will use EBMUD data or if needed estimate monthly rainfall in the following water year types: wet, average, moderate drought, severe drought and critical drought.
3. To allow EBMUD to assess the effects of climate change by 2040, two estimates of future rainfall and evaporation (for landscape irrigation usage) will be made using downscaled monthly IPCC data. The scenarios will be RCP8.5 (high climate change) and RCP4.5 (medium low climate change forcing).
4. For each watershed, CONSULTANT will identify the number and average size of properties in each customer category using GIS data from EBMUD. CONSULTANT will utilize some of the 21 land cover classes within EBMUD's Irrigation Reduction Information System (IRIS) to estimate average roof area and landscape irrigation needs

aggregated to the watershed and customer category level. Based on a pilot test conducted by CONSULTANT for the Peralta Creek watershed, CONSULTANT anticipates collecting data on single and multiple family residences, commercial and institutional properties. CONSULTANT will investigate the potential for rainfall / stormwater capturing on properties in the industrial and petroleum category, but anticipate that water quality issues and limitations on suitable uses for the water harvested may limit the potential for this customer category, as with irrigation users. CONSULTANT will estimate rainfall / stormwater capture area for existing land use conditions (2015) and projected forwards to 2040 land use conditions, using the information developed under WSMP 2040. IRIS data analyzed from this task will also support the water reuse calculation (Task B).

5. For each watershed, CONSULTANT will identify the area of municipal open space that could be utilized for regional-scale projects using Contra Costa and Alameda County GIS data. CONSULTANT will examine each watershed in GIS and identify 3-4 potential representative open space opportunities per watershed for regional water capture, to serve as typical sites. CONSULTANT will make unit area estimations of runoff volume under each water year type using the Rational Method with local parameters, and scaled up from the typical projects to the entire watershed based on the number and area of such sites apparent in GIS.

6. CONSULTANT will estimate the theoretical water volume that could be supplied by the stormwater system by taking the impervious area within each watershed and assuming that all rainfall to impervious areas eventually enters the stormwater system. CONSULTANT would assume that all rainfall to pervious surfaces is lost to infiltration or evapotranspiration. CONSULTANT will estimate stormwater runoff for the different watersheds and water years.

7. For each watershed, CONSULTANT will identify the documented water quality issues and competing water needs such as minimum instream requirements for creeks (using publically available data from EBMUD, SF Bay RWQCB, NOAA Fisheries, and CDF&W). CONSULTANT will perform a desk-based reconnaissance-level groundwater opportunities and constraints assessment.

8. In order to assess the potential effects of a rainwater / stormwater harvest program on instream flows, CONSULTANT will scale up the results of the sub-watershed rainfall-runoff model we previously developed for the City of Oakland rain barrel effectiveness study to the EBMUD project watersheds. CONSULTANT will do this by scaling up the water capture volumes that were assessed in the Oakland program into the Bay Area Hydrology Model that CONSULTANT developed for that project, and running the model (a continuous rainfall-runoff model) to estimate the change in peak flow and baseflow for receiving creeks. This will provide a basis for estimating not just the available instream flows (baseflows), but the potential reduction in peak flows (a potential ancillary benefit to EBMUD for stormwater treatment and first flush management). CONSULTANT does not propose to model the entire EBMUD service area: the model will be a representative unit area that can be scaled up to mimic entire watersheds.

9. CONSULTANT will aggregate the potential supplies from the sources in subtasks A1-9 to identify the total volume of water that could theoretically be harvested for each watershed in each customer category while meeting instream flow requirements and other relevant regulations.

Deliverables

CONSULTANT will provide the District with a discussion of the proposed methodology that will be used for calculating theoretical rainwater / stormwater supplies. The methodology will include the approach for considering catchment areas as well as all data sources and calculation methods. Once approved by the District, the CONSULTANT will perform the estimate and prepare a technical memorandum summarizing the work effort. The main deliverable for this task will be a technical memorandum (TM) presenting estimates of theoretical water supplies from all EBMUD service area watersheds except those draining to the five terminal reservoirs, broken down into single-family residential, multi-family residential, commercial categories.

EBMUD staff will provide comments to a draft TM. Edits and/or comments will be used by the CONSULTANT team to prepare a final TM for Task A.

II. PROJECT SCHEDULE

The project schedule assumes that the consultant receives a written Notice to Proceed from EBMUD on or before December 9th 2014. If the Notice to Proceed is received later than this date the schedule will be set back by the equivalent number of days.

Task	***Deliverable***	***Date Due***
Notice to Proceed	-	December 9th 2014
0	Kickoff meeting	December 14th 2014
A	Draft technical memo	January 30th 2014
A	Final technical memo	February 27th 2015

Appendix B: Conservation BMP Estimates by Agency

Appendix B presents further information on the conservation analysis, including the methodology and assumptions used to quantify the conservation BMPs for each agency.

Amador Water Agency

AWA prepared and adopted a Water Conservation Plan in 2010 which included descriptions of the fourteen BMPs, the current level of implementation, and plan for future implementation. This Plan was incorporated into its 2010 UWMP including estimated levels of implementation of each conservation measure for Fiscal Year (FY) 2012 through FY 2016. AWA estimated potential water savings for BMPs 2, 5, 6, 9, and 14 using assumptions provided in the CUWCC MOU, as well as the existing number of single family accounts, multi-family accounts, potable and raw water accounts, and other parameters (see Table B-1). The BMPs are described in the following sections.

Table B-1: AWA's Estimated Water Savings for Select BMPs (AFY)

BMP	FY11-12	FY12-13	FY13-14	FY14-15	FY15-16
2. Residential Plumbing Retrofit	2.7	5.4	5.4	5.4	5.4
5. Large Landscape Conservation Programs and Incentives	3.9	5.3	5.3	5.3	5.3
6. High-Efficiency Clothes Washing Machine Financial Incentive Programs	0.9	1.7	1.7	1.7	1.7
9. Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts	2.0	3.0	3.0	3.0	4.0
14. ULFT Replacement Programs	0.4	0.9	0.9	0.9	0.9
Total	**12.1**	**20.8**	**20.8**	**20.8**	**21.8**

Source: AWA 2011.

1. Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers

AWA has had an informal water survey program since 1985, but it formalized the BMP in its 2010 UWMP. It conducts residential and landscape water surveys, and distributes WaterSense Specification (WSS) (i.e. low-flow) showerheads and faucet aerators. The surveys include both indoor and outdoor surveys and suggestions for both single family and multi-family residences. Because AWA did not provide an estimated water savings associated with this BMP, the potential savings that could be achieved were calculated. Assuming that CCWD and AWA have similar customer profiles, the assumptions used by CCWD are applied to AWA. This assumes a 15 percent savings per customer per water survey which would result in 68 gallons per day (gpd) per single family unit and 40 gpd per multi-family unit per survey conducted.

Current Program: In AWA's 2010 UWMP, it assumed it would complete the number of surveys shown in the following table.

Table B-2: AWA Projected Water Survey Program

	FY12	FY13	FY14	FY15	FY16
# single family surveys	50	100	100	100	100
# multi-family surveys	1	1	2	3	4
# landscape surveys	50	100	100	100	100

AWA would save 3.9 AFY if it performs surveys for 50 single family homes and 1 multi-family home. According to the AWA 2010 UWMP, it had 6,319 single family connections and 30 multi-family connections in 2010. Therefore, in FY12, AWA planned to perform surveys for 0.8 percent of its single family accounts and 3.3 percent of its multi-family accounts. If AWA maintains these current levels of implementation and performs surveys on 0.8 percent and 3.3 percent of its single and multi-family accounts in 2040, AWA can expect to conserve 6.7 AFY.

Knowing population will continue to increase in the AWA service area, there is greater potential for water savings if the number of surveys performed increase as population increases. Population was projected through 2030 in the AWA 2010 UWMP as shown in the following table.

Table B-3: AWA Population

2010	25,640
2015	27,880
2020	30,448
2025	33,374
2030	36,766
2040 (estimated)*	44,395

* The Department of Finance estimates Amador County population at 38,334 in 2040.

Assuming the population growth rate in the AWA service area grows at the same rate from 2030 to 2040 as it did from 2020 to 2030, the population in 2040 would be 44,395. Single family customers account for 24.6 percent of the population and multi-family customers account for 0.1 percent. Assuming the same percentages in 2040, based on a population of

44,395, there would be 10,941 single family accounts in the AWA service area and 52 multi-family accounts.

Expanded (Double) Program: If AWA were to expand the program by doubling the current implementation rates (1.6 percent for single family and 6.7 percent for multi-family), it would perform 100 single family surveys and 2 multi-family surveys. In 2040, AWA would perform 173 single family surveys and 3 multi-family surveys, saving 13.3 AFY.

Expanded (Quadruple) Program: If AWA doubled its expanded program, it would conduct 200 single family surveys and 4 multi-family surveys (reaching 3.2 percent and 13.3 percent of customers, respectively). Under the doubled expanded program in 2040, AWA would conduct 346 single family surveys and 7 multi-family surveys. This would result in a savings of 26.7 AFY.

In summary, the following water savings could be achieved:

- BMP 1, 2010 Water Savings Based on UWMP: 3.9 AFY
- BMP 1, 2040 Water Savings if Current Implementation Level is Maintained: 6.7 AFY
- BMP 1, 2040 Savings if Expanded (Double): 13.3 AFY
- BMP 1, 2040 Savings if Expanded (Quadruple): 26.7 AFY

2. Residential Plumbing Retrofit

AWA plans to combine this BMP with BMP 8 – School Education Programs. Outreach will be conducted to fifth graders at schools in the AWA service area, and WSS showerheads will be provided to the students to install with their parents/guardians.

Current Program: AWA did not budget for this BMP until FY12. Thus, no savings are associated with this BMP in 2010. In FY13 and each year after (through its planning period of FY16), AWA planned to provide WSS showerheads to all fifth graders. The number of fifth graders is expected to increase over time as population in the service area increases. In 2010, 389 fifth graders equated to 1.5 percent of the AWA service area population. In 2040, using the same population percentage, there would be 674 fifth graders. If AWA provides WSS showerheads to all 674 fifth graders, water savings of 9.4 AFY would be achieved (assuming 0.014 AFY water savings per showerhead replaced).

Expanded (Double) Program: As stated above, AWA did not budget for this BMP until FY12. In FY12, AWA planned to provide showerheads to half of all fifth graders (roughly 195 students), resulting in a water savings of 2.7 AFY. Because the BMP is assumed to be fully implemented under its current program by 2040, there would be no additional water savings associated with this BMP in 2040.

Expanded (Quadruple) Program: If AWA doubled its expanded program in 2010, it would reach all fifth graders. Because the BMP is assumed to be fully implemented under its current program by 2040, there would be no additional water savings associated with this BMP in 2040.

In summary, implementation of BMP 2 achieves the following:

- BMP 2, 2010 Water Savings Based on BMP: 0 AFY
- BMP 2, 2040 Water Savings if Current Implementation Level is Maintained: 9.4 AFY
- BMP 2, 2040 Water Savings if Expanded (Double): 9.4 AFY
- BMP 2, 2040 Water Savings if Expanded (Quadruple): 9.4 AFY

3. System Water Audits, Leak Detection and Repair

AWA implements this BMP through ongoing repair and maintenance of its water distribution system. It has conducted system water audits since its founding. AWA plans to conduct an annual pre-screening audit of its entire system, then if indicated by the pre-screening audit, a system-wide detailed water audit will be completed. Water savings have not been quantified since detailed information on AWA leaks before and after BMP implementation is not available. New requirements in SB 1420, which mandates Urban Water Management Plans, will require agencies to determine unaccounted-for water (UAW).

4. Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections

AWA has been converting services from flat rate to metered service upon transfer of ownership. As of 2011, there were 27 residential, commercial and raw water customers requiring metering, and 153 accounts yet to be converted from flat rate to volumetric billing. According to the 2010 UWMP, AWA should have fully metered its system as of 2013 and converted all accounts to volumetric billing. This BMP is fully implemented. Water savings have not been quantified since detailed information on customer water use patterns before and after BMP implementation is not available.

5. Large Landscape Conservation Programs and Incentives

There are approximately 30 accounts that are dedicated solely to large landscape irrigation in the AWA service area. AWA has offered surveys to these accounts, along with commercial, industrial, and institutional (CII) accounts since 1985 as an informal service.

Current Program: The BMP was formalized in its 2010 UWMP. The BMP was not budgeted until FY12, so in 2010, there would be no water savings associated with BMP 5. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: In FY12, AWA assumed it would complete 4 surveys and then increase that to 6 in each of the following years through FY16. In the UWMP, AWA assumed water budgets would be created for half of the surveys conducted. It was then assumed that creating a water budget would reduce landscape water use by 10 percent. AWA estimated average water use per landscape account in 2010 to be 19.5 AFY, so conducting a landscape survey and creating a water budget would save 1.95 AFY. According to the LAFCO, the project landscape water use in the AWA service area in 2010 is the same in 2025. It was assumed that no additional increase in landscape water use would occur between 2025 and

2040. If AWA expanded BMP 2 and conducted and prepared twice as many surveys and water budgets, it would save 11.7 AFY (6 landscape water budgets at 1.95 AFY savings each).

Expanded (Quadruple) Program: If AWA doubled its expanded program in 2040, it would perform 12 water budgets (24 landscape surveys), resulting in a savings of 23.4 AFY.

In summary, the following water savings could be achieved:

- BMP 5, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 5, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 5, 2040 Savings if Expanded (Double): 11.7 AFY
- BMP 5, 2040 Savings if Expanded (Quadruple): 23.4 AFY

6. High-Efficiency Clothes Washing Machine Financial Incentive Programs

Current Program: AWA had not yet implemented this BMP at the time of its 2010 UWMP and did not budget for BMP 6 until FY12. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040. AWA intended to begin a rebate program in the Lake Camanche Village area initially, providing $75 rebates for high-efficiency washing machines.

Expanded (Double) Program: In FY12, AWA planned to give 35 rebates, increasing the number of rebates to 70 rebates per year through FY16. Each rebate results in a savings of 0.025 AFY. As described in BMP 1, in 2040, it is estimated there will be 10,941 single family accounts and 52 multi-family accounts. If AWA provided rebates to 5 percent of these customers, it would provide 550 rebates, resulting in a water savings of 13.8 AFY.

Expanded (Quadruple) Program: If AWA doubled its expanded program in 2040, it would provide rebates to 10 percent of its single family and multi-family customers. This would result in 1,099 rebates and a savings of 27.5 AFY.

In summary, the following savings could be achieved:

- BMP 6, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 6, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 6, 2040 Savings if Expanded (Double): 13.8 AFY
- BMP 6, 2040 Savings if Expanded (Quadruple): 27.5 AFY

7. Public Information Programs

AWA promotes public awareness of water conservation through bill inserts, brochures, a demonstration garden, and special events throughout the year. It has and will continue to implement this BMP. CUWCC does not provide a methodology for quantifying water savings from this BMP.

8. School Education Programs

Historically, AWA provided presentation and demonstrations to schools and classes upon request. Per the 2010 UWMP, it plans to formalize its school education program, focusing on outreach to fifth graders (believed to be the age to best reach children and instill the importance of water conservation). AWA gives presentations to all fifth grade classes in its service area and provides students with low-flow showerheads and conservation tips. Water savings associated with the distribution of low-flow showerheads are captured in BMP 2. There is no method available from the CUWCC to quantify water savings from the other measures included in this BMP.

9. Conservation Programs for Commercial, Industrial, and Institutional Accounts

Current Program: According to the 2010 AWA UWMP, in 2010, AWA had about 389 CII accounts. It formalized this BMP in its UWMP and did not budget for it until FY12. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: AWA estimated average water use of 4 AFY per CII account and a 5 percent water savings per survey conducted (0.20 AFY savings per survey). In FY12, it assumed it would conduct 10 CII surveys, increasing to a total of 30 surveys per year. Based on population increases and the percent of CII accounts in 2010, in 2040, AWA will have a service area population of 44,395 and 616 CII accounts. If AWA could conduct surveys for 8.4 percent of CII accounts (equivalent to 52 in 2040), it would achieve a water savings of 10.4 AFY.

Expanded (Quadruple) Program: If AWA doubled its expanded program in 2040, it would conduct surveys for 16.9 percent of CII accounts. This would result in 104 surveys and a savings of 20.8 AFY.

In summary, implementation of BMP 9 results in the following:

- BMP 9, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 9, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 9, 2040 Savings if Expanded (Double): 10.4 AFY
- BMP 9, 2040 Savings if Expanded (Quadruple): 20.8 AFY

10. Wholesale Agency Assistance Programs

AWA offers the same conservation measures to all customers, including wholesale customers – Jackson, Plymouth, Drytown Community Services District (CSD), Pine Grove CSD, Rabb Park CSD, and Mace Meadows. AWA provides surveys, prepares water budgets, and provides residential and industrial rebates to its wholesale customers. Water savings have not been quantified since detailed information on customer water use patterns before and after BMP implementation is not available.

11. Retail Conservation Pricing

AWA uses a tiered water rate structure for water service rates in a portion of its service area. It will continue to charge volumetric pricing and expand this practice to the rest of its service area.

12. Conservation Coordinator

The Agency's Conservation Coordinator retired and the position has not yet been filled due to budget constraints. AWA plans to appoint a replacement Conservation Coordinator staffed at half-time. It is anticipated that when this position is filled, additional water savings will be achieved, however, CUWCC has not identified a method to quantify savings from this BMP.

13. Water Waste Prohibition

AWA adopted a water conservation policy that supports local ordinance that prohibits water waste. In addition, it will consider the development and adoption of a water waste ordinance, a year-round policy that prohibits overwatering landscape, system leaks, and open hoses for example. Potential water savings from this BMP have not been quantified since detailed information on customer water use patterns before and after BMP implementation is not available.

14. Residential Ultra-Low-Flow Toilet Replacement Programs

Current Program: AWA began offering rebates for ULFT to customers in the Lake Camanche Village area as a pilot program. Assuming 30 rebates are offered each year in Lake Camanche Village, a savings of 0.9 AFY could be achieved (equivalent to 0.029 AFY per toilet replaced, reaching 0.5 percent of the population). If AWA maintains these current levels of implementation and offers 30 rebates in 2040, AWA can expect to see the same 0.9 AFY in savings in 2040.

Expanded (Double) Program: As described in BMP 1, population is expected to increase to 44,395 in 2040, resulting in estimated single family accounts totaling 10,941 and multi-family accounts total 52. If AWA provided rebates to 1 percent of these customers in 2040, it would provide a total of 110 rebates, resulting in a water savings of 3.2 AFY.

Expanded (Quadruple) Program: If AWA doubled its expanded program in 2040, it would provide rebates for 2 percent of its customers in 2040. This would result in 104 surveys and a savings of 20.8 AFY.

In summary, implementation of BMP 14 results in the following:

- BMP 14, 2010 Water Savings Based on UWMP: 0.9 AFY
- BMP 14, 2040 Water Savings if Current Implementation Level is Maintained: 0.9 AFY
- BMP 14, 2040 Savings if Expanded (Double): 3.2 AFY
- BMP 14, 2040 Savings if Expanded (Quadruple): 6.4 AFY

Maximum Theoretical Expanded Program (85 gpcd)

In 2020, AWA anticipates reaching a gpcd of 166. Assuming this gpcd in 2040, AWA would use 8,260.5 AFY in 2040, with an estimated 2040 population of 44,395. If AWA were to achieve 85 gpcd in 2040, it would use 4,229.8 AFY in 2040. This results in a maximum theoretical savings of 4,030.7 AFY.

Calaveras County Water District

CCWD is a signatory to the CUWCC MOU and views conservation as an integral part of its water resources stewardship responsibility. As described in its 2010 UWMP, CCWD began implementing conservation BMPs, including leak detection and repair, 100 percent metered service, metered rates, public information programs, water waste prohibitions, and others, prior to signing the MOU. Current and planned implementation efforts for the fourteen CUWCC BMPs are described in CCWD's UWMP and briefly summarized in the following sections. CCWD has found that BMPs 1, 2, 5, 6, 9, and 14 are not locally cost-effective; it has therefore submitted exemption reports to the CUWCC for the 2008 to 2010 reporting period. Should funding be made available and these BMPs be implemented, additional water savings could be achieved.

1. Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers

CCWD offers on-site surveys to customers upon request and monitors customer usage through metering. When customers with unusually high usage are identified, CCWD alerts these customers to the possibility of a water leak. If requested, a field service representative will visit the customer to perform a water usage analysis at no cost to the customer. Even though CCWD implements this BMP, it filed a cost exemption with CUWCC since implementing the BMP to CUWCC coverage is not cost effective. Based on the exemption report, CCWD assumes a 15 percent savings per customer per water survey which would result in 68 gpd per single family unit and 40 gpd per multi-family unit per survey conducted.

<u>Current Program</u>: While CCWD was implementing BMP 1 in 2010, due to the lack of data, it is assumed there was a 0 AFY water savings. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

<u>Expanded (Double) Program</u>: In the cost exemption report, CCWD assumed 180 single family surveys would be completed and 6 multi-family surveys would be completed (~1.5 percent of its customers), resulting in a water savings of 14 AFY. This is the value of water savings that could have been saved in 2010 with the implementation of an expanded program. If CCWD completed the same percentage of surveys for its single family and multi-family customers in 2040, it would conduct 379 single family surveys and 33 multi-family surveys, resulting in a cost savings of 30.3 AFY.

Expanded (Quadruple) Program: If CCWD doubled its expanded program in 2040, it would conduct 758 single family surveys and 60 multi-family surveys (multi-family surveys are capped at 60, as there are only 60 multi-family connections projected within the CCWD service area in 2040). This would result in a savings of 60.4 AFY in 2040.

In summary, the following water savings could be achieved:

- BMP 1, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 1, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 1, 2040 Savings if Expanded (Double): 30.3 AFY
- BMP 1, 2040 Savings if Expanded (Quadruple): 60.4 AFY

2. Residential Plumbing Retrofit

CCWD offers "Living Wise" water conservation kits to all customers, free of charge. The kits include a low flow showerhead, low flow kitchen sink nozzle, bathroom faucet hot water saver fixture, a hot water temperature indicator gauge and a water use/energy cost calculation card and guide.

Current Program: Similar to BMP 1, although CCWD implements this BMP, it filed a cost exemption with CUWCC since implementation per the CUWCC annual implementation target would not be cost effective. CCWD will continue to make these kits available to customers upon request, but it could only expand the program with additional funding. Due to the lack of data, it is assumed there was a water savings of 0 AFY in 2010. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: Based on the exemption report, CCWD assumes a 10 percent savings per customer per retrofit. This equates to a water savings of 45 gpd per single family retrofit and 30 gpd per multi-family retrofit. In its cost exemption report, CCWD assumes it could reach 4.9 percent of its single family customers and 63.6 percent of its multi-family customers. Assuming these implementation rates in 2040, CCWD would distribute 1,236 kits to single family customers and 38 kits to multi-family customers, resulting in a water savings of 63.6 AFY.

Expanded (Quadruple) Program: If CCWD doubled its expanded program in 2040, it would reach 9.8 percent of its single family customers and 100 percent of its multi-family customers, CCWD would distribute 2,471 kits to single family customers and all 60 of its multi-family customers, saving 126.6 AFY.

In summary, the following water savings could be achieved:

- BMP 2, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 2, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 2, 2040 Savings if Expanded (Double): 63.6 AFY
- BMP 2, 2040 Savings if Expanded (Quadruple): 126.6 AFY

3. System Water Audits, Leak Detection and Repair

CCWD operations staff performs regular inspection and maintenance of water distribution systems as part of its leak detection and repair program. CCWD regularly tracks water loss in the system and attempts to repair leaks when funding is available. This BMP is fully implemented and ongoing. Leak detection and repair is a major element of CCWD's operations and maintenance budget. The amount spent each year, and water saved each year, depends on the extent of repair and replacement projects planned. Water savings have not been quantified since detailed information on CCWD leaks before and after BMP implementation is not available.

4. Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections

CCWD meters all connection in its service area and bill bi-monthly using base rates plus volumetric charges. This BMP is fully implemented.

5. Large Landscape Conservation Programs and Incentives

Current Program: CCWD filed a cost exemption with CUWCC for this BMP since it determined implementation per the CUWCC annual implementation target would not be cost effective. Based on the cost exemption report, it has implemented 0 ETo-based water budgets, therefore, there was a 0 AFY cost savings in 2010. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: If funding were available, CCWD could expand upon this program. Based on the exemption report, CCWD assumes a 15 percent water savings per year per customer receiving a budget or 0.35 AF/site for customers receiving an ETo-based landscape water budget. CCWD has approximately 100 metered connections dedicated for landscape in 2010. Based on the cost exemption report, CCWD assumed it would begin with 5 budgets per year (~5 percent of its dedicated landscape meters). In 2040, CCWD is projected to have 150 landscape customers. If it implemented budgets for the same percentage of customers in 2040 (5 percent), it would create 8 budgets and save 2.8 AFY.

Expanded (Quadruple) Program: If CCWD doubled its expanded program and created water budgets for 10 landscape customers (10 percent) in 2040, it would create 15 budgets and save 5.3 AFY.

In summary, the following water savings could be achieved:

- BMP 5, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 5, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 5, 2040 Savings if Expanded: 2.8 AFY
- BMP 5, 2040 Savings if Double Expanded: 5.3 AFY

6. High-Efficiency Clothes Washing Machine Financial Incentive Programs

Current Program: This BMP was determined to not be cost effective, so it is not planned for implementation by CCWD. CCWD submitted an exemption report to CUWCC, therefore it assumed in 2010 there was a 0 AFY cost savings. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: Based on the exemption report, CCWD estimates 5,250 gallons per year could be saved with the replacement of one high-efficiency clothes washer. CCWD's exemption report cites that it could provide rebates to 0.8 percent of the population. If CCWD provided rebates to 0.8 percent of its single family and multi-family population in 2040, it would distribute 203 rebates, resulting in a water savings of 3.3 AFY.

Expanded (Quadruple) Program: If CCWD doubled its expanded program in 2040, it would provide rebates to 1.6 percent of its single family and multi-family customers. This would result in 405 rebates and a savings of 6.5 AFY.

In summary, the following water savings could be achieved:

- BMP 6, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 6, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 6, 2040 Savings if Expanded (Double): 3.3 AFY
- BMP 6, 2040 Savings if Expanded (Quadruple): 6.5 AFY

7. Public Information Programs

CCWD implements a public information program consisting of brochures and handouts, water conservation kits, public informational meetings, and other events. It also continuously updates its website which contains conservation tips and FAQs. CCWD has and will continue to implement this BMP. CUWCC has not identified a method for quantifying water savings from this BMP.

8. School Education Programs

CCWD has and will continue to implement various school education programs in its service area. For example, in January of every year, CCWD sponsors water awareness program to third graders in each of Calaveras County's ten schools, followed by a "Be a Water Saver" poster contest for the students. There is no method available from the CUWCC to quantify water savings from this BMP.

9. Conservation Programs for Commercial, Industrial, and Institutional Accounts

Current Program: CCWD implements an informal program for CII accounts by completing on-site water surveys upon request. It submitted a cost exemption report to CUWCC since it is not cost effective. If funding were available, it could expand upon its existing efforts for this BMP. Due to the lack of data, it is assumed there was a cost savings of 0 AFY in 2010.

Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: Based on the exemption report it assumes 200 gpd could be saved from one survey. If CCWD expanded BMP 9 in 2040 to the estimates indicated in the cost exemption report, it would conduct approximately 6 surveys per year (1 percent of CII customers), resulting in a cost savings of 1.3 AFY.

Expanded (Quadruple) Program: If CCWD doubled its expanded program in 2040, it would conduct surveys for 2 percent of CII accounts. This would result in 13 surveys and a savings of 2.9 AFY.

In summary, the following water savings could be achieved:

- BMP 9, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 9, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 9, 2040 Savings if Expanded (Double): 1.3 AFY
- BMP 9, 2040 Savings if Expanded (Quadruple): 2.9 AFY

10. Wholesale Agency Assistance Programs

CCWD is not a wholesale water supplier; therefore this BMP is not applicable. CCWD provided supplemental water to three private water companies that serve a total of 2,200 connections. It provides public information handouts and kits for distribution to the companies' customers.

11. Retail Conservation Pricing

As described in BMP 4, CCWD meters all of its customers and uses a rate structure that includes a base rate and consumption charge. This BMP is fully implemented.

12. Conservation Coordinator

CCWD designated a Conservation Coordinator in 2005 and has outlined specific duties for them to fulfill. CUWCC has not identified a method to quantify water savings from this BMP.

13. Water Waste Prohibition

Article II, Section 16 of the CCWD Board Policy prohibits water waste. It also adopted Ordinance 2010-02, which updated the ordinance preventing water waste in July 2010. CUWCC has not identified a method to quantify water savings from this BMP.

14. Residential Ultra-Low-Flow Toilet Replacement Programs

Current Program: This BMP is not cost effective for CCWD, so an exemption report was submitted to CUWCC. For the purposes of this analysis, it is assumed there was a 0 AFY water savings in 2010. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: Should funding be available, CCWD could provide rebates to customers to encourage installation of low flow toilets (CCWD 2011). Based on the exemption report CCWD assumes installation of an ULFT would save 21.3 gpd in a single-family home and 51.1 gpd in a multi-family home. If, in 2010, CCWD expanded implementation of BMP 14 to the level indicated in its cost exemption report, it would distribute 1,200 ULFT rebates to single family customers. This assumes there were approximately 12,000 single family connections, 50% of which were pre-1992 and required toilet replacements (i.e. 6,000). It assumed 10% of the single family homes would receive 2 rebates each, for 2 toilets in their homes, resulting in 1,200 rebates distributed per year. If CCWD distributed 1,200 ULFT rebates every year, it would have fully implemented this BMP (by providing rebates to the 6,000 pre-1992 homes) by 2020. The potential savings associated with full implementation of this program us 1,283.7 AFY.

Expanded (Quadruple) Program: Because the program would already be fully implemented under the expanded (double) program, no additional savings is associated with this BMP.

In summary, the following water savings could be achieved:

- BMP 14, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 14, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 14, 2040 Savings if Expanded (Double): 1,283.7 AFY
- BMP 14, 2040 Savings if Expanded (Quadruple): 1,283.7 AFY

Maximum Theoretical Expanded Program (85 gpcd)

In 2020, CCWD anticipates reaching a gpcd of 172. Assuming this gpcd in 2040, CCWD would use 10,096.4 AFY in 2040, with an estimated 2040 population of 52,369. If CCWD were to achieve 85 gpcd in 2040, it would use 4,989.5 AFY in2040. This results in a maximum theoretical savings of 5,106.9 AFY.

The City of Stockton

The City of Stockton meets its water demands from a combination of sources including wholesale treated surface water from SEWD, the Delta Water Supply Project (DWSP) (raw surface water from the San Joaquin River and the Mokelumne River), WID (surface water from the Mokelumne River), and groundwater. The City's current and projected water supplies are provided in Table B-4.

Table B-4: Stockton Current and Project Water Supplies (AFY)*

Source	2010	2015	2020	2025	2030	2035
SEWD Surface Water	29,780	17,500	17,500	17,500	17,500	17,500
DWSP Surface Water	0	33,600	33,600	33,600	33,600	33,600
WID Surface Water	0	6,500	6,500	13,000	13,000	13,000
Groundwater	5,475	23,114	23,114	23,114	23,114	23,114
Recycled Water	-	-	-	-	-	-
Total	35,255	80,714	80,714	87,214	87,214	87,214

Source: Stockton 2011.

* Note that this table only shows available supply available to the City and are not necessarily equal to demands.

The City implements a robust water conservation program in its service area. All of the 14 BMPs are implemented in the City and briefly described in the following sections.

1. Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers

<u>Current Program</u>: Until May 2010, the City offered water use surveys for single and multi-family residential customers. Due to staff limitations, these complimentary surveys are no longer offered. Instead, the City is developing a self-performed water use survey. Therefore, it is assumed there was 0 AFY water savings in 2010. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

<u>Expanded (Double) Program</u>: As described in the City's 2010 UWMP, it currently does not have a means to quantify water savings for this BMP. Applying the same water savings assumptions used for AWA and CCWD (68 gpd for a single family survey and 40 gpd for a multi-family survey), if Stockton were to perform surveys for 1 percent of its single family and multi-family customers in 2040 (666 single family surveys and 78 multi-family surveys), it would achieve a water savings of 54.2 AFY.

Population growth is assumed in this calculation. Population was projected through 2035 in the Stockton 2010 UWMP. Assuming the population growth rate from 2035 to 2040 is the same as it was from 2030 to 2035, the population in 2040 would be 262,161 (see Table B-5). In 2010, single family customers accounted for 25.4 percent of the total population and multi-family customers accounted for 3.0 percent of the population. Applying these percentages to the 2040 population results in 66,591 single family accounts and 7,771 multi-family accounts in 2040.

Table B-5: Population in City of Stockton Water Service Area

Year	Population
2010	169,963
2015	183,247
2020	199,948
2025	216,038
2030	231,955
2035	246,596
2040 (estimated)	262,161

Expanded (Quadruple) Program: If Stockton doubled its expanded program in 2040, it would conduct surveys on 2% of its single family and multi-family customers. This is 1,332 single-family surveys and 155 multi-family surveys, which results in a savings of 108.4 AFY.

In summary, the following water savings could be achieved:

- BMP 1, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 1, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 1, 2040 Savings if Expanded (Double): 54.2 AFY
- BMP 1, 2040 Savings if Expanded (Quadruple): 108.4 AFY

2. Residential Plumbing Retrofit

The City offers low-flow water use efficiency kits that include two 1.5 gpm low-flow showerheads, a 1.5 gpm kitchen aerator, two 1.0 gpm bathroom aerators, toilet flappers, and a metal garden hose nozzle. The City has been distributing kits since 1990 and began tracking the number of kits distributed in 2009.

Current Program: According to the City's 2010 UWMP, in 2009 it distributed 467 kits and 595 kits in 2010. The City will continue to offer these kits. These kits are similar to those provided to customers by CCWD. Using the same assumptions, distribution of these kits equates to a water savings of 45 gpd per single family retrofit and 30 gpd per multi-family retrofit. As stated, in 2010, the City distributed 595 kits, resulting in a water savings of 25 AFY in 2010 (assuming an average water savings of 37.5 gpd per kit). Distributing kits to 595 customers is 1.2 percent of single family and multi-family accounts. Due to population growth, if the City distributed kits to 1.2 percent of its population in 2040, it would distribute 918 kits resulting in a water savings of 38.6 AFY.

Expanded (Double) Program: If Stockton expanded its current program to distribute kits to 2.5% of its single family and multi-family customers in 2040, the City would distribute 1,836 kits and save 77.1 AFY.

Expanded (Quadruple) Program: If Stockton doubled its expanded program, it would reach 4.9% of its customers, distributing 3,671 kits and saving 154.2 AFY.

In summary, the following water savings could be achieved:

- BMP 2, 2010 Water Savings Based on UWMP: 25.0 AFY
- BMP 2, 2040 Water Savings if Current Implementation Level is Maintained: 38.6 AFY
- BMP 2, 2040 Savings if Expanded (Double): 77.1 AFY
- BMP 2, 2040 Savings if Expanded (Quadruple): 154.2 AFY

3. System Water Audits, Leak Detection and Repair

The City implements an ongoing water audit program which has allowed them to maintain an average of 5.4 percent water loss from 2000 to 2010. The BMP is currently being fully implemented and will continue to be implemented as part of the City's ongoing O&M program.

4. Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections

The City of Stockton service area is fully metered and all connections are billed based on the volume of water used; therefore, this BMP has been fully implemented.

5. Large Landscape Conservation Programs and Incentives

Current Program: While it does not currently have a formal Large Landscape Conservation Program, in 2010, the City of Stockton began implementing the State's Model Water Efficient Landscape Ordinance (MWELO), finalized conversion of 12 of the newest City parks to computerized irrigation controls to achieve a water savings of approximately 25 percent, and launched a website offering water wise landscaping resources and tips. The City intends to develop water budgets for its largest landscape customers as part of a pilot program. Because no budgets were developed in 2010, it is assumed there was a water savings of 0 AFY. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: According to the City's 2010 UWMP, this BMP is currently not quantifiable. The City has approximately 900 landscape-dedicated meters. Similar to the BMP 1estimates, the number of landscape accounts in 2040 was estimated based on the population growth rate and 2010 percentage of landscape users. The estimated number of landscape customers in 2040 is 1,450. If the City offered this BMP to 1% of these customers, it would prepare 15 budgets resulting in a water savings of 5.3 AFY in 2040.

Expanded (Quadruple) Program: If Stockton doubled its expanded program, it would create water budgets for 29 landscape customers (2%) in 2040, saving 10.2 AFY.

In summary, the following water savings could be achieved:

- BMP 5, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 5, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 5, 2040 Savings if Expanded (Double): 5.3 AFY
- BMP 5, 2040 Savings if Expanded (Quadruple): 10.2 AFY

6. High-Efficiency Clothes Washing Machine Financial Incentive Programs

Current Program: In 2007 the City began offering $150 rebates for high-efficiency clothes washers through the CUWCC SMART Rebate Program. According to the City's 2010 UWMP, each installation is assumed to save 0.314 AF. The City provided 311 rebates from 2007 to 2010. Assuming the City provided the same number of rebates each year from 2007 to 2010, then it provided 78 rebates each year. If the City provided 78 rebates in 2010, it saved 24.5 AFY of water. Providing 78 rebates to its single family customers is equivalent to providing rebates to 0.2% of its single family customers. If the City continued providing rebates to 0.2% of its single-family customers in 2040, it would provide 133 rebates and save 41.8 AFY in 2040.

Expanded (Double) Program: If the City doubled current implementation levels and provided rebates to 0.4% percent of its single family customers, it would provide 266 rebates in 2040, resulting in a water savings of 83.5 AFY.

Expanded (Quadruple) Program: If the City quadrupled current implementation levels and provided rebates to 0.8% percent of its single family customers, it would provide 533 rebates in 2040, resulting in a water savings of 167.4 AFY.

In summary, the following water savings could be achieved:

- BMP 6, 2010 Water Savings Based on UWMP: 24.5 AFY
- BMP 6, 2040 Water Savings if Current Implementation Level is Maintained: 41.8 AFY
- BMP 6, 2040 Savings if Expanded (Double): 83.5 AFY
- BMP 6, 2040 Savings if Expanded (Quadruple): 167.4 AFY

7. Public Information Programs

Public information regarding water conservation is performed through the City's outreach program. Measures include monthly bill inserts, public outreach events, print and web-based publications, and annual updates. CUWCC has not identified a method to quantify water savings from this BMP.

8. School Education Programs

The City provides water conservation school education through the Stockton Area Water Suppliers (SAWS), comprised of the City of Stockton, SEWD, California American Water Company, and San Joaquin County. SAWS provides teachers at public and private schools packets of water conservation materials that can be discussed during class programs. The City plans to continue to participate in this program. CUWCC has not identified a method to quantify water savings from this BMP.

9. Conservation Programs for Commercial, Industrial, and Institutional Accounts

Current Program: The City offers a high efficiency toilet (HET) Direct Install Program for its CII customers. The program covers the cost of the installation and hardware. The City has installed 269 toilets since it started implementing this BMP in 2010 resulting in a water savings of 252.9 AFY (or 0.94 AFY / toilet replacement). If the City continued installing toilets in 2040 at the same rate (16.5%) that it did in 2010, the City could save 390.1 AFY in 2040. The City also makes periodic visits to CII customers to conduct water use evaluations.

Expanded (Double) Program: If Stockton doubled its current program, it would provide installs for 33% of its CII customers in 2040. CII accounts in 2040 were estimated using the same approach as the single family, multi-family, and landscape accounts (based on population growth rate and percentage of 2010 accounts to total population). If Stockton provided installs for 33% of its CII customers, it would provide 830 installs and save 780.2 AFY.

Expanded (Quadruple) Program: If Stockton quadrupled its current program, it would provide installs for 66% of its CII customers in 2040, which would result in 1,660 installs and a savings of 1,560.4 AFY.

In summary, the following water savings could be achieved:

- BMP 9, 2010 Water Savings Based on UWMP: 252.9 AFY
- BMP 9, 2040 Water Savings if Current Implementation Level is Maintained: 390.1 AFY
- BMP 9, 2040 Savings if Expanded (Double): 780.2 AFY
- BMP 9, 2040 Savings if Expanded (Quadruple): 1,560.4 AFY

10. Wholesale Agency Assistance Programs

The City of Stockton meets with California American Water Company, San Joaquin County, and SEWD (all members of SAWS) once a month to discuss water-related matters including supply and conservation. There is no method identified by the CUWCC to quantify water savings from this BMP.

11. Retail Conservation Pricing

The City has a fee schedule with a uniform rate schedule. The City's water conservation ordinance allows the City to raise rates during declared water emergencies. Potential water savings from this BMP have not been quantified since detailed information on customer water use patterns before and after BMP implementation is not available.

12. Conservation Coordinator

The City's Water Resources Program Manager acts as the Water Conservation Coordinator. The BMP is in place and the City will continue to implement it. As such, this BMP is fully implemented.

13. Water Waste Prohibition

Chapter 13.28 of the City's Municipal Code restricts certain uses of water which is enforceable per the Code. This BMP is fully implemented.

14. Residential Ultra-Low-Flow Toilet Replacement Programs

Current Program: Since 2007, the City has offered up to $100 rebates for ULFTs through the CUWCC SMART Rebate Program. The City has issued 137 rebates to date. Assuming it provided the same number of rebates each year from 2007 to 2010, it provided 34 rebates per year. Based on the City's 2010 UWMP, it is assume each ULFT installation saves 0.56 AF. Therefore, in 2010, if the City provided 34 ULFT rebates, a water savings of 19.0 AFY was achieved. Providing 34 rebates in 2010 is equivalent to providing rebates to 0.1% of its single family customers. If the City continued offering rebates in 2040 at this same level, the City could save 29.4 AFY in 2040.

Expanded (Double) Program: If the City expanded implementation of BMP 14 and provided rebates to 0.2% of its single family customers (149 rebates), it would save 83.3 AFY of water in 2040.

Expanded (Quadruple) Program: If the City quadrupled its current program and provided rebates to 0.4% of its single family customers (297 rebates), it would save 166.6 AFY of water in 2040.

In summary, the following water savings could be achieved:

- BMP 14, 2010 Water Savings Based on UWMP: 19.0 AFY
- BMP 14, 2040 Water Savings if Current Implementation Level is Maintained: 29.4 AFY
- BMP 14, 2040 Savings if Expanded (Double): 83.3 AFY
- BMP 14, 2040 Savings if Expanded (Quadruple): 166.6 AFY

Maximum Theoretical Expanded Program (85 gpcd)

In 2020, the City of Stockton anticipates reaching a gpcd of 165. Assuming this gpcd in 2040, the City of Stockton would use 48,485.8 AFY in 2040, with an estimated 2040 population of 262,161. If the City were to achieve 85 gpcd in 2040, the City would use 24,977.5 AFY in 2400. This results in a maximum theoretical savings of 23,508.2 AFY.

The City of Lodi

The City of Lodi is committed to water conservation and has implemented several policies and ongoing programs to promote and encourage water conservation. It has also implemented several drought-specific programs that take effect when water supplies become limited. The City's current water conservation program consists primarily of outdoor watering restrictions. As described in the City's 2010 UWMP, benefit-cost (B/C) ratios were developed for each of the fourteen BMPs. B/C ratios of less than one were not considered to be financially beneficial and were not recommended for implementation. The status of implementation of each BMPs, and the B/C ratio of each BMP not being implemented, are provided in Table B-6.

Table B-6: City of Lodi's BMPs

	BMP	City Measure	Compliance with UWMP Act
1.	Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers	None at this time	B/C = 0.9
2.	Residential Plumbing Retrofit	Rebates offered at time of purchase for water savings device	Yes
3.	System Water Audits, Leak Detection and Repair	Goal to replace 1% of pipeline system annually	Yes
4.	Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections	Residential Water Meter Program underway; majority of commercial, industrial, landscape connections metered	In Progress
5.	Large Landscape Conservation Programs and Incentives	None at this time; Water conservation Ordinance applies to large landscape	B/C Ratio = 5.6
6.	High-Efficiency Clothes Washing Machine Financial Incentive Programs	None at this time	B/C Ratio = 0.7
7.	Public Information Programs	Conservation information included in bill inserts, newsletters, brochures, demonstration gardens, special events, website	Yes

Table B-6: City of Lodi's BMPs

BMP		City Measure	Compliance with UWMP Act
8.	School Education Programs	K-6 classroom presentations (currently suspended until full-time Water Conservation Coordinator position filled)	Yes
9.	Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts	Water surveys not offered at this time; ULFT replacement program is available to CII accounts	B/C Ratio = 2.2
10.	Wholesale Agency Assistance Programs	Not applicable	Not applicable
11.	Retail Conservation Pricing	Residential Water Meter Program will allow for conservation pricing	In Progress
12.	Conservation Coordinator	Position is currently vacant; part-time employees fulfill similar water conservation enforcement duties	Yes
13.	Water Waste Prohibition	Restriction and penalties in place and enforced for wasted water; emergency conservation measures in place for emergency conditions	Yes
14.	Residential Ultra-Low-Flow Toilet (ULFT) Replacement Programs	Rebates offered at the time of purchase for ULFTs	Yes

Source: RMC 2011

The BMPs and estimated water savings are briefly summarized in the following sections.

1. Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers

Water surveys would consist of residential indoor and outdoor water use reviews resulting in staff recommendations for water savings.

Current Program: The City does not currently have a residential water survey program in place and does not plan to implement one. Therefore, water savings in 2010 from BMP 1 was 0 AFY. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: Based on the City's 2010 UWMP, it assumes each survey conducted would save 0.032 AFY[1]. Population was projected through 2035 in the City's 2010 UWMP, as shown in Table B-7. Assuming the population growth rate from 2035 to 2040 is the same as it was from 2030 to 2035 (5.1 percent), the population in 2040 would be 85,654. Single family customers account for 26.2% of the total population in 2010 and multi-family users account for 8.9% of population. Using the same percentages, based on a population of 85,654, there would be 22,454 single family users and 7,652 multi-family users.

Table B-7: Population in the City of Lodi Service Area

Year	Population
2010	63,549
2015	66,791
2020	70,198
2025	73,778
2030	77,542
2035	81,497
2040 (estimated)	85,654

If the City conducted surveys for 1% of its single family and multi-family customers in 2040, it would conduct 301 surveys, resulting in a water savings of 9.6 AFY.

Expanded (Quadruple) Program: In the double expanded program, Lodi would conduct surveys on 2% of its single family and multi-family customers. In 2040, it would conduct 602 surveys, resulting in a savings of 19.3 AFY.

In summary, the following water savings could be achieved:

- BMP 1, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 1, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 1, 2040 Savings if Expanded (Double): 9.6 AFY
- BMP 1, 2040 Savings if Expanded (Quadruple): 19.3 AFY

[1] Water savings can vary widely depending on the individual customer's implementation of recommendations. The CUWCC estimates that outdoor water use could be decreased by 10 percent for each unit surveyed.

2. Residential Plumbing Retrofit

The City promotes retrofitting residential plumbing fixtures through a rebate program. Rebates of 50 percent of the cost of the low-flow device are provided at the store at the time of purchase. The City then reimburses the store the cost of the rebate. The number of rebates provided since 2005 has significantly decreased due to the economic downturn and because two of the stores that were carrying the rebates went out of business or stopped participating in the program. The City expects more rebates to be distributed as the economy recovers.

<u>Current Program</u>: In 2010, no low flow showerhead, hose bib timer, or hot water heater blanket rebates were distributed, resulting in a water savings of 0 AFY. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040. Applying the CUWCC assumption that a low-flow showerhead retrofit will save 2.9 gpcd on post-1980 constructed homes and 7.2 gpcd on pre-1980 constructed homes, the City estimates a 0.2 AFY savings if 10 low flow showerhead, 5 hose bib timer, and 5 hot water heater blanket rebates are distributed. They assumed this number of rebates would be provided each year from 2011 through 2015.

<u>Expanded (Double) Program</u>: If BMP 2 is expanded and rebates are provided to 1% of the City's single family and multi-family customers, a water savings of 13.9 AFY would be achieved in 2040 (225 rebates for single family users and 77 rebates to multi-family users).

<u>Expanded (Quadruple) Program</u>: If Lodi doubled its expanded program, it would reach 2% of its customers, providing 449 rebates to single family customers and 153 rebates to multi-family customers. This would result in a savings of 27.8 AFY in 2040.

In summary, the following water savings could be achieved:

- BMP 2, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 2, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 2, 2040 Savings if Expanded (Double): 13.9 AFY
- BMP 2, 2040 Savings if Expanded (Quadruple): 27.8 AFY

3. System Water Audits, Leak Detection and Repair

The City implements a capital improvement program with a goal of replacing 1 percent of the pipeline system annually. The City plans to survey and replace 5,000 feet of water main every year from 2011 through 2015 resulting in water savings ranging from 163 AFY to 178 AFY. According to the City's 2010 UWMP, water savings in 2010 was not quantified due to the lack of data. It would be possible to further expand this BMP and save additional water if pipeline replacement increased; due to limited information about the savings expected from program scaling, this is unable to be estimated at this time.

4. Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections

The City meters and bills for actual water use for most CII accounts and landscape customers. The City plans to install water meters for unmetered commercial accounts upon completion of its Residential Water Meter Program. Through the Residential Water Meter Program, customers with existing meters are converted to usage-based rates.

Current Program: This BMP is not being currently implemented. As such, there is assumed to be no savings associated with this BMP in 2010. The City's plan for implementation is provided in Table B-8. The City estimates all single family customers will be converted to usage-based water rates by January 2019. As such, the program is assumed to be fully implemented by 2040. Assuming Lodi meters the 6,649 unmetered accounts remaining in 2015 by the end of the program (and thus, by 2040), 316 AF will be saved (0.05 AFY savings per retrofit). This assumes 0.05 AF in savings per retrofit. This means that a total of 730.1 AF will be saved by 2040 (414 anticipated savings by 2015 and 316 AF achieved through full implementation).

Table B-8: City of Lodi BMP 4 Implementation

	2011	2012	2013	2014	2015
Unmetered Accounts	17,009	13,336	10,660	8,605	6,649
Retrofit Meters Installed	3,071	2,073	1,453	1,354	874
Accounts without Commodity Rates	19,685	19,685	17,462	13,793	11,123
Accounts with Commodity Rates	2,874	3,100	5,551	9,449	12,353
Water Savings (AFY)	146	158	255	347	414

Expanded (Double) Program: In 2040, this BMP will be fully implemented because this program is expected to be completed by January 2019 and is already anticipated to be fully implemented under the current program. Thus, no additional savings would be achieved under a double expanded program in 2040.

Expanded (Quadruple) Program: In 2040, this BMP will be fully implemented because this program is expected to be completed by January 2019 and is already anticipated to be fully implemented under the current program. Thus, no additional savings would be achieved under a quadruple expanded program in 2040.

In summary, the following water savings could be achieved:

- BMP 4, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 4, 2040 Water Savings if Current Implementation Level is Maintained: 730.1 AFY

- BMP 4, 2040 Savings if Expanded (Double): 730.1 AFY
- BMP 4, 2040 Savings if Expanded (Quadruple): 730.1 AFY

5. Large Landscape Conservation Programs and Incentives

Current Program: The City installed "Maxicom" irrigation controllers and telecommunications equipment to better manage its park irrigation. The City does not currently budget for this BMP due to staff shortages and the priority of the water meter program; however, because the B/C ratio of this BMP is 5.6, the City will consider implementing it in the future. Because implementation of BMP 5 had not yet begun, it is assumed there was a 0 AFY water savings in 2010. If that the level of implementation was maintained form 2010 to 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: Assuming a 15 percent reduction in water use after a survey is completed, an estimated 12 AFY could be saved if 10 surveys were conducted, or 1.2 AFY per survey, according to the City's 2010 UWMP. Based on population projections and the percent of landscape customers in 2010, there would be 31 landscape customers in 2040. If the City conducts surveys for 5% of its 31 landscape customers in 2040, it would save 2.4 AFY.

Expanded (Quadruple) Program: If the City doubles its expanded double program, it would conduct surveys for 10% of its 31 landscape customers in 2040. This would result in savings of 4.8 AFY.

In summary, the following water savings could be achieved:

- BMP 5, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 5, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 5 2040 Savings if Expanded (Double): 2.4 AFY
- BMP 5 2040 Savings if Expanded (Quadruple): 4.8 AFY

6. High-Efficiency Clothes Washing Machine Financial Incentive Programs

Current Program: The City does not currently implement this BMP because it was not determined to be cost effective, therefore there was no associated water savings with this BMP in 2010. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: If the City implements this BMP in 2040 and provides $75 rebates for high-efficiency washing machines to its single family and multi-family customers, 5,100 gallons per year would be saved per rebate. If the City provided rebates to 1% of its single family and multi-family customers in 2040, the City would provide 301 rebates and save 4.7 AFY.

Expanded (Quadruple) Program: If the City doubles its double expanded program, it would provide rebates to 2% of its single family and multi-family customers in 2040. This would result in 602 rebates and savings of 9.4 AFY.

In summary, the following water savings could be achieved:

- BMP 6, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 6, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 6, 2040 Savings if Expanded (Double): 4.7 AFY
- BMP 6, 2040 Savings if Expanded (Quadruple): 9.4 AFY

7. Public Information Programs

The City has an ongoing public information program which began in 1977. CUWCC has not determined a method to estimate savings from this BMP; however, the City believes this Program is beneficial and will continue to implement it. Because CUWCC has not identified methodology for estimating potential savings, savings have not been projected for implementation of the BMP.

8. School Education Programs

In 1986 the City began its Water Educational Program in Lodi elementary schools. The program focuses on grades kindergarten through six because those are believed to be the most effective grades for cultivating water awareness and the formation of good water habits. There is no method available to quantify water savings from the program. The City has fully implemented this program and will continue implementing this BMP.

9. Conservation Programs for Commercial, Industrial, and Institutional Accounts

Current Program: The City's conservation program applies to all customers, including CII accounts, however, the City plans to implement a water use survey program specifically for CII accounts when staffing and priorities allow. Because no surveys were conducted in 2010 for CII accounts, it is assumed there was a 0 AFY water savings. Assuming that this level of 2010 implementation was maintained in 2040, there would be no conservation savings associated with this BMP in 2040.

Expanded (Double) Program: Based on the 2010 UWMP, a water use survey for a CII account would save an average of 1.5 AFY. If the City expands implementation of BMP 9 and conducts surveys for 1 percent of its CII customers in 2040 (179 surveys), it could achieve a water savings of 262.2 AFY.

Expanded (Quadruple) Program: If the City doubles implementation of its double expanded program, it would conduct surveys for 2 percent of its CII customers in 2040. This would result in 358 surveys and 524.5 AFY of water savings.

In summary, the following water savings could be achieved:

- BMP 9, 2010 Water Savings Based on UWMP: 0 AFY
- BMP 9, 2040 Water Savings if Current Implementation Level is Maintained: 0 AFY
- BMP 9, 2040 Savings if Expanded (Double): 262.2 AFY
- BMP 9, 2040 Savings if Expanded (Quadruple): 524.5 AFY

10. Wholesale Agency Assistance Programs

The City is not a wholesale water agency so this BMP is not applicable. The City does not currently budget for a program specific to CII and does not intend to. Since the B/C ratio is greater than 1, it will consider future implementation. Assuming the City surveys 10 percent of its CII accounts over an 8 year period, 138 surveys would be conducted resulting in a potential water savings of 44 AFY.

11. Retail Conservation Pricing

The City is in the process of implementing its Residential Water Meter Program. Water meters will be installed between 2011 and 2019. As meters are installed it will apply commodity pricing (see BMP 4). The City has developed a tiered rate structure for single family residential accounts with escalating rates for customers that use more water, encouraging water conservation. Water savings from this BMP are factored into the water savings described in BMP 4. Because this BMP is planned to be fully implemented, additional savings are not projected for this BMP.

12. Conservation Coordinator

The City's' Water Conservation Coordinator position is not currently filled. Several City staff members work part-time to perform many of the same duties. CUWCC does not have a method for quantifying water savings from this BMP.

13. Water Waste Prohibition

The City has an existing Water Conservation Ordinance that defines water waste prohibitions for its customers. This BMP was implemented in 1977 and will continue to be enforced in the future. Because this BMP is fully implemented, additional water savings from this BMP are not anticipated.

14. Residential Ultra-Low-Flow Toilet Replacement Programs

Current Program: The City's Building Code requires all new residential construction and major remodels/renovations of existing homes to install low-flow fixtures. A rebate program (as described in BMP 2) is implemented by the City to encourage the installation of ULFTs. The installation of ULFTs is estimated to save 1.9 gallons per flush or 0.03 AFY per rebate. In 2010 the City provided 1 ULFT rebate resulting in a water savings of 0.03 AFY. Assuming this same level of implementation in 2040, the City could expect to have the same savings of 0.03 AFY in 2040.

Expanded (Double) Program: If the City expands the program and provides rebates to 1% of its estimated 30,106 single family and multi-family customers in 2040, it would provide 301 rebates and achieve water savings of 8.8 AFY.

Expanded (Quadruple) Program: If the City doubles its double expanded program and provides rebates to 2% of its single family and multi-family customers in 2040, it would provide 602 rebates and achieve water savings of 17.7 AFY.

In summary, the following water savings could be achieved:

- BMP 14, 2010 Water Savings Based on UWMP: 0.03 AFY
- BMP 14, 2040 Water Savings if Current Implementation Level is Maintained: 0.03 AFY
- BMP 14, 2040 Savings if Expanded (Double): 8.8 AFY
- BMP 14, 2040 Savings if Expanded (Quadruple): 17.7 AFY

Maximum Theoretical Expanded Program (85 gpcd)

In 2020, the City of Lodi anticipates reaching a gpcd of 199. Assuming this gpcd in 2040, Lodi would use 19,105.68 AFY in 2040, with an estimated 2040 population of 85,654. If the City were to achieve 85 gpcd in 2040, the City would use 8,160.7 AFY in 2040. This results in a maximum theoretical savings of 10,945.0 AFY.

Woodbridge Irrigation District

WID diverts water from the Mokelumne River and the Delta to supply water to its customers. Landowners in the WID service area also pump groundwater for approximately 26,000 acres not serviced directly by the canal system. At one time WID's diversions from the Mokelumne River exceeded 100,000 AFY. Over the years they have decreased to 60,000 AFY. Its base supply of 60,000 AFY is to be released by EBMUD as part of its 1938 and 1965 settlement agreements. WID has taken an additional 12,000 AFY in the past per additional water rights, bringing its total base supply in wet years to an average of 72,000 AFY. WID is further reduced in dry years when entitlements are reduced by provisions in its agreements with EBMUD.

In order to comply with the Water Conservation Act of 2009, WID prepared a 2014 AWMP. WID also measures the volume of water delivered to customers and has a pricing structure for customers based on quantity delivered, as required by the Act. Some of the additional water conservation measures it has implemented in recent years are described in the following sections.

Farm Gate Meters, Metering and Volumetric Pricing System

WID meters all water diversions on a volumetric basis at the point of use. A metering technician at WID keeps accurate records and monitors farm gate meters on a daily basis and Micrometer meters on a monthly basis. Growers pay a base rate to WID when they sign up to receive water. If a grower uses more water than was included in the base rate, they pay additional charges for the excess water used. If they use less water than was included in the base rate, they are eligible for a refund.

Municipal Water Meters

Municipalities served by WID, including Lodi and Stockton, receive water on a bulk basis and are required to meter supplies. WID uses a Supervisory Control and Data Acquisition (SCADA) system which shows the flow rate and total flow for each city.

Automated Canal Gate Structures

WID invested in an automated SCADA control system to operate its diversion dam, fish screen, and canal gate control system. The SCADA system has saved water, reduced labor costs, and provides reliable and accurate control of reservoir water levels and downstream flows in the Mokelumne River and the District's canal system.

Drip Irrigation System

WID provides growers with advice and consultation on the design of drip irrigation systems to help maximize water and power efficiency.

WID recently implemented a drip irrigation conversion program. Through this program, WID has made available 6,000 AFY of Mokelumne River supply to the City of Lodi at a cost of $200/AF. The funds secured from this transfer were used to fund the Woodbridge Diversion Dam replacement.

Strict Water Conservation Rules

Rules that restrict waste of water are included in WID's Rules and Regulations are strictly enforced. For example, if a grower intentionally spills irrigation water, that grower may lose a turn in line or be denied service. Growers can also be denied water service for failing to maintain and clean their ditches.

Weed Control and Canal Maintenance

Weeds and overgrowth in canals restrict water flows and their roots can perforate canal walls, resulting in leakage and water consumption. WID employs a trained vegetation control manager who implements a weed control program. The canal is also inspected for leaks and maintained accordingly.

Zero Spillage Requirement

WID operates the canal such that the amount of water in the canal equals the demand for water. Spills at the end of the system are monitored. The ditch tenders operate the canals to maximize efficiency and save water (WID 2013).

North San Joaquin Water Conservation District

As a California Water Conservation District, NSJWCD has the power to impose groundwater charges, form improvement districts to fund projects, and sell surface water. NSJWCD serves approximately 154,000 acres, 4,740 acres of which are within the Lodi city limits and 5,600 acres within Lodi's sphere of influence. It operates two pump stations on the Mokelumne River. In 1996, NSJWCD adopted a Groundwater Management Plan (GWMP) meeting requirements of Assembly Bill 3030 (AB3030) to address declining groundwater levels. Actions to address the groundwater quality and quantity issues included securing a surface water supply and implementing efficient water application methods. NSJWCD has access to 20,000 AFY of Mokelumne River water (permit 10477 – a post-1914 appropriative right) when certain criteria are met.

Appendix C: MOCASIM for the MokeWISE Program Technical Memorandum

Appendix C provides the MOCASIM for the MokeWISE Program Technical Memorandum, which further describes the MOCASIM model.

AD Consultants

Preliminary Draft
Technical Memorandum

MOCASIM
for the MokeWISE Program

Prepared for:

Upper Mokelumne River Watershed Authority

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November 2013

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Contents

Figures

MOCASIM for MokeWISE

1 Purpose

Utilize MOCASIM to perform water availability analysis and then quantify the potential benefits and impacts to the study partners and other water users in the Mokelumne basin resulting from proposed water supply projects identified in the MokeWISE Program.

2 Model Background

MOCASIM is a reservoir operations model designed to simulate water storage and diversion operations on the Mokelumne River. MOCASIM is capable of analyzing various operating strategies of Pardee and Camanche reservoirs on the Mokelumne River, assessing water availability to serve EBMUD; Amador, Calaveras and San Joaquin counties; and then simulating newly proposed storage and diversion alternatives for beneficial use. MOCASIM also incorporates imports from water supply developments in the American and Calaveras River Watersheds.

MOCASIM is a mass-balance simulation model. It uses either monthly or daily time-step (depending on the geographical area, as explained below) for the hydrologic period beginning in 1953 through 2010. Senior appropriations, fishery flows, and hydropower releases are based on historical and/or future levels of development in the basin, water rights and agreements, and reservoir operating rules.

The model was developed by AD Consultants in 2007 for the Mokelumne River Water and Power Authority (MRW&PA) and has been maintained and upgraded by AD Consultants ever since. The original version of the model concentrated on the Lower Mokelumne River system starting at the Mokelumne Hill gage upstream of Pardee Reservoir and culminating at the confluence with the Cosumnes River. The model was designed at the time to examine potential yield from the MORE Water Project, an off-stream storage reservoir that would capture non-appropriated high flows from the Mokelumne River and regulate this supply to an integrated system of conjunctive use projects to provide additional water supply and reliability for the region.

In 2012, MOCASIM was expanded to include representation of the Upper Mokelumne River Basin upstream of the Mokelumne Hill gage. The model was also enhanced to allow evaluating the water supply and hydroelectric benefits from future developments in the basin, including: Enlarged Lower Bear Reservoir, Raised Pardee Dam and MORE Water Project.

For the water supply benefits, the expanded MOCASIM could be used to evaluate the overall system non-appropriated water that could be managed in the additional storage created by the Enlarged Lower Bear Reservoir, Raised Pardee Dam and/or the off-stream storage reservoir at Duck Creek (MORE Water Project). These storage facilities could be operated in any sequence of development. Therefore, the expanded MOCASIM allows for the examination of the incremental benefits obtained from each project. Water stored in these new facilities could be diverted at various points throughout the system for beneficial use, including groundwater recharge.

For the hydropower benefits, the expanded MOCASIM could be used to evaluate the additional generation of Project 137, resulting from the Enlarged Lower Bear Reservoirs, as well as the additional changes in generation from the Pardee and Camanche power plants.

Finally, MOCASIM is also equipped with the ability to assess the magnitude and duration of water availability for Groundwater Banking via existing or newly proposed diversion facilities in the system, by devising new agreements and water management policies amongst stakeholders.

3 Geographical Areas

MOCASIM in its present configuration encompasses two interrelated geographical areas: The Upper Mokelumne system and the Lower Mokelumne system. The model can simulate the operation of each geographical area independently or in sequence (from top to bottom).

The time-step for simulating the Upper Mokelumne is daily while the time-step for simulation the Lower Mokelumne is monthly. The primary reason is that the Upper Mokelumne is "peakier" hydrology wise, than the Lower Mokelumne. The combined reservoirs' storage in the Lower Mokelumne is an order of magnitude greater than the Upper Mokelumne, thus providing higher degree of attenuation of flood events (which coincides with the actual practice of regulating flow below Camanche for safety and environmental considerations). Furthermore, most the water rights and agreements associated with existing water users on the Lower Mokelumne were defined on a monthly basis. Internally in the model, the difference in time-step resolution is handled by converting the daily outflow from the Upper Mokelumne to monthly inflow to the Lower Mokelumne. The transition point is the Mokelumne Hill gage at Hwy 49 Bridge gage (USGS #11319500), immediately upstream of Pardee Reservoir.

The following describe the characteristics and operating rules associated with each geographical area as simulated in MOCASIM.

3.1 Upper Mokelumne System

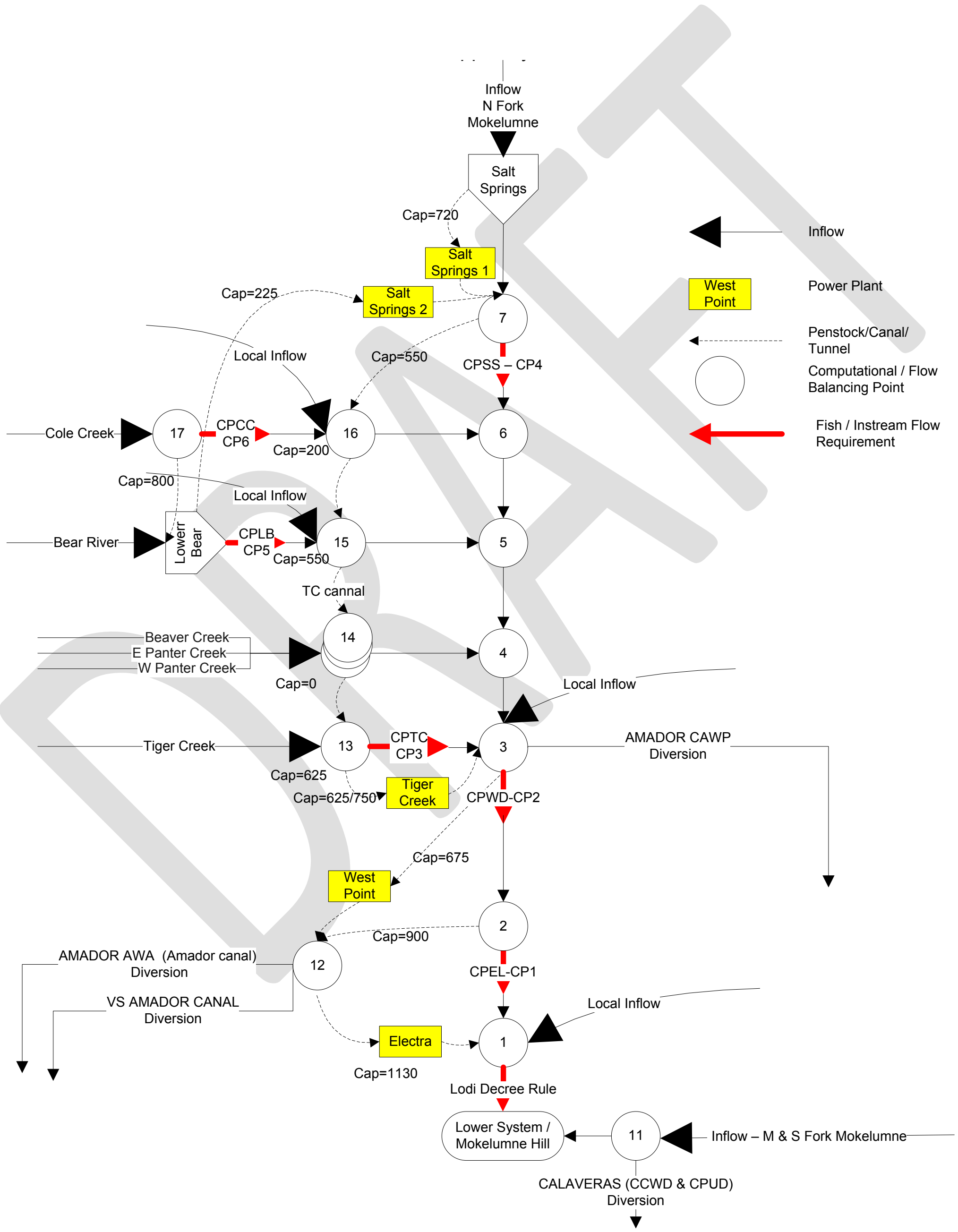
The flow regime in the Upper Mokelumne system is primarily dominated by the operation of PG&E Project 137 on the North Fork Mokelumne. Project 137 consists of two reservoirs: Salt Springs and Lower Bear reservoirs and five hydroelectric power plants: and Salt Springs #1 & #2, Tiger Creek, West Point and Electra powerhouses. PG&E operates these facilities with consideration to power generation objectives, instream flow requirements mandated by the Federal Energy Regulatory Commission, and in accordance with the Lodi Decree[i].

[i] The Lodi Decree is a series of court decisions from the 1940's and 50's that mandate average monthly outflow from Salt Springs and Lower Bear reservoirs as function of reservoirs' storage.

MOCASIM is coded to include the physical characteristics of the upper basin including PG&E reservoirs, waterways and power plants as well as all applicable operational rules for these facilities. Figure 1 shows an overview of the Upper Mokelumne system as coded into MOCASIM.

In addition to the existing system, a new feature was added recently to the model where by it is possible now to analyze the potential additional yield from the proposed Enlarged Lower Bear Project. This feature is explained in more detailed in Section 5 of the TM.

Figure 1- Upper Mokelumne System



As shown in Figure 1, the Middle and South forks of the Mokelumne were combined in the model into a single inflow node (inflow to Node 11), as the flow in these forks is hardly regulated. Similarly, the watershed upstream of Salt Springs Reservoir is also represented as a single inflow component to the Salt Springs Reservoir because of the limited storage regulation in that area.

Other boundary conditions are: inflow to Lower Bear Reservoir, the flow in Cole Creek, Tiger Creek, and the combined flow from Beaver, East Panther and West Panther creeks. Local inflow is introduced in the model at discrete points as shown this schematic.

Primary facilities of Project 137 and operational rules that have been incorporated in the model are described herein (refer also to Figure 1for waterways capacities):

Figure 2 - Upper Mokelumne Reservoirs and Power Plants

Reservoirs	Minimum (AF)	Maximum (AF)	Modeling Assumption
Salt Springs Reservoir	5,000	141,860	Reservoir operate based on target rule curve subject to downstream release requirements
Lower Bear Reservoir	2,150	52,020	Reservoir operate based on target rule curve subject to downstream release requirements
Upper Blue Lake Lower Blue Lake Twin lakes Reservoir Meadow Lake			Are not explicitly modeled. Represented as a single input node to Salt Springs Reservoir.
Upper Bear River Reservoir			Is not explicitly modeled. Represented as a single input node to Lower Bear Reservoir.
Cole Creek Diversion			Storage is not explicitly modeled. Represented as a diversion node.
Tiger Creek Regulator, Forebay and Afterbay			Are not explicitly modeled. Represented as diversion nodes.
Lake Tabeaud			Storage is not explicitly modeled. Represented as a diversion node.
Power Plants	Maximum (MW)	Maximum (CFS)	Modeling Assumption
Salt Springs #1	11.0	700	Usually not peaking (although model provides for this option)
Salt Springs #2	33.0	225	Usually not peaking (although model provides for this option)
Tiger Creek	58.0	750	Usually Peaking (defined by specified plant factors)
West Point	14.5	675	Usually Peaking (defined by specified plant factors)
Electra	92.0	1130	Usually Peaking (defined by

			specified plant factors)

3.1.1 Lodi Decree

The Lodi Decree establishes minimum flow and releases relative to reservoir storage levels in the North Fork Mokelumne Reservoirs. The flow is measured immediately upstream of the confluence with the Middle Fork Mokelumne River (Node 1 in Figure 1). The Lodi Decree is quite complex from the interpretation and implementation point of view. However, in the expanded model, the Lodi Decree was simplified by defining a required flow schedule in the North Fork (NF) as function of the combined storage in Salt Springs and Lower Bear reservoirs (SS+LB), as shown in Figure 3 below.

Figure 3 - Lodi Decree

(NF Flow schedule in CFS)

	Dry Year		Normal Year
Storage (SS+LB)	<130,000		>130,000
when ?	always		June 1st
month	and greater than:	the following flow or NF whichever is less	minimum flow
Jun	112,000	300	500
Jul	94,000	300	500
Aug	76,000	300	500
Sep	58,000	300	500
Oct	40,000	200	500
Nov	30,000	200	500
Dec	20,000	200	500
Jan	10,000	200	300
Feb	0	200	200
Mar	0	200	200
Apr	0	200	200
May	0	300	300

In the simplified Lodi Decree there are two year types depending on the combined storage in Salt Springs and Lower Bear reservoirs on June 1. If the storage is greater than 130 TAF, then the minimum required flow from the North Fork Mokelumne for the next 12 months is as prescribed in the table for Normal Year. If the storage on June 1 is less than 130 TAF, then the minimum required flow from the North Fork Mokelumne is in accordance with the prescribed schedule for Dry Year, but could also be reduced to as low as natural flow in a manner to gradually empty the reservoirs down to the target storage levels shown above (in the “and greater than” col.).

3.1.2 Instream flow requirements

Instream flow requirements (see Figure 4) are mandated by FERC and are defined at six control points as depicted in Figure 1 (CP 1 to CP 6). FERC also requires maintaining pulse flow at these points as shown in Figure 5.

Figure 4 - FERC Instream Flow Requirements in CFS

CP1 - NF below Electra Diversion												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Critical Dry	20	25	30	40	60	40	20	15	15	15	20	20
Dry	25	30	50	80	95	50	20	20	20	20	20	20
Below Normal	40	40	80	135	250	180	35	20	20	20	25	30
Above Normal	60	60	110	190	490	270	40	20	20	20	20	40
Wet	90	120	150	400	980	850	145	30	20	20	50	50
CP2 - NF below Tiger Cr. Afterbay (bypass to West Point PP)												
Critical Dry	20	25	30	40	60	40	20	15	15	15	20	20
Dry	25	30	50	80	95	50	20	20	20	20	20	20
Below Normal	40	40	80	135	250	180	35	20	20	20	25	30
Above Normal	60	60	110	190	490	270	40	20	20	20	20	40
Wet	90	120	150	400	980	850	145	30	20	20	50	50
CP3 - Tiger Creek below Tiger Creek Regulator												
Critical Dry	7	7	10	10	7	5	5	3	3	3	5	5
Dry	7	7	10	10	7	5	5	3	3	3	5	5
Below Normal	7	7	10	10	7	5	5	3	3	3	5	5
Above Normal	7	7	10	10	7	5	5	3	3	3	5	5
Wet	7	7	10	10	7	5	5	3	3	3	5	5
CP4 - NF below Salt Springs Reservoir												
Critical Dry	20	25	30	40	60	40	20	15	15	15	20	20
Dry	25	30	40	60	70	40	20	20	20	20	20	20
Below Normal	40	40	70	110	210	160	30	20	20	20	20	25
Above Normal	50	50	90	170	430	230	30	20	20	20	20	30
Wet	75	110	135	375	930	720	145	20	20	20	43	43
CP5 - Bear River below Lower Bear												
Critical Dry	4	6	6	10	8	6	40	4	4	4	4	4
Dry	6	8	10	25	20	8	6	4	4	4	6	6
Below Normal	10	10	15	25	40	20	10	6	4	4	6	8
Above Normal	14	14	20	30	70	40	15	6	6	6	8	10
Wet	20	20	25	50	110	70	30	15	6	6	15	15
CP6 - Cole Creek below div. to Lower Bear												
Critical Dry	2	2	4	8	6	4	2	2	2	2	2	2
Dry	4	6	8	15	14	8	2	2	2	2	4	4
Below Normal	8	8	10	25	50	15	6	4	4	4	4	6
Above Normal	10	10	15	30	70	30	15	6	6	6	6	8
Wet	15	15	20	45	100	60	25	10	6	6	12	12

Figure 5 - FERC Pulse Flow Requirements in CFS

CP/month	Critical Dry	Dry	Below Normal	Above Normal	Wet	Duration and timing
CP1 - NF below Electra Diversion						
May	0	500	1000	1800	0	5 continuous days
CP2 - NF below Tiger Cr. Afterbay (bypass to West Point PP)						
May	0	500	1000	1800	0	5 continuous days
CP3 - Tiger Creek below Tiger Creek Regulator						
Feb	35	35	35	35	35	one day
Mar	35	35	35	35	35	one day
CP4 - NF below Salt Springs Reservoir						
May	0	500	1000	1800	0	5 continuous days
CP5 - Bear River below Lower Bear						
May	0	300	570	700	0	5 continuous days
CP6 - Cole Creek below div. to Lower Bear						
May	0	0	Natural Flow	Natural Flow	Natural Flow	5 continuous days

Note: for modeling purposes, it was assumed that pulse flow is triggered at the beginning of the month.

3.1.3 Upper Mokelumne System Operation

The operation of the upper Mokelumne River System can be summarized as follows:

1. Minimum demand of the System is computed starting with most downstream point (Node 1) taking into account the Lodi Decree, instream flow requirements, diversion, local runoff and power plants plant factors (if specified).
2. Maximum demand is calculated the same way except assuming maximum plant factor for all power plants (=1). This demand represents the maximum release from the upper reservoirs (Salt Springs and Lower Bear) without hydropower spill.
3. Maximum and minimum demands are divided between Salt Springs (SS) and Lower Bear (LB) reservoirs based on storage ratios LB/ (SS+LB), SS/(SS+LB).
4. If the computed storage falls below the reservoir rule curve with minimum demand, the model accepts the minimum demand as the release.
5. If the computed storage is above the reservoir rule curve with maximum demand, the model accepts the maximum demand as the release.
6. Otherwise, the model releases to hit the rule curve.

3.1.4 Power plants operation

The operation of the power plants in the upper Mokelumne River System when plant factors are specified (usually for Tiger Creek, West Point and Electra power plants), can be summarized as follows:

1. The model always tries to run at maximum flow (assuming maximum power).
2. If the available flow is less than the maximum for the specified plant factor, the plant factor is modified to accommodate maximum flow.
3. Two flow rates are reported – average during period (24 hours) and flow ‘producing’, meaning flow corresponding to the resulting plant factor.

3.1.5 Test run

A test run was made to evaluate how well the model simulates the operation the Upper Mokelumne system. Results of the model run for energy production by power plant vs. actual generation provided by PG&E are presented in Figure 6 below. Note that the period selected is 2001 to 2010, as the year 2001 is the first year when the new FERC instream flow requirements per the relicensing articles for Project 137 been implemented.

The results demonstrate that MOCASIM estimates match pretty well (within 98% for the overall system) the actual generation of Project 137 given the fact that other factors such as outages, day-to-day operational decisions, shutdown due to maintenance, etc., are not included in the model.

Figure 6 - Test Run for Energy Production

MOCASIM II Estimated Energy Generation vs. Actual

(MWH)

	SALT SPRINGS #1	SALT SPRINGS #2	TIGER CREEK	WEST POINT	ELECTRA	TOTAL
Actual						
2001	13,212	106,436	231,992	65,122	296,902	713,664
2002	27,022	199,406	322,871	90,307	399,545	1,039,151
2003	33,710	179,992	310,237	93,862	444,021	1,061,822
2004	26,896	128,824	301,124	88,424	373,436	918,704
2005	36,565	203,843	339,430	100,854	555,477	1,236,169
2006	51,911	214,619	334,700	100,216	553,951	1,255,397
2007	15,251	103,395	211,904	59,952	283,109	673,610
2008	20,037	117,381	231,223	63,576	292,082	724,299
2009	32,550	152,502	288,839	87,052	423,773	984,716
2010	21,403	139,747	255,828	84,672	456,641	958,291
TOTAL	278,556	1,546,146	2,828,149	834,036	4,078,935	9,565,823
MOCASIM II						
2001	14,482	115,404	226,331	71,610	256,710	684,537
2002	26,743	184,671	300,147	97,144	370,219	978,924
2003	30,244	182,497	300,714	100,332	399,103	1,012,890
2004	23,183	167,684	304,603	97,170	371,880	964,520
2005	34,476	210,958	343,286	117,338	536,611	1,242,669
2006	50,773	245,216	354,742	118,540	576,630	1,345,901
2007	15,248	149,746	235,163	75,127	267,520	742,804
2008	20,673	149,245	260,411	80,270	286,733	797,332
2009	35,013	174,744	291,158	92,212	368,383	961,510
2010	33,453	160,545	294,835	97,601	419,397	1,005,831
TOTAL	284,288	1,740,710	2,911,390	947,344	3,853,186	9,736,918
Actual/MOCASIM II						
2001	91%	92%	103%	91%	116%	104%
2002	101%	108%	108%	93%	108%	106%
2003	111%	99%	103%	94%	111%	105%
2004	116%	77%	99%	91%	100%	95%
2005	106%	97%	99%	86%	104%	99%
2006	102%	88%	94%	85%	96%	93%
2007	100%	69%	90%	80%	106%	91%
2008	97%	79%	89%	79%	102%	91%
2009	93%	87%	99%	94%	115%	102%
2010	64%	87%	87%	87%	109%	95%
TOTAL	98%	89%	97%	88%	106%	98%

3.2 Lower Mokelumne System

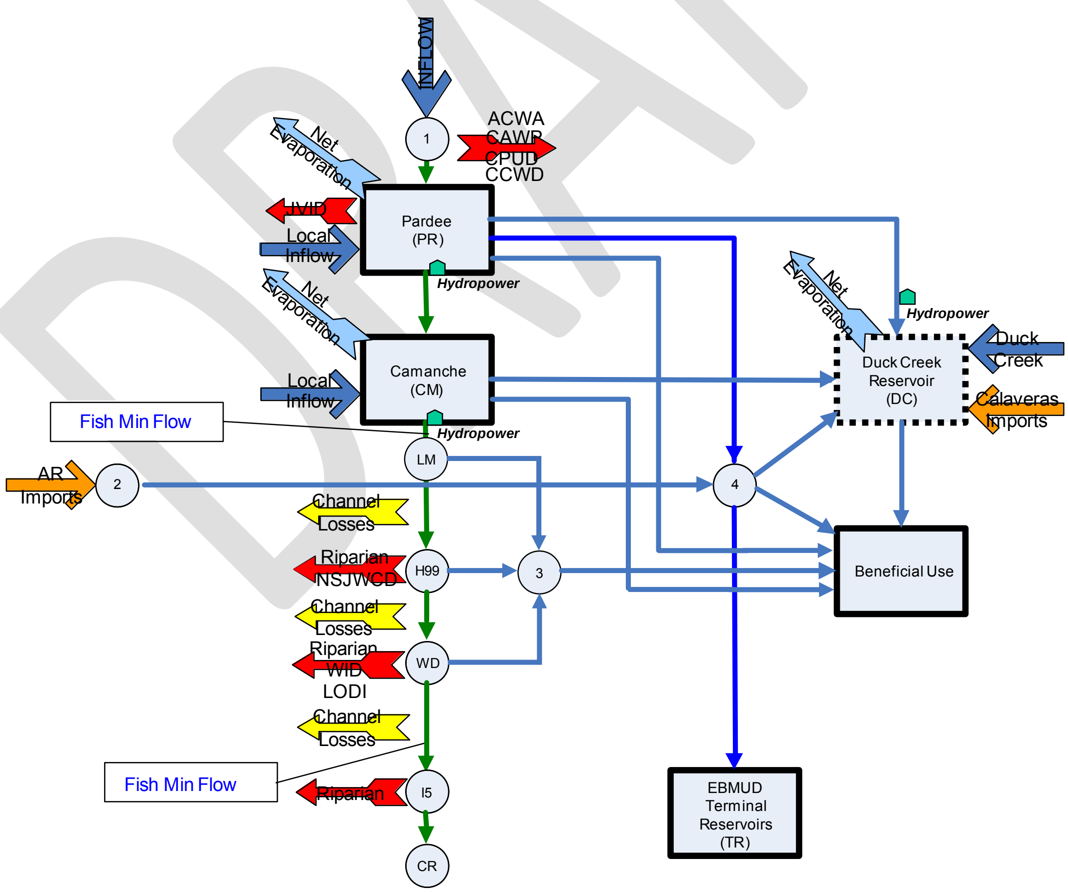
The Lower Mokelumne system as depicted in MOCASIM consists of two primary components:

1. The Existing System – Encompasses Pardee and Camanche Reservoirs, the Mokelumne Aqueduct which conveys water from Pardee Reservoir to the EBMUD Terminal Reservoir Area (TRA), and the lower Mokelumne River downstream of Camanche Reservoir to I5. The reach below I5 is considered as the contribution to the North Delta (not including the contribution from the Cosumnes River).
2. Proposed New Projects – Consist of proposed facilities in the Mokelumne River System that would divert water to the place of use for beneficial use. Water could also be diverted to storage facilities, such as the proposed Duck Creek Reservoir (MORE Water Project).

Secondary components of the model include water imported from the American River through the Freeport Regional Water Project to the Mokelumne Aqueduct and to Duck Creek Reservoir, and water imported from the Calaveras River Basin (Stockton East Water District water supply system) to Duck Creek Reservoir.

A logical overview of Lower Mokelumne as coded into MOCASIM is presented in Figure 7 below:

Figure 7 - MOCASIM Logical Overview.



The inflow in Node 1 in the above Logical Overview represents the entire flow from the Upper Mokelumne watershed, as measured at the Mokelumne Hill gage after adjustment for historical diversion by Amador and Calaveras counties (historical diversions were added to the gauged data to allow simulation of future diversion by these counties under various levels of development). This option is superseded if the mode is run a mode where the Upper Mokelumne system is operated first and the outflow form the upper system becomes the inflow to the lower system.

The operation of the Lower Mokelumne is driven by a series of water rights and agreements, instream flow requirements, channel loss, and flood control rules.

The following is a brief description of those.

3.2.1 Upstream Diversion

Upstream water users include Amador County and Calaveras County. The model has the provision to handle specific entities within these counties as shown in:

Amador County:

- Amador Water Agency (ACWA) via Amador Canal Diversion
- Amador Water Agency via Central Amador Water Project (CAWP)
- Jackson Valley Irrigation District (JVID)

Calaveras County:

- Calaveras Public Utility District (CPUD)
- Calaveras County Water District (CCWD)

The water allocation to upstream users depends on the basin's level of development. MOCASIM uses the year 2020 as the default year for level of development. The default allocations to the upstream users can be overridden by specifying explicit numbers in the input file.

Figure 8 - Annual Upstream Diversions

User	Level of Development	
	2020	Max
Amador County (Total) ACWA CAWP JVID*	20.0 18.0 2.0	20
Calaveras County (Total) CPUD CCWD	11.7 4.9 6.8	27
Total	31.7	47

* JVID demand is included in ACWA demand in 2020 Level of Development

The model assumes that the annual allocation to the upstream users is distributed on a monthly basis in accordance with the percentages depicted in Figure 9.

Figure 9 - Percent Distribution of Annual Diversion to Upstream Users

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Amador												
ACWA	5.8%	5.6%	6.2%	6.8%	8.9%	10.4%	11.7%	12.0%	10.4%	8.6%	7.1%	6.5%
CAWP	5.8%	5.6%	6.2%	6.8%	8.9%	10.4%	11.7%	12.0%	10.4%	8.6%	7.1%	6.5%
JVID	0.0%	0.0%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	0.0%	0.0%
Calaveras												
CPUD	6.9%	5.7%	5.8%	8.2%	10.0%	11.7%	11.1%	10.6%	9.2%	7.4%	6.6%	6.9%
CCWD	6.9%	5.7%	5.8%	8.2%	10.0%	11.7%	11.1%	10.6%	9.2%	7.4%	6.6%	6.9%

The flow after being regulated by PG&E's system and reduced by the upstream diversions becomes the inflow to Pardee Reservoir. The flow is measured at the USGS gaging station Mokelumne River near Mokelumne Hill (near Hwy. 49 Bridge).

In simulating future conditions on the river, MOCASIM uses historical flow at the gage adjusted for the difference between the historical upstream diversion and newly projected ones.

3.2.2 EBMUD Water Supply System

The EBMUD water supply system on the Mokelumne River consists of Pardee Reservoir and power plant, Camanche Reservoir and power plant, and the Mokelumne Aqueducts, which deliver water to the EBMUD service area. The operation of the EBMUD system is modeled with the MOCASIM model, as follows:

1. Pardee Reservoir and Power Plant:

Pardee Reservoir has a gross storage capacity of about 198 TAF. It fills up and draws down to target storage levels using forecasting procedures that minimize reservoir spills. This mode of operation takes into account delivery of water to EBMUD customers via the Mokelumne Aqueducts and releases to Camanche in order to supply Lower Mokelumne flow requirements.

Pardee power plant is situated at the base of Pardee Dam and contains three Francis turbines with a total generating capacity of 28,650 kilowatts. The total rated flow for the plant is 1,100 cfs. MOCASIM assumes that Pardee power plant operates at a uniform flow rate governed by water supply and flood control rules (no peaking).

Because of limited information from public documents about the characteristics of Pardee power plant, MOCASIM is using generic performance curves for Francis turbines. Refinement of these curves is recommended if PG&E or EBMUD will release this information in the future.

2. Camanche Reservoir and Power Plant:

Camanche Reservoir has a gross storage capacity of about 417 TAF. It provides releases to meet flow requirements for the Lower Mokelumne River, including: water demands by downstream diverters, releases to offset channel depletion (loss), fish release, and provides releases to maintain flood control space in the system.

Camanche power plant is situated at the base of Camanche Dam and contains three Kaplan turbines with a total generating capacity of 10,680 kilowatts. The total rated flow for the plant is 1,200 cfs. MOCASIM assumes that Camanche power plant operates at a uniform flow rate (no peaking).

Because of limited information from public documents about the characteristics of Camanche power plant, MOCASIM is using generic performance curves for Kaplan turbines. Refinement of these curves is recommended if PG&E or EBMUD will release this information in the future.

3. Aqueduct Draft and Early Deficiency Rules

EBMUD demand is expressed in the model as average annual daily demand in Million Gallons per Day (MGD) and percent distribution by month. EBMUD demand is delivered from Pardee Reservoir via the Mokelumne Aqueduct to terminal reservoirs in the Bay Area.

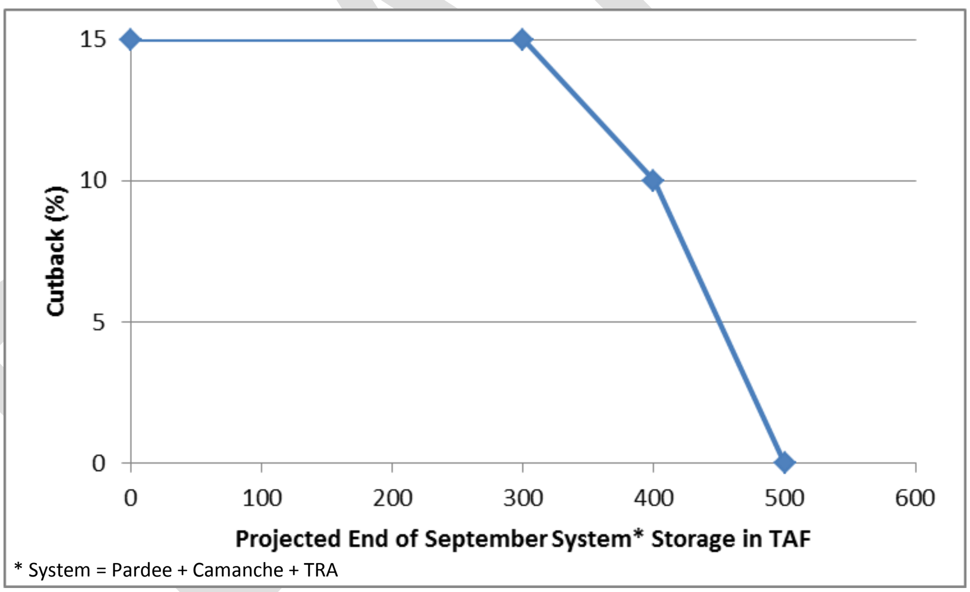
The maximum capacity of the Mokelumne Aqueduct is assumed to equal 325 MGD (approximately 500 cfs) which is EBMUD's full allocation under its water rights. The terminal reservoirs in the Bay Area are represented in the model by a single reservoir called Terminal Reservoir Area (TRA) with a combined capacity of 160 TAF.

The TRA has target storage levels which the model tries to maintain during the simulation. Water is withdrawn from the TRA only when there is shortage in supply from Mokelumne Aqueduct (Pardee Reservoir).

In dry years when shortages in supply occur, EBMUD imposes rationing on its customers called in the model Early Deficiency Rules. These rules impose cutback of deliveries to EBMUD whenever total system storage at the end of September is projected to fall below 500 TAF. The total system storage is defined as the combined storage in Pardee, Camanche and TRA.

The Early Deficiency Rules result in a sliding scale of reduction to EBMUD demand, depending on projected end of September total system storage levels, as shown in Figure 10.

Figure 10 - EBMUD Early Deficiency Rules



MOCASIM mimics hydrologic forecasting by employing iterative process of decision making as explained above. Accordingly, the model operates the system first without cutback until end of September. If system storage falls below 500 TAF, it defines the percent cutback based on the Early Deficiency Rules, resets the simulation Clock to January and re-operates the system again imposing cutback on EBMUD demand. This concept is consistent with the way EBMUD models customer cutback as found in public documents.

Another provision in MOCASIM is to assume that in the first year of a drought the model reduces the computed cutback by 50%. The logic is that, in the first year of the drought, it could take up to six months before customers respond to the imposed conservation measures. This concept is also compatible with EBMUD modeling assumptions.

3.2.3 Flood Control Operation

Flood control operation is one of the most important factors in estimating the available water for future developments in the basin as described in Section 5.1 below.

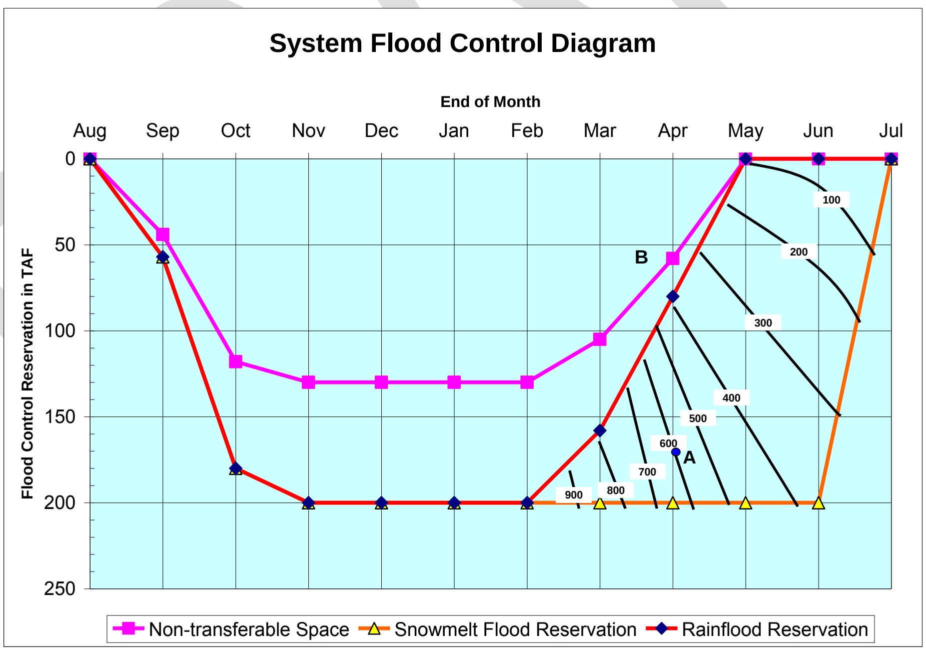
The flood control operation must be done in accordance with the US Army Corps of Engineers (COE) Flood Control Manual for the Mokelumne River Basin and can be summarized as follows:

- System's flood control requirements is 200 TAF from November 15 to March 15
- Up to 70 TAF is transferable to PG&E's Salt Springs and Lower Bear reservoirs based on COE guidelines (only a portion of the free space in PG&E's reservoirs can be used to offset flood space requirements in Pardee and Camanche reservoirs).
- Flood control space can be divided in any portion between Pardee and Camanche reservoirs.
- After March 15, flood storage space requirements are based on rainfall and snow pack estimates (see example in Figure 11).

The system flood control diagram is presented in Figure 11.

MOCASIM simulates the above-mentioned flood control operation rules, with some approximation subject to the model's time-step resolution.

Figure 11 - Flood Control Diagram



Example: If on end of April the forecasted runoff from May 1 to July 31 is 600 TAF (point A on the 600 TAF curve), then the total flood space requirement is 170 TAF of which 60 TAF (point B) is non-transferable and 110 TAF is transferable (170-60=110. Of this amount, 20 TAF is for rainflood reservation and 90 TAF is for snowmelt reservation. The transferable space is further reduced depending on the free space in PG&E's Salt Springs and Lower Bear reservoirs.

3.2.4 Lower Mokelumne Watershed

The Lower Mokelumne Watershed is defined as the portion of the Mokelumne basin downstream of Camanche Reservoir. The flow regime in this area is governed by the need to supply water for downstream water users (diversions), channel losses and fish release requirements, as follows:

1. Diversions:

Diversions to downstream users depend primarily on the hydrologic conditions. Figure 12 summarizes the diversion amounts on an annual basis:

Figure 12 - Annual Downstream Diversions

User	Amount (TAF)	Comments
Riparian & Senior Appropriators	20	When Oct to Jun TNF is greater than 250 TAF (see Note 1)
	16.1	When Oct to Jun TNF $\leq$ 250 TAF, diversions in July, August and September are reduced to 50%
North San Joaquin Water Conservation District (NSJWCD)	20	In normal years
	0	When Camanche storage is in deficit (see Note 2)
Woodbridge Irrigation District (WID)	60	When Pardee actual inflow is greater than 375 TAF
	39	When Pardee Actual Inflow is less than 375 TAF
City of Lodi	3.6	All years (see Note 3)

Notes:

1) TNF is the True Natural Flow as measured at the Mokelumne Hill gage.
2) NSJWCD supply can be modeled in two ways:
   - Providing full supply up to 20 TAF every year
   - Providing water equal to the projected November spill (but not more than its full allocation amount of 20 TAF)
3) City of Lodi supply is based on the Lodi Decree which allows the city to divert water to offset declining groundwater levels.

The model assumes that the annual allocation to the downstream users is distributed on a monthly basis in accordance with the following percentages:

Figure 13 - Percent Distribution of Annual Diversion to Downstream Users

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Riparian												
Dry Year	0.9%	0.8%	2.5%	8.1%	20.6%	29.3%	14.3%	9.3%	4.7%	4.4%	1.9%	3.4%
Wet Year	0.7%	0.6%	1.9%	6.3%	16.0%	22.8%	22.3%	14.6%	7.3%	3.4%	1.4%	2.6%
WID												
Dry Year	0.0%	0.0%	1.0%	8.4%	14.8%	19.2%	21.9%	18.9%	12.1%	3.6%	0.0%	0.0%
Wet Year	0.0%	0.0%	0.7%	5.3%	12.9%	18.4%	22.8%	21.1%	12.5%	6.3%	0.0%	0.0%
NSJWCD												
All Years	0.0%	0.0%	0.0%	0.0%	17.0%	23.0%	27.0%	17.0%	10.0%	6.0%	0.0%	0.0%
Lodi												
All Years	0.0%	0.0%	3.4%	14.9%	18.4%	17.7%	17.4%	16.6%	8.9%	2.5%	0.0%	0.0%

2. Fish Release Requirements:

MOCASIM includes the fish flow requirements agreed upon in the 1997 Joint Settlement Agreement. The Agreement prescribes minimum release requirements below Camanche Reservoir in different year types, subject to meeting minimum flow conditions below Woodbridge Diversion Dam. In other words, if the minimum release required from Camanche does not result in flow below Woodbridge as prescribed in the schedule, Camanche release has to increase accordingly.

The annual fish release requirements are summarized in Figure 14 below:

Figure 14 - Fish Release Requirements in CFS

Year Type	Requirements	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual (TAF)
Normal	Minimum Camanche Release	325	325	325	325	325	325	325	325	325	100	100	100	194
Below Normal		250	250	250	250	250	250	250	250	250	100	100	100	154
Dry		220	220	220	220	220	220	220	220	100	100	100	100	130
Critical		115	130	130	130	130	130	130	100	100	100	100	100	80
Normal	Expected Flow below Woodbridge Diversion Dam	100	100	100	100	100	100	150	300	300	25	25	25	86
Below Normal		100	100	100	100	100	100	150	200	200	20	20	20	73
Dry		80	80	80	80	80	80	150	150	20	20	20	20	52
Critical		45	75	75	75	75	75	75	15	15	15	15	15	34

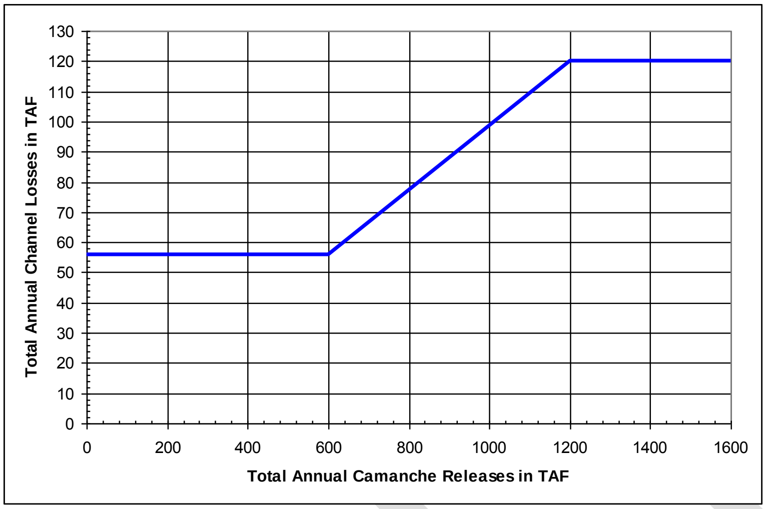
3. Channel Losses:

Channel losses to the groundwater basin occur in the Lower Mokelumne River. EBMUD, under water rights agreements with other water users on the river, is obligated to release sufficient water to ensure that entitlements are delivered to the users at the point of diversion.

Channel losses deplete the amount of water in the river, thus requiring EBMUD to increase the releases from Camanche Dam to compensate for the losses. MOCASIM incorporates the same methodology used by EBMUD for modeling channel losses (obtained from public records).

Channel losses in the model depend on the total release from Camanche as illustrated in Figure 15.

Figure 15 - Channel Losses on the Lower Mokelumne as function of Camanche Release



3.2.5 Freeport Project (American River Import)

Import of water from the American River via the Freeport Project is considered an integral part of current system operation. In general, water is pumped directly into the Mokelumne Aqueduct during dry years thus serving EBMUD customers and reducing the stress on the Mokelumne River water system. As in the early deficiency rules, American River Import is triggered by the projected end of September Total System Storage (also when below 500 TAF).

The Freeport pipeline is also an element of the proposed MORE Water Project. The original concept was to have the flexibility to “rent space” in the pipeline whenever EBMUD is not diverting. Here again, the Freeport mechanism as coded into MOCASIM could be used as a way to assess the viability of the American River import to the Mokelumne Basin, if such alternative would be considered under the MokeWISE Program.

4 Hydrology and Simulation Period

The primary source of flow hydrologic data used in MOCASIM is the recorded flow at the Mokelumne Hill Gage (USGS # 11319500), immediately upstream of Pardee Reservoir. The simulation period in the model is 1953-2010. A flow duration curve showing monthly flow measured at the gage is provided in Figure 16. The figure also shows the annual runoff in each year for this period.

The starting year 1953 was selected because it provides the first year for which complete records for storage conditions in the Upper Mokelumne River Basin are available. Storage conditions in PG&E’s reservoirs at the Upper Mokelumne River Basin (so-called Project 137), namely, Salt Springs and Lower Bear reservoirs are important factors for the simulation as MOCASIM considers the available space in these two reservoirs when computing the required flood control space in the Pardee-Camanche reservoirs system (per the COE flood control rules). Lower Bear Reservoir, the more recently constructed of the two, was completed in 1952 and storage conditions have been available since January 1953, thus defining the beginning year for the simulation period. The year 2010 is the last year for which complete hydrological data were compiled for the latest version of the model.

As explained earlier the model can simulate the operation of the Upper Mokelumne as a standalone system. To do so, an additional hydrologic data set was developed. Unlike the Lower Mokelumne which operates in the model on a monthly time step (a reasonable assumption given the ability to regulate flow in Pardee and Camanche reservoirs), the Upper Mokelumne required higher level of resolution given the limited storage in the Upper Mokelumne reservoirs to regulate flow. As such, a daily time step was selected for the upper watershed.

The data was synthesized from over two dozen hydrological monitoring stations provided by PG&E, USGS and CDEC as shown in Figure 17. This resulted in developing ten discrete inflow time series as illustrated in the logical view in Figure 1and explained below:

1. **SALT SPRINGS** : Inflow to Salt Springs Reservoir
2. **LOWER BEAR** : Inflow to Lower Bear Reservoir
3. **COLE CREEK** : Inflow to Cole Creek above Diversion Dam (Node 17)
4. **COLE CREEK LOCAL** : Runoff between Cole Creek Diversion Dam and Tiger Creek Canal (Node 16)
5. **BEAR RIVER LOCAL** : Runoff between Lower Bear Dam and Tiger Creek Canal (Node 15)
6. **OTHER TIGER CREEK** : Runoff from Beaver, East and West Panther creeks (Node 14)
7. **TIGER CREEK** : Inflow to Tiger Creek Regulator (Node 13)
8. **TIGER CREEK AB – LOCAL** : Runoff between Salt Springs Reservoir and Tiger Creek Afterbay (Node 7 to Node 3)
9. **NF,SF,MF - LOCAL TO NODE 1** : Runoff between Tiger Creek Afterbay and the Mokelumne River upstream of Mokelumne Hill Gage (Node 3 to Node 1). This also includes local runoff between Calaveras County diversion on the South and Middle forks Mokelumne (Node 11) and Node 1.
10. **MS FORK MOKELUMNE – LOCAL** : Inflow from the Middle and South forks Mokelumne before Calaveras County diversion (Node 11)

Figure 16 - MOCASIM Hydrology

 # USGS 11319500 MOKELUMNE R NR MOKELUMNE HILL CA

MONTHLY STREAM FLOW (TAF)

Source: US Geological Survey, Water Resources Data

Year	%Exc.	TAF
1977	100%	145
1976	98%	187
1988	97%	229
1987	95%	262
1961	93%	276
1994	91%	277
1992	90%	286
1990	88%	317
1991	86%	318
2001	84%	371
2007	83%	371
2008	81%	372
1959	79%	383
1960	78%	403
1968	76%	436
1985	74%	443
1981	72%	464
1966	71%	468
2004	69%	486
1972	67%	498
2002	66%	529
1989	64%	535
1954	62%	543
1955	60%	545
1964	59%	594
1957	57%	604
1962	55%	629
2009	53%	632
1953	52%	648
2003	50%	651
1979	48%	697
2000	47%	727
1971	45%	732
2010	43%	775
1975	41%	793
1973	40%	822
1963	38%	865
1999	36%	880
1984	34%	896
1978	33%	909
1970	31%	914
1974	29%	918
1993	28%	965
1958	26%	1,024
1965	24%	1,037
1967	22%	1,057
1980	21%	1,074
2005	19%	1,087
1996	17%	1,090
1997	16%	1,095
1956	14%	1,101
1986	12%	1,185
1998	10%	1,247
1969	9%	1,313
2006	7%	1,387
1995	5%	1,496
1982	3%	1,569
1983	2%	1,916
1953-2010	Average	732

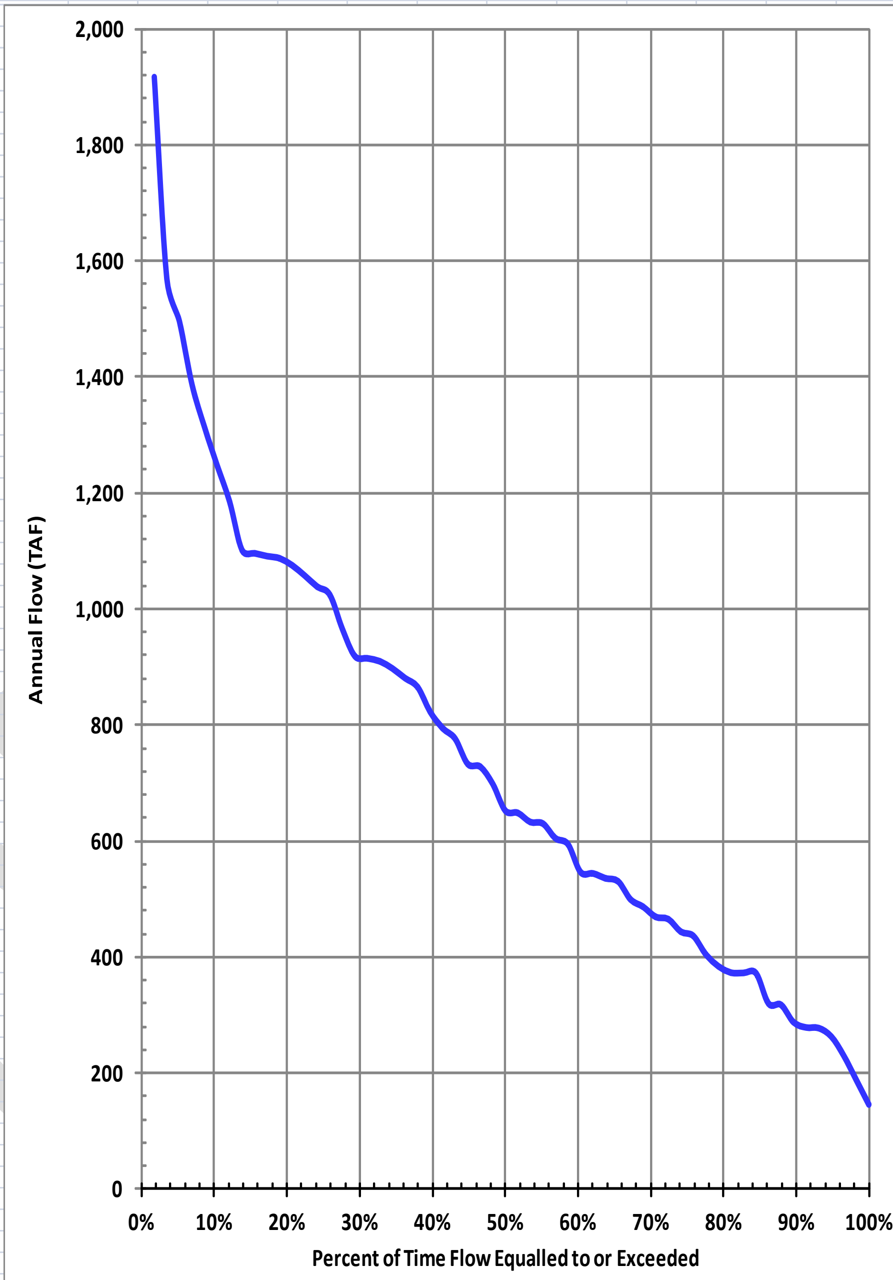
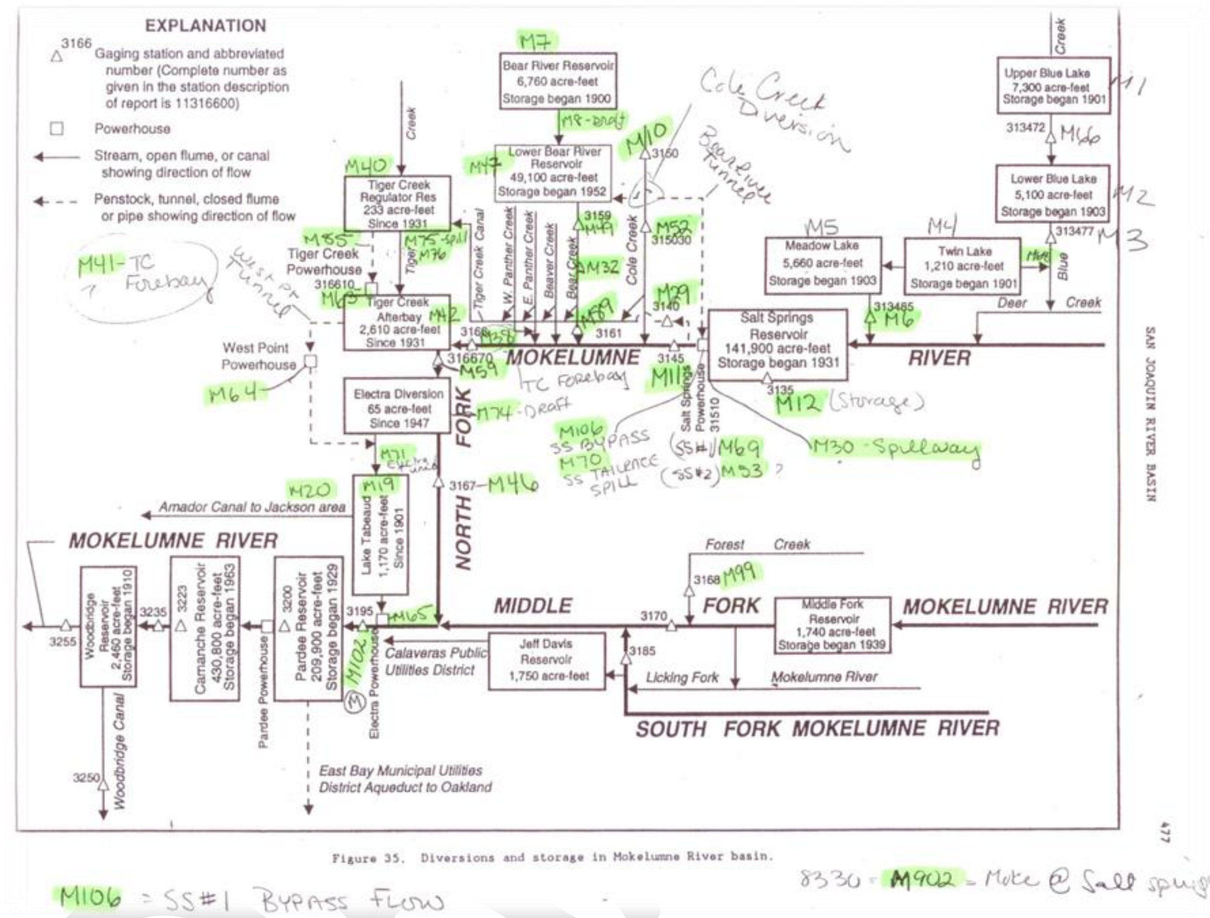


Figure 17 - Hydrological Monitoring Stations in the Mokelumne River Basin



5 System Operation

MOCASIM was designed in mind to perform specifically water availability analysis and then to assess the potential yield from proposed new developments in the Mokelumne watershed.

In order to do so, the model is run, internally, in several passes (i.e., it performs full simulation for the entire simulation period several times):

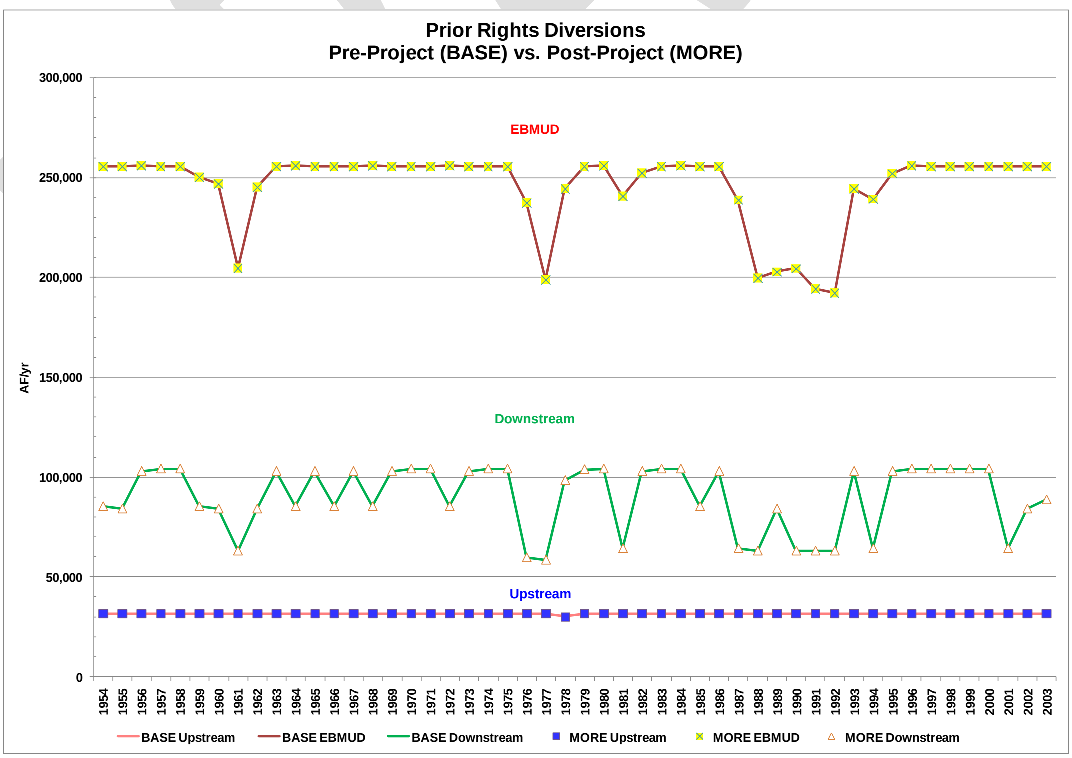
1) In the first pass, MOCASIM simulates the operation of the existing facilities in the Mokelumne River system in accordance with current water rights permits and agreements. The results of this pass are the deliveries to all existing users and the magnitude and duration of non-appropriated water. In general, non-appropriated water is defined in the model as the flow to the Bay-Delta (as measure at I5 Bridge, not including the contribution from the Cosumnes River), in excess of what is needed to satisfy all existing users in the entire Mokelumne River system (Upper and Lower), including fish flow (see more about this in Section 5.2).

2) In the second pass, MOCASIM allocates the non-appropriated water for beneficial use through new developments. New developments may include additional on-stream storage (e.g., enlarged Lower Bear or Pardee reservoirs), off-stream storage (e.g., Duck Creek Reservoir), direct diversion for water supply, or groundwater recharge.
3) A third pass is a private case for stacking new developments (i.e., developing several projects in sequence). Essentially, it computes the yield for direct diversion (e.g., surface water supply or groundwater recharge) and diversion to off-stream storage (e.g., Duck Creek) after the implementation of on-stream storage development (e.g., enlarged Lower Bear or Pardee reservoirs).

The underlying concept in the second and third passes is that water allocation computed from the previous pass is maintained in full (both amount and time of delivery). For example: two new developments are being considered - (1) enlarging Lower Bear reservoir and (2) groundwater recharge by diverting water through new facilities below Camanche. In this case, three passes will take place: first – the model will run a base case (existing conditions) and will define the non-appropriated water. Second – portion of the non-appropriated water will be stored in the enlarged Lower Bear (for use by any water user throughout the system) and the model will redefine the remaining non-appropriated. Third – portion the remaining the non-appropriated water will be diverted for groundwater recharge. Since each project is built upon conditions from the previous pass, none of the users from the previous passes will be impacted. In this example, EBMUD will be kept whole and the new developments will not affect deliveries from Pardee to the TRA, customer cutback, Freeport imports, etc.

The following is an illustration of how the model ensures that existing users are kept whole (Pre-Project) after the implementation of the MORE Water Project (Post-Project) in this case.

Figure 18 - Example for Prior Rights Diversion under Pre and Post Project



It should be noted that on-stream storage development such as enlarged Lower Bear Reservoir or enlarge Pardee Reservoir, presents a modeling challenge as far as water accounting is concerned, as the “new” water being stored in the enlarged reservoir (from the second pass) co-mingles with the “old” water (from the first pass). Yet, when operating the reservoir, two different rules (demands) are applied: one to the “old” water (based on existing agreements and water rights) and one to the “new” water (based on new agreements between the project’s partners). To deal with that, a new concept was developed called Virtual Storage, as discussed in Section 5.2 below.

However, before discussing the VS concept, it is important to understand how the non-appropriated water is defined in the model:

5.1 Non-Appropriated Water

In its most basic form, non-appropriated is defined as the flow to the Bay-Delta (as measure at I5 Bridge, not including the contribution from the Cosumnes River) in excess of what is needed to satisfy all existing users in the entire Mokelumne River system (Upper and Lower), including fish flow. However, since MOCASIM is designed to “capture” non-appropriated water at three discrete points in the system, i.e., Lower Bear Reservoir, Pardee Reservoir and downstream of Camanche Reservoir, not all the non-appropriated water as measured at I5 is physically available those points. For example, Lower Bear Reservoir cannot capture the flood flow from the Middle and South forks of the Mokelumne, while Pardee Reservoir (or Duck Creek Reservoir for that matter) can. Therefore, depending of the development being considered, the model “knows” how to compute the non-appropriated water, thus providing a realistic assessment of how much “new” water is really available.

It is also important to note that since non-appropriated water is defined as “water in excess of what is needed to satisfy all existing users in the entire Mokelumne River system”, MokeWISE partners should agree upon the level of development that constitutes existing conditions or the base case. MOCASIM provides the flexibility to examine various levels of development for the base case and perform a sensitivity analysis for the non-appropriated water, as such.

5.2 Virtual Storage Concept

The Virtual Storage (VS) represents the additional storage space in the reservoir obtained from the proposed development (either by raising Pardee Dam or enlarging Lower Bear Reservoir) and where “new” water can be stored. The “new” water is essentially the non-appropriated water that would have otherwise spilled, as quantified by the first pass described above. MOCASIM is tracking separately the quantity of “old” and “new” water at any given time and applying different demands and water rights priorities rules to those two categories of water.

Using the VS concept, it is possible to look at sequencing future developments in the basin, including MORE, and to quantify the yield obtained from each development. The general principles in operating in a VS mode are summarized below (LB=Lower Bear, P=Pardee, DC=Duck Creek, LM=Lower Mokelumne):

- Define additional storage at each reservoir (VS)
  (for example: 30K for LB, 170K for P, 150K for DC)
- Define available non-appropriated water (from 1st pass)
  a. At Camanche (Camanche Spill)
  b. At Pardee: min(spills at Pardee, spills at Camanche)
  c. At Lower Bear: min(spills at LB, spills at Pardee)

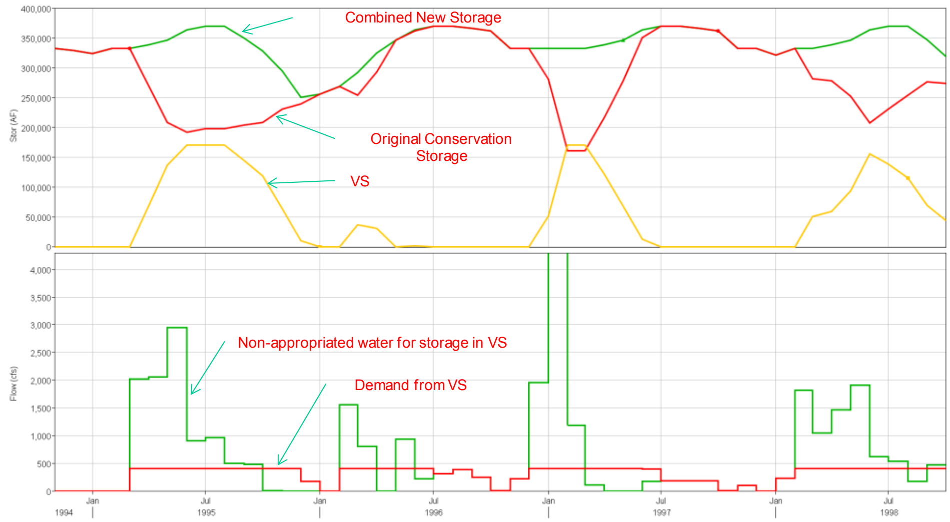
- VS management
    a. Priorities for filling VS: LB first, P second
    b. Each VS has a water contract (demand schedule)
    c. Contract could serve multiple users
- Diversion points
    a. Amador Canal (Node 12)
    b. Pardee - Generic diversion point
    c. Pardee – to Duck Creek (original MORE configuration)
    d. Lower Mokelumne (assumed immediately below Camanche Dam)
- Diversion priorities
    a. Top to bottom (LB, P, LM, DC)

The following chart (Figure 19) illustrates how the expanded MOCASIM tracks the storage in the enlarged Pardee Reservoir. The model "knows" at any given time what portion of the total volume of water in Pardee is "old" and what is "new". The "new" water is stored or withdrawn from the VS depending on supply (of non-appropriated water) and demand (of VS users). Accordingly, the VS portion in Pardee can increase or decrees in size (not to exceed the total new addition of storage in the reservoir). The chart also shows that when VS storage diminishes (as a result of demand by VS users), the available space can be occupied by "old" water. This is merely due to the fact that Pardee "old" inflow can now be stored in the enlarged Pardee reservoir instead of being discharged for storage in Camanche.

The outcome of this type of operation is that in many years Pardee will be fuller than historically occurred and Camanche will be emptier (as illustrated in the lower chart). This is consistent with the flood control rules that allow dividing flood space at any proportion between Pardee and Camanche. For EBMUD, this type of operation is advantages as it has access to more volume of water to serve its customers since that the intake to the Mokelumne Aqueduct is situated in Pardee.

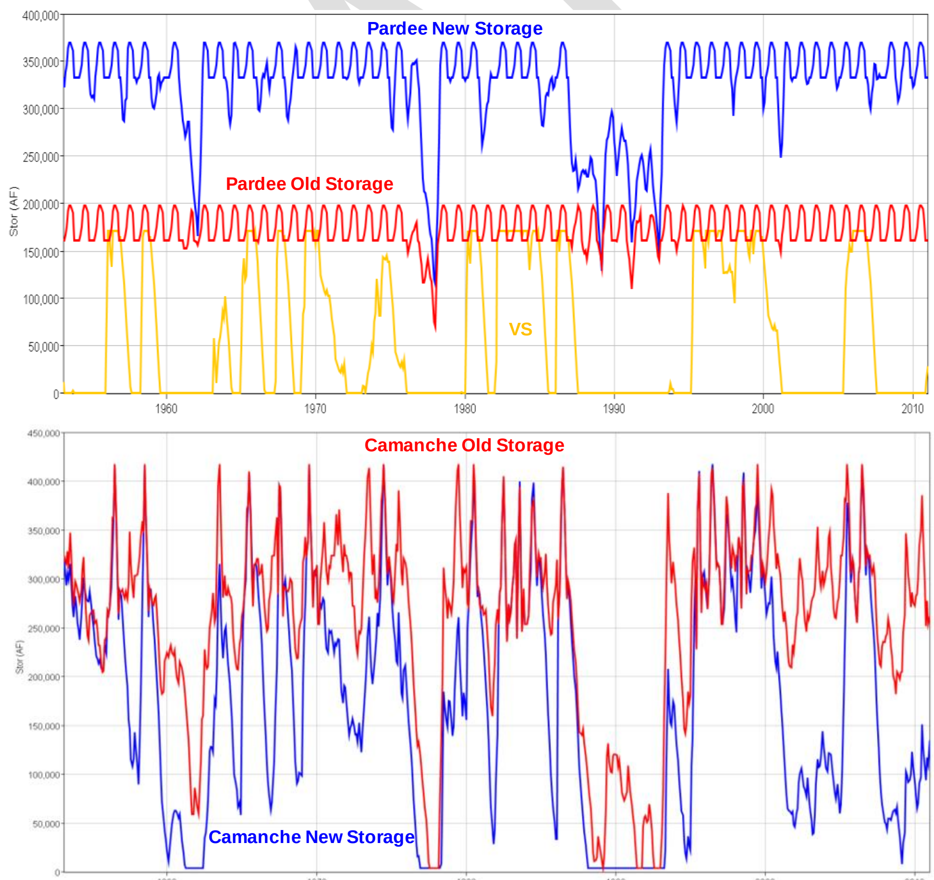
The same principles in the above example are applied for the Enlarged Lower Bear alternative.

Figure 19 - Illustration of VS Concepts in Pardee Reservoir



Enlarged Pardee Operation using VS concepts

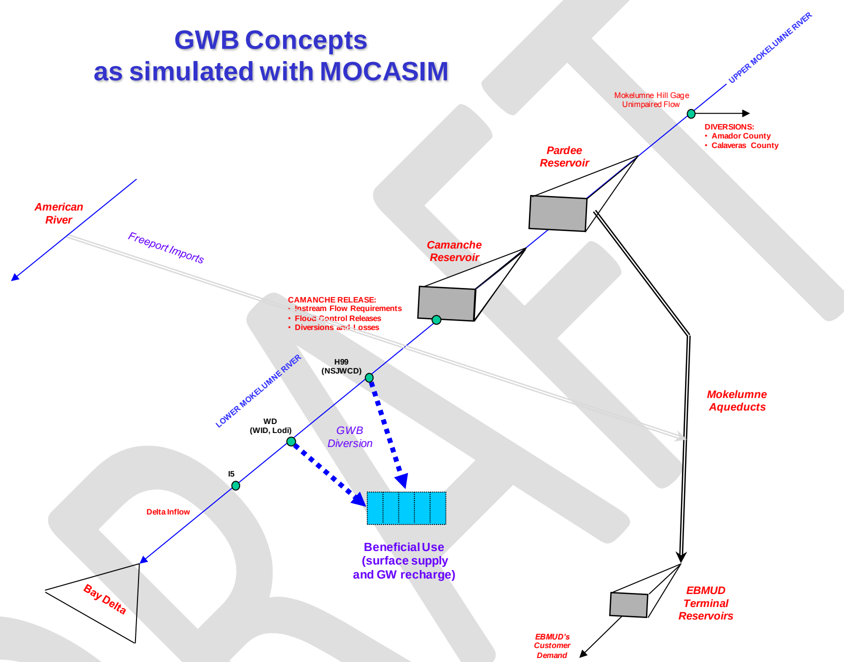
VS is the portion of storage in Pardee due to the enlargement of the reservoir where non-appropriated water can be deposited to and withdrawn from.



5.3 Groundwater Banking (GWB)

Another feature in MOCASIM is the ability to analyze the potential benefit from banking in Eastern San Joaquin County the unused remaining water entitlement of upstream water users (Calaveras and/or Amador counties). This is a non-structural alternative that merely represents diversion of water to percolation ponds in the Lower Mokelumne basin via existing diversion facilities at NSJWCD and WID diversion structures, as illustrated in Figure 20 below.

Figure 20 - GWB Diversion along the Lower Mokelumne



Special logic was added to the model in the spirit of keeping existing users whole, as described in System Operation above:

- GWB diversion is curtailed if this action is the sole reason for EBMUD to start imposing rationing on its customers.
- GWB diversion is curtailed if this action is the sole reason for EBMUD to start importing water from the American River.
- All existing water rights, agreements, operational rules and instream flow requirements in the basin remain unchanged.

6 Conclusion

In conclusion, MOCASIM is a powerful tool that will be used for the MokeWISE Program to identify:

- What is the size of the water supply ”pie” (current conditions)
- How the water supply “pie” is sliced (establish base case(s))

- What is the remaining "pie" that could be divided amongst the stakeholders (non-appropriated water)
- What new projects should be considered for implementation (structural and non-structural)
- What is the yield associated with each one of them (given certain sequence of implementation)

Appendix D: Annual Flow as Modeled in MOCASIM

Appendix D shows the annual flow duration curves at four locations along the river. Flow duration curves indicate the percentage of time over the period of record that flow in the river would be expected to be equal to or exceed a certain amount of water, based on historical hydrologic conditions and projected diversion levels. Results indicate that total flow decreases downstream and that there is projected to be less flow in 2040 than in 2010 due to increased diversions.

Annual Flow

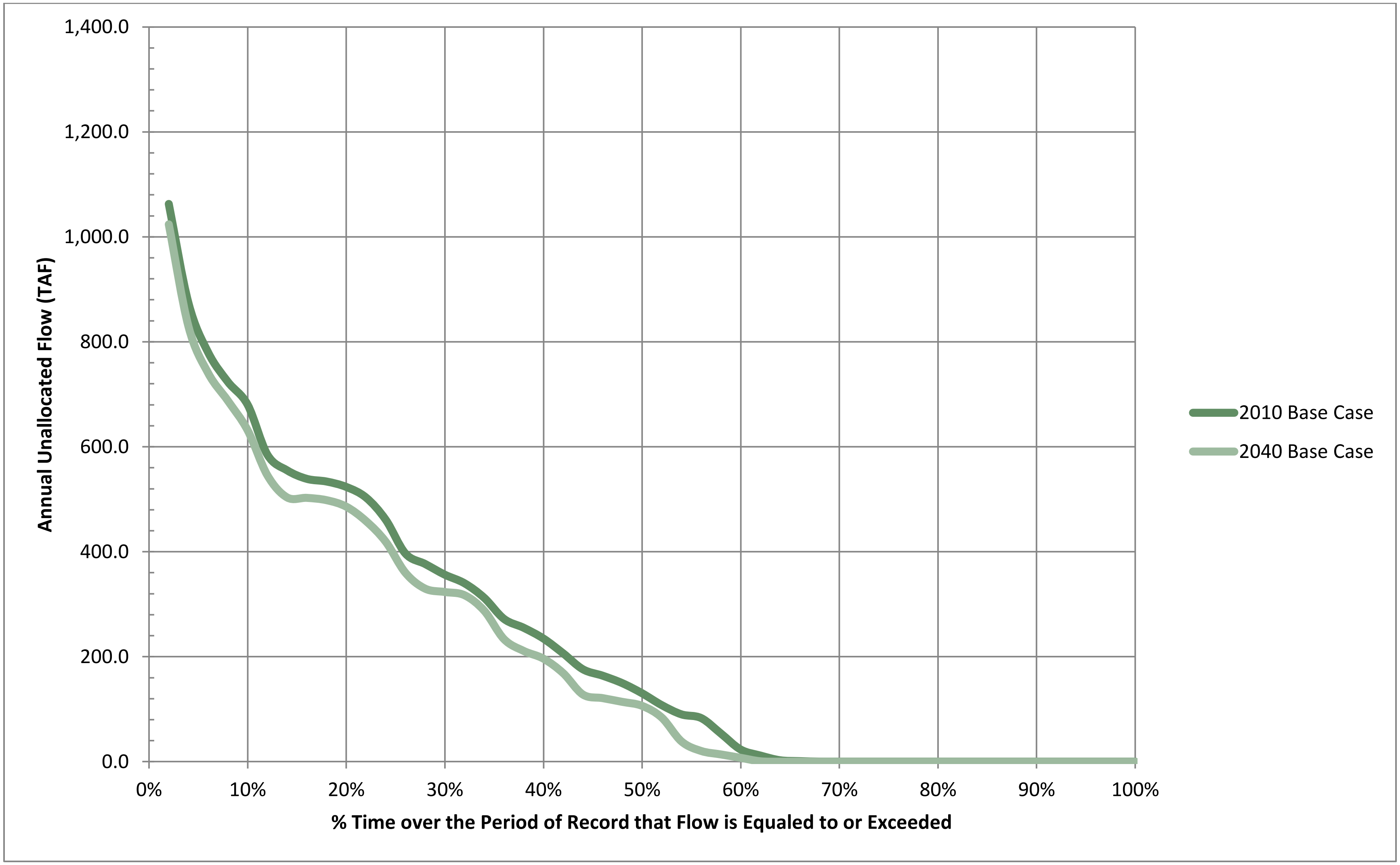
The following figures show the annual flow duration curves for each of the four locations along the river. Flow duration curves indicate the percentage of time over the period of record that flow in the river is expected to be equal to or exceed a certain amount of water, based on historical hydrologic conditions and projected diversion levels.

Flow duration curves for each location under 2010 and 2040 baseline diversion assumptions are presented in Figure D-1, Figure D-2, Figure D-3, and Figure D-4. Note that the unallocated flow curve is presented for below Camanche and total flow curves are presented for the remaining three nodes. The figures indicate that total flow decreases downstream.

Unallocated water at the nodes below Highway 99, below Woodbridge Dam, and below Interstate 5 is the same as the unallocated water at the below Camanche Dam node. This is due in part to MOCASIM acting as a mass balance model. Unallocated water released from Camanche Dam is calculated after all diversions and riparian diverter needs are met, as well as after any system losses that can be expected to occur (modeled riparian diversions are presented in Appendix I). The model assumes that this amount of unallocated water will be available for use at any point downstream of Camanche Dam, including below Highway 99, below Woodbridge Dam, and below Interstate 5.[1] System losses are included in the total release from Camanche and are not deducted from the unallocated portion.

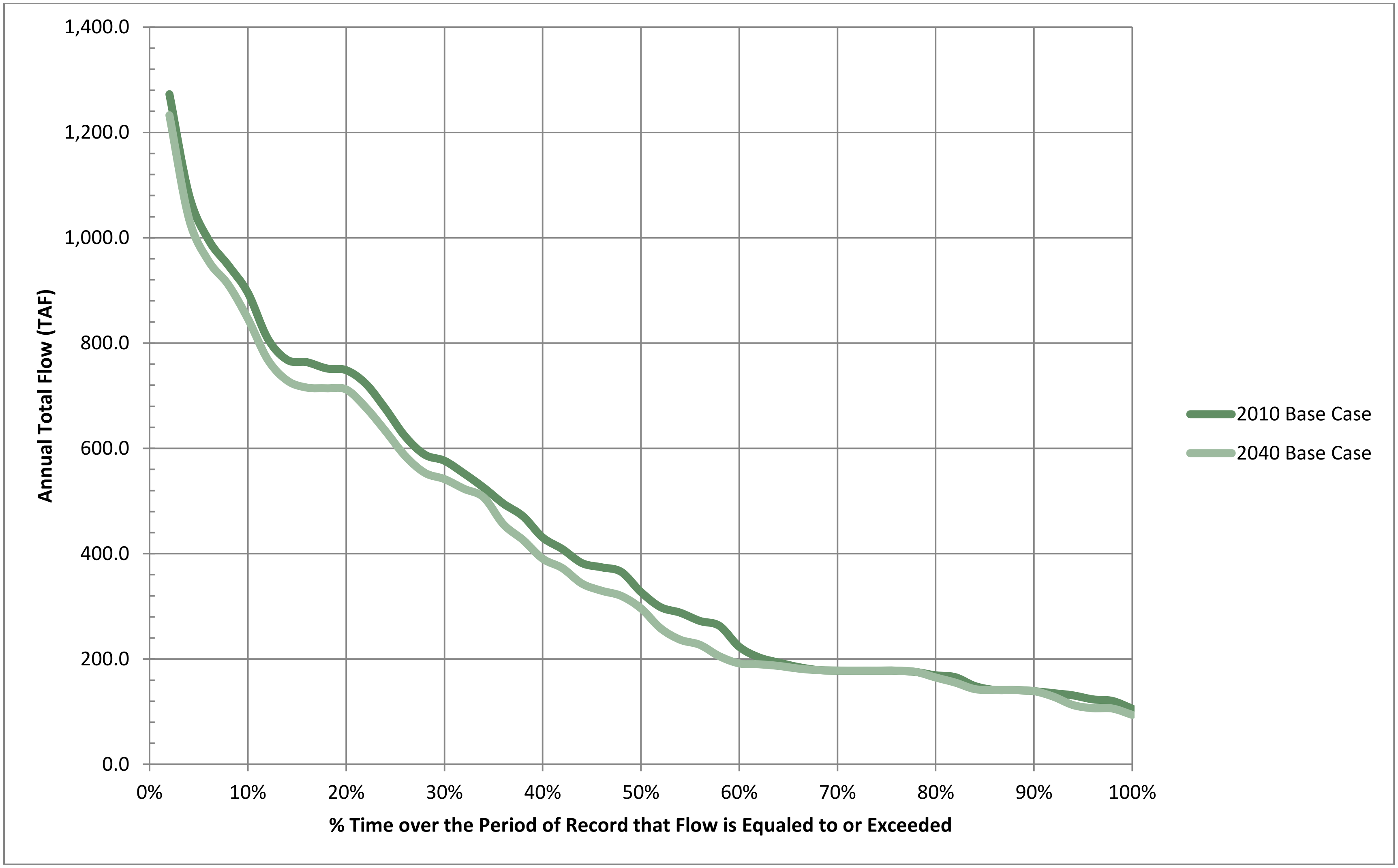
[1] Any project considered in MokeWISE that proposes diverting water upstream will affect unallocated water in that and all downstream reaches.

Figure D-1: Flow Duration Curve for Annual Unallocated Flow below Camanche Reservoir*



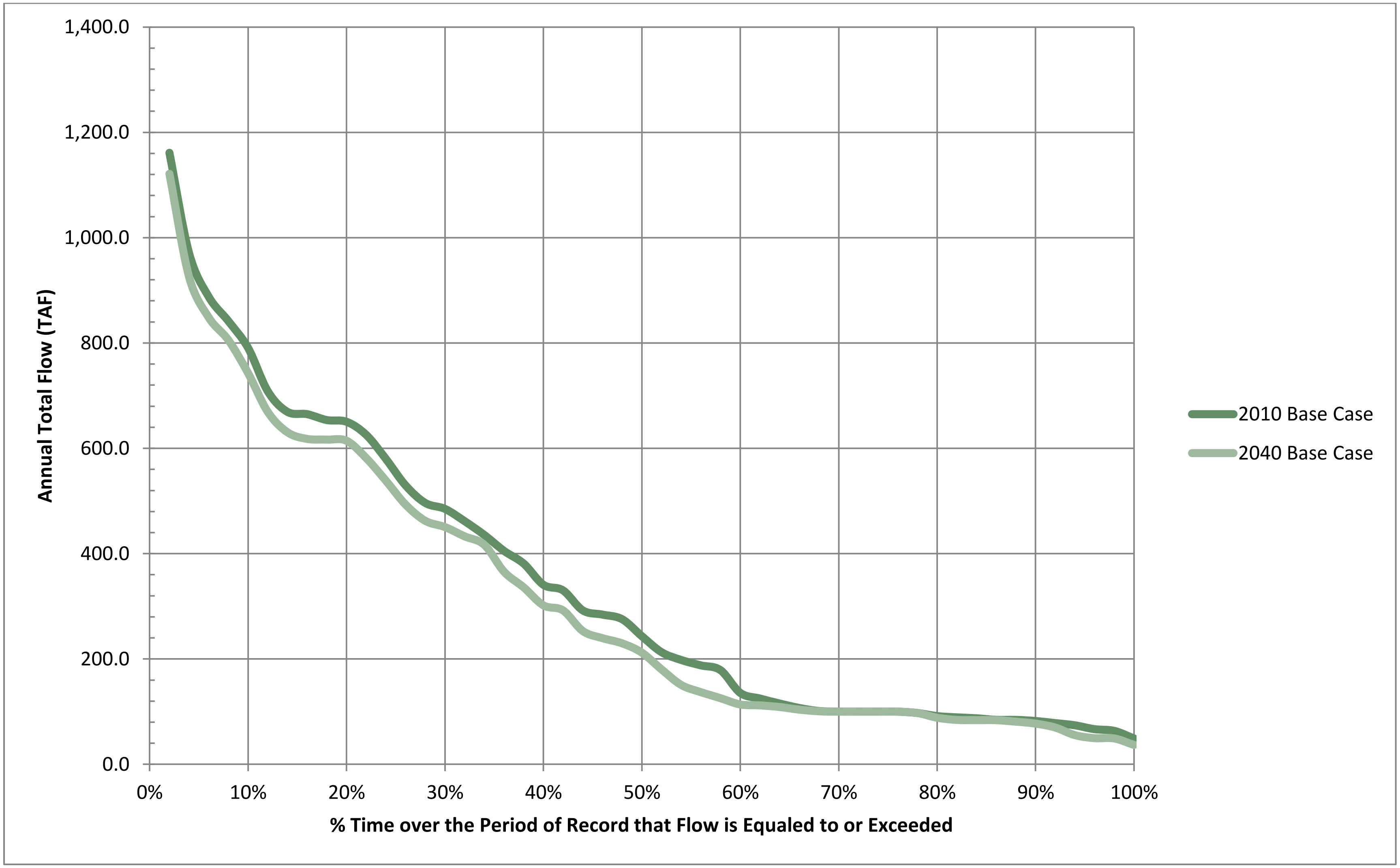
* Flow duration curves indicate the percentage of time that flow in the River is expected to be equal to or exceed a certain amount of water.

Figure D-2: Flow Duration Curve for Annual Total Flow below Highway 99*



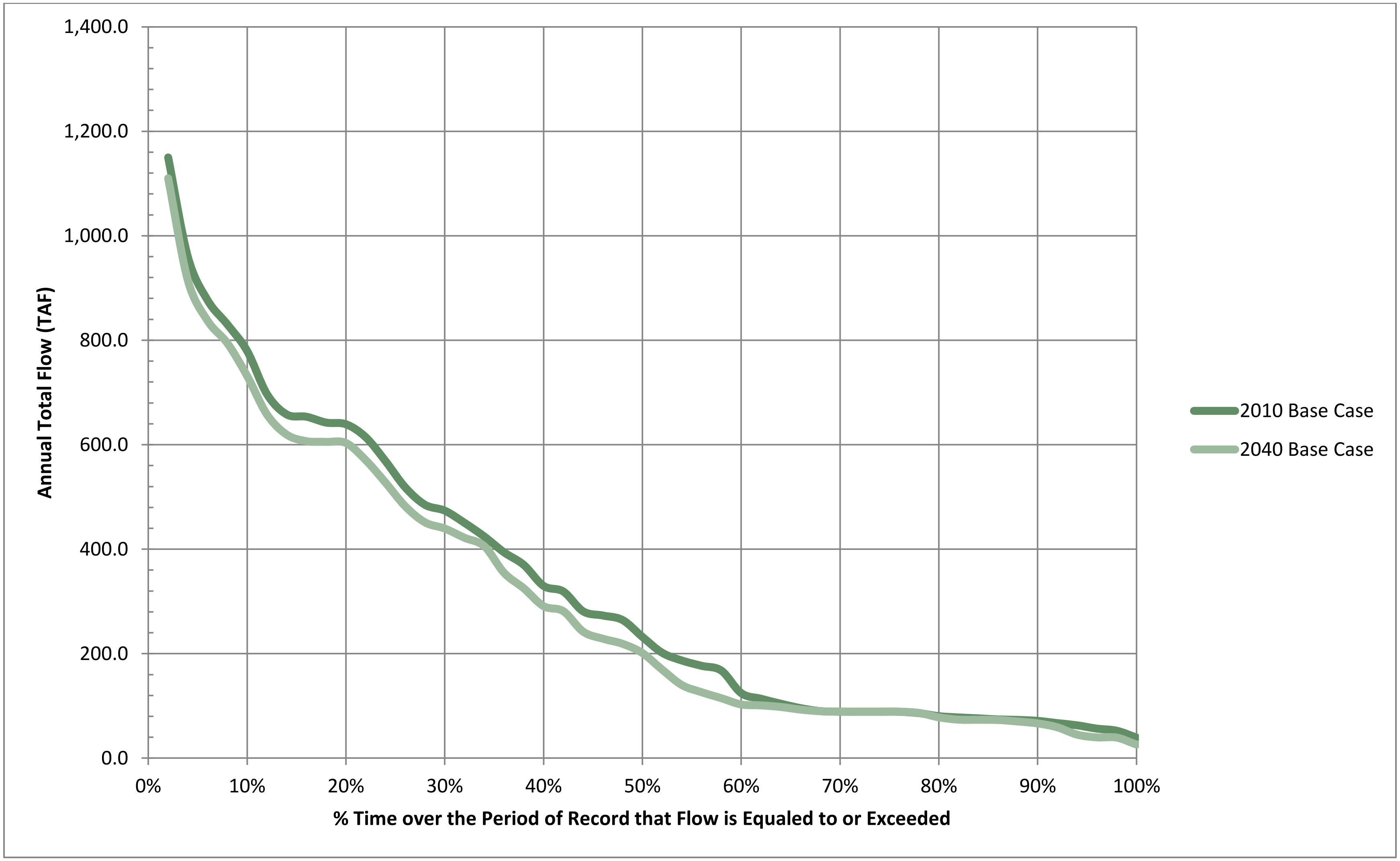
* Flow duration curves indicate the percentage of time that flow in the River is expected to be equal to or exceed a certain amount of water.

Figure D-3: Flow Duration Curve for Annual Total Flow below Woodbridge Diversion Dam*



* Flow duration curves indicate the percentage of time that flow in the River is expected to be equal to or exceed a certain amount of water.

Figure D-4: Flow Duration Curve for Annual Total Flow below Interstate 5*



* Flow duration curves indicate the percentage of time that flow in the River is expected to be equal to or exceed a certain amount of water.

Appendix E: Monthly Flow as Modeled in MOCASIM

Appendix E shows monthly unallocated flow alongside regulated flow and unimpaired flow for the full period of historical hydrology as simulated by the model. This appendix also shows flow distributions by month for five different hydrologic year types, at selected threshold flow levels. Results indicate that there is generally more unallocated flow in wetter years, and that there is a higher likelihood for unallocated flows occurring in the months from January to June compared with the months from July to December. Results also show less unallocated flows in 2040 than in 2010 due to increased diversions.

Monthly Flow

Water year types from the San Joaquin Valley Index were used to determine annual total flows in a given year type. The Index is based on measured unimpaired runoff and includes five water year types, including wet, above normal, below normal, dry, and critically dry (DWR 2013). The frequency of each water year type in the San Joaquin Valley Index is shown in Table E-1.

Table E-1: Frequency of San Joaquin Valley Index Water Year Types within MOCASIM Period of Record

San Joaquin Valley Index Water Year Type	Frequency within MOCASIM Period of Record (Total Number)	Frequency within MOCASIM Period of Record (Percentage)
Wet	19	33%
Above Normal	8	14%
Below Normal	8	14%
Dry	10	17%
Critically Dry	13	22%
TOTAL	58	100%

The tables below show flow distributions by month for five different hydrologic year types, at selected threshold flow levels. Table E-2 and Table E-3 indicate the percentage of months over the period of record when unallocated water is greater than 25,000 AF (345 cfs) below Camanche under the 2010 and 2040 baselines, respectively. The amount of unallocated water below Camanche is the same as the amount of unallocated water at the Highway 99, Woodbridge Dam, and Interstate 5 nodes, as noted earlier. Results indicate that there is more unallocated flow in wetter years; in those wetter years, the months from January through May are generally the most likely to have greater unallocated flows.

Table E-2: Percentage of Months when Unallocated Water below Camanche is >25,000 AF (2010)

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	53%	74%	63%	53%	89%	89%	89%	89%	89%	0%	11%	21%
Above Normal	38%	75%	38%	0%	75%	63%	75%	75%	63%	0%	25%	38%
Below Normal	13%	0%	0%	0%	13%	13%	13%	13%	13%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	30%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table E-3: Percentage of Months when Unallocated Water below Camanche is >25,000 AF (2040)

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	47%	63%	63%	47%	84%	79%	79%	79%	79%	0%	11%	21%
Above Normal	25%	75%	38%	0%	25%	25%	25%	25%	25%	0%	13%	38%
Below Normal	13%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	30%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table E-4 and Table E-5 indicate the percentage of months over the period of record when unallocated water is greater than 50,000 AF (690 cfs) below Camanche under the 2010 and 2040 baselines, respectively.

Table E-4: Percentage of Months when Unallocated Water below Camanche is >50,000 AF (2010)

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	47%	47%	42%	42%	84%	53%	42%	42%	32%	0%	11%	21%
Above Normal	25%	38%	0%	0%	13%	13%	0%	0%	0%	0%	13%	13%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	30%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table E-5: Percentage of Months when Unallocated Water below Camanche is >50,000 AF (2040)

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	47%	47%	42%	42%	63%	47%	26%	26%	26%	0%	11%	21%
Above Normal	25%	38%	0%	0%	13%	0%	0%	0%	0%	0%	13%	13%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	30%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table E-6 and Table E-7 indicate the percentage of months over the period of record when unallocated water is greater than 100,000 AF (1,380 cfs) below Camanche under the 2010 and 2040 baselines, respectively.

Table E-6: Percentage of Months when Unallocated Water below Camanche is >100,000 AF (2010)

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	26%	32%	16%	21%	47%	5%	5%	5%	0%	0%	5%	11%
Above Normal	13%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	20%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table E-7: Percentage of Months when Unallocated Water below Camanche is >100,000 AF (2040)

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	26%	32%	16%	21%	47%	5%	0%	0%	0%	0%	5%	11%
Above Normal	13%	13%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Below Normal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	20%
Critically Dry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

The following tables show monthly unallocated flow alongside regulated flow and unimpaired flow for the full period of historical hydrology as simulated by the model. The unallocated flow is represented at the node below Camanche, while the regulated and unimpaired flows are simulated at the Mokelumne Hill gage. The regulated flow simulates PG&E operations upstream and the unimpaired flow simulates the natural flow of the Mokelumne River at the Mokelumne Hill gage, assuming no upstream impairments or diversions. Table E-8 and Table E-9 present this information for the 2010 baseline, with Table E-8 showing the months January through July and Table E-9 showing August through December. Table E-10 and Table E-11 show the 2040 baseline; Table E-10 shows January through July and Table E-11 shows August through December. Regulated flow and natural flow are the same under both baseline cases; unallocated flow is the variable factor. Results indicate that there is generally more unallocated flow from January to May, and that there is more unallocated flow in the 2010 baseline than in the 2040 baseline due to increased diversions in 2040.

Table E-8: Unallocated, Regulated, and Natural Flow Comparison for January through July below Camanche (2010) (in TAF)*

	January			February			March			April			May			June			July		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1953	24.7	60.9	68.6	0.0	41.0	31.9	0.0	45.0	51.5	0.0	62.2	131.1	23.3	76.1	151.6	22.5	124.5	159.1	23.3	55.3	39.8
1954	0.0	38.3	26.0	0.0	37.9	37.3	0.0	56.7	88.6	0.0	73.4	158.2	0.5	88.7	163.9	0.5	42.5	42.6	0.5	32.5	13.5
1955	0.0	29.9	32.1	0.0	26.9	27.6	0.0	37.1	39.5	0.0	29.9	68.0	0.0	48.7	172.0	0.0	53.4	97.6	0.0	33.8	11.2
1956	167.0	179.0	207.3	53.6	98.8	77.7	7.1	95.6	78.4	1.6	97.6	118.0	113.5	192.2	276.0	66.4	197.0	205.4	42.9	51.6	42.3
1957	0.0	36.5	15.0	0.0	40.8	56.8	0.0	49.0	91.2	0.0	42.2	91.7	11.2	93.6	180.3	10.8	129.5	133.7	11.2	33.9	14.7
1958	0.0	48.1	26.0	47.9	80.1	87.2	48.0	94.2	103.9	95.2	142.7	197.3	133.5	201.3	353.0	71.4	215.4	222.4	48.3	62.0	52.7
1959	0.0	39.4	31.6	0.0	44.8	42.5	0.0	40.7	54.5	0.0	24.1	99.2	0.0	26.8	91.2	0.0	31.0	35.2	0.0	32.9	3.0
1960	0.0	20.5	8.4	0.0	34.2	50.0	0.0	31.1	76.3	0.0	31.2	105.8	0.0	57.9	123.1	0.0	54.1	42.1	0.0	31.5	3.7
1961	0.0	23.3	7.8	0.0	15.2	19.6	0.0	17.6	29.4	0.0	18.5	73.1	0.0	22.1	105.4	0.0	30.3	33.9	0.0	31.2	1.4
1962	0.0	20.7	8.8	0.0	54.7	73.3	0.0	50.8	50.2	0.0	87.4	175.0	0.0	69.3	164.3	0.0	131.6	140.3	0.0	39.4	17.0
1963	0.0	47.0	43.4	62.3	82.6	170.0	0.0	46.3	45.9	0.0	104.9	130.8	77.3	215.0	270.8	50.4	139.9	140.7	37.9	42.2	27.5
1964	0.0	47.1	24.9	0.0	37.1	22.2	0.0	34.0	31.7	0.0	31.9	85.4	0.0	32.6	145.4	0.0	33.9	70.2	0.0	36.6	8.9
1965	128.3	161.7	155.2	35.1	86.4	72.5	0.0	73.8	63.6	12.2	113.9	162.4	50.7	134.9	205.2	49.1	161.9	168.7	50.7	57.4	45.9
1966	2.7	41.1	23.5	0.0	23.4	22.9	0.0	42.3	69.5	0.0	51.7	136.4	0.0	46.5	126.8	0.0	27.3	45.2	0.0	33.4	4.4
1967	25.7	68.0	64.7	16.3	54.8	58.1	48.8	99.8	123.0	55.0	109.4	116.5	165.1	162.7	297.0	60.0	250.5	298.3	62.0	128.9	124.9
1968	0.0	39.2	20.2	0.0	46.0	72.5	0.0	45.8	62.5	0.0	37.8	87.5	0.0	30.1	115.9	0.0	38.0	35.9	0.0	31.1	3.9
1969	149.1	162.2	201.9	78.2	103.6	105.8	39.8	97.4	89.0	123.6	148.9	210.8	176.8	282.9	382.6	67.8	220.6	233.8	51.9	71.9	61.5
1970	195.8	162.2	242.7	42.7	84.6	80.7	16.4	100.0	85.4	0.0	67.8	76.0	15.4	115.7	187.2	14.9	120.3	117.6	15.4	45.7	18.4
1971	26.9	65.2	57.0	17.5	61.5	49.2	17.8	77.5	72.5	0.0	73.3	108.0	26.4	66.7	170.9	25.6	129.1	181.9	26.4	59.9	31.6
1972	0.0	36.7	20.4	0.0	29.8	32.8	0.0	57.5	100.1	0.0	49.1	80.3	0.0	39.7	160.7	0.0	71.5	67.9	0.0	38.4	7.0
1973	45.6	76.9	79.6	57.0	79.3	75.5	27.5	79.5	68.8	0.0	77.6	126.3	28.9	138.0	279.8	27.9	102.5	108.0	28.9	46.9	10.1
1974	68.3	91.3	113.3	0.0	63.6	37.5	38.6	118.0	122.4	25.7	114.6	141.3	50.5	140.4	250.4	42.9	140.8	148.9	44.3	62.2	35.7
1975	0.0	28.3	17.9	0.0	37.2	41.8	0.0	75.1	85.4	0.0	73.4	71.4	50.7	108.8	256.2	49.0	178.1	233.6	50.7	67.6	41.5
1976	0.0	28.2	10.0	0.0	13.5	13.8	0.0	16.4	28.2	0.0	16.9	44.3	0.0	18.6	71.8	0.0	17.0	7.9	0.0	17.1	1.4
1977	0.0	11.1	4.0	0.0	6.0	6.5	0.0	7.5	9.2	0.0	13.7	35.9	0.0	18.3	43.1	0.0	16.2	25.4	0.0	16.9	1.6
1978	0.0	72.3	88.6	0.0	65.6	61.3	0.0	97.0	129.4	0.0	114.0	152.4	20.3	113.4	238.0	19.6	191.2	215.7	20.3	67.6	50.6
1979	0.0	49.1	47.6	5.7	49.2	47.3	22.8	81.6	94.3	0.1	86.5	120.8	25.6	118.6	261.8	24.8	92.2	94.3	25.6	39.5	12.2
1980	178.1	167.4	248.4	124.3	153.8	167.7	17.6	114.2	99.2	0.0	87.3	132.8	55.4	133.4	203.2	47.5	170.9	175.4	49.1	78.9	68.3
1981	0.0	42.0	18.6	0.0	34.8	27.0	0.0	34.7	47.0	0.0	41.6	111.0	0.0	32.0	126.4	0.0	32.3	32.1	0.0	34.5	0.4
1982	79.1	109.5	102.2	155.0	166.3	206.4	99.4	156.6	154.0	198.6	245.2	303.4	153.0	287.3	314.1	60.6	182.0	186.5	62.7	78.9	55.5
1983	70.6	119.3	102.1	113.7	150.9	144.3	198.8	243.3	267.9	93.3	140.3	142.9	237.8	210.7	320.3	169.8	372.4	379.9	100.7	209.2	206.4
1984	77.3	114.4	87.5	37.4	88.3	56.3	8.2	96.8	85.0	0.0	80.1	86.6	30.3	145.4	217.8	29.3	109.8	99.2	30.3	58.9	17.7
1985	0.0	24.6	15.8	0.0	35.4	28.0	0.0	51.2	41.6	0.0	62.2	129.6	0.0	32.9	142.0	0.0	30.6	34.2	0.0	31.3	4.3
1986	0.0	52.9	69.0	285.4	266.4	340.3	157.4	192.4	259.8	8.0	125.1	142.2	80.5	194.1	214.1	34.4	133.2	142.6	35.5	45.8	24.5
1987	0.0	25.7	7.9	0.0	17.9	21.2	0.0	25.3	41.7	0.0	22.4	85.1	0.0	17.8	79.8	0.0	22.2	11.6	0.0	33.2	2.2
1988	0.0	22.1	17.9	0.0	14.9	20.1	0.0	17.5	41.5	0.0	19.3	67.7	0.0	23.5	68.3	0.0	27.5	22.6	0.0	28.9	3.7
1989	0.0	13.9	11.0	0.0	15.1	24.9	0.0	61.0	144.9	0.0	81.5	151.8	0.0	106.7	130.3	0.0	70.7	63.3	0.0	35.4	6.4
1990	0.0	33.3	17.3	0.0	22.8	18.5	0.0	33.3	59.2	0.0	24.4	97.6	0.0	33.4	72.1	0.0	34.7	33.9	0.0	33.4	3.6
1991	0.0	4.9	3.6	0.0	8.2	4.0	0.0	22.9	51.5	0.0	26.4	66.8	0.0	30.9	133.6	0.0	44.2	79.7	0.0	34.1	8.8

Table E-8: Unallocated, Regulated, and Natural Flow Comparison for January through July below Camanche (2010) (in TAF)*

	January			February			March			April			May			June			July		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1992	0.0	23.4	10.1	0.0	29.3	41.6	0.0	39.9	53.8	0.0	24.6	107.6	0.0	21.7	56.9	0.0	18.7	8.5	0.0	30.9	8.8
1993	0.0	76.0	105.2	0.0	73.8	69.3	0.0	120.7	155.3	0.0	104.0	149.5	35.8	177.1	272.9	34.7	177.8	190.2	35.8	53.7	43.2
1994	0.0	20.8	9.9	0.0	16.2	17.3	0.0	18.8	43.5	0.0	17.7	78.0	0.0	22.3	94.2	0.0	29.4	27.9	0.0	24.1	2.2
1995	0.0	109.9	144.9	33.2	73.4	73.1	167.0	204.0	253.4	138.0	164.4	188.9	242.1	250.6	332.3	89.5	302.8	317.2	78.3	182.9	194.8
1996	0.0	44.6	54.7	111.1	114.2	165.9	52.9	130.0	131.8	9.2	119.1	152.9	92.0	228.0	259.8	27.8	114.0	117.3	28.7	45.7	25.0
1997	359.2	348.8	442.7	74.9	112.6	87.1	12.8	94.8	85.0	0.0	95.2	124.3	12.7	148.2	174.9	12.3	81.9	69.8	12.7	39.8	11.2
1998	23.5	62.6	82.6	106.1	123.7	141.1	67.3	127.2	159.7	88.1	124.0	159.2	139.6	161.6	223.2	74.8	282.8	349.3	67.7	135.4	137.7
1999	20.9	69.2	61.2	90.4	119.9	130.9	29.0	90.7	83.3	0.0	87.2	112.5	41.3	123.8	244.8	46.2	155.1	166.0	39.2	59.9	28.3
2000	0.0	51.0	62.2	48.4	82.8	113.4	26.9	94.1	95.7	0.0	68.2	134.6	18.4	128.5	207.2	17.8	83.4	69.2	18.4	51.5	9.9
2001	0.0	19.8	12.8	0.0	18.2	20.9	0.0	38.2	63.9	0.0	54.0	89.7	0.0	44.7	140.3	0.0	32.5	12.3	0.0	34.5	4.1
2002	0.0	54.1	43.5	0.0	36.5	36.8	0.0	69.8	66.2	0.0	66.1	132.0	0.0	53.6	161.1	0.0	61.4	62.6	0.0	32.0	10.3
2003	0.0	57.2	38.2	0.1	49.7	33.2	0.0	48.2	57.0	0.0	59.8	96.6	16.7	105.9	216.4	16.2	123.8	132.3	16.7	36.1	16.2
2004	0.0	51.8	22.8	3.2	50.1	49.0	13.0	78.7	111.1	0.0	47.3	121.6	0.0	28.5	116.1	0.0	47.8	30.1	0.0	32.7	4.5
2005	0.0	83.9	72.3	31.9	78.3	65.1	67.6	123.8	118.6	29.6	122.1	125.6	95.3	181.1	320.3	54.3	169.7	198.7	40.0	73.5	49.8
2006	90.0	109.9	141.8	49.8	79.9	95.9	65.7	159.7	131.5	230.8	292.0	312.7	146.7	293.6	356.4	65.9	191.0	191.7	32.7	70.6	33.2
2007	0.0	32.8	18.2	0.0	35.7	53.7	0.0	46.7	74.5	0.0	29.0	98.7	0.0	35.6	95.8	0.0	28.4	17.3	0.0	32.2	6.8
2008	0.0	29.8	22.2	0.0	30.9	27.9	0.0	46.5	50.6	0.0	28.9	82.8	0.0	40.5	143.0	0.0	35.5	51.2	0.0	24.3	5.6
2009	0.0	42.0	31.8	0.0	38.5	45.3	0.0	79.8	103.0	0.0	69.8	113.5	5.0	159.9	243.1	4.8	57.7	54.1	5.0	39.9	9.8
2010	0.0	45.7	26.7	0.0	42.6	31.0	0.0	59.3	58.7	0.0	81.6	103.8	31.6	117.0	170.5	30.6	133.0	235.6	31.6	48.7	30.4

* Unallocated water is simulated below Camanche and regulated and unimpaired flow is simulated at Mokelumne Hill.

Table E-9: Unallocated, Regulated, and Natural Flow Comparison for August through December below Camanche (2010) (in TAF)*

	August			September			October			November			December			Total		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1953	23.3	37.5	4.0	22.5	38.0	2.2	0.0	42.1	5.7	0.0	39.3	11.4	0.0	38.0	14.7	139.5	660.0	671.5
1954	0.5	34.9	0.0	0.5	36.8	2.3	0.0	38.1	4.1	0.0	41.0	7.9	0.0	34.7	28.6	2.4	555.4	572.9
1955	0.0	34.4	2.8	0.0	32.6	0.9	0.0	33.7	2.4	0.0	33.8	5.8	121.0	163.3	259.8	121.0	557.5	719.6
1956	42.9	37.0	6.5	41.5	34.4	4.4	0.0	40.1	9.1	0.0	43.0	10.7	0.0	45.2	13.2	536.6	1,111.5	1,049.0
1957	11.2	31.5	2.4	10.8	32.4	2.3	0.0	39.8	4.0	0.0	43.6	7.2	0.0	43.6	16.1	55.3	616.3	615.6
1958	48.3	44.9	8.7	46.7	35.9	3.7	0.0	40.0	3.9	0.0	38.3	5.5	0.0	33.8	5.0	539.1	1,036.7	1,069.3
1959	0.0	32.7	0.1	0.0	30.9	4.6	0.0	32.6	2.2	0.0	30.6	1.9	0.0	32.2	3.3	0.0	398.7	369.4
1960	0.0	31.8	0.0	0.0	30.8	1.0	0.0	31.1	0.5	0.0	30.1	6.6	0.0	31.9	10.8	0.0	416.2	428.3
1961	0.0	30.1	0.0	0.0	30.1	0.3	0.0	31.0	0.4	0.0	19.1	3.8	0.0	18.8	10.4	0.0	287.5	285.4
1962	0.0	37.3	2.4	0.0	34.3	0.0	0.0	40.3	20.0	0.0	37.8	6.8	0.0	37.9	18.5	0.0	641.5	676.6
1963	37.9	38.9	2.8	36.7	36.6	3.4	0.0	38.2	7.0	23.0	41.7	46.4	0.0	43.7	23.9	325.5	876.8	912.8
1964	0.0	35.3	2.0	0.0	34.6	2.5	0.0	36.7	4.4	0.0	42.9	15.6	229.4	202.7	315.5	229.4	605.5	728.7
1965	50.7	45.4	20.9	49.1	56.1	7.0	0.0	56.1	5.3	19.2	57.0	26.5	2.8	46.5	21.9	447.8	1,051.1	955.1
1966	0.0	33.6	1.0	0.0	36.2	1.9	0.0	33.4	1.5	0.0	40.3	17.6	0.0	71.8	72.3	2.7	481.0	523.0
1967	62.0	40.5	14.0	60.0	38.5	5.3	0.0	39.6	5.4	0.0	39.9	7.1	0.0	40.2	11.0	554.8	1,072.9	1,125.3
1968	0.0	31.6	2.5	0.0	32.4	1.0	0.0	32.8	4.6	0.0	40.1	34.5	0.0	44.6	23.9	0.0	449.4	465.0
1969	51.9	50.0	7.0	50.3	46.7	3.7	0.0	48.5	11.1	0.0	39.7	11.8	9.9	54.8	65.7	799.4	1,327.3	1,384.7
1970	15.4	35.5	3.9	14.9	34.2	0.3	0.0	36.6	2.9	21.7	52.5	31.1	32.7	74.5	53.8	385.3	929.7	900.1
1971	26.4	54.5	3.4	25.6	41.5	0.5	0.0	44.4	3.2	4.9	33.3	12.1	7.3	41.5	29.8	204.8	748.2	720.0
1972	0.0	34.2	0.9	0.0	33.9	0.9	0.0	37.5	4.4	0.0	39.7	11.3	0.0	46.1	38.6	0.0	514.0	525.3
1973	28.9	34.7	1.5	27.9	34.8	0.0	0.0	38.8	6.3	64.4	54.9	85.6	39.2	76.0	73.8	376.3	839.7	915.3
1974	44.3	56.4	5.8	42.9	44.6	0.9	0.0	35.8	3.1	0.0	30.7	5.2	0.0	33.0	11.3	357.5	931.4	875.9
1975	50.7	55.7	7.4	49.0	52.9	2.9	0.0	45.8	21.9	4.6	41.6	22.9	0.0	39.0	12.0	254.8	803.5	814.9
1976	0.0	17.8	4.3	0.0	17.2	2.2	0.0	12.3	2.0	0.0	12.2	2.5	0.0	9.1	1.9	0.0	196.3	190.2
1977	0.0	16.4	1.4	0.0	17.5	1.4	0.0	1.1	0.8	0.0	2.9	3.4	0.0	23.7	29.5	0.0	151.4	162.2
1978	20.3	53.0	3.7	19.6	40.7	13.6	0.0	36.8	2.2	0.0	34.4	5.2	0.0	31.6	8.8	100.0	917.7	969.4
1979	25.6	36.1	3.1	24.8	32.0	0.2	0.0	34.8	9.0	0.0	38.9	18.1	0.0	48.4	19.9	155.1	707.0	728.5
1980	49.1	36.8	7.4	47.5	34.6	2.9	0.0	35.3	2.5	0.0	33.3	3.0	0.0	37.9	8.1	568.6	1,083.8	1,118.9
1981	0.0	28.6	0.5	0.0	30.1	0.5	0.0	35.0	5.6	0.0	45.0	78.2	87.2	83.4	132.6	87.2	474.1	579.8
1982	62.7	55.4	7.9	60.6	43.1	13.7	0.0	47.5	67.8	66.4	83.5	61.8	90.7	122.0	109.1	1,088.9	1,577.2	1,582.5
1983	100.7	70.0	31.0	97.4	57.6	16.8	0.0	56.1	10.4	122.3	116.2	160.1	151.3	179.5	188.4	1,456.5	1,925.7	1,970.6
1984	30.3	50.2	3.6	29.3	35.4	1.3	0.0	39.0	4.7	16.6	46.3	31.1	0.8	43.2	16.6	289.9	907.7	707.2
1985	0.0	34.5	1.5	0.0	34.1	2.7	0.0	37.1	1.9	0.0	39.6	11.8	0.0	39.8	25.2	0.0	453.3	438.6
1986	35.5	38.7	6.7	34.4	37.2	2.0	0.0	37.9	1.6	0.0	37.8	1.6	0.0	33.3	3.5	670.9	1,194.8	1,208.0
1987	0.0	32.3	0.7	0.0	28.6	0.7	0.0	15.1	1.8	0.0	13.8	2.0	0.0	18.2	3.5	0.0	272.6	258.2
1988	0.0	24.2	0.8	0.0	21.1	0.7	0.0	14.3	0.2	0.0	13.3	9.5	0.0	13.7	9.4	0.0	240.5	262.4
1989	0.0	32.2	1.8	0.0	33.8	3.7	0.0	24.1	10.2	0.0	36.9	12.8	0.0	35.6	10.3	0.0	546.9	571.2
1990	0.0	29.7	1.0	0.0	28.9	0.4	0.0	32.4	0.4	0.0	9.3	0.9	0.0	12.3	3.1	0.0	327.9	308.2

Table E-9: Unallocated, Regulated, and Natural Flow Comparison for August through December below Camanche (2010) (in TAF)*

	August			September			October			November			December			Total		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1991	0.0	29.9	2.0	0.0	29.8	0.0	0.0	33.3	5.7	0.0	34.1	8.6	0.0	31.4	8.7	0.0	330.0	373.1
1992	0.0	30.2	1.2	0.0	20.3	2.2	0.0	20.0	2.2	0.0	15.4	5.4	0.0	24.6	18.7	0.0	299.0	316.9
1993	35.8	54.2	9.8	34.7	35.4	4.0	0.0	40.6	4.3	0.0	32.1	2.6	0.0	32.4	4.1	176.8	977.8	1,010.3
1994	0.0	26.5	1.3	0.0	33.3	1.1	0.0	33.4	2.9	0.0	14.5	15.2	0.0	32.9	20.5	0.0	290.1	314.0
1995	78.3	51.0	30.4	75.8	47.3	7.5	0.0	50.7	4.7	0.0	34.0	4.4	0.0	36.6	31.3	902.3	1,507.7	1,582.9
1996	28.7	44.7	6.1	27.8	34.8	2.4	0.0	33.3	0.0	18.1	53.3	40.4	129.3	141.5	161.8	525.7	1,103.3	1,118.0
1997	12.7	41.5	4.6	12.3	37.0	3.3	0.0	39.8	2.2	10.2	41.9	8.9	0.0	28.1	11.6	520.1	1,109.7	1,025.6
1998	67.7	58.8	15.9	65.6	50.1	8.1	0.0	42.8	7.5	0.8	41.9	17.7	0.0	49.4	25.4	701.3	1,260.3	1,327.4
1999	39.2	41.6	7.6	38.0	37.8	3.5	0.0	35.5	1.6	0.0	39.8	9.9	0.0	34.6	8.3	344.3	895.2	858.0
2000	18.4	43.5	1.6	17.8	33.3	4.2	0.0	34.7	5.2	0.0	36.4	6.3	0.0	34.8	5.6	166.2	742.3	715.1
2001	0.0	32.1	2.3	0.0	28.1	3.6	0.0	25.7	0.0	0.0	20.3	14.0	0.0	37.2	32.7	0.0	385.1	396.5
2002	0.0	31.5	1.7	0.0	30.0	0.0	0.0	32.0	1.2	0.0	34.2	20.0	0.0	40.8	22.7	0.0	542.0	558.1
2003	16.7	33.1	1.0	16.2	35.1	0.9	0.0	35.8	0.8	0.0	32.1	4.0	0.0	47.2	30.5	82.6	664.0	627.0
2004	0.0	34.2	0.3	0.0	31.0	0.0	0.0	17.6	9.7	0.0	33.0	11.8	0.0	45.3	24.6	16.1	498.1	501.5
2005	40.0	49.3	5.4	38.7	41.0	1.7	0.0	32.7	6.3	0.0	37.4	8.5	91.6	104.9	128.5	489.0	1,097.8	1,100.8
2006	32.7	53.4	7.1	31.6	31.9	4.6	0.0	34.4	6.3	2.7	37.1	14.4	3.4	45.7	20.1	751.9	1,399.2	1,315.6
2007	0.0	31.2	1.4	0.0	29.9	2.6	0.0	21.2	0.6	0.0	32.8	3.0	0.0	25.3	6.9	0.0	380.7	379.6
2008	0.0	28.8	2.6	0.0	20.7	3.2	0.0	31.0	0.2	0.0	32.3	13.6	0.0	28.8	7.7	0.0	377.9	410.6
2009	5.0	34.9	3.3	4.8	25.5	1.6	0.0	26.7	4.0	0.0	28.4	3.0	0.0	34.5	10.8	24.7	637.5	623.2
2010	31.6	28.7	2.2	30.6	20.9	1.4	0.0	42.2	31.8	25.1	40.2	25.2	74.4	120.0	123.4	255.4	779.9	840.7

* Unallocated water is simulated below Camanche and regulated and unimpaired flow is simulated at Mokelumne Hill.

Table E-10: Unallocated, Regulated, and Natural Flow Comparison for January through July below Camanche (2040) (in TAF)*

	January			February			March			April			May			June			July		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1953	23.3	60.9	68.6	0.0	41.0	31.9	0.0	45.0	51.5	0.0	62.2	131.1	16.5	76.1	151.6	16.0	124.5	159.1	16.5	55.3	39.8
1954	0.0	38.3	26.0	0.0	37.9	37.3	0.0	56.7	88.6	0.0	73.4	158.2	0.0	88.7	163.9	0.0	42.5	42.6	0.0	32.5	13.5
1955	0.0	29.9	32.1	0.0	26.9	27.6	0.0	37.1	39.5	0.0	29.9	68.0	0.0	48.7	172.0	0.0	53.4	97.6	0.0	33.8	11.2
1956	165.6	179.0	207.3	52.3	98.8	77.7	5.6	95.6	78.4	0.2	97.6	118.0	108.8	192.2	276.0	60.5	197.0	205.4	37.1	51.6	42.3
1957	0.0	36.5	15.0	0.0	40.8	56.8	0.0	49.0	91.2	0.0	42.2	91.7	4.0	93.6	180.3	3.9	129.5	133.7	4.0	33.9	14.7
1958	0.0	48.1	26.0	42.2	80.1	87.2	46.5	94.2	103.9	93.8	142.7	197.3	128.9	201.3	353.0	65.5	215.4	222.4	42.5	62.0	52.7
1959	0.0	39.4	31.6	0.0	44.8	42.5	0.0	40.7	54.5	0.0	24.1	99.2	0.0	26.8	91.2	0.0	31.0	35.2	0.0	32.9	3.0
1960	0.0	20.5	8.4	0.0	34.2	50.0	0.0	31.1	76.3	0.0	31.2	105.8	0.0	57.9	123.1	0.0	54.1	42.1	0.0	31.5	3.7
1961	0.0	23.3	7.8	0.0	15.2	19.6	0.0	17.6	29.4	0.0	18.5	73.1	0.0	22.1	105.4	0.0	30.3	33.9	0.0	31.2	1.4
1962	0.0	20.7	8.8	0.0	54.7	73.3	0.0	50.8	50.2	0.0	87.4	175.0	0.0	69.3	164.3	0.0	131.6	140.3	0.0	39.4	17.0
1963	0.0	47.0	43.4	105.9	82.6	170.0	0.0	46.3	45.9	0.0	104.9	130.8	64.0	215.0	270.8	43.9	139.9	140.7	31.6	42.2	27.5
1964	0.0	47.1	24.9	0.0	37.1	22.2	0.0	34.0	31.7	0.0	31.9	85.4	0.0	32.6	145.4	0.0	33.9	70.2	0.0	36.6	8.9
1965	126.9	161.7	155.2	33.8	86.4	72.5	0.0	73.8	63.6	9.1	113.9	162.4	45.4	134.9	205.2	43.6	161.9	168.7	45.0	57.4	45.9
1966	1.3	41.1	23.5	0.0	23.4	22.9	0.0	42.3	69.5	0.0	51.7	136.4	0.0	46.5	126.8	0.0	27.3	45.2	0.0	33.4	4.4
1967	4.4	68.0	64.7	15.1	54.8	58.1	47.3	99.8	123.0	53.7	109.4	116.5	160.6	162.7	297.0	54.5	250.5	298.3	56.3	128.9	124.9
1968	0.0	39.2	20.2	0.0	46.0	72.5	0.0	45.8	62.5	0.0	37.8	87.5	0.0	30.1	115.9	0.0	38.0	35.9	0.0	31.1	3.9
1969	142.3	162.2	201.9	77.0	103.6	105.8	38.5	97.4	89.0	122.2	148.9	210.8	172.2	282.9	382.6	61.9	220.6	233.8	46.2	71.9	61.5
1970	194.4	162.2	242.7	41.4	84.6	80.7	14.9	100.0	85.4	0.0	67.8	76.0	9.4	115.7	187.2	9.1	120.3	117.6	9.4	45.7	18.4
1971	25.5	65.2	57.0	16.2	61.5	49.2	16.3	77.5	72.5	0.0	73.3	108.0	20.3	66.7	170.9	19.6	129.1	181.9	20.3	59.9	31.6
1972	0.0	36.7	20.4	0.0	29.8	32.8	0.0	57.5	100.1	0.0	49.1	80.3	0.0	39.7	160.7	0.0	71.5	67.9	0.0	38.4	7.0
1973	22.8	76.9	79.6	55.7	79.3	75.5	26.0	79.5	68.8	0.0	77.6	126.3	23.2	138.0	279.8	22.5	102.5	108.0	23.2	46.9	10.1
1974	66.9	91.3	113.3	0.0	63.6	37.5	35.8	118.0	122.4	24.1	114.6	141.3	45.8	140.4	250.4	37.2	140.8	148.9	38.4	62.2	35.7
1975	0.0	28.3	17.9	0.0	37.2	41.8	0.0	75.1	85.4	0.0	73.4	71.4	43.1	108.8	256.2	41.7	178.1	233.6	43.1	67.6	41.5
1976	0.0	28.2	10.0	0.0	13.5	13.8	0.0	16.4	28.2	0.0	16.9	44.3	0.0	18.6	71.8	0.0	17.0	7.9	0.0	17.1	1.4
1977	0.0	11.1	4.0	0.0	6.0	6.5	0.0	7.5	9.2	0.0	13.7	35.9	0.0	18.3	43.1	0.0	16.2	25.4	0.0	16.9	1.6
1978	0.0	72.3	88.6	0.0	65.6	61.3	0.0	97.0	129.4	0.0	114.0	152.4	5.9	113.4	238.0	5.7	191.2	215.7	5.9	67.6	50.6
1979	0.0	49.1	47.6	0.0	49.2	47.3	21.3	81.6	94.3	0.0	86.5	120.8	19.5	118.6	261.8	18.8	92.2	94.3	19.5	39.5	12.2
1980	173.8	167.4	248.4	123.0	153.8	167.7	16.1	114.2	99.2	0.0	87.3	132.8	49.3	133.4	203.2	41.8	170.9	175.4	43.2	78.9	68.3
1981	0.0	42.0	18.6	0.0	34.8	27.0	0.0	34.7	47.0	0.0	41.6	111.0	0.0	32.0	126.4	0.0	32.3	32.1	0.0	34.5	0.4
1982	77.7	109.5	102.2	153.7	166.3	206.4	97.9	156.6	154.0	197.0	245.2	303.4	148.1	287.3	314.1	54.8	182.0	186.5	56.6	78.9	55.5
1983	69.2	119.3	102.1	112.5	150.9	144.3	197.3	243.3	267.9	91.7	140.3	142.9	232.8	210.7	320.3	163.7	372.4	379.9	94.7	209.2	206.4
1984	75.9	114.4	87.5	36.1	88.3	56.3	6.8	96.8	85.0	0.0	80.1	86.6	24.1	145.4	217.8	23.3	109.8	99.2	24.1	58.9	17.7
1985	0.0	24.6	15.8	0.0	35.4	28.0	0.0	51.2	41.6	0.0	62.2	129.6	0.0	32.9	142.0	0.0	30.6	34.2	0.0	31.3	4.3
1986	0.0	52.9	69.0	260.7	266.4	340.3	155.9	192.4	259.8	6.8	125.1	142.2	76.0	194.1	214.1	28.9	133.2	142.6	29.9	45.8	24.5
1987	0.0	25.7	7.9	0.0	17.9	21.2	0.0	25.3	41.7	0.0	22.4	85.1	0.0	17.8	79.8	0.0	22.2	11.6	0.0	33.2	2.2
1988	0.0	22.1	17.9	0.0	14.9	20.1	0.0	17.5	41.5	0.0	19.3	67.7	0.0	23.5	68.3	0.0	27.5	22.6	0.0	28.9	3.7
1989	0.0	13.9	11.0	0.0	15.1	24.9	0.0	61.0	144.9	0.0	81.5	151.8	0.0	106.7	130.3	0.0	70.7	63.3	0.0	35.4	6.4
1990	0.0	33.3	17.3	0.0	22.8	18.5	0.0	33.3	59.2	0.0	24.4	97.6	0.0	33.4	72.1	0.0	34.7	33.9	0.0	33.4	3.6

Table E-10: Unallocated, Regulated, and Natural Flow Comparison for January through July below Camanche (2040) (in TAF)*

	January			February			March			April			May			June			July		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1991	0.0	4.9	3.6	0.0	8.2	4.0	0.0	22.9	51.5	0.0	26.4	66.8	0.0	30.9	133.6	0.0	44.2	79.7	0.0	34.1	8.8
1992	0.0	23.4	10.1	0.0	29.3	41.6	0.0	39.9	53.8	0.0	24.6	107.6	0.0	21.7	56.9	0.0	18.7	8.5	0.0	30.9	8.8
1993	0.0	76.0	105.2	0.0	73.8	69.3	0.0	120.7	155.3	0.0	104.0	149.5	24.8	177.1	272.9	24.0	177.8	190.2	24.8	53.7	43.2
1994	0.0	20.8	9.9	0.0	16.2	17.3	0.0	18.8	43.5	0.0	17.7	78.0	0.0	22.3	94.2	0.0	29.4	27.9	0.0	24.1	2.2
1995	0.0	109.9	144.9	18.7	73.4	73.1	165.7	204.0	253.4	136.5	164.4	188.9	237.3	250.6	332.3	83.5	302.8	317.2	72.5	182.9	194.8
1996	0.0	44.6	54.7	105.4	114.2	165.9	51.4	130.0	131.8	7.8	119.1	152.9	87.4	228.0	259.8	22.2	114.0	117.3	22.9	45.7	25.0
1997	357.8	348.8	442.7	73.7	112.6	87.1	11.3	94.8	85.0	0.0	95.2	124.3	6.8	148.2	174.9	6.6	81.9	69.8	6.8	39.8	11.2
1998	20.6	62.6	82.6	104.8	123.7	141.1	65.9	127.2	159.7	86.7	124.0	159.2	134.9	161.6	223.2	68.9	282.8	349.3	61.9	135.4	137.7
1999	17.3	69.2	61.2	89.2	119.9	130.9	27.5	90.7	83.3	0.0	87.2	112.5	35.4	123.8	244.8	40.1	155.1	166.0	33.4	59.9	28.3
2000	0.0	51.0	62.2	42.7	82.8	113.4	25.4	94.1	95.7	0.0	68.2	134.6	12.2	128.5	207.2	11.9	83.4	69.2	12.2	51.5	9.9
2001	0.0	19.8	12.8	0.0	18.2	20.9	0.0	38.2	63.9	0.0	54.0	89.7	0.0	44.7	140.3	0.0	32.5	12.3	0.0	34.5	4.1
2002	0.0	54.1	43.5	0.0	36.5	36.8	0.0	69.8	66.2	0.0	66.1	132.0	0.0	53.6	161.1	0.0	61.4	62.6	0.0	32.0	10.3
2003	0.0	57.2	38.2	0.0	49.7	33.2	0.0	48.2	57.0	0.0	59.8	96.6	2.9	105.9	216.4	2.8	123.8	132.3	2.9	36.1	16.2
2004	0.0	51.8	22.8	0.0	50.1	49.0	9.0	78.7	111.1	0.0	47.3	121.6	0.0	28.5	116.1	0.0	47.8	30.1	0.0	32.7	4.5
2005	0.0	83.9	72.3	11.9	78.3	65.1	66.1	123.8	118.6	27.9	122.1	125.6	90.8	181.1	320.3	48.6	169.7	198.7	34.4	73.5	49.8
2006	88.6	109.9	141.8	48.5	79.9	95.9	64.3	159.7	131.5	229.4	292.0	312.7	142.0	293.6	356.4	60.0	191.0	191.7	26.9	70.6	33.2
2007	0.0	32.8	18.2	0.0	35.7	53.7	0.0	46.7	74.5	0.0	29.0	98.7	0.0	35.6	95.8	0.0	28.4	17.3	0.0	32.2	6.8
2008	0.0	29.8	22.2	0.0	30.9	27.9	0.0	46.5	50.6	0.0	28.9	82.8	0.0	40.5	143.0	0.0	35.5	51.2	0.0	24.3	5.6
2009	0.0	42.0	31.8	0.0	38.5	45.3	0.0	79.8	103.0	0.0	69.8	113.5	0.0	159.9	243.1	0.0	57.7	54.1	0.0	39.9	9.8
2010	0.0	45.7	26.7	0.0	42.6	31.0	0.0	59.3	58.7	0.0	81.6	103.8	22.7	117.0	170.5	22.0	133.0	235.6	22.7	48.7	30.4

* Unallocated water is simulated below Camanche and regulated and unimpaired flow is simulated at Mokelumne Hill.

Table E-11: Unallocated, Regulated, and Natural Flow Comparison for August through December below Camanche (2040) (in TAF)*

	August			September			October			November			December			Total		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1953	16.5	37.5	4.0	16.0	38.0	2.2	0.0	42.1	5.7	0.0	39.3	11.4	0.0	38.0	14.7	105.0	660.0	671.5
1954	0.0	34.9	0.0	0.0	36.8	2.3	0.0	38.1	4.1	0.0	41.0	7.9	0.0	34.7	28.6	0.0	555.4	572.9
1955	0.0	34.4	2.8	0.0	32.6	0.9	0.0	33.7	2.4	0.0	33.8	5.8	108.1	163.3	259.8	108.1	557.5	719.6
1956	37.1	37.0	6.5	35.9	34.4	4.4	0.0	40.1	9.1	0.0	43.0	10.7	0.0	45.2	13.2	503.0	1,111.5	1,049.0
1957	4.0	31.5	2.4	3.9	32.4	2.3	0.0	39.8	4.0	0.0	43.6	7.2	0.0	43.6	16.1	19.7	616.3	615.6
1958	42.5	44.9	8.7	41.1	35.9	3.7	0.0	40.0	3.9	0.0	38.3	5.5	0.0	33.8	5.0	502.9	1,036.7	1,069.3
1959	0.0	32.7	0.1	0.0	30.9	4.6	0.0	32.6	2.2	0.0	30.6	1.9	0.0	32.2	3.3	0.0	398.7	369.4
1960	0.0	31.8	0.0	0.0	30.8	1.0	0.0	31.1	0.5	0.0	30.1	6.6	0.0	31.9	10.8	0.0	416.2	428.3
1961	0.0	30.1	0.0	0.0	30.1	0.3	0.0	31.0	0.4	0.0	19.1	3.8	0.0	18.8	10.4	0.0	287.5	285.4
1962	0.0	37.3	2.4	0.0	34.3	0.0	0.0	40.3	20.0	0.0	37.8	6.8	0.0	37.9	18.5	0.0	641.5	676.6
1963	31.6	38.9	2.8	30.5	36.6	3.4	0.0	38.2	7.0	21.5	41.7	46.4	0.0	43.7	23.9	329.0	876.8	912.8
1964	0.0	35.3	2.0	0.0	34.6	2.5	0.0	36.7	4.4	0.0	42.9	15.6	193.3	202.7	315.5	193.3	605.5	728.7
1965	45.0	45.4	20.9	43.6	56.1	7.0	0.0	56.1	5.3	17.7	57.0	26.5	1.3	46.5	21.9	411.3	1,051.1	955.1
1966	0.0	33.6	1.0	0.0	36.2	1.9	0.0	33.4	1.5	0.0	40.3	17.6	0.0	71.8	72.3	1.3	481.0	523.0
1967	56.3	40.5	14.0	54.5	38.5	5.3	0.0	39.6	5.4	0.0	39.9	7.1	0.0	40.2	11.0	502.6	1,072.9	1,125.3
1968	0.0	31.6	2.5	0.0	32.4	1.0	0.0	32.8	4.6	0.0	40.1	34.5	0.0	44.6	23.9	0.0	449.4	465.0
1969	46.2	50.0	7.0	44.7	46.7	3.7	0.0	48.5	11.1	0.0	39.7	11.8	6.9	54.8	65.7	758.2	1,327.3	1,384.7
1970	9.4	35.5	3.9	9.1	34.2	0.3	0.0	36.6	2.9	20.2	52.5	31.1	31.3	74.5	53.8	348.8	929.7	900.1
1971	20.3	54.5	3.4	19.6	41.5	0.5	0.0	44.4	3.2	3.4	33.3	12.1	5.9	41.5	29.8	167.2	748.2	720.0
1972	0.0	34.2	0.9	0.0	33.9	0.9	0.0	37.5	4.4	0.0	39.7	11.3	0.0	46.1	38.6	0.0	514.0	525.3
1973	23.2	34.7	1.5	22.5	34.8	0.0	0.0	38.8	6.3	62.9	54.9	85.6	37.7	76.0	73.8	319.9	839.7	915.3
1974	38.4	56.4	5.8	37.2	44.6	0.9	0.0	35.8	3.1	0.0	30.7	5.2	0.0	33.0	11.3	323.8	931.4	875.9
1975	43.1	55.7	7.4	41.7	52.9	2.9	0.0	45.8	21.9	3.1	41.6	22.9	0.0	39.0	12.0	215.7	803.5	814.9
1976	0.0	17.8	4.3	0.0	17.2	2.2	0.0	12.3	2.0	0.0	12.2	2.5	0.0	9.1	1.9	0.0	196.3	190.2
1977	0.0	16.4	1.4	0.0	17.5	1.4	0.0	1.1	0.8	0.0	2.9	3.4	0.0	23.7	29.5	0.0	151.4	162.2
1978	5.9	53.0	3.7	5.7	40.7	13.6	0.0	36.8	2.2	0.0	34.4	5.2	0.0	31.6	8.8	29.2	917.7	969.4
1979	19.5	36.1	3.1	18.8	32.0	0.2	0.0	34.8	9.0	0.0	38.9	18.1	0.0	48.4	19.9	117.4	707.0	728.5
1980	43.2	36.8	7.4	41.8	34.6	2.9	0.0	35.3	2.5	0.0	33.3	3.0	0.0	37.9	8.1	532.2	1,083.8	1,118.9
1981	0.0	28.6	0.5	0.0	30.1	0.5	0.0	35.0	5.6	0.0	45.0	78.2	72.3	83.4	132.6	72.3	474.1	579.8
1982	56.6	55.4	7.9	54.8	43.1	13.7	0.0	47.5	67.8	64.9	83.5	61.8	89.3	122.0	109.1	1,051.2	1,577.2	1,582.5
1983	94.7	70.0	31.0	91.6	57.6	16.8	0.0	56.1	10.4	120.8	116.2	160.1	149.9	179.5	188.4	1,418.9	1,925.7	1,970.6
1984	24.1	50.2	3.6	23.3	35.4	1.3	0.0	39.0	4.7	15.1	46.3	31.1	0.0	43.2	16.6	252.9	907.7	707.2
1985	0.0	34.5	1.5	0.0	34.1	2.7	0.0	37.1	1.9	0.0	39.6	11.8	0.0	39.8	25.2	0.0	453.3	438.6
1986	29.9	38.7	6.7	28.9	37.2	2.0	0.0	37.9	1.6	0.0	37.8	1.6	0.0	33.3	3.5	616.9	1,194.8	1,208.0
1987	0.0	32.3	0.7	0.0	28.6	0.7	0.0	15.1	1.8	0.0	13.8	2.0	0.0	18.2	3.5	0.0	272.6	258.2
1988	0.0	24.2	0.8	0.0	21.1	0.7	0.0	14.3	0.2	0.0	13.3	9.5	0.0	13.7	9.4	0.0	240.5	262.4
1989	0.0	32.2	1.8	0.0	33.8	3.7	0.0	24.1	10.2	0.0	36.9	12.8	0.0	35.6	10.3	0.0	546.9	571.2
1990	0.0	29.7	1.0	0.0	28.9	0.4	0.0	32.4	0.4	0.0	9.3	0.9	0.0	12.3	3.1	0.0	327.9	308.2

Table E-11: Unallocated, Regulated, and Natural Flow Comparison for August through December below Camanche (2040) (in TAF)*

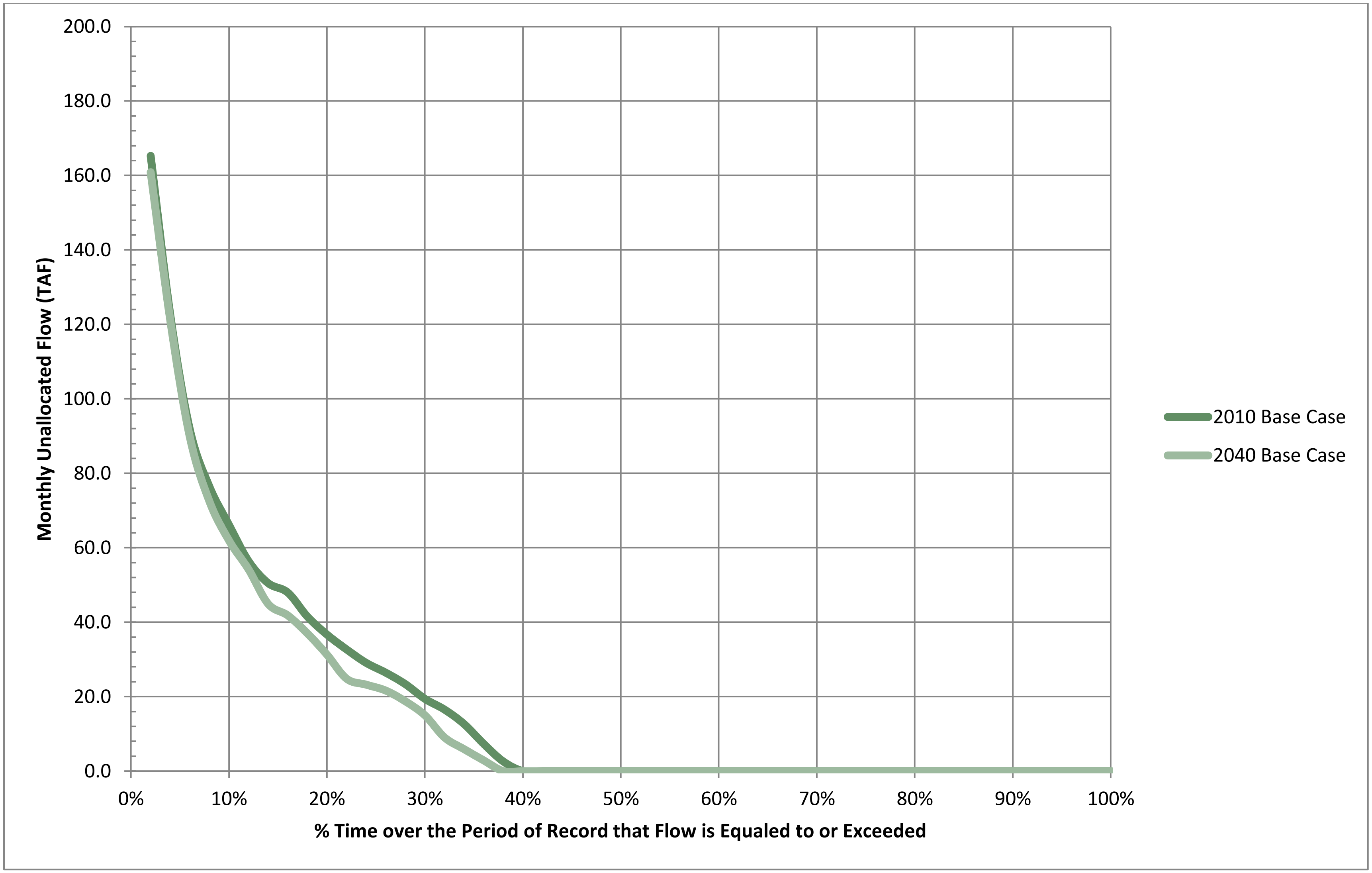
	August			September			October			November			December			Total		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1991	0.0	29.9	2.0	0.0	29.8	0.0	0.0	33.3	5.7	0.0	34.1	8.6	0.0	31.4	8.7	0.0	330.0	373.1
1992	0.0	30.2	1.2	0.0	20.3	2.2	0.0	20.0	2.2	0.0	15.4	5.4	0.0	24.6	18.7	0.0	299.0	316.9
1993	24.8	54.2	9.8	24.0	35.4	4.0	0.0	40.6	4.3	0.0	32.1	2.6	0.0	32.4	4.1	122.3	977.8	1,010.3
1994	0.0	26.5	1.3	0.0	33.3	1.1	0.0	33.4	2.9	0.0	14.5	15.2	0.0	32.9	20.5	0.0	290.1	314.0
1995	72.5	51.0	30.4	70.1	47.3	7.5	0.0	50.7	4.7	0.0	34.0	4.4	0.0	36.6	31.3	856.7	1,507.7	1,582.9
1996	22.9	44.7	6.1	22.2	34.8	2.4	0.0	33.3	0.0	16.6	53.3	40.4	127.9	141.5	161.8	486.6	1,103.3	1,118.0
1997	6.8	41.5	4.6	6.6	37.0	3.3	0.0	39.8	2.2	8.7	41.9	8.9	0.0	28.1	11.6	485.2	1,109.7	1,025.6
1998	61.9	58.8	15.9	59.9	50.1	8.1	0.0	42.8	7.5	0.0	41.9	17.7	0.0	49.4	25.4	665.7	1,260.3	1,327.4
1999	33.4	41.6	7.6	32.4	37.8	3.5	0.0	35.5	1.6	0.0	39.8	9.9	0.0	34.6	8.3	308.8	895.2	858.0
2000	12.2	43.5	1.6	11.9	33.3	4.2	0.0	34.7	5.2	0.0	36.4	6.3	0.0	34.8	5.6	128.5	742.3	715.1
2001	0.0	32.1	2.3	0.0	28.1	3.6	0.0	25.7	0.0	0.0	20.3	14.0	0.0	37.2	32.7	0.0	385.1	396.5
2002	0.0	31.5	1.7	0.0	30.0	0.0	0.0	32.0	1.2	0.0	34.2	20.0	0.0	40.8	22.7	0.0	542.0	558.1
2003	2.9	33.1	1.0	2.8	35.1	0.9	0.0	35.8	0.8	0.0	32.1	4.0	0.0	47.2	30.5	14.2	664.0	627.0
2004	0.0	34.2	0.3	0.0	31.0	0.0	0.0	17.6	9.7	0.0	33.0	11.8	0.0	45.3	24.6	9.0	498.1	501.5
2005	34.4	49.3	5.4	33.3	41.0	1.7	0.0	32.7	6.3	0.0	37.4	8.5	88.7	104.9	128.5	436.1	1,097.8	1,100.8
2006	26.9	53.4	7.1	26.0	31.9	4.6	0.0	34.4	6.3	1.2	37.1	14.4	2.0	45.7	20.1	715.7	1,399.2	1,315.6
2007	0.0	31.2	1.4	0.0	29.9	2.6	0.0	21.2	0.6	0.0	32.8	3.0	0.0	25.3	6.9	0.0	380.7	379.6
2008	0.0	28.8	2.6	0.0	20.7	3.2	0.0	31.0	0.2	0.0	32.3	13.6	0.0	28.8	7.7	0.0	377.9	410.6
2009	0.0	34.9	3.3	0.0	25.5	1.6	0.0	26.7	4.0	0.0	28.4	3.0	0.0	34.5	10.8	0.0	637.5	623.2
2010	22.7	28.7	2.2	22.0	20.9	1.4	0.0	42.2	31.8	23.6	40.2	25.2	72.9	120.0	123.4	208.7	779.9	840.7

* Unallocated water is simulated below Camanche and regulated and unimpaired flow is simulated at Mokelumne Hill.

Flow duration curves for each location under 2010 and 2040 baseline diversion assumptions are presented in Figure E-1, Figure E-2, Figure E-3, and Figure E-4. Note that the unallocated flow curve is presented for below Camanche and total flow curves are presented for the remaining three nodes. Flow duration curves indicate the percentage of time over the period of record that flow in the river is expected to be equal to or exceed a certain amount of water, based on historical hydrologic conditions and projected diversion levels.

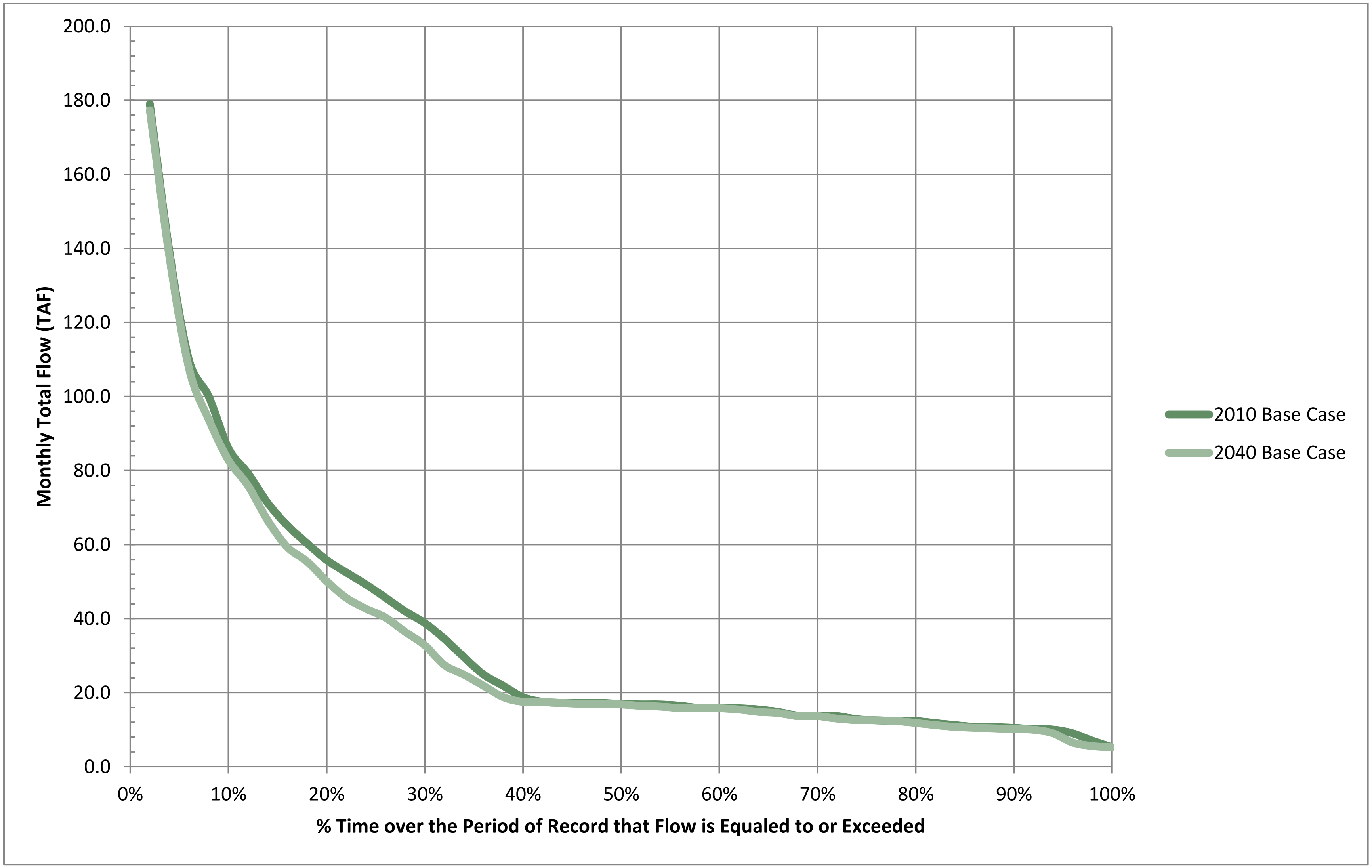
Appendix J includes a monthly breakdown over the period of record of the amount of unallocated water in the Mokelumne River below Camanche Reservoir for both the 2010 and the 2040 base cases.

Figure E-1: Flow Duration Curve for Monthly Unallocated Flow below Camanche Reservoir*



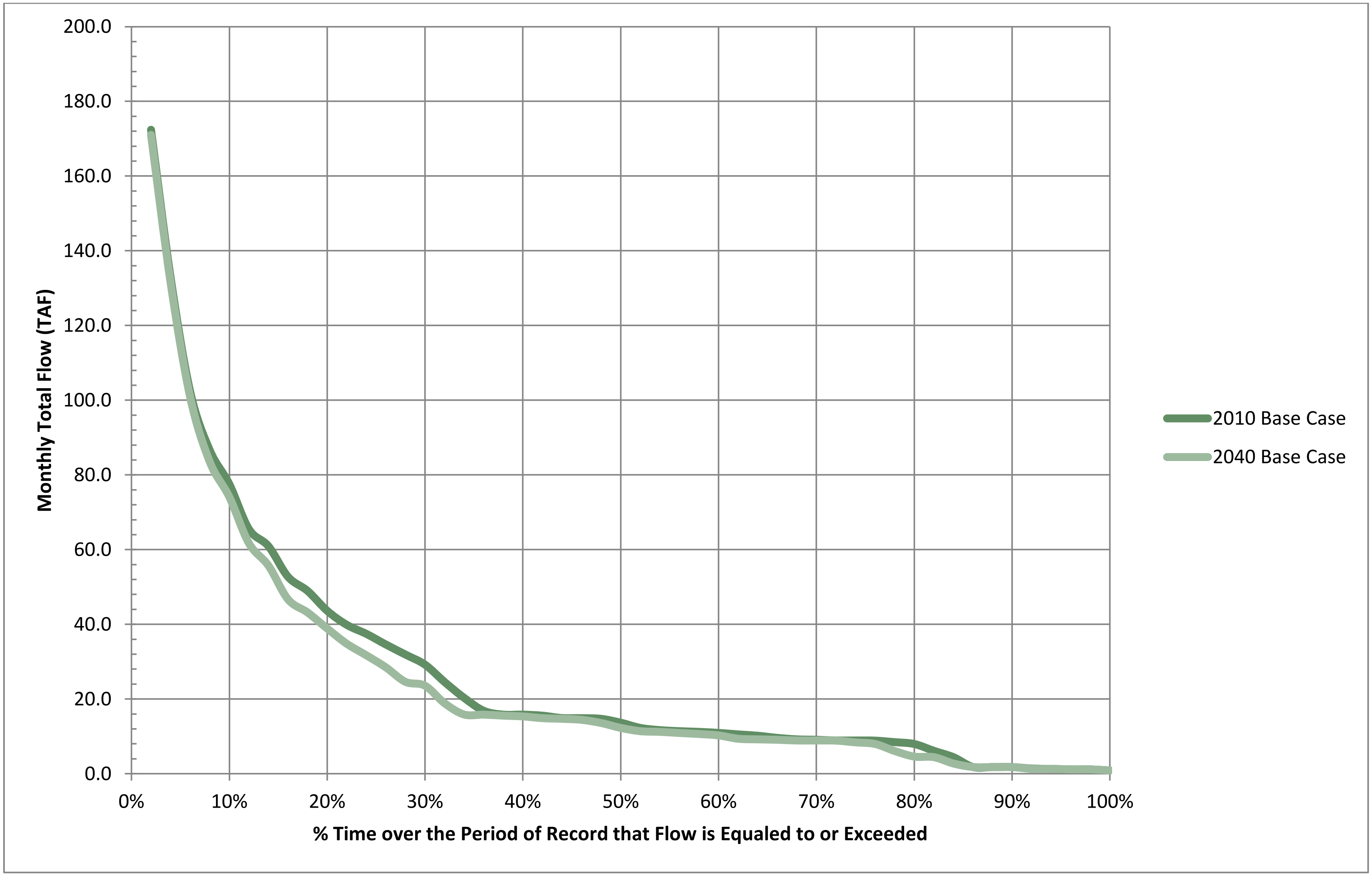
* Flow duration curves indicate the percentage of time that flow in the River is expected to be equal to or exceed a certain amount of water.

Figure E-2: Flow Duration Curve for Monthly Total Flow below Highway 99*



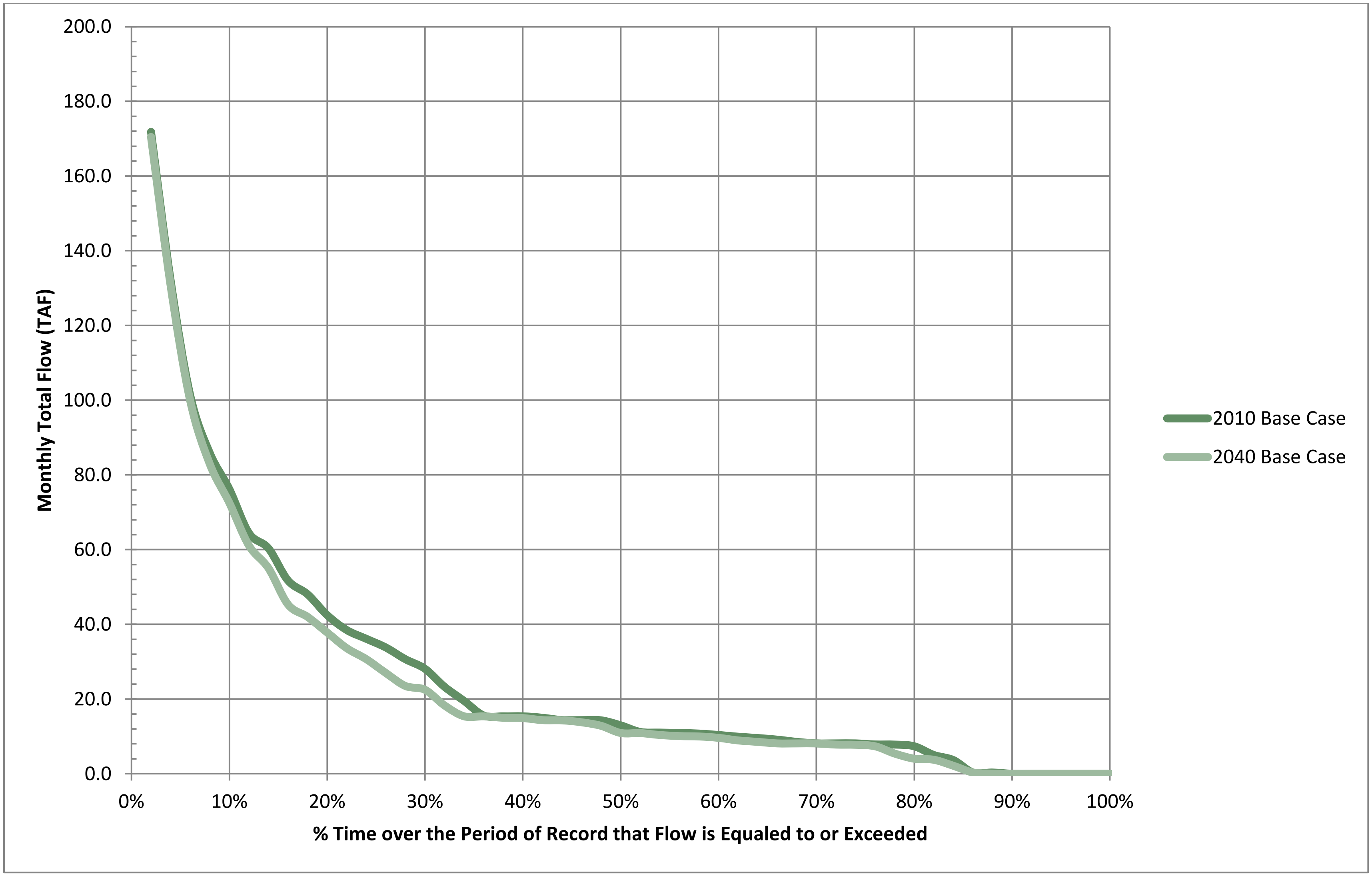
* Flow duration curves indicate the percentage of time that flow in the River is expected to be equal to or exceed a certain amount of water.

Figure E-3: Flow Duration Curve for Monthly Total Flow below Woodbridge Diversion Dam*



* Flow duration curves indicate the percentage of time that flow in the River is expected to be equal to or exceed a certain amount of water.

Figure E-4: Flow Duration Curve for Monthly Total Flow below Interstate 5*



* Flow duration curves indicate the percentage of time that flow in the River is expected to be equal to or exceed a certain amount of water.

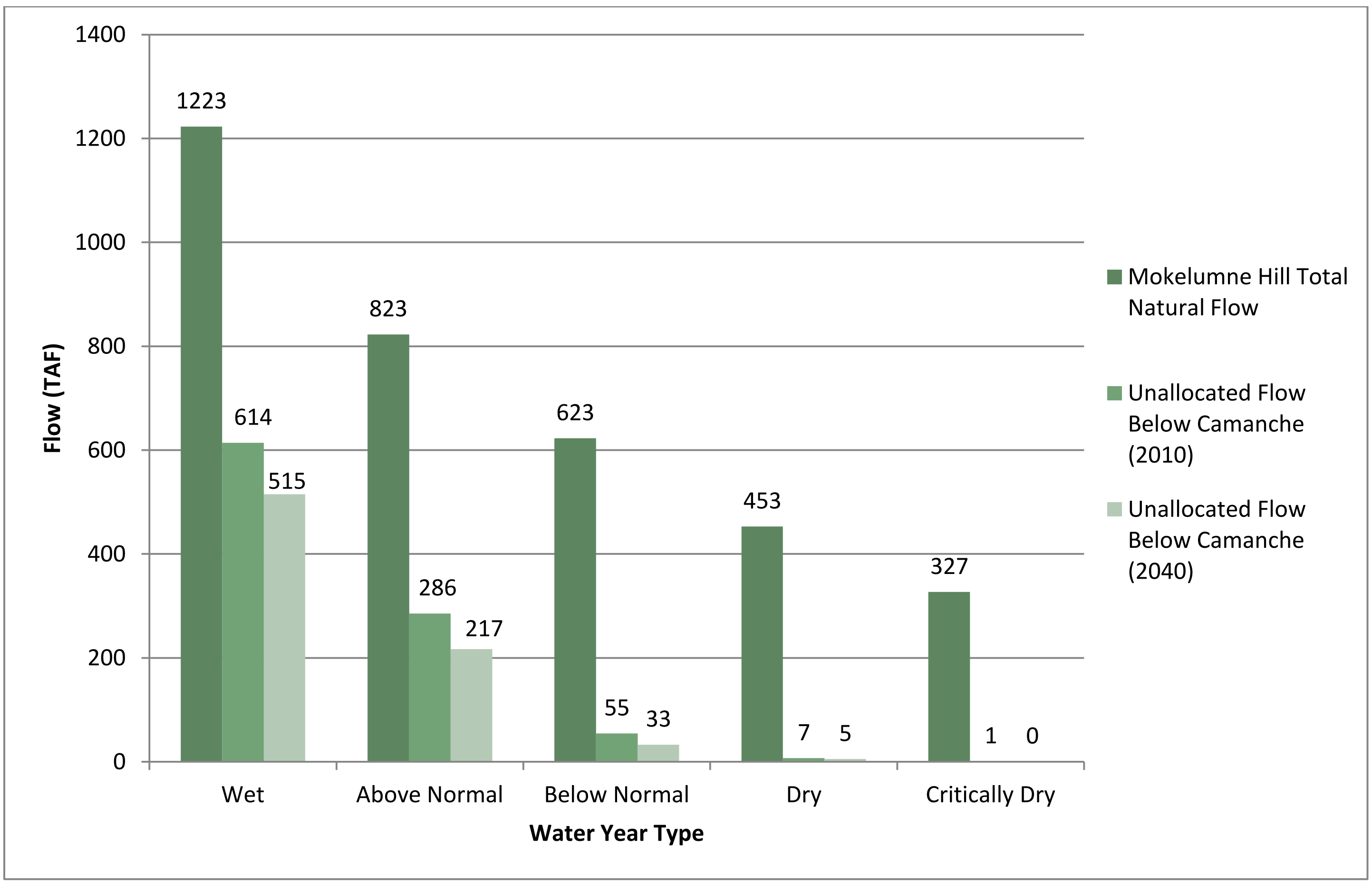
Appendix F: Hydrologic Year Type Average Unallocated Flow

Appendix F compares water year type and the averages for total natural flow at Mokelumne Hill and unallocated flow below Camanche in 2010 and 2040 by water year type. Results indicate that total natural flow is greater than unallocated flow at Mokelumne Hill and that unallocated flow in 2010 is greater than unallocated flow in 2040 due to increased diversions in 2040. This pattern holds for each of the five hydrologic year types.

Hydrologic Year Type Average Unallocated Flow

Water year types from the San Joaquin Valley Index were used to determine average unallocated water and average total natural flow in a given year type. As described previously, the Index is based on measured unimpaired runoff and includes five water year types, including wet, above normal, below normal, dry, and critically dry (DWR 2013). For each of these water year types, the averages for total natural flow at Mokelumne Hill and unallocated flow below Camanche in 2010 and 2040 were calculated. Results are shown in Figure F-1 and indicate that total natural flow is greater than unallocated flow at Mokelumne Hill and that unallocated flow in 2010 is greater than unallocated flow in 2040. This pattern holds for each of the five hydrologic year types.

Figure F-1: Average Total Natural Flow at Mokelumne Hill Compared to Unallocated Flow below Camanche in 2010 and 2040 Baseline Conditions by Water Year Type (in TAF)



Appendix G: MOCASIM Modeled Releases and Joint Settlement Agreements Flows

Appendix G compares annual JSA required flows and annual modeled flows. Results indicate that the amount of water being released decreases from 2010 to 2040, but that in each case, more water is being released than is required by the JSA.

Modeled Releases and Joint Settlement Agreement Flows

The JSA specifies in-river flows that help maintain fishery, wildlife, and habitat resources along the Mokelumne River. These flows are specified below Camanche Dam and below Woodbridge Diversion Dam and are based on time of year and hydrologic year type. As noted in the 2008 Lower Mokelumne River Project Joint Settlement Agreement Ten-Year Review Report, actual flows at these two points have always exceeded the required JSA flows (EBMUD 2008).

Figures G-1 through G-4 show the annual JSA required flows and the annual modeled flows. The bars indicate the modeled flows and the line indicates the JSA required flows. Figure G-1 and Figure G-2 are for the compliance point below Camanche Dam for 2010 and 2040, respectively. Figure G-3 and Figure G-4 are for the compliance point below Woodbridge Diversion Dam for 2010 and 2040, respectively. Results indicate that the amount of water being released decreases from 2010 to 2040, but that in each case, more water is being released than is required by the JSA.[1]

[1] The Joint Settlement Agreement is not static and is subject to change. Any increase in required flows would likely decrease the amount of unallocated water.

Figure G-1: Required and Modeled Annual Flows for the 2010 Base Case from Camanche Reservoir

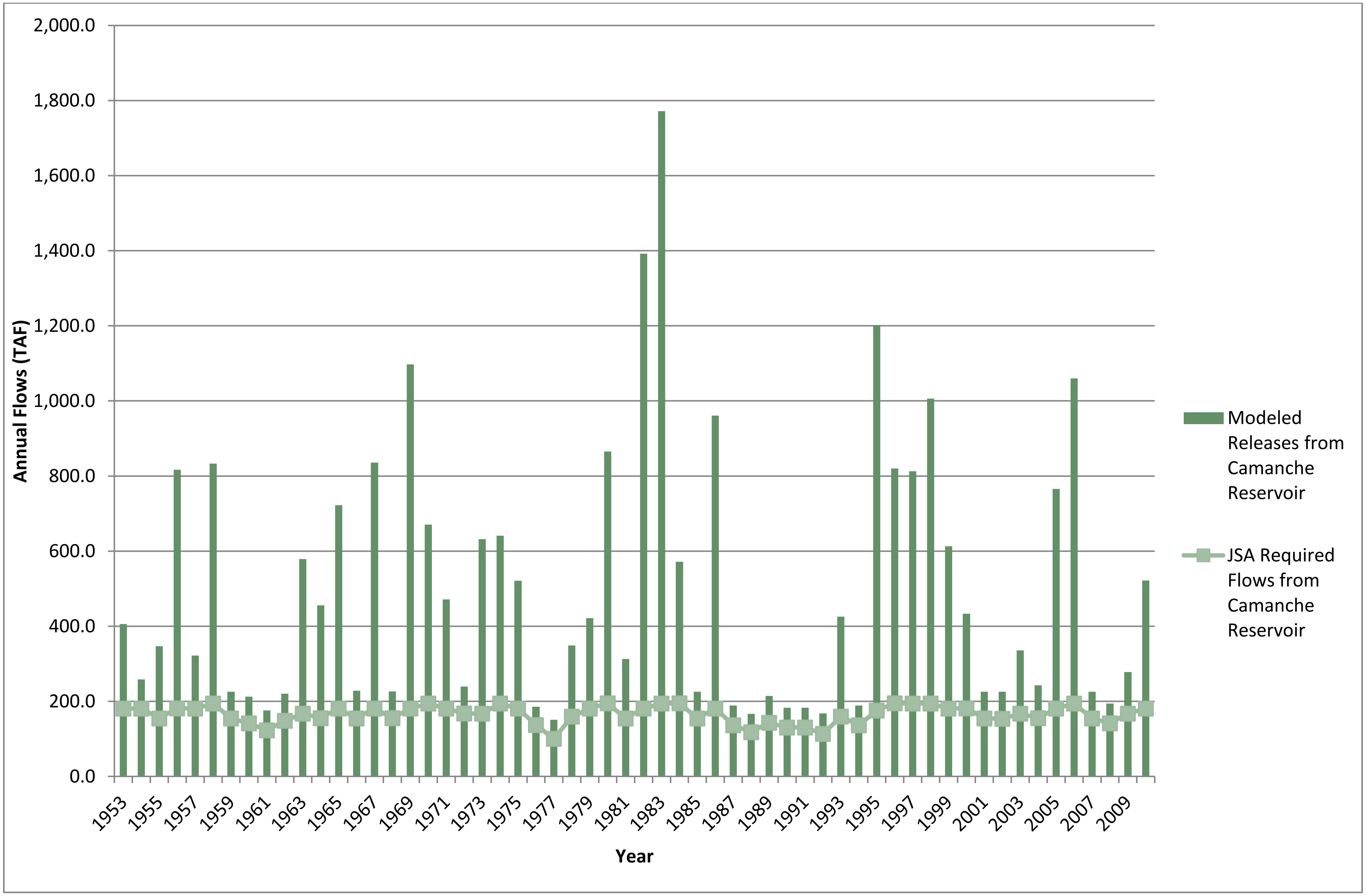


Figure G-2: Required and Modeled Annual Flows for the 2040 Base Case from Camanche Reservoir

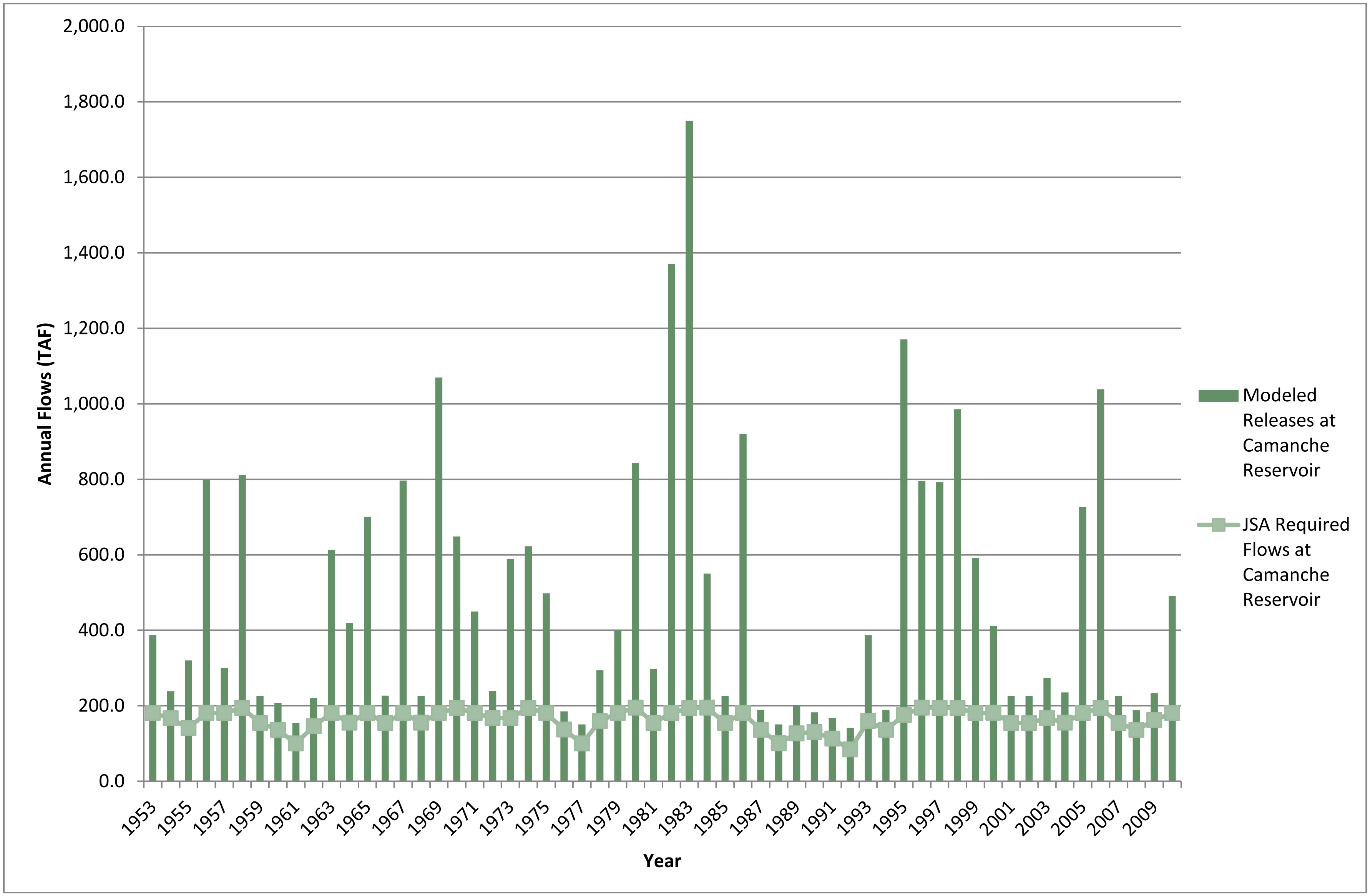


Figure G-3: Required and Modeled Annual Flows for the 2010 Base Case from Woodbridge Diversion Dam

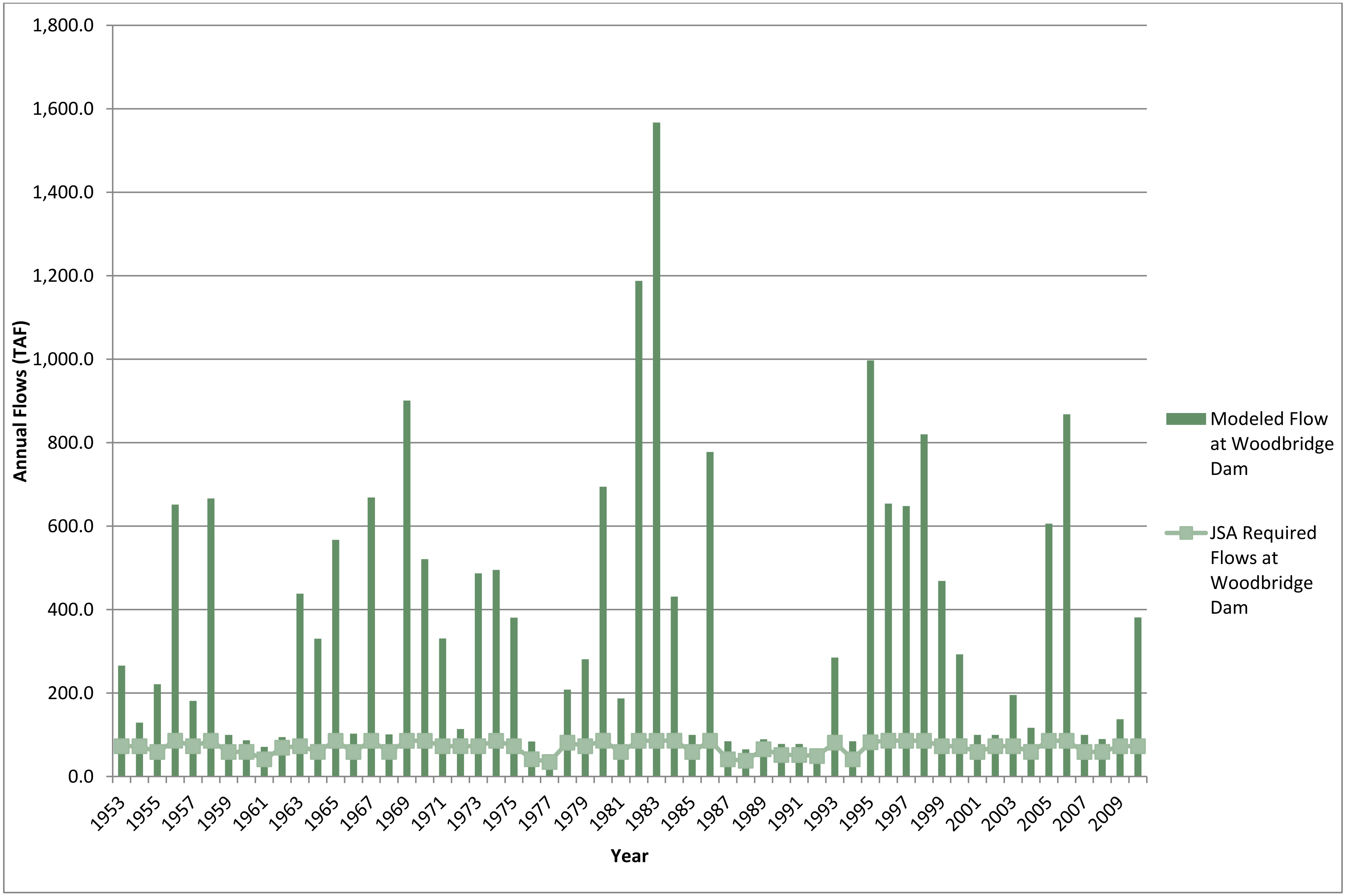
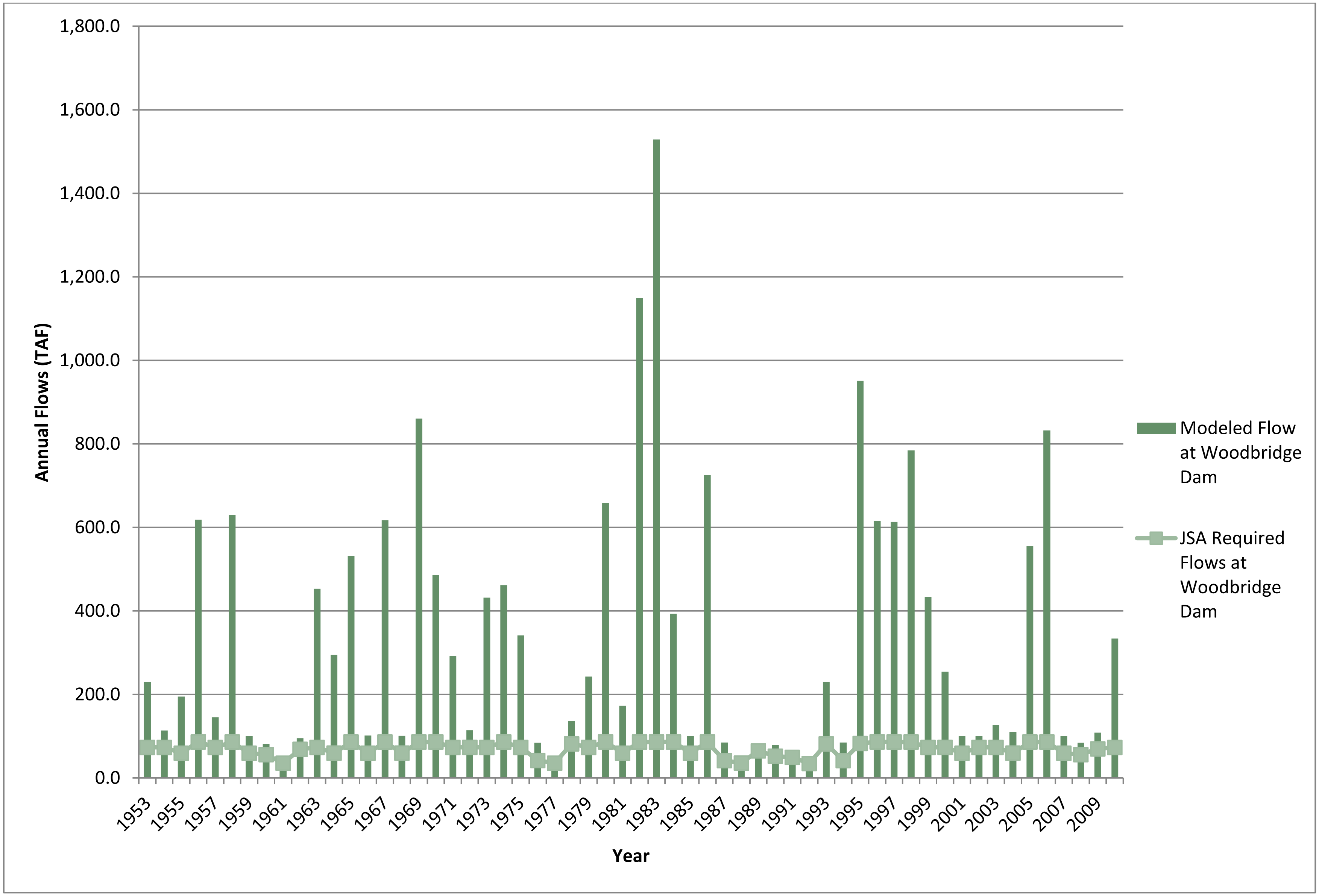


Figure G-4: Required and Modeled Annual Flows for the 2040 Base Case from Woodbridge Diversion Dam



Appendix H: Calculated Daily Unallocated Flows

Appendix H presents a constructed daily flow regime downstream of Camanche Dam by year for all years between 1998 and 2010. For the three wet years during that period (1998, 2005, and 2006), daily allocated and unallocated flows are presented on a monthly basis. This information is shown to provide information regarding historical daily flow variability. It is not intended to establish estimated pulse flows or geomorphic and/or fishery impacts.

Calculated Daily Unallocated Flows

A daily flow regime was constructed to provide indication of the historical daily variability of flows downstream of Camanche Dam. Historical daily flow data for Camanche Reservoir was downloaded (from USGS gage 11323500 for the years 1988 through 2010). This data was used to define the historical daily flow distribution downstream of Camanche Dam for the simulated period of record. This daily distribution was applied to the modeled monthly flows at the below Camanche node to construct a simulated daily flow pattern below Camanche reflecting historical Camanche Reservoir operating conditions. Daily flows were only calculated from 1998 to 2010 because historical flow patterns prior to 1998 are not reflective of current river conditions.

It was assumed that the difference between simulated total monthly flows and simulated monthly unallocated flows reflected simulated monthly "allocated flows." Daily allocated flows were calculated assuming that daily allocations or withdrawals would remain relatively constant throughout the month when sufficient flow was available to meet the average requirement. Because sufficient flow was not available in all days to meet an "average" daily allocated flow, the allocated flow in days with sufficient flow available was slightly increased to reflect the reductions required during lower flow days. Daily unallocated flow was calculated as the difference between daily total flow and daily allocated flow.

Estimated daily flows are presented by year for all years between 1998 and 2010. For the three wet years during that period (1998, 2005, and 2006), daily allocated and unallocated flows are presented on a monthly basis. These figures are provided for both the 2010 and 2040 baseline cases. This information is shown to provide information regarding historical daily flow variability. It is not intended to establish estimated pulse flows or geomorphic and/or fishery impacts.

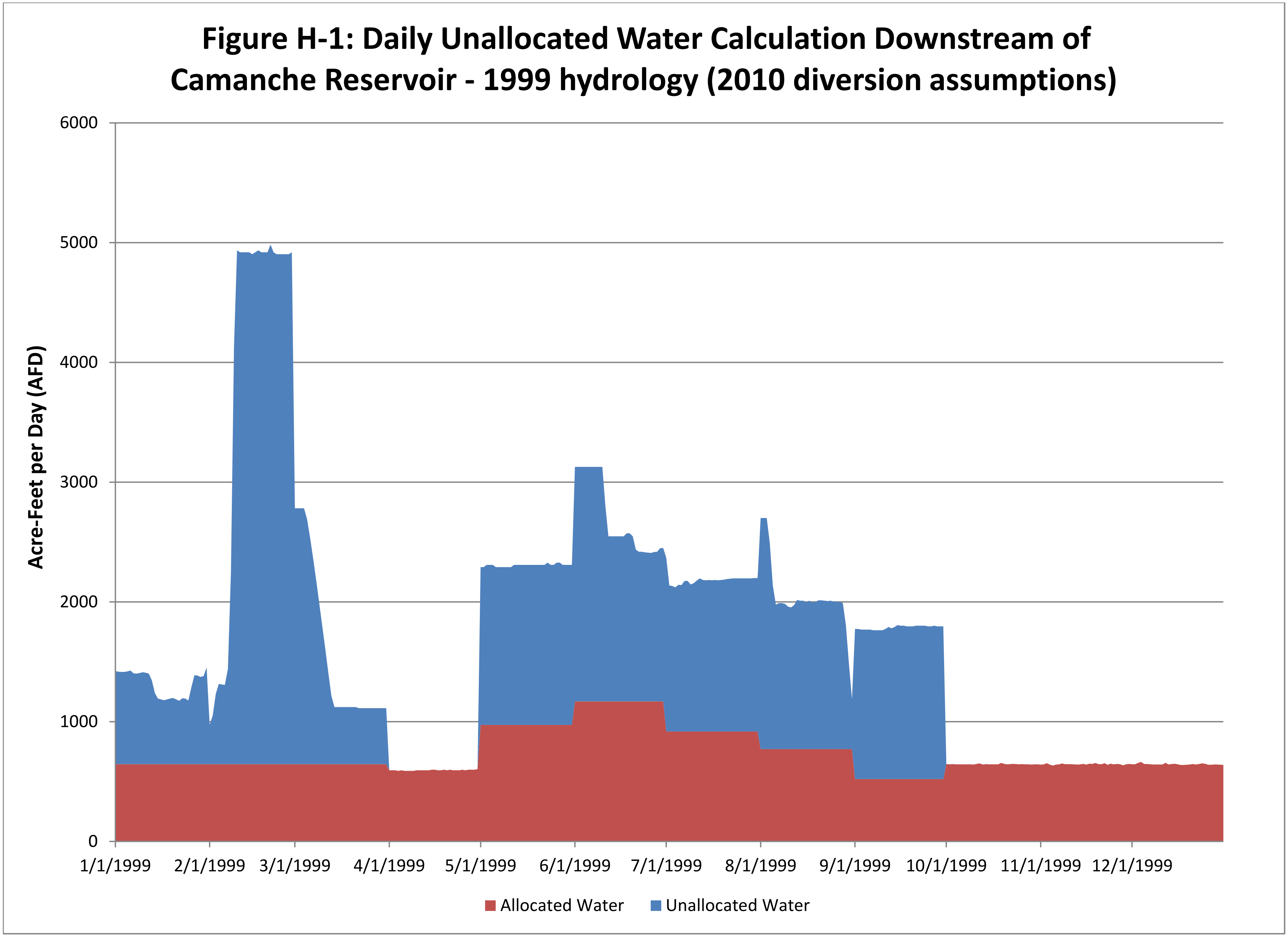


Figure H-1: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 1999 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
6000
5000
4000
3000
2000
1000
0
1/1/1999
2/1/1999
3/1/1999
4/1/1999
5/1/1999
6/1/1999
7/1/1999
8/1/1999
9/1/1999
10/1/1999
11/1/1999
12/1/1999
Allocated Water
Unallocated Water

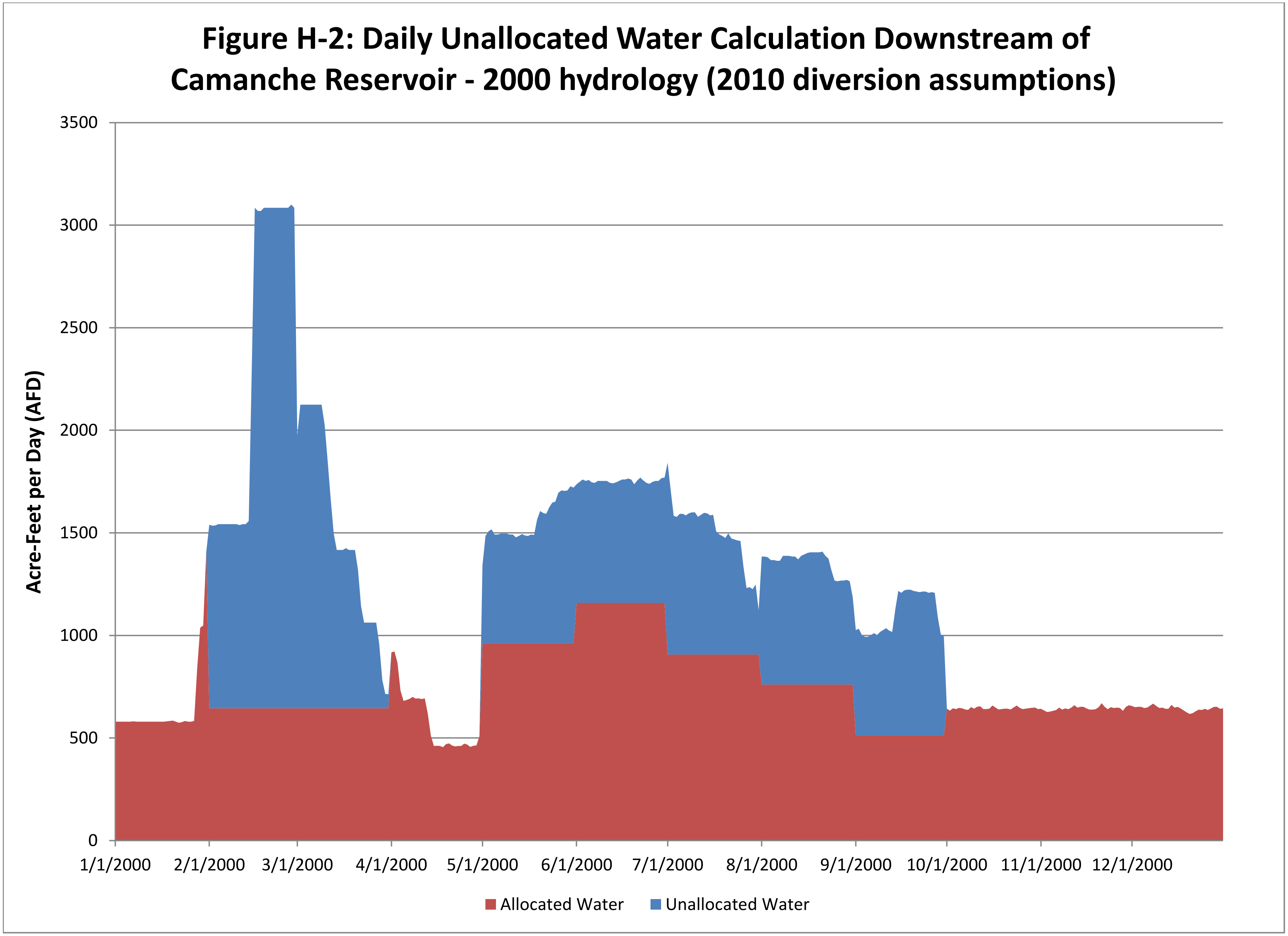


Figure H-2: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2000 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
3500
3000
2500
2000
1500
1000
500
0
1/1/2000
2/1/2000
3/1/2000
4/1/2000
5/1/2000
6/1/2000
7/1/2000
8/1/2000
9/1/2000
10/1/2000
11/1/2000
12/1/2000
Allocated Water
Unallocated Water

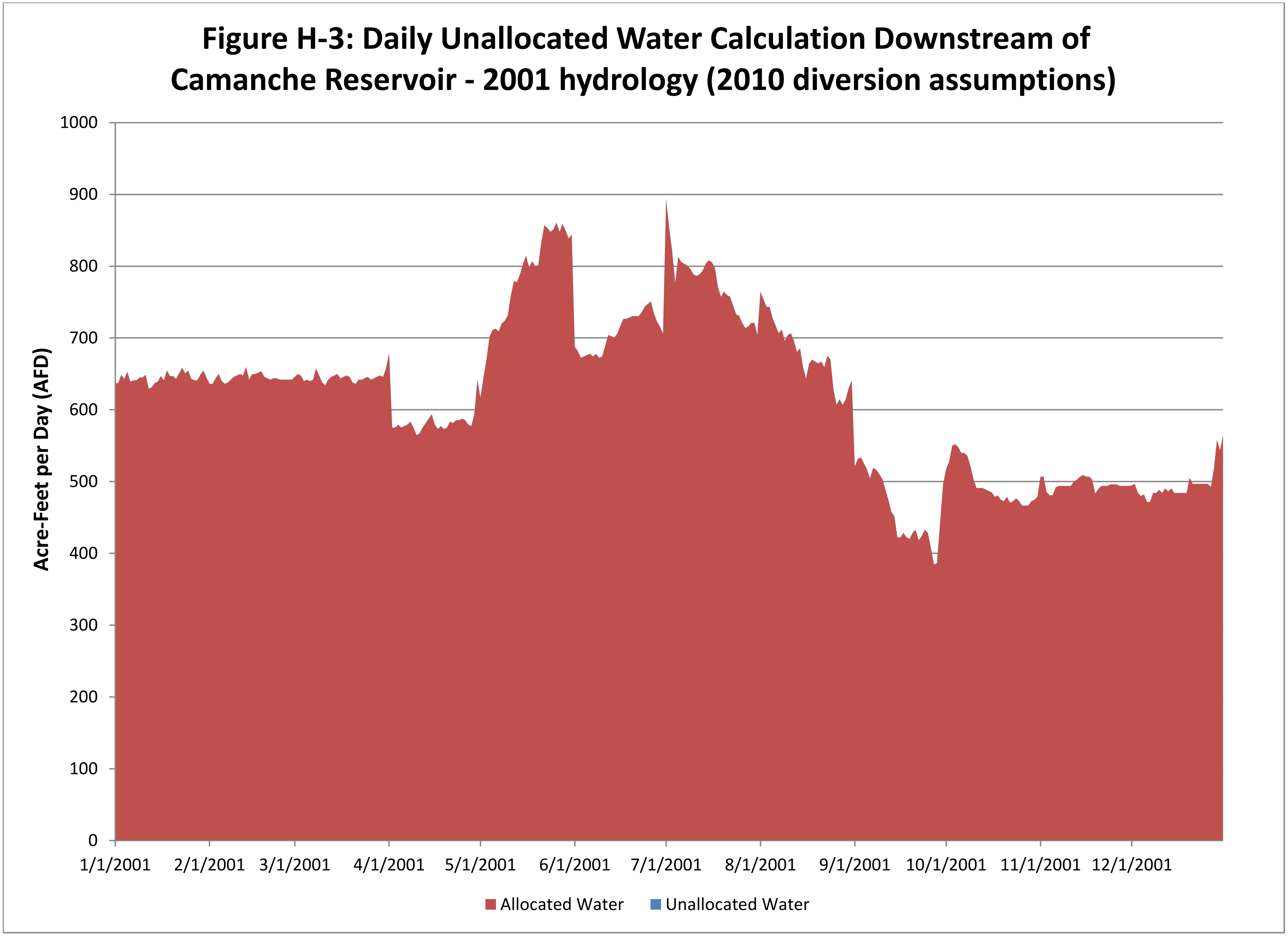


Figure H-3: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2001 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
1000
900
800
700
600
500
400
300
200
100
0
1/1/2001
2/1/2001
3/1/2001
4/1/2001
5/1/2001
6/1/2001
7/1/2001
8/1/2001
9/1/2001
10/1/2001
11/1/2001
12/1/2001
Allocated Water
Unallocated Water

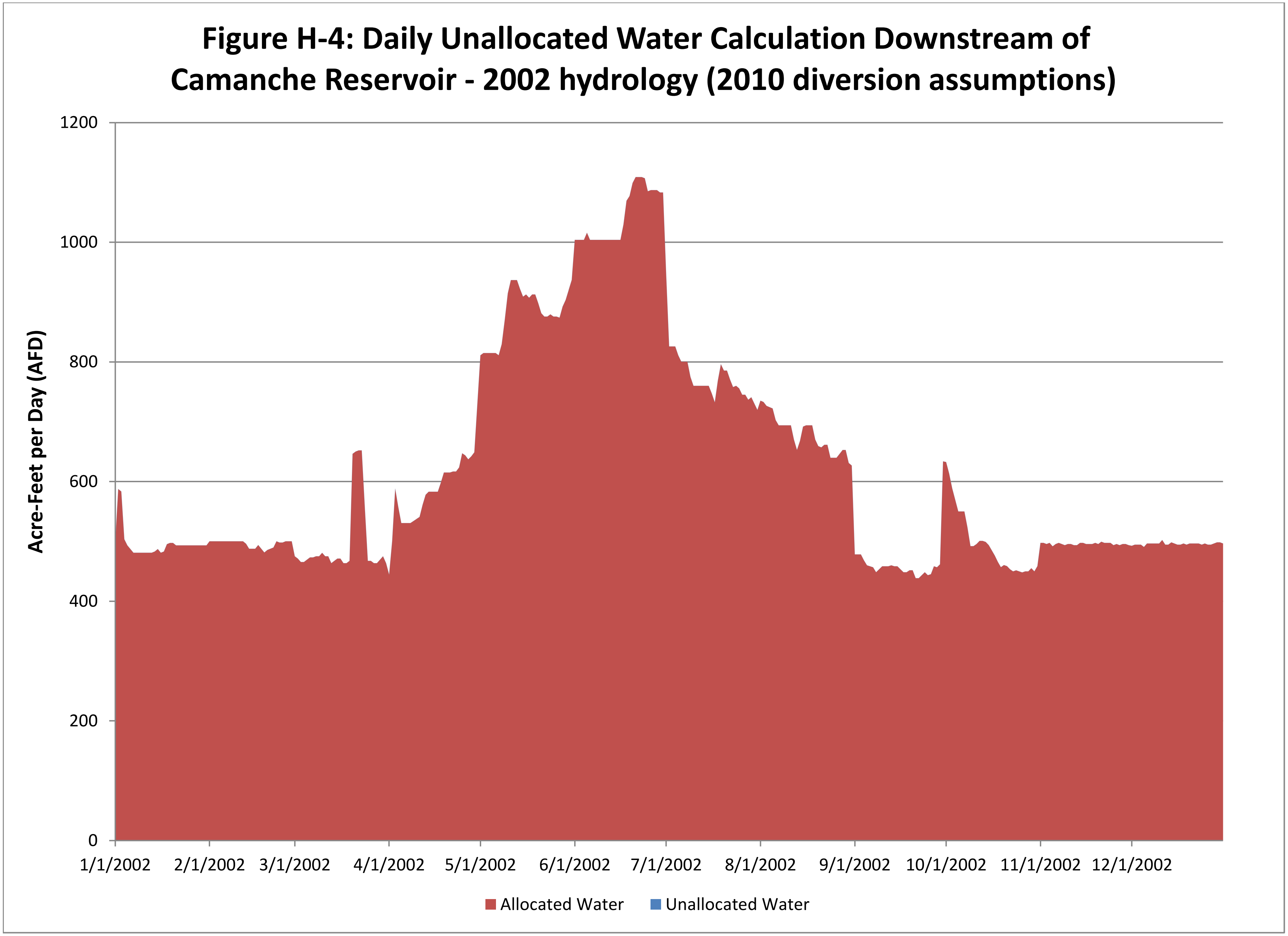


Figure H-4: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2002 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
1200
1000
800
600
400
200
0
1/1/2002
2/1/2002
3/1/2002
4/1/2002
5/1/2002
6/1/2002
7/1/2002
8/1/2002
9/1/2002
10/1/2002
11/1/2002
12/1/2002
Allocated Water
Unallocated Water

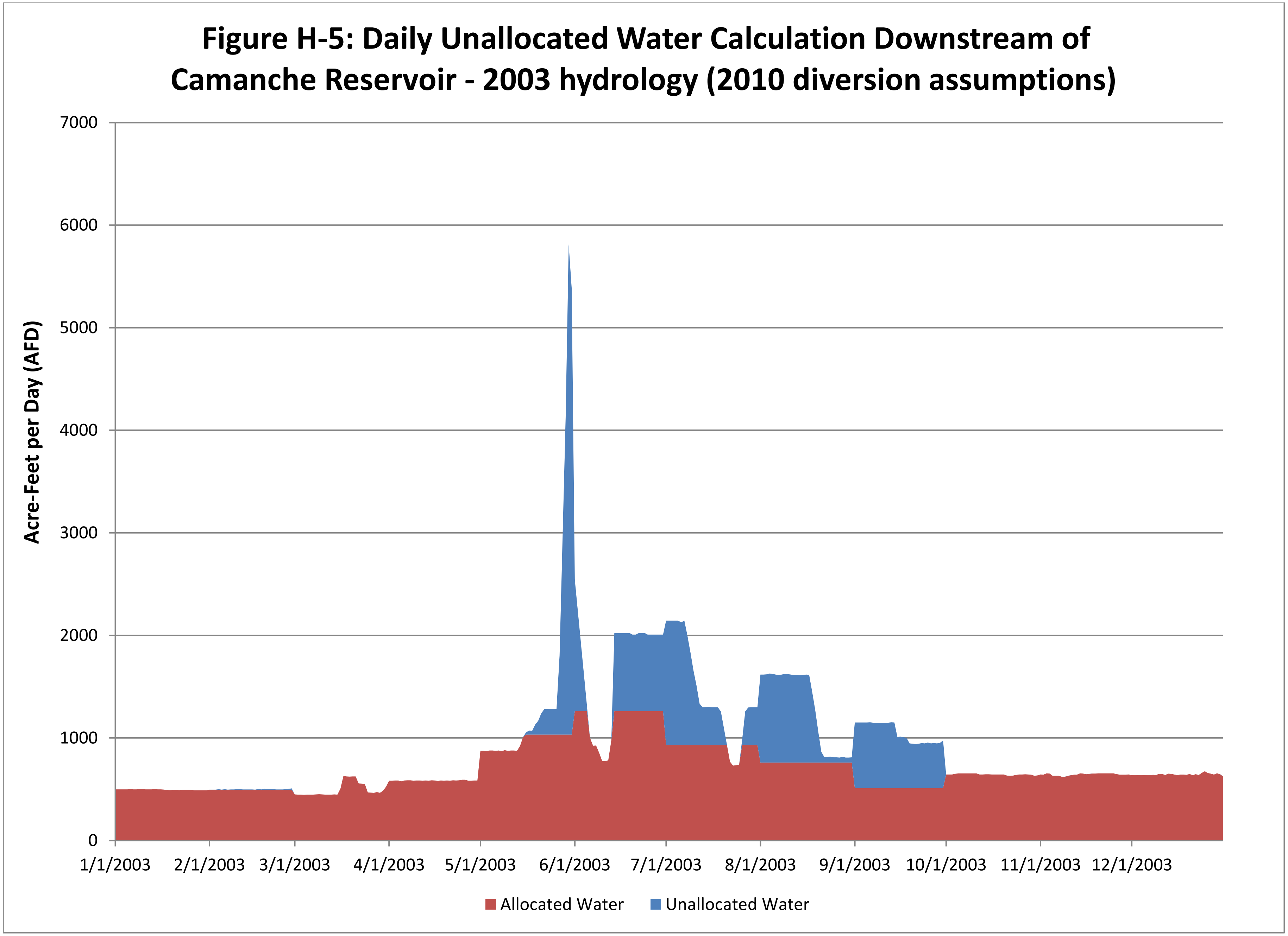


Figure H-5: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2003 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
7000
6000
5000
4000
3000
2000
1000
0
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/2003
12/1/2003
Allocated Water
Unallocated Water

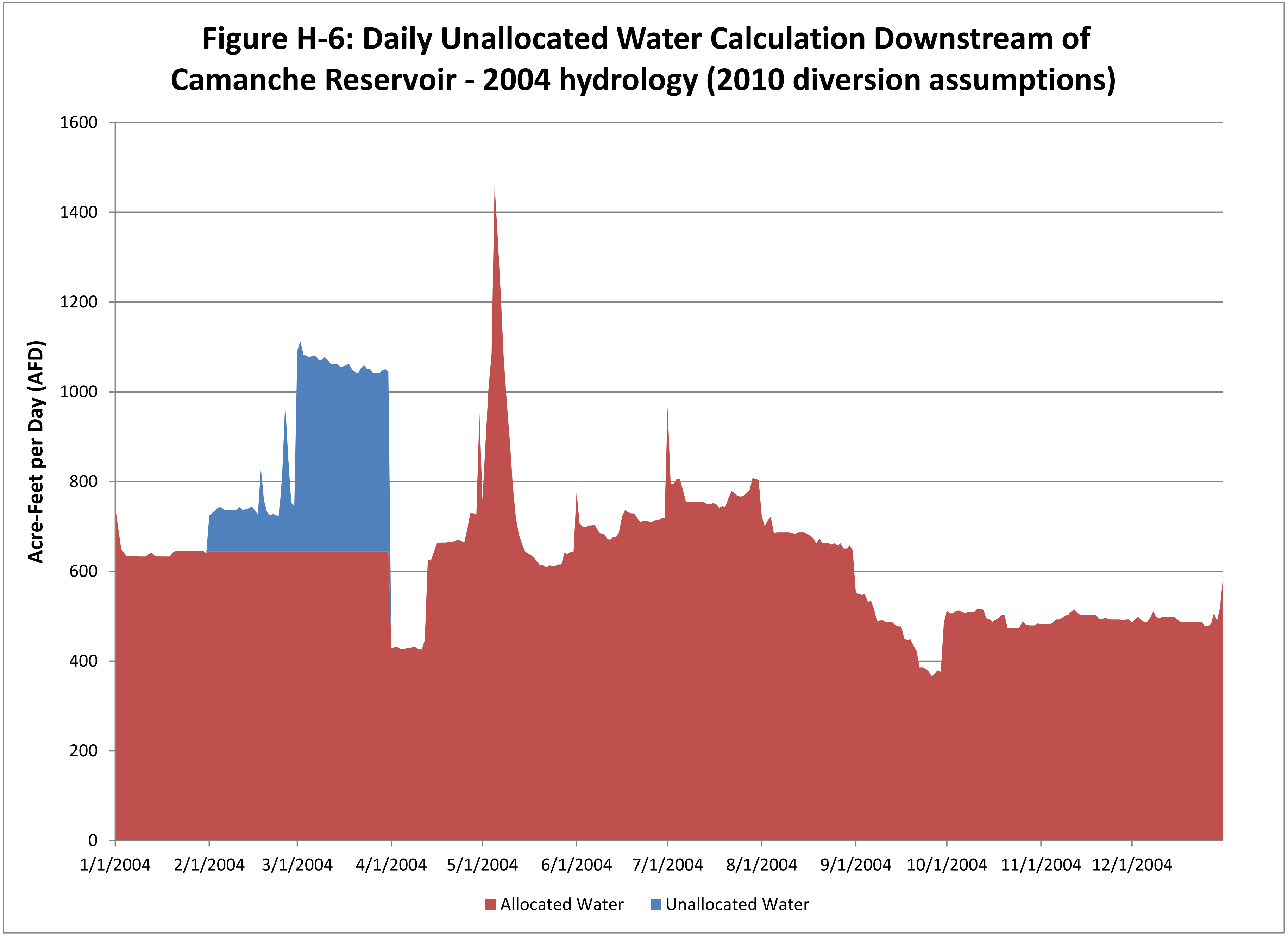


Figure H-6: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2004 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
1600
1400
1200
1000
800
600
400
200
0
1/1/2004
2/1/2004
3/1/2004
4/1/2004
5/1/2004
6/1/2004
7/1/2004
8/1/2004
9/1/2004
10/1/2004
11/1/2004
12/1/2004
Allocated Water
Unallocated Water

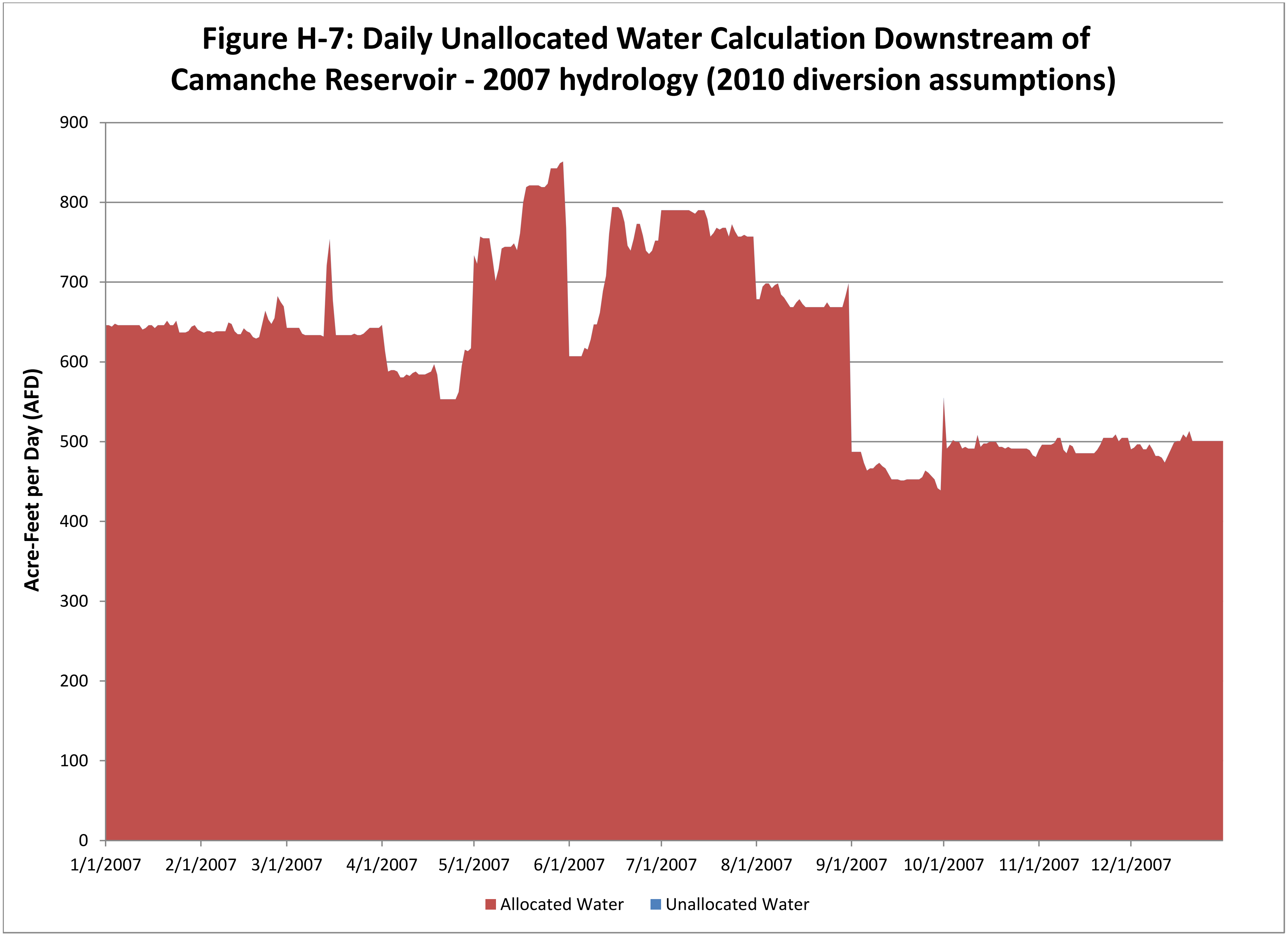
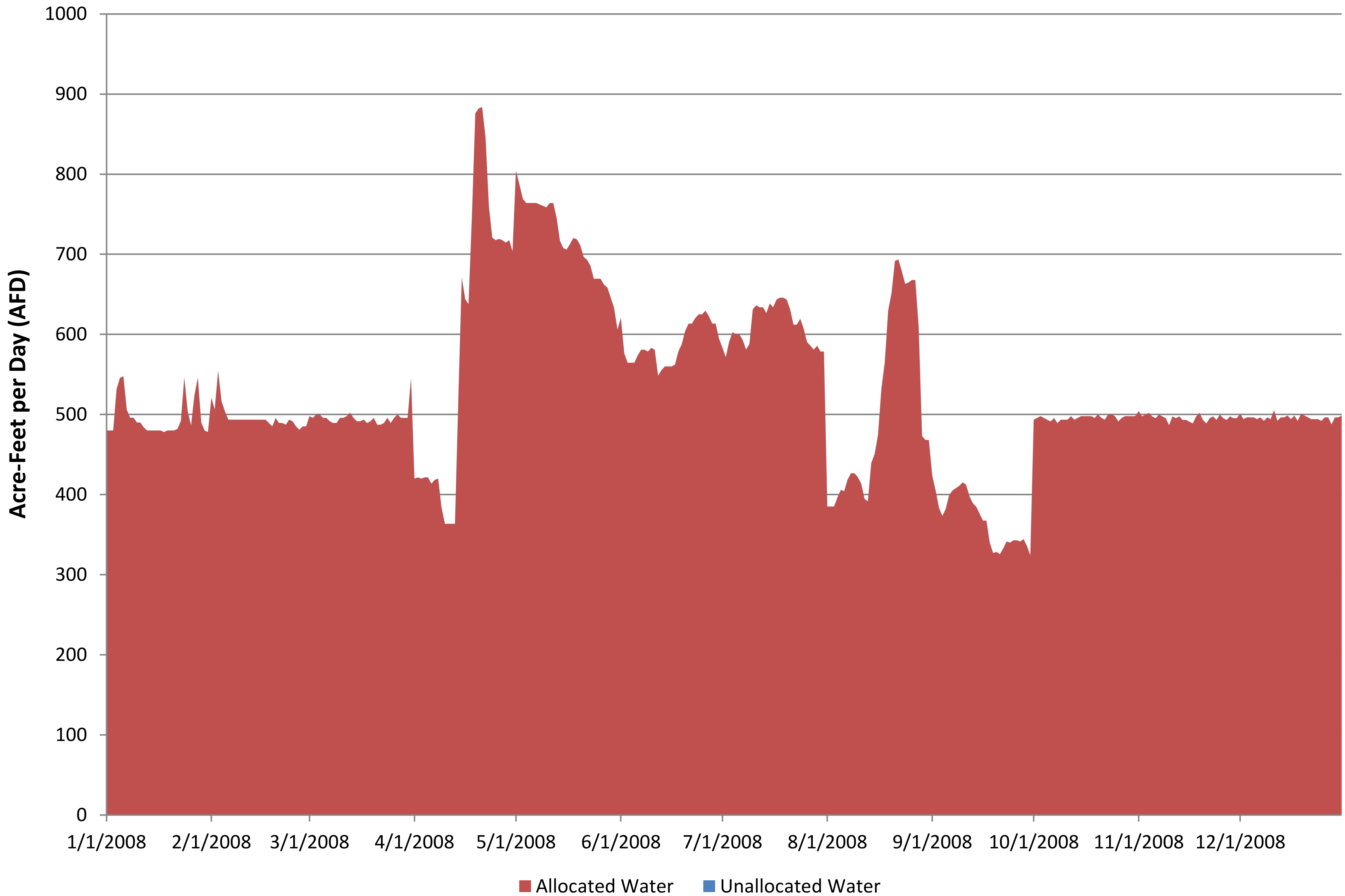


Figure H-7: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2007 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
900
800
700
600
500
400
300
200
100
0
1/1/2007
2/1/2007
3/1/2007
4/1/2007
5/1/2007
6/1/2007
7/1/2007
8/1/2007
9/1/2007
10/1/2007
11/1/2007
12/1/2007
Allocated Water
Unallocated Water

Figure H-8: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2008 hydrology (2010 diversion assumptions)



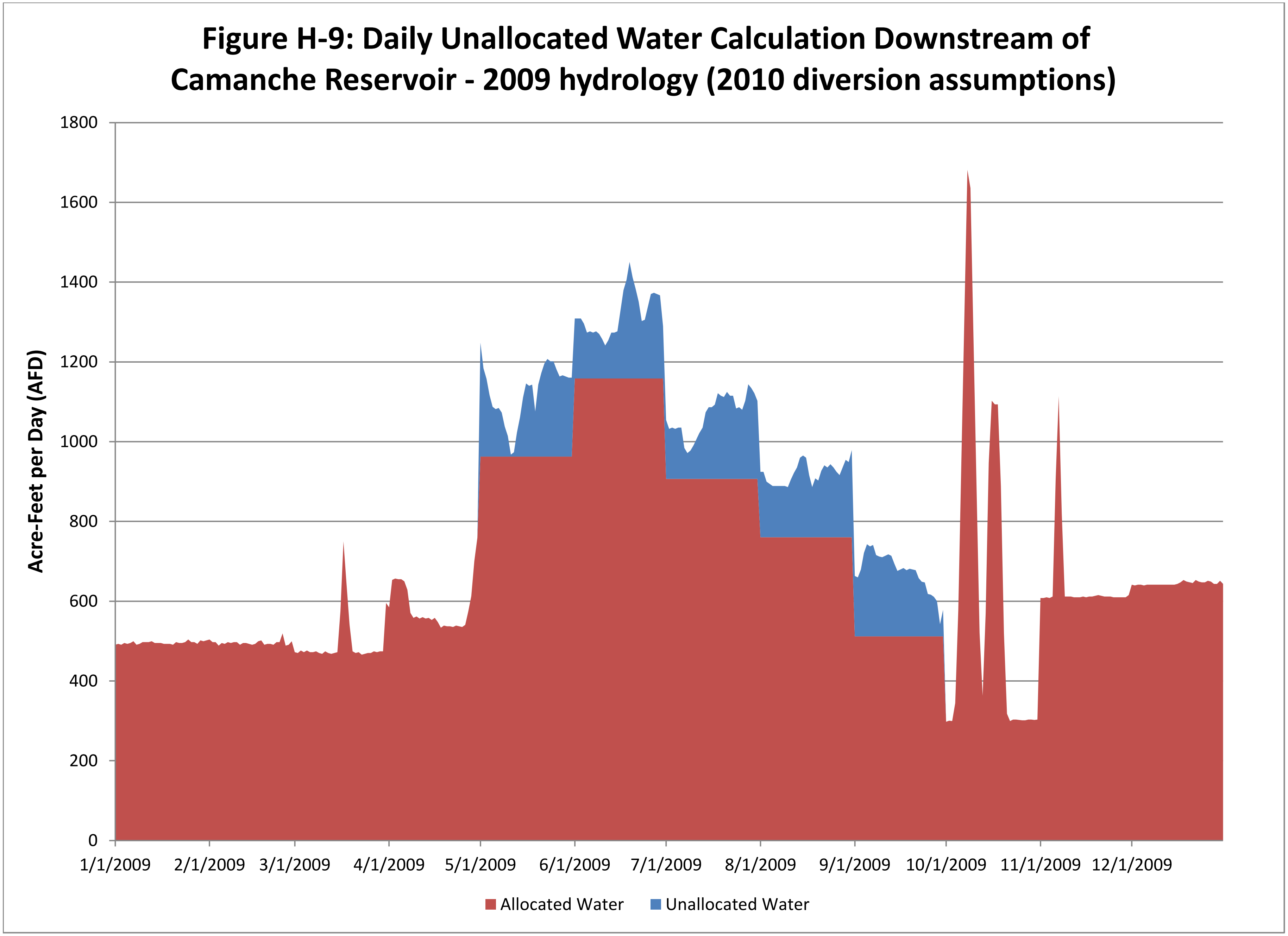


Figure H-9: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2009 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
1800
1600
1400
1200
1000
800
600
400
200
0
1/1/2009
2/1/2009
3/1/2009
4/1/2009
5/1/2009
6/1/2009
7/1/2009
8/1/2009
9/1/2009
10/1/2009
11/1/2009
12/1/2009
Allocated Water
Unallocated Water

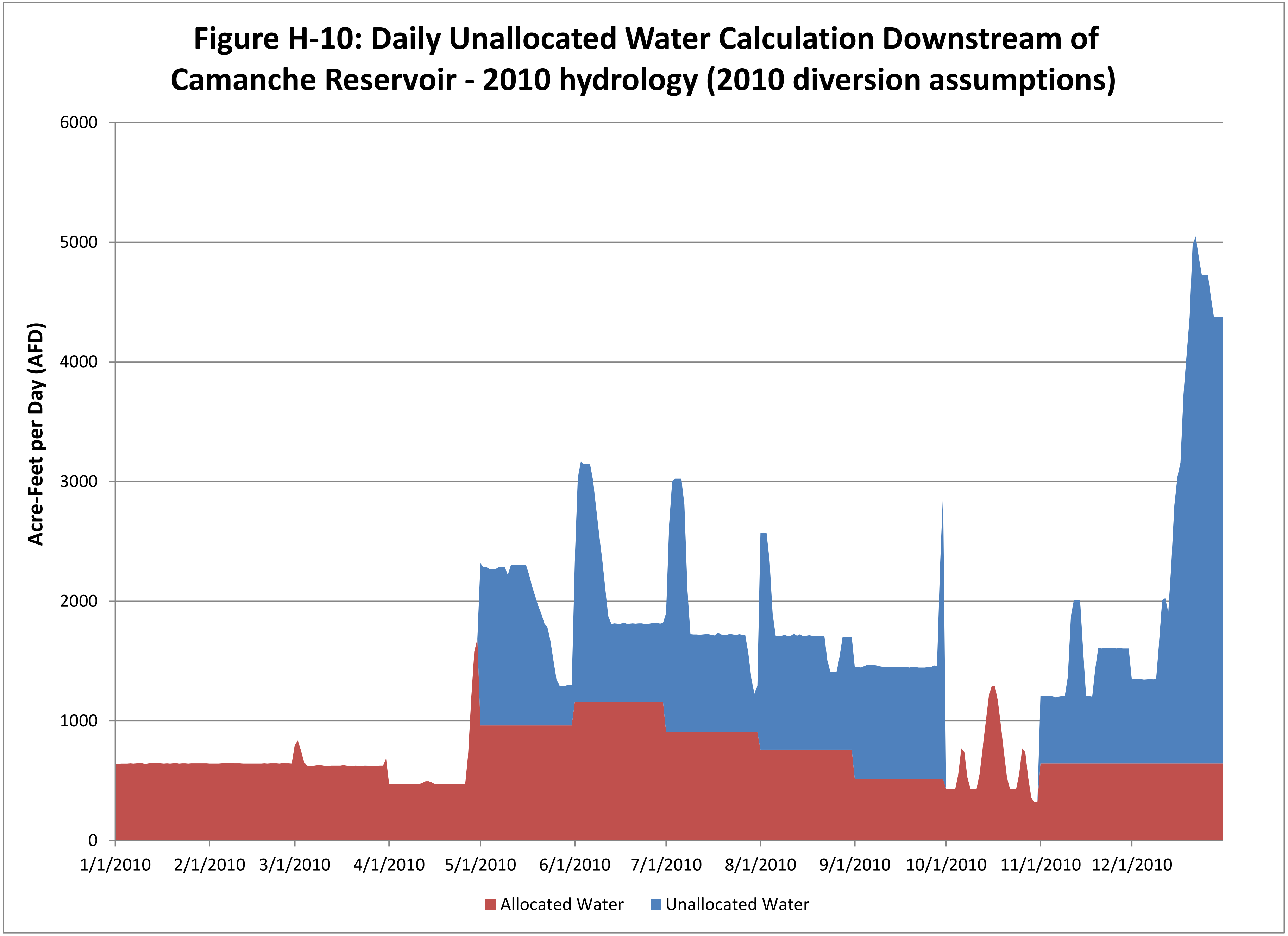


Figure H-10: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2010 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
6000
5000
4000
3000
2000
1000
0
1/1/2010
2/1/2010
3/1/2010
4/1/2010
5/1/2010
6/1/2010
7/1/2010
8/1/2010
9/1/2010
10/1/2010
11/1/2010
12/1/2010
Allocated Water
Unallocated Water

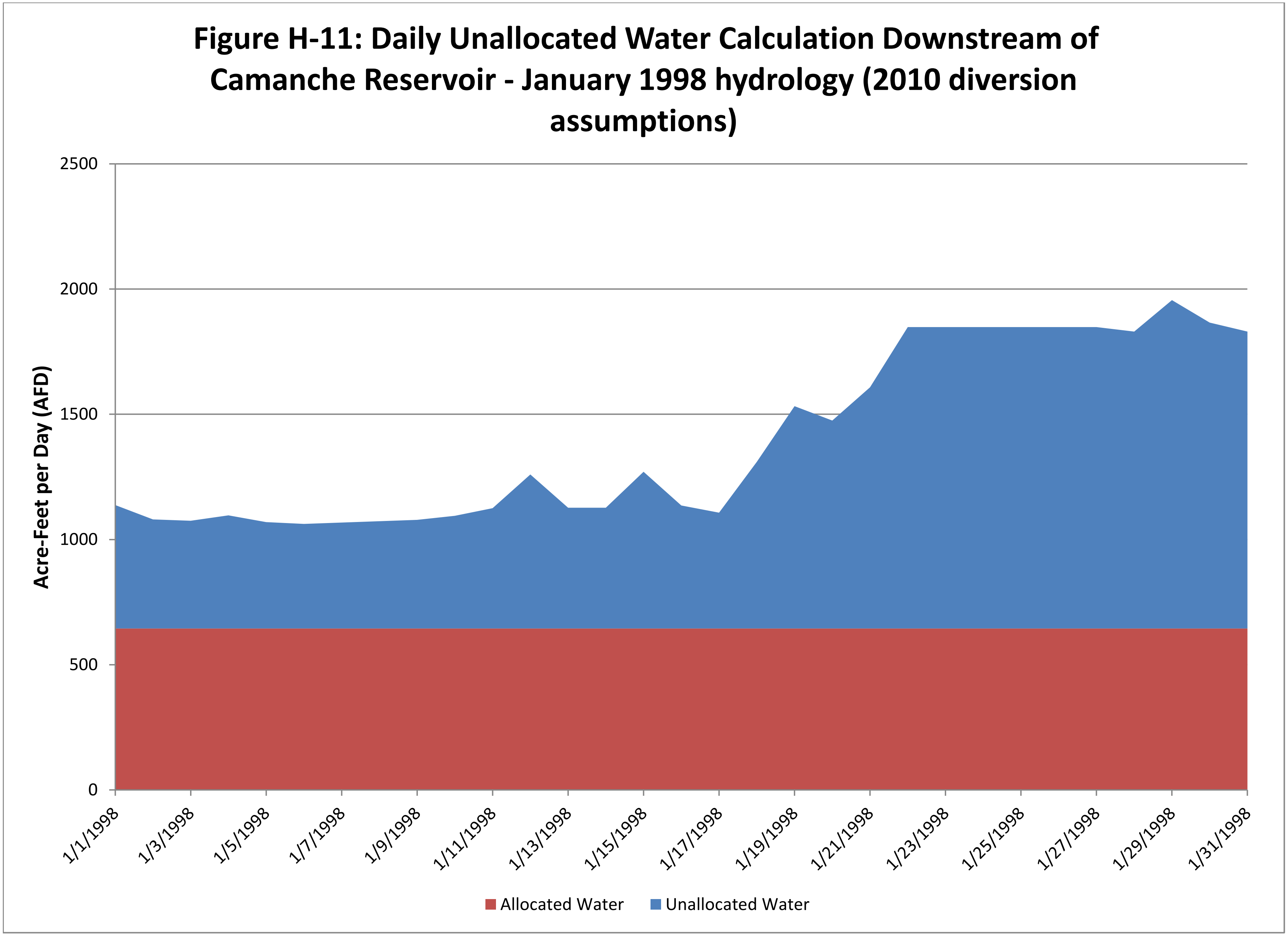


Figure H-11: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - January 1998 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
2500
2000
1500
1000
500
0
1/1/1998
1/3/1998
1/5/1998
1/7/1998
1/9/1998
1/11/1998
1/13/1998
1/15/1998
1/17/1998
1/19/1998
1/21/1998
1/23/1998
1/25/1998
1/27/1998
1/29/1998
1/31/1998
Allocated Water
Unallocated Water

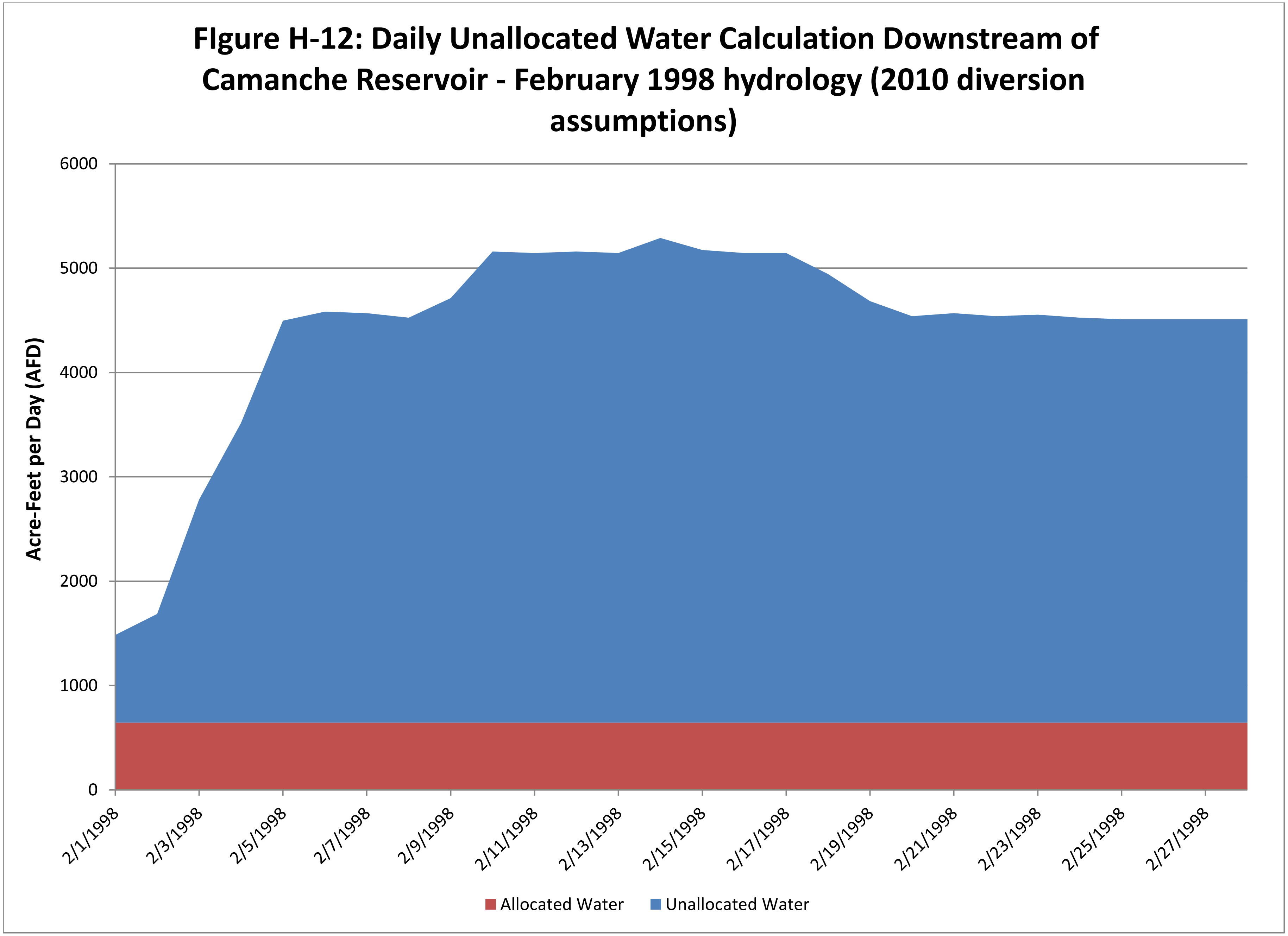


FIgure H-12: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - February 1998 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
6000
5000
4000
3000
2000
1000
0
2/1/1998
2/3/1998
2/5/1998
2/7/1998
2/9/1998
2/11/1998
2/13/1998
2/15/1998
2/17/1998
2/19/1998
2/21/1998
2/23/1998
2/25/1998
2/27/1998
Allocated Water
Unallocated Water

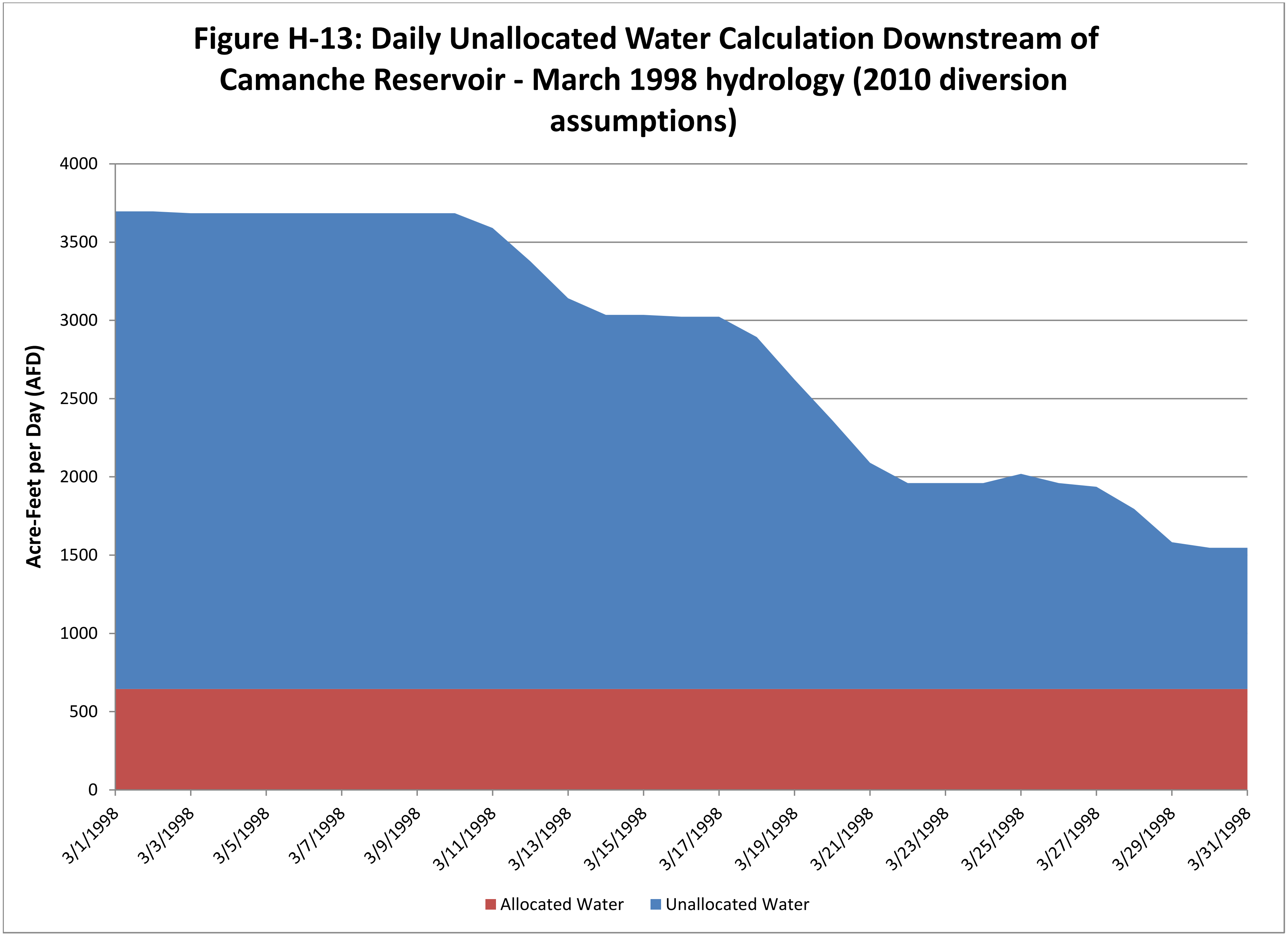


Figure H-13: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - March 1998 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
3/1/1998
3/3/1998
3/5/1998
3/7/1998
3/9/1998
3/11/1998
3/13/1998
3/15/1998
3/17/1998
3/19/1998
3/21/1998
3/23/1998
3/25/1998
3/27/1998
3/29/1998
3/31/1998
Allocated Water
Unallocated Water

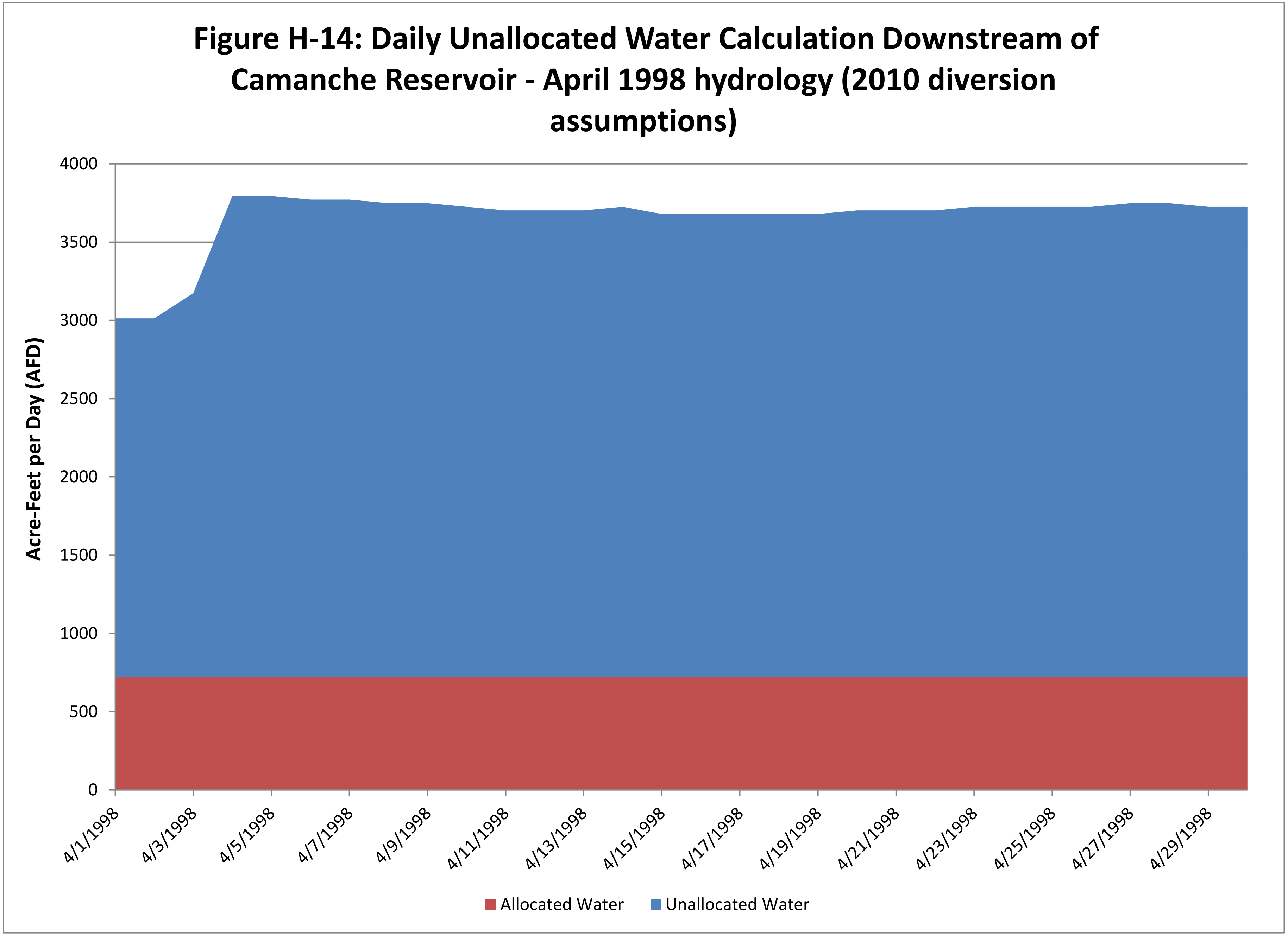


Figure H-14: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - April 1998 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
4/1/1998
4/3/1998
4/5/1998
4/7/1998
4/9/1998
4/11/1998
4/13/1998
4/15/1998
4/17/1998
4/19/1998
4/21/1998
4/23/1998
4/25/1998
4/27/1998
4/29/1998
Allocated Water
Unallocated Water

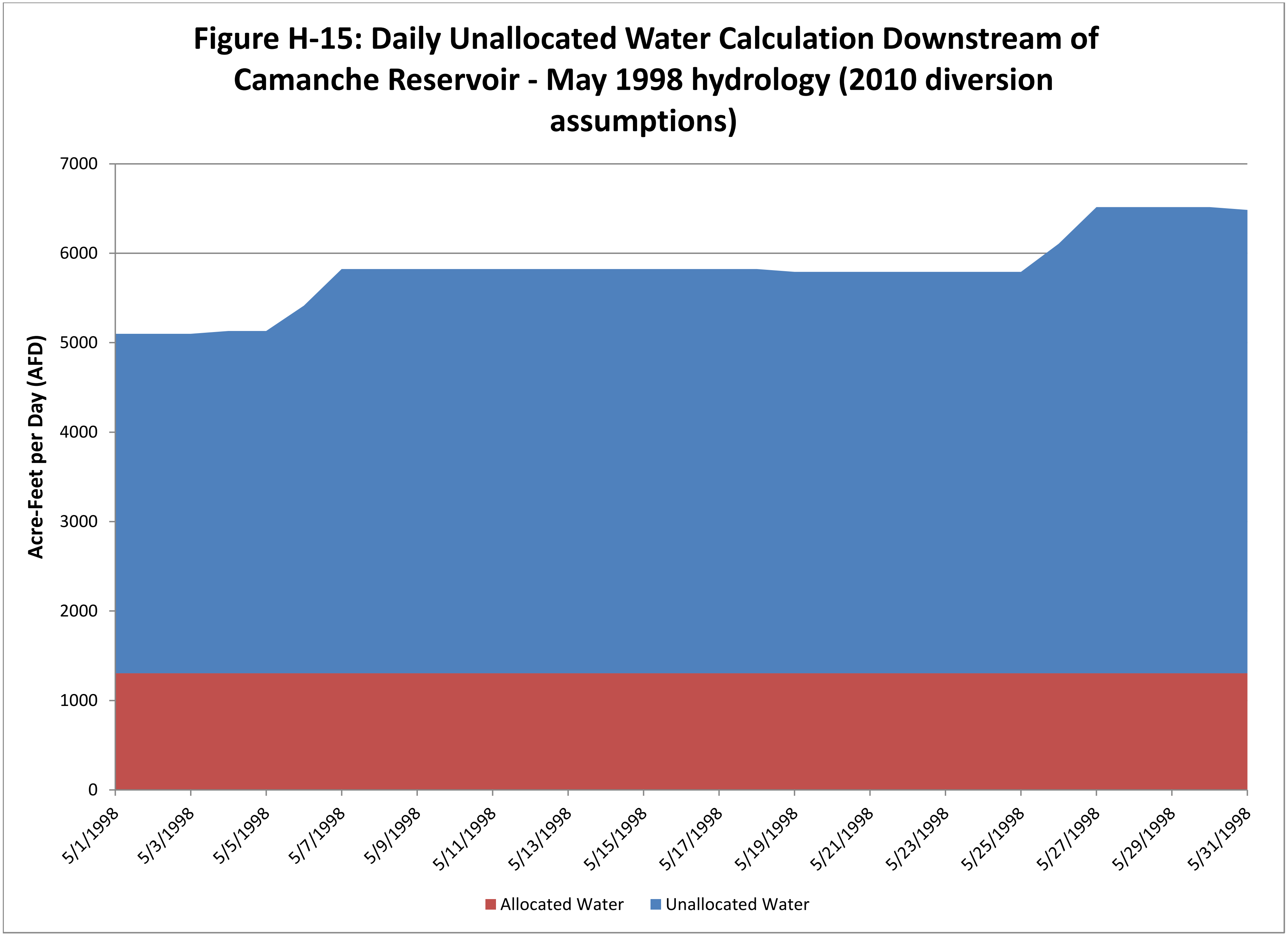


Figure H-15: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - May 1998 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
7000
6000
5000
4000
3000
2000
1000
0
5/1/1998
5/3/1998
5/5/1998
5/7/1998
5/9/1998
5/11/1998
5/13/1998
5/15/1998
5/17/1998
5/19/1998
5/21/1998
5/23/1998
5/25/1998
5/27/1998
5/29/1998
5/31/1998
Allocated Water
Unallocated Water

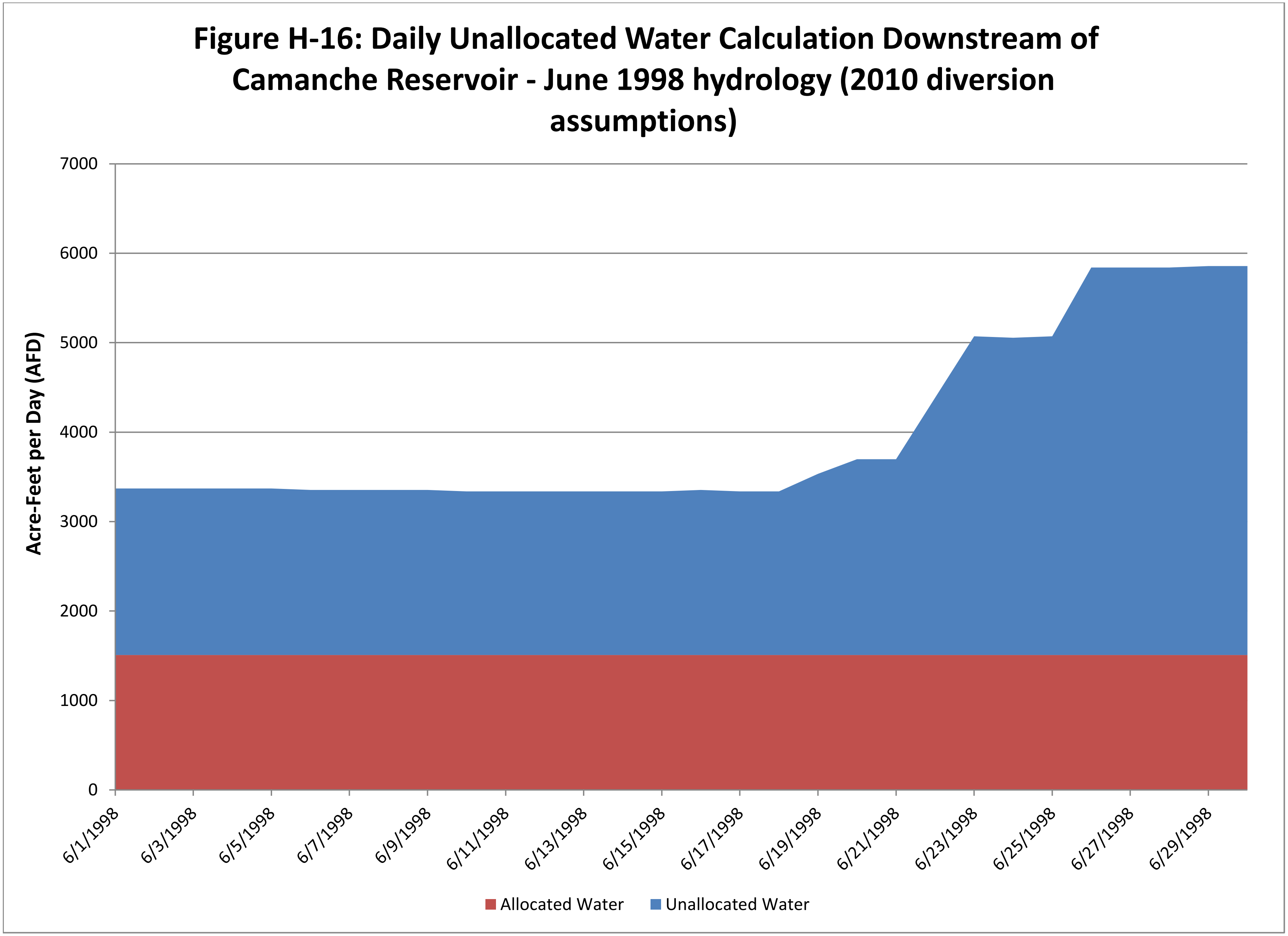


Figure H-16: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - June 1998 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
7000
6000
5000
4000
3000
2000
1000
0
6/1/1998
6/3/1998
6/5/1998
6/7/1998
6/9/1998
6/11/1998
6/13/1998
6/15/1998
6/17/1998
6/19/1998
6/21/1998
6/23/1998
6/25/1998
6/27/1998
6/29/1998
Allocated Water
Unallocated Water

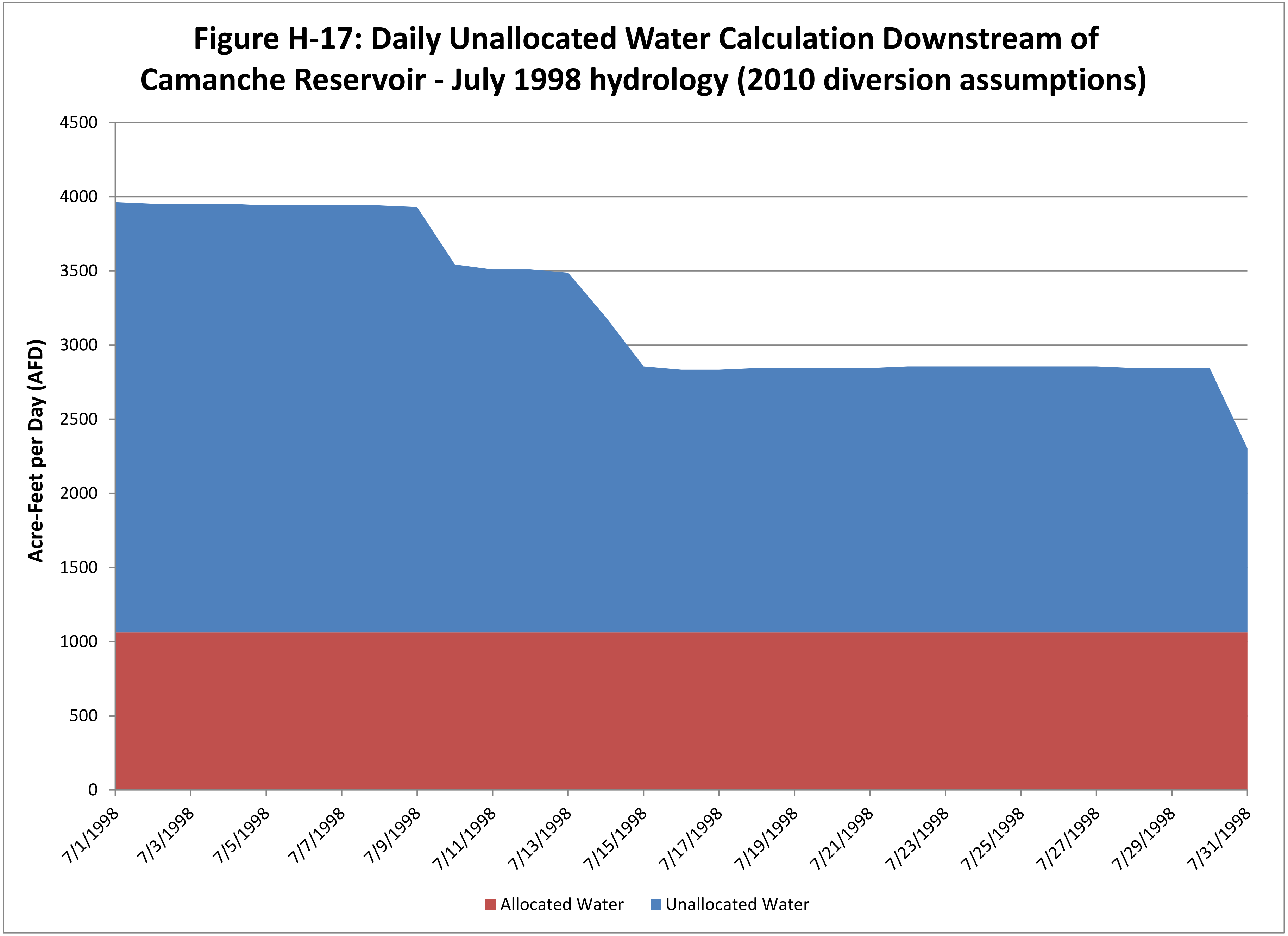


Figure H-17: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - July 1998 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
7/1/1998
7/3/1998
7/5/1998
7/7/1998
7/9/1998
7/11/1998
7/13/1998
7/15/1998
7/17/1998
7/19/1998
7/21/1998
7/23/1998
7/25/1998
7/27/1998
7/29/1998
7/31/1998
Allocated Water
Unallocated Water

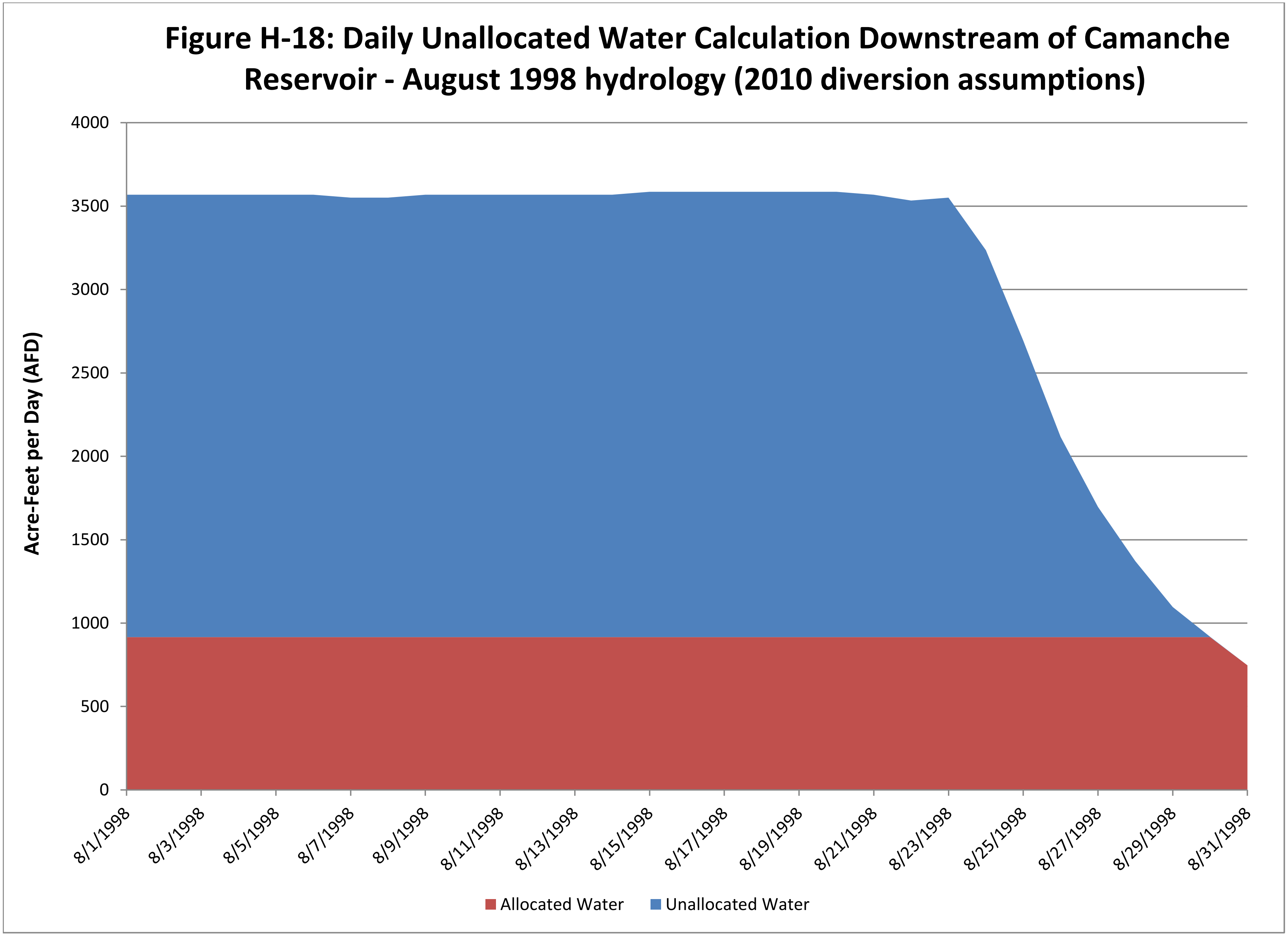


Figure H-18: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - August 1998 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
8/1/1998
8/3/1998
8/5/1998
8/7/1998
8/9/1998
8/11/1998
8/13/1998
8/15/1998
8/17/1998
8/19/1998
8/21/1998
8/23/1998
8/25/1998
8/27/1998
8/29/1998
8/31/1998
Allocated Water
Unallocated Water

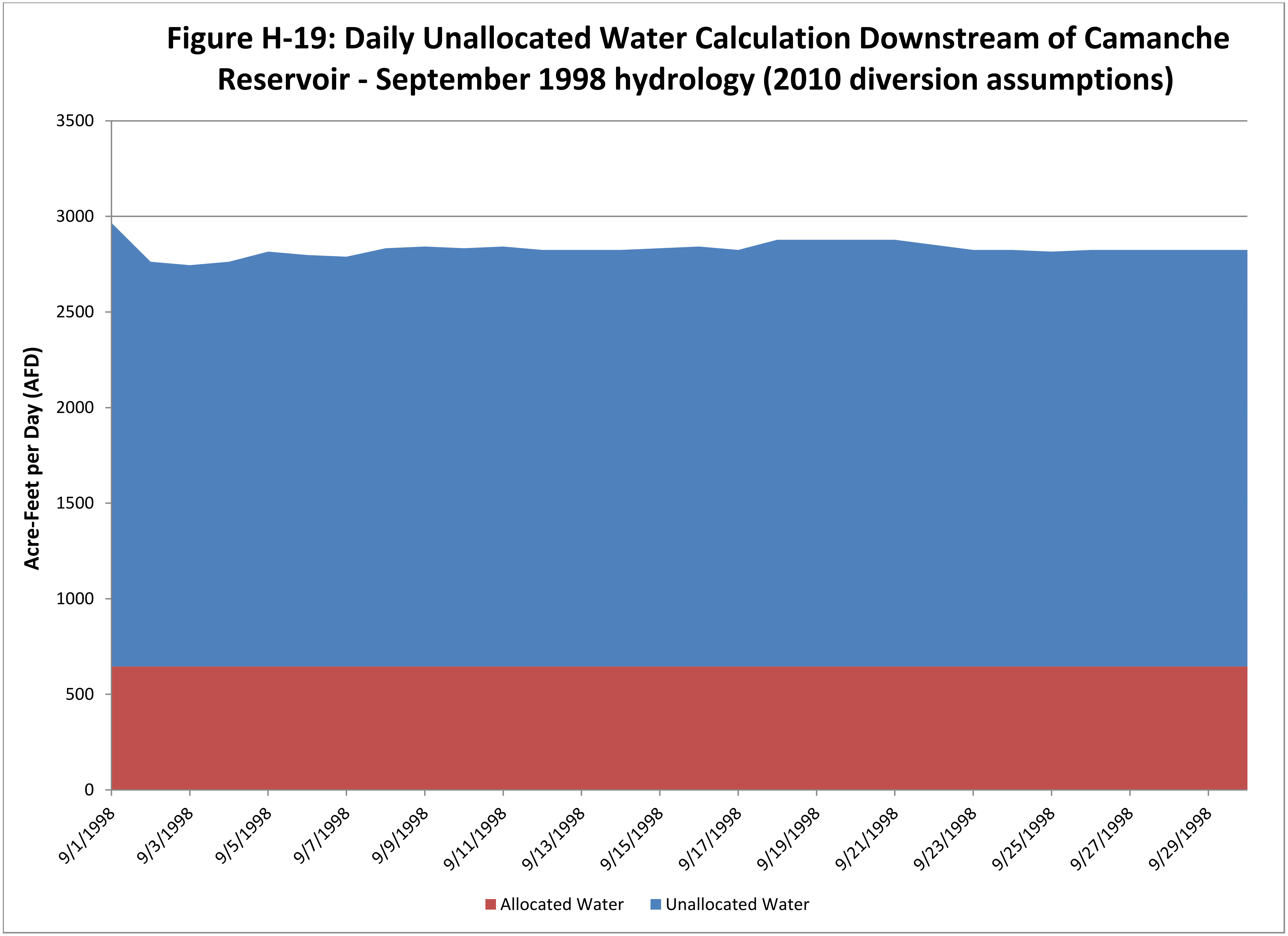


Figure H-19: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - September 1998 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
3500
3000
2500
2000
1500
1000
500
0
9/1/1998
9/3/1998
9/5/1998
9/7/1998
9/9/1998
9/11/1998
9/13/1998
9/15/1998
9/17/1998
9/19/1998
9/21/1998
9/23/1998
9/25/1998
9/27/1998
9/29/1998
Allocated Water
Unallocated Water

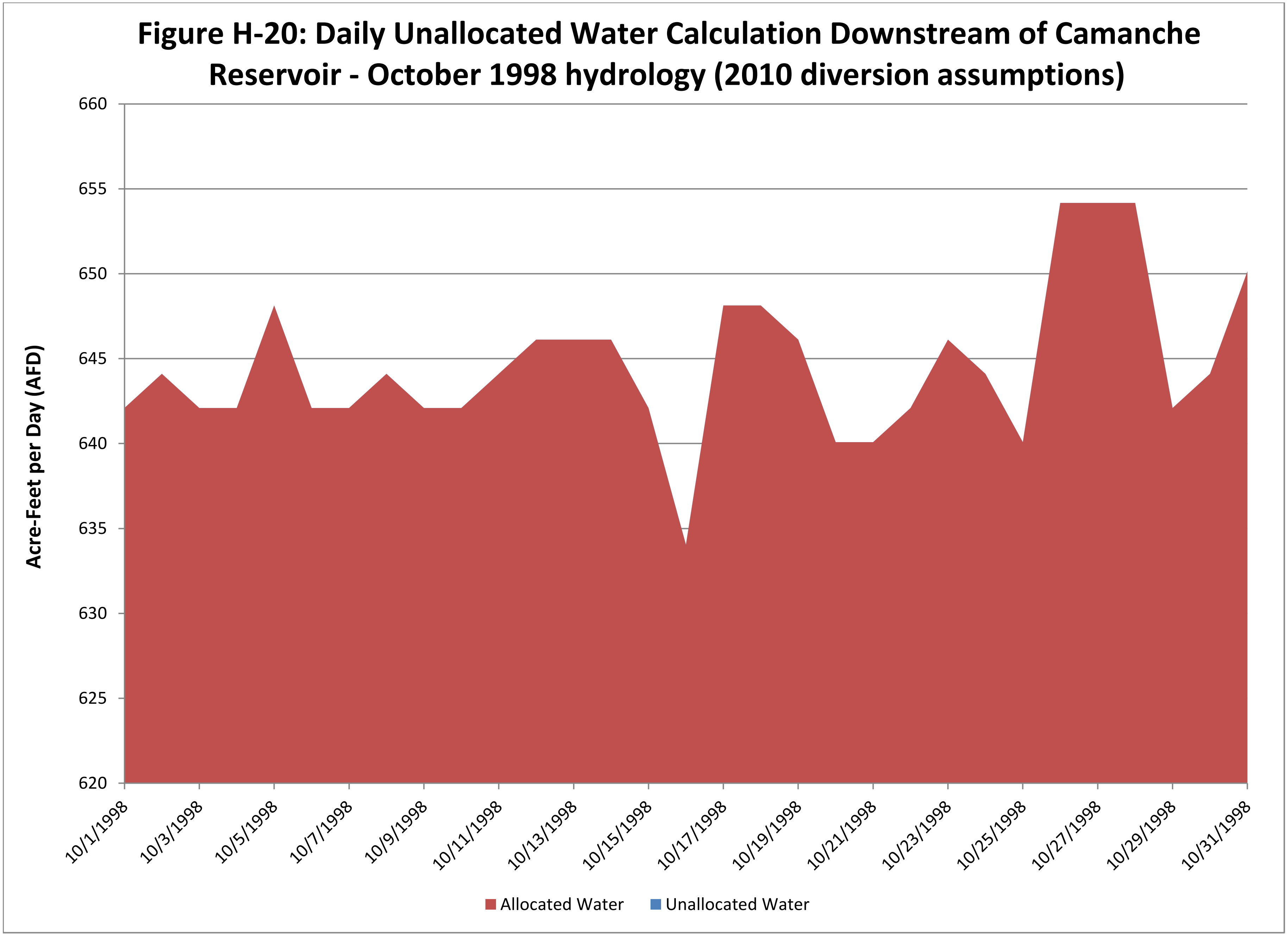


Figure H-20: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - October 1998 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
660
655
650
645
640
635
630
625
620
10/1/1998
10/3/1998
10/5/1998
10/7/1998
10/9/1998
10/11/1998
10/13/1998
10/15/1998
10/17/1998
10/19/1998
10/21/1998
10/23/1998
10/25/1998
10/27/1998
10/29/1998
10/31/1998
Allocated Water
Unallocated Water

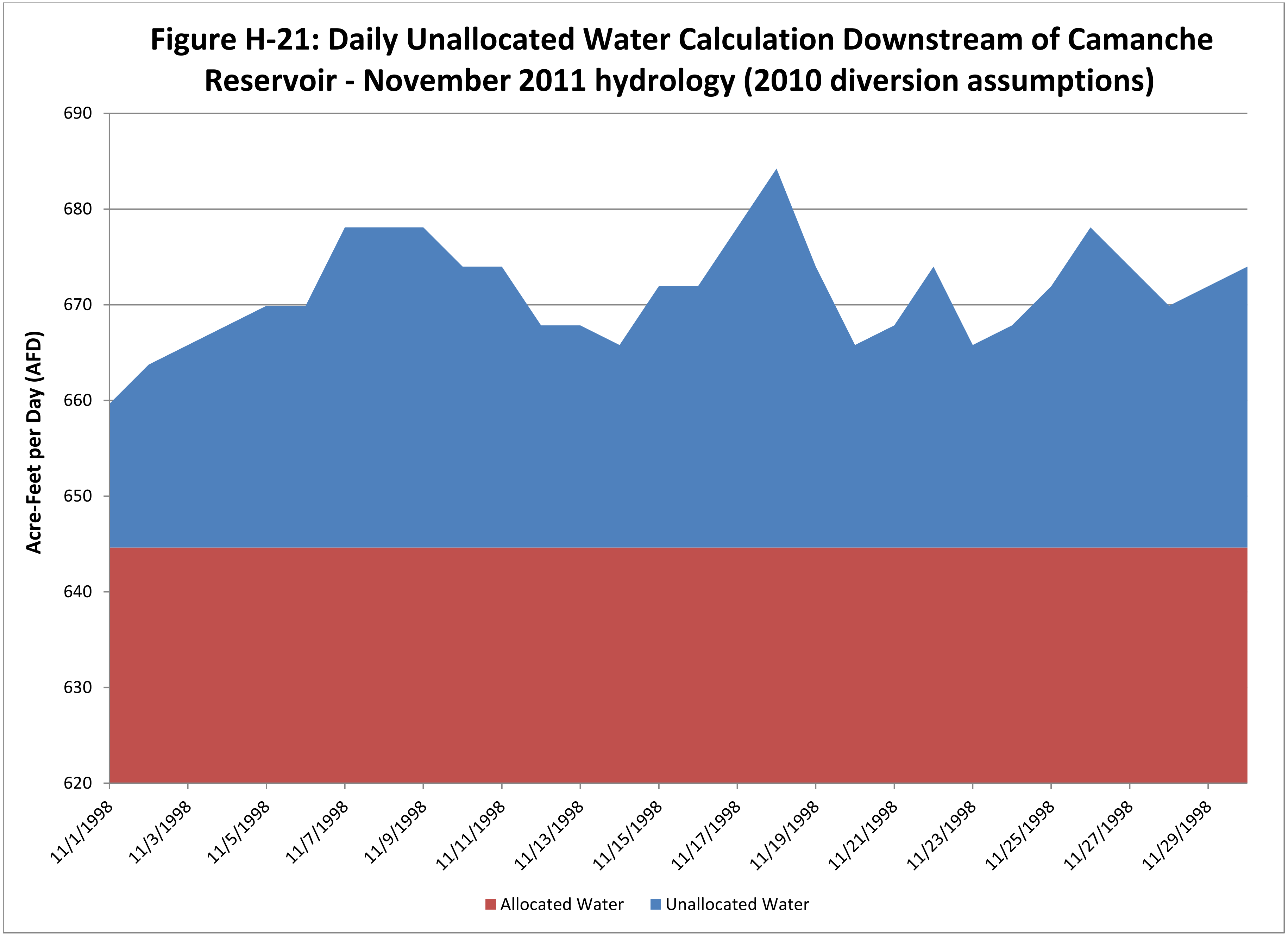


Figure H-21: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - November 2011 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
690
680
670
660
650
640
630
620
11/1/1998
11/3/1998
11/5/1998
11/7/1998
11/9/1998
11/11/1998
11/13/1998
11/15/1998
11/17/1998
11/19/1998
11/21/1998
11/23/1998
11/25/1998
11/27/1998
11/29/1998
Allocated Water
Unallocated Water

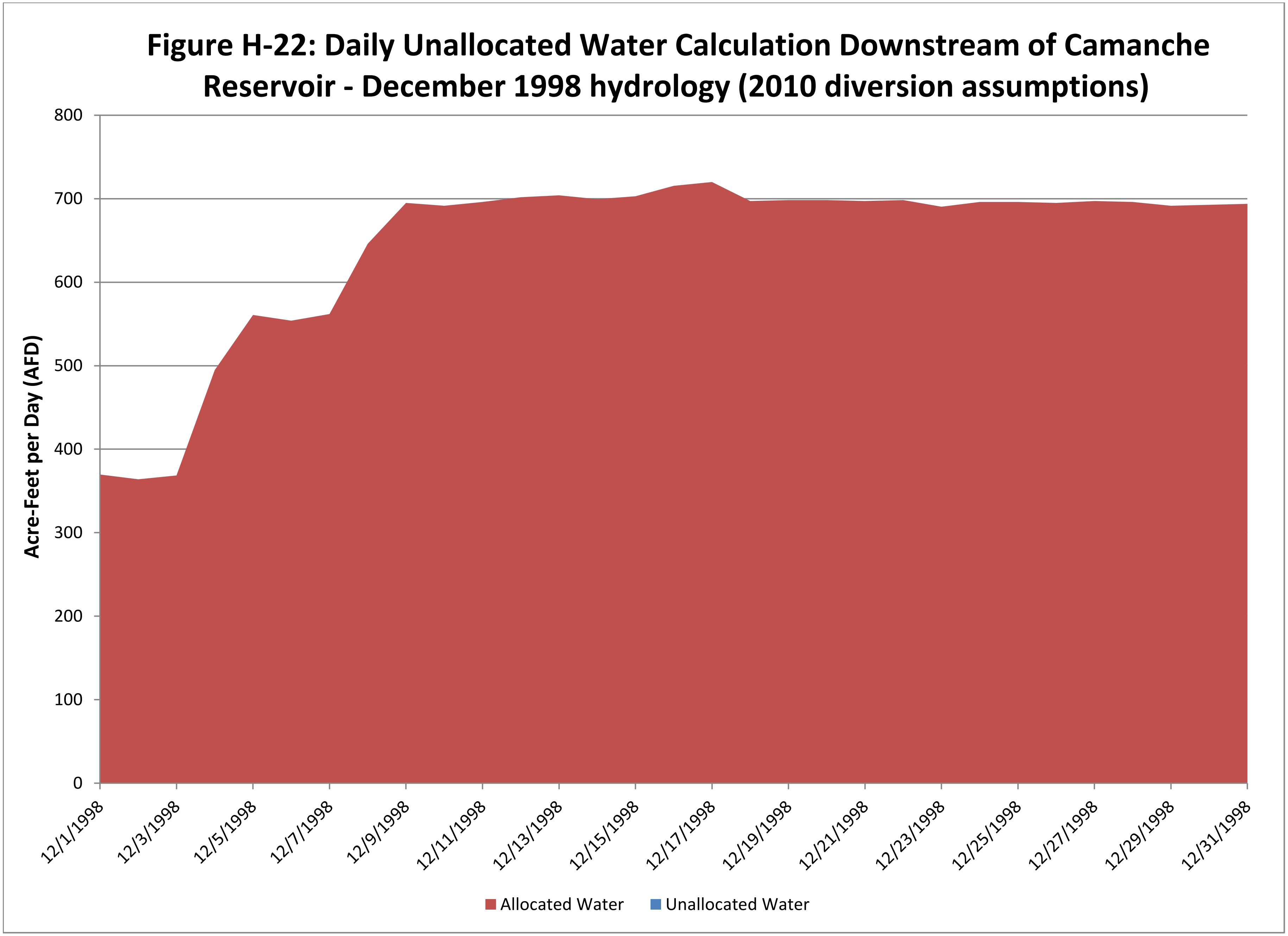


Figure H-22: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - December 1998 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
800
700
600
500
400
300
200
100
0
12/1/1998
12/3/1998
12/5/1998
12/7/1998
12/9/1998
12/11/1998
12/13/1998
12/15/1998
12/17/1998
12/19/1998
12/21/1998
12/23/1998
12/25/1998
12/27/1998
12/29/1998
12/31/1998
Allocated Water
Unallocated Water

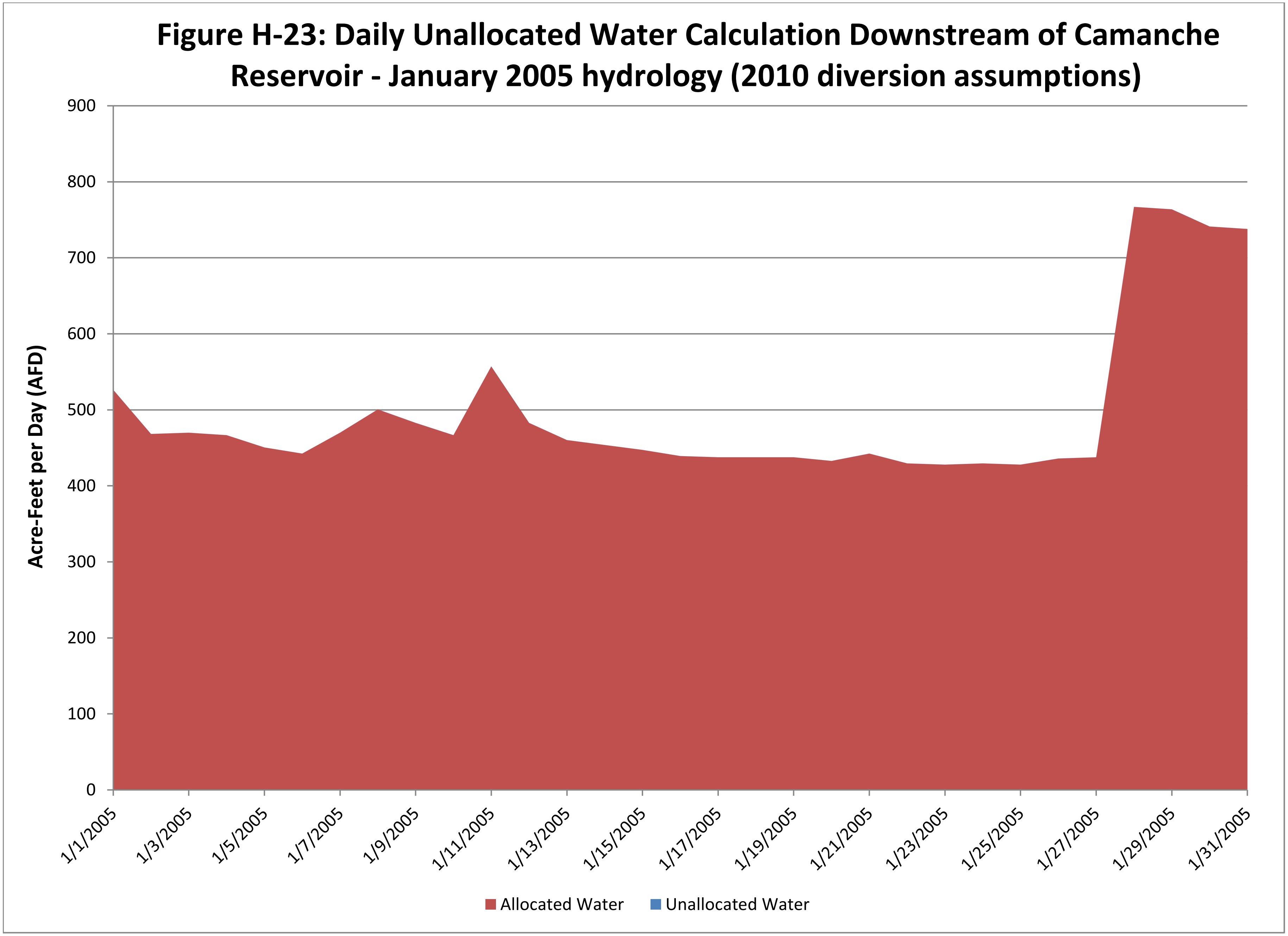


Figure H-23: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - January 2005 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
0
100
200
300
400
500
600
700
800
900
1/1/2005
1/3/2005
1/5/2005
1/7/2005
1/9/2005
1/11/2005
1/13/2005
1/15/2005
1/17/2005
1/19/2005
1/21/2005
1/23/2005
1/25/2005
1/27/2005
1/29/2005
1/31/2005
Allocated Water
Unallocated Water

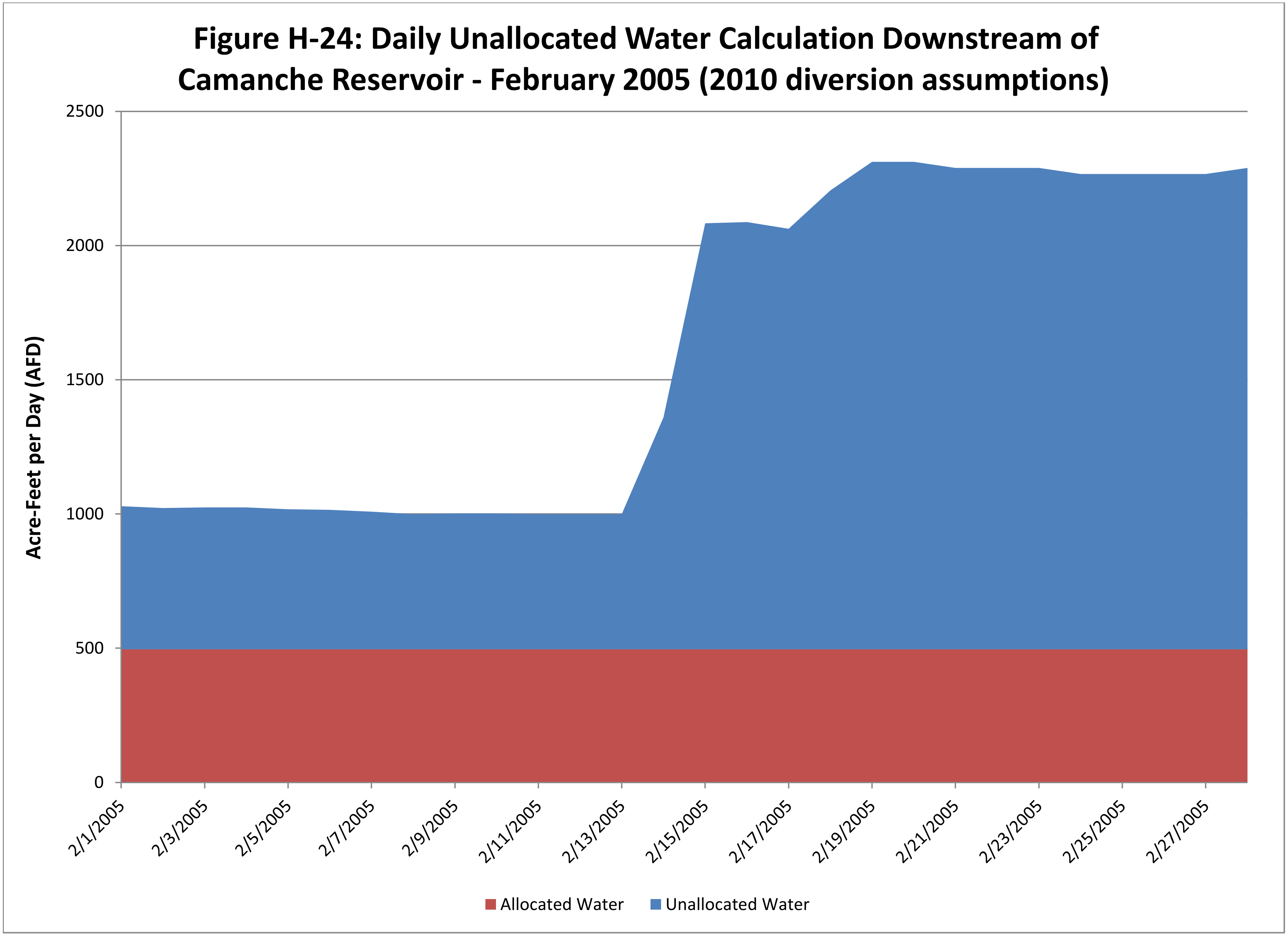


Figure H-24: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - February 2005 (2010 diversion assumptions)
Acre-Feet per Day (AFD)
2500
2000
1500
1000
500
0
2/1/2005
2/3/2005
2/5/2005
2/7/2005
2/9/2005
2/11/2005
2/13/2005
2/15/2005
2/17/2005
2/19/2005
2/21/2005
2/23/2005
2/25/2005
2/27/2005
Allocated Water
Unallocated Water

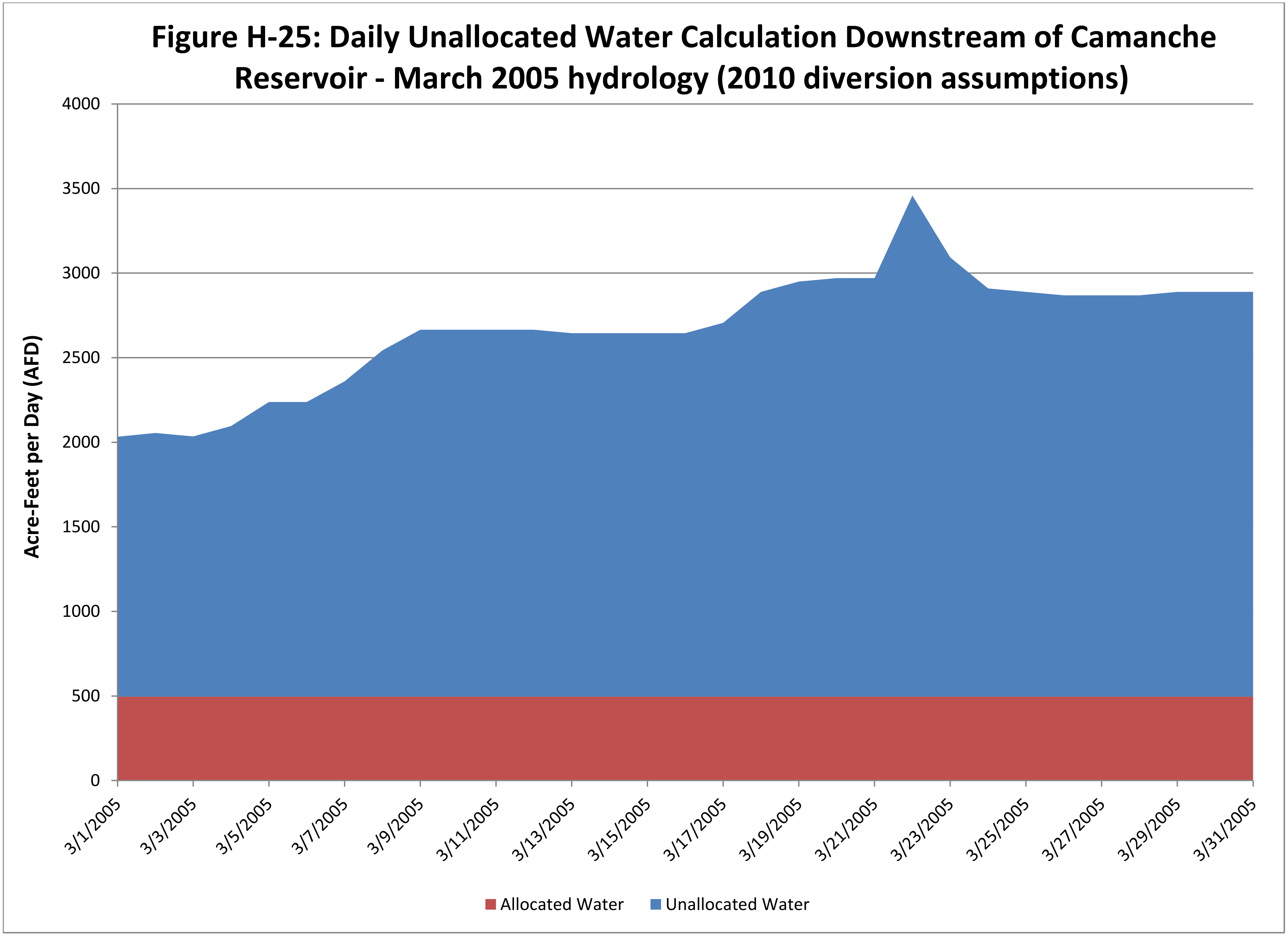


Figure H-25: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - March 2005 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
3/1/2005
3/3/2005
3/5/2005
3/7/2005
3/9/2005
3/11/2005
3/13/2005
3/15/2005
3/17/2005
3/19/2005
3/21/2005
3/23/2005
3/25/2005
3/27/2005
3/29/2005
3/31/2005
Allocated Water
Unallocated Water

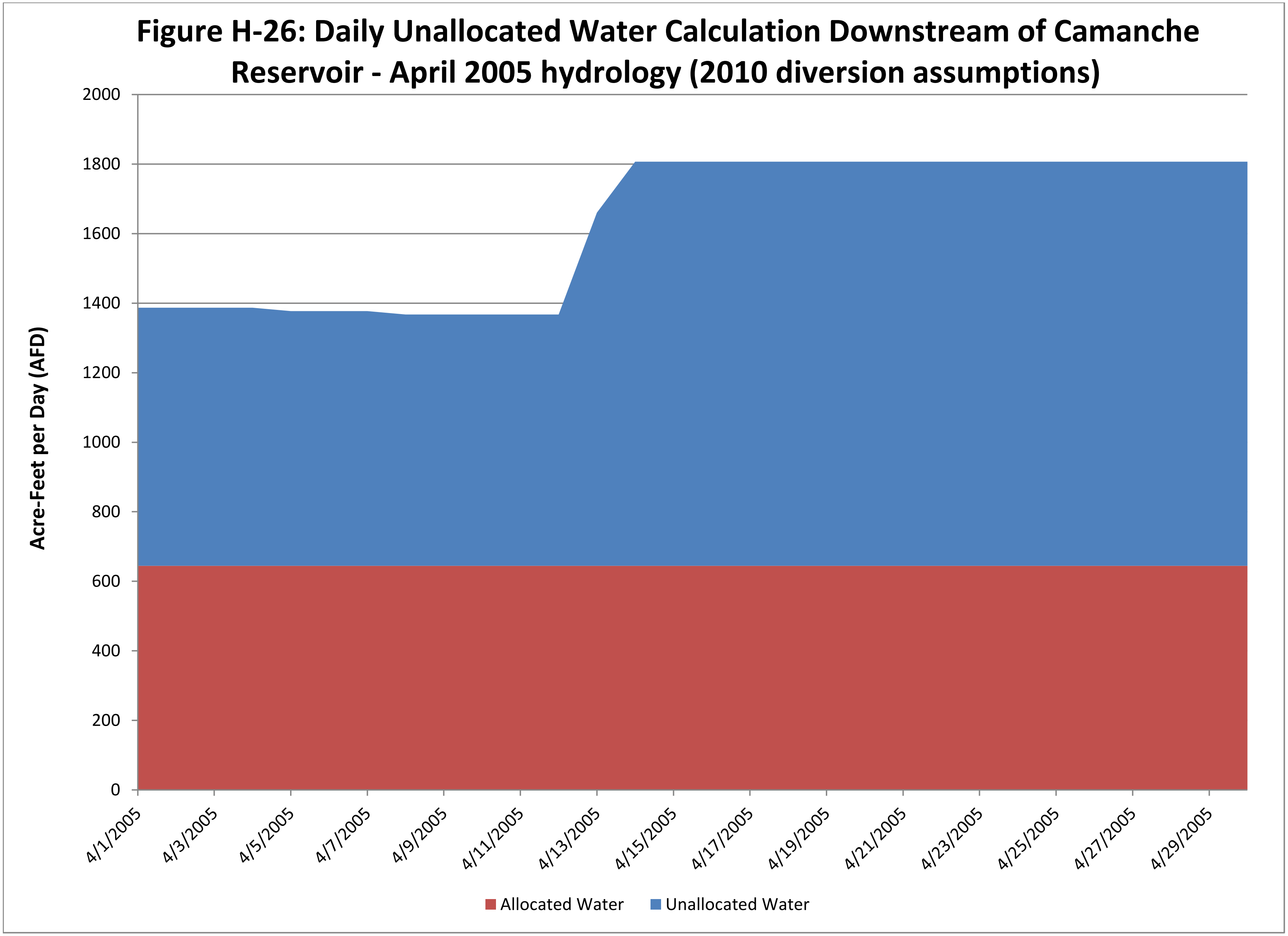
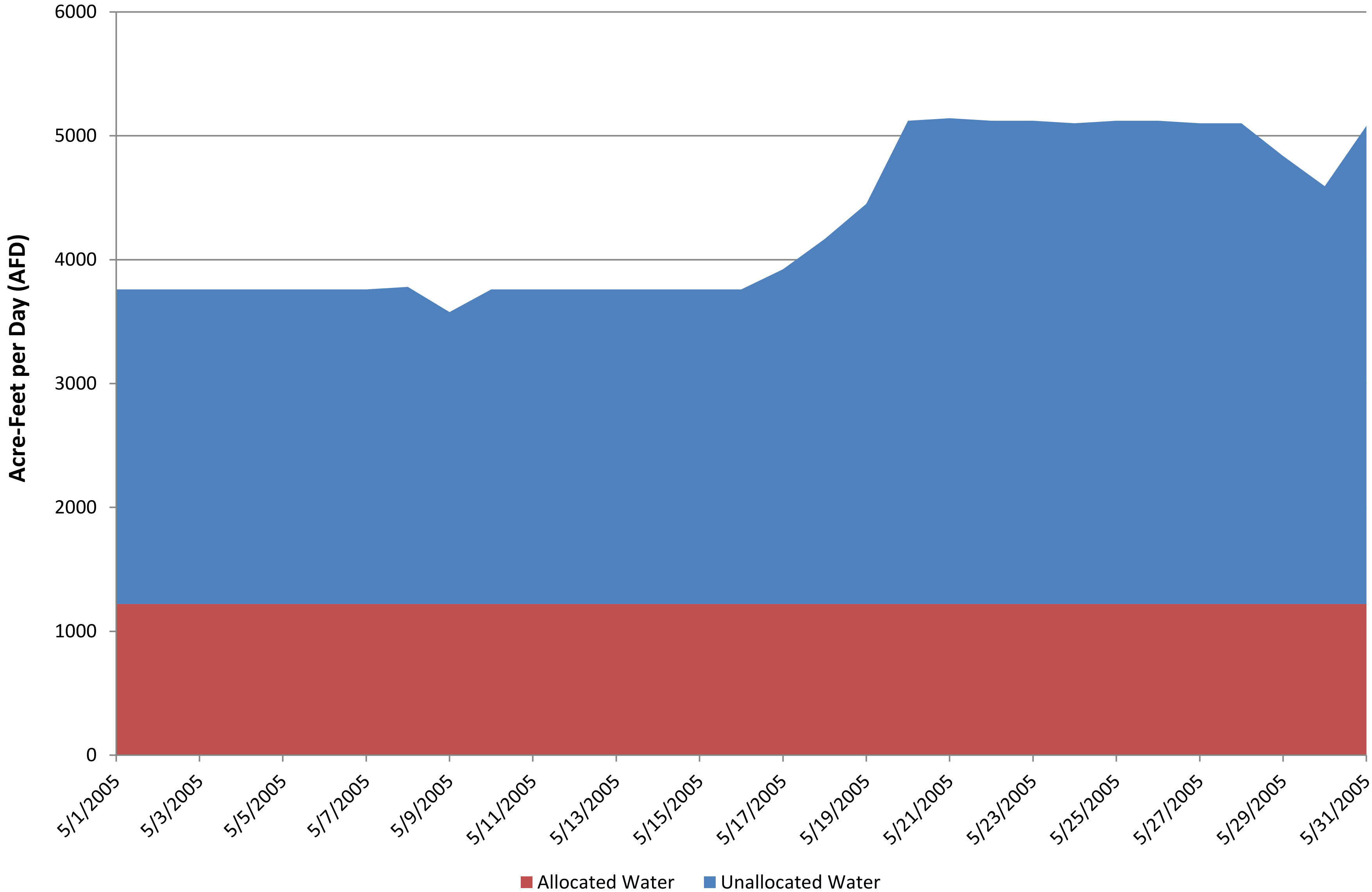


Figure H-26: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - April 2005 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
4/1/2005
4/3/2005
4/5/2005
4/7/2005
4/9/2005
4/11/2005
4/13/2005
4/15/2005
4/17/2005
4/19/2005
4/21/2005
4/23/2005
4/25/2005
4/27/2005
4/29/2005
Allocated Water
Unallocated Water

Figure H-27: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - May 2005 hydrology (2010 diversion assumptions)



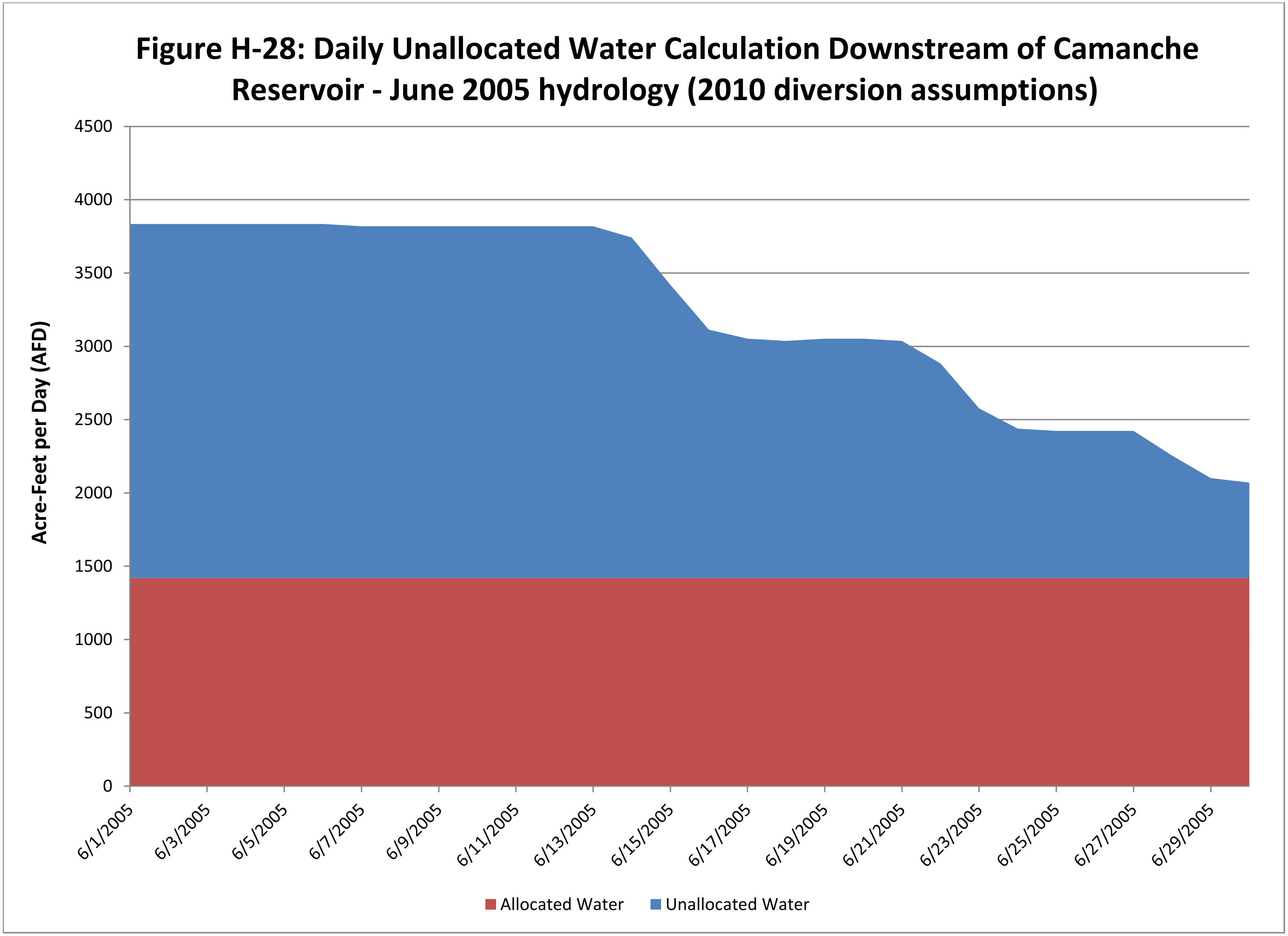


Figure H-28: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - June 2005 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
6/1/2005
6/3/2005
6/5/2005
6/7/2005
6/9/2005
6/11/2005
6/13/2005
6/15/2005
6/17/2005
6/19/2005
6/21/2005
6/23/2005
6/25/2005
6/27/2005
6/29/2005
Allocated Water
Unallocated Water

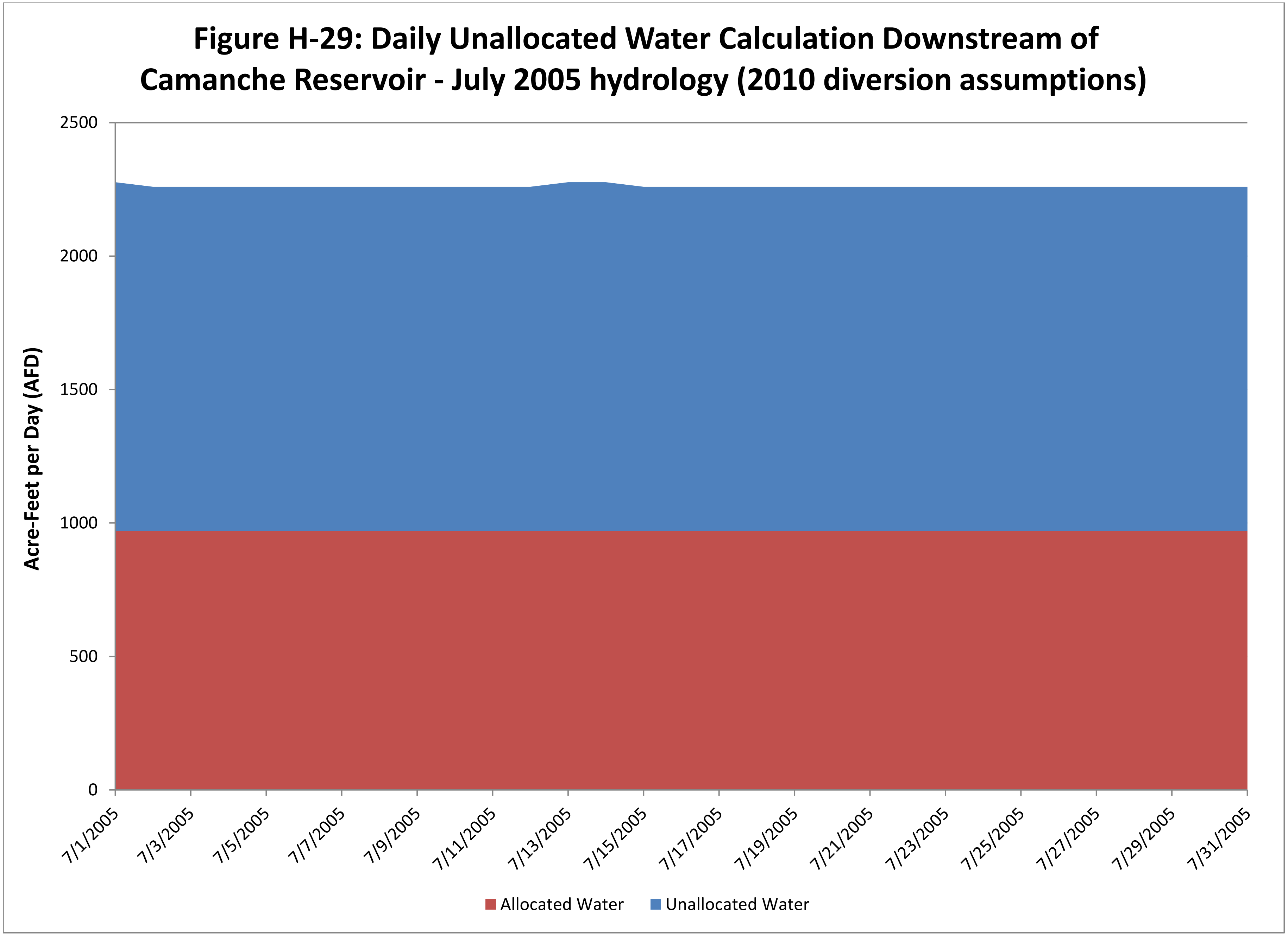


Figure H-29: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - July 2005 hydrology (2010 diversion assumptions)
2500
2000
1500
1000
500
0
Acre-Feet per Day (AFD)
7/1/2005
7/3/2005
7/5/2005
7/7/2005
7/9/2005
7/11/2005
7/13/2005
7/15/2005
7/17/2005
7/19/2005
7/21/2005
7/23/2005
7/25/2005
7/27/2005
7/29/2005
7/31/2005
Allocated Water
Unallocated Water

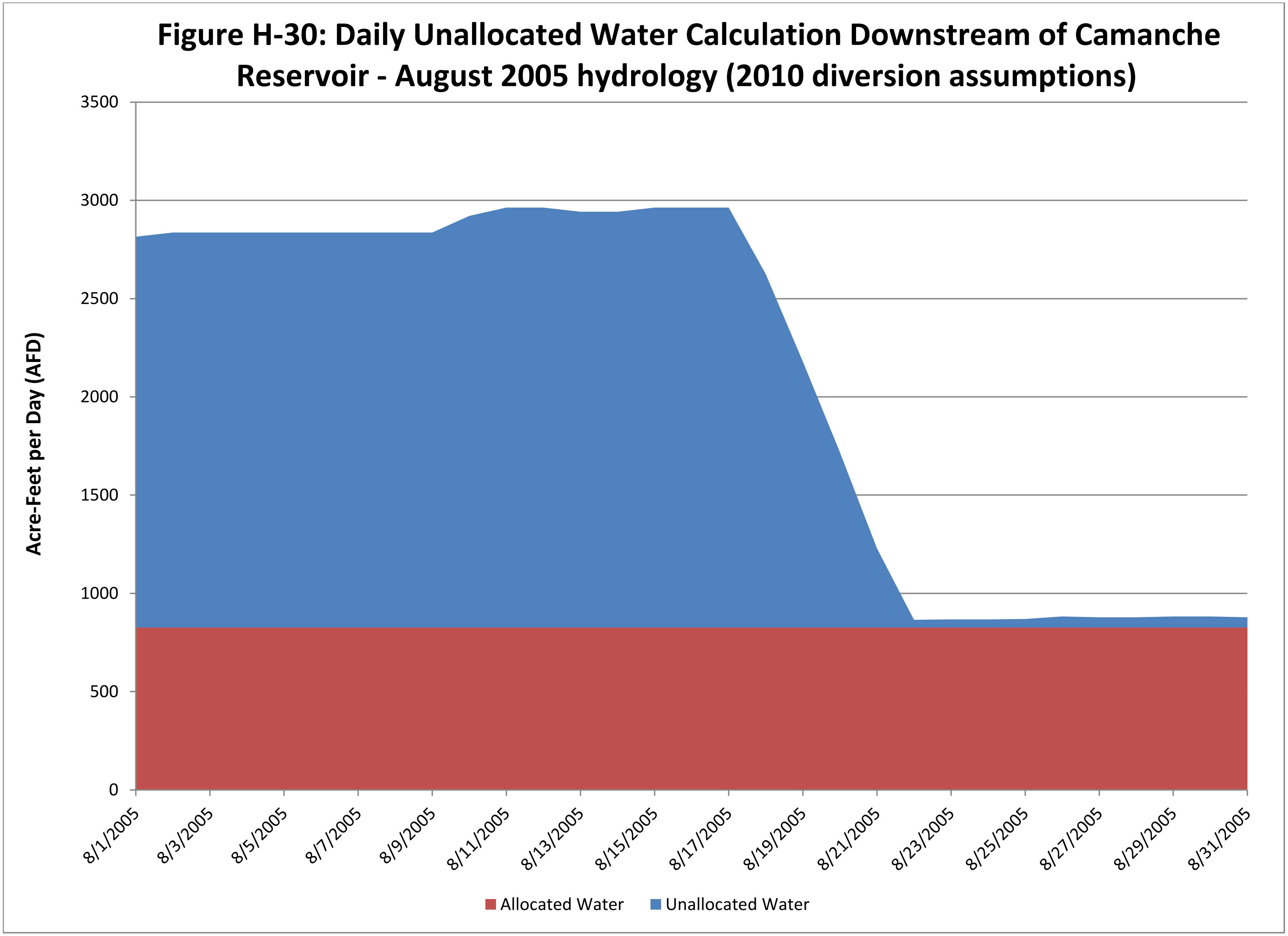


Figure H-30: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - August 2005 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
3500
3000
2500
2000
1500
1000
500
0
8/1/2005
8/3/2005
8/5/2005
8/7/2005
8/9/2005
8/11/2005
8/13/2005
8/15/2005
8/17/2005
8/19/2005
8/21/2005
8/23/2005
8/25/2005
8/27/2005
8/29/2005
8/31/2005
Allocated Water
Unallocated Water

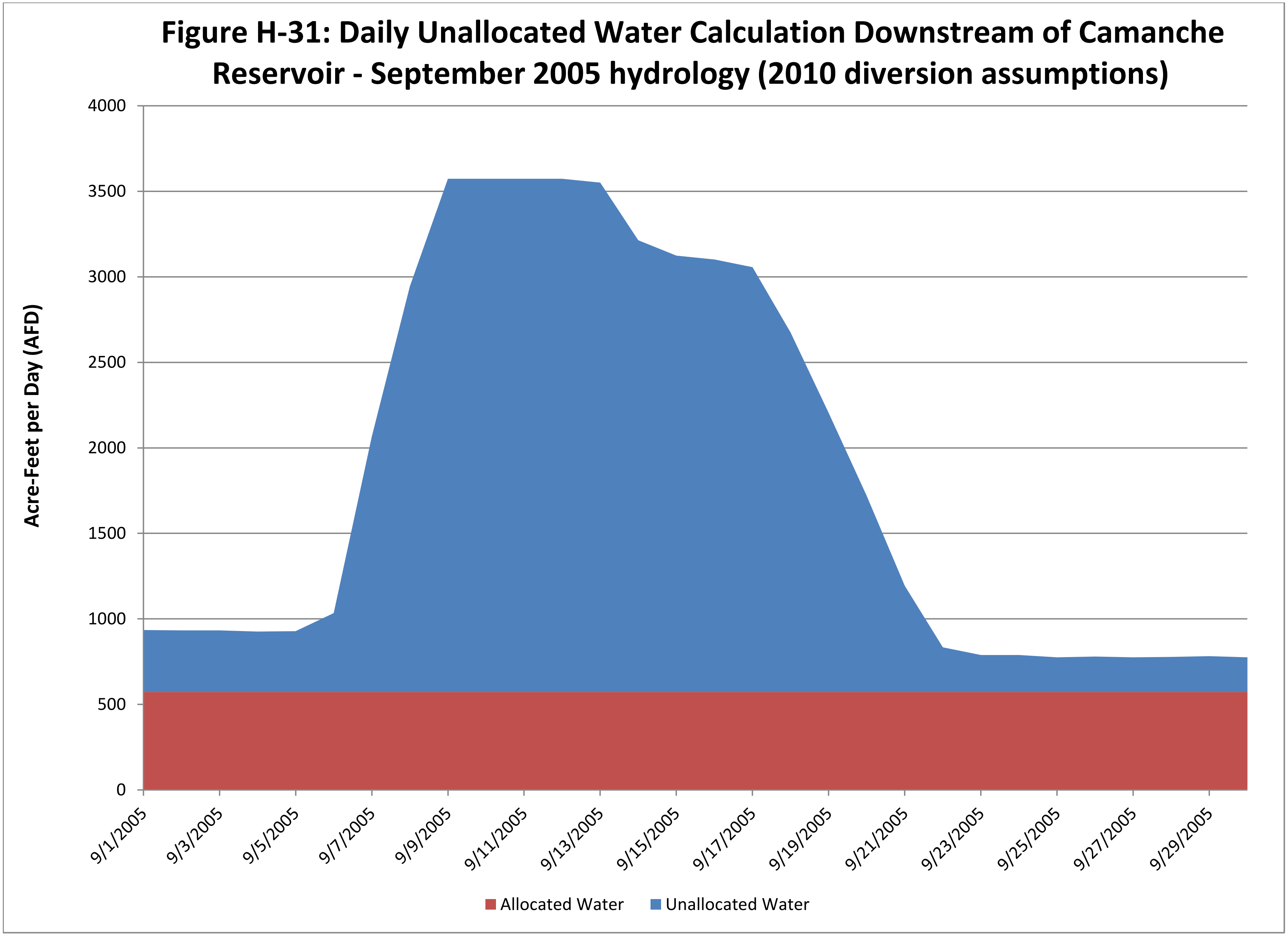


Figure H-31: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - September 2005 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
9/1/2005
9/3/2005
9/5/2005
9/7/2005
9/9/2005
9/11/2005
9/13/2005
9/15/2005
9/17/2005
9/19/2005
9/21/2005
9/23/2005
9/25/2005
9/27/2005
9/29/2005
Allocated Water
Unallocated Water

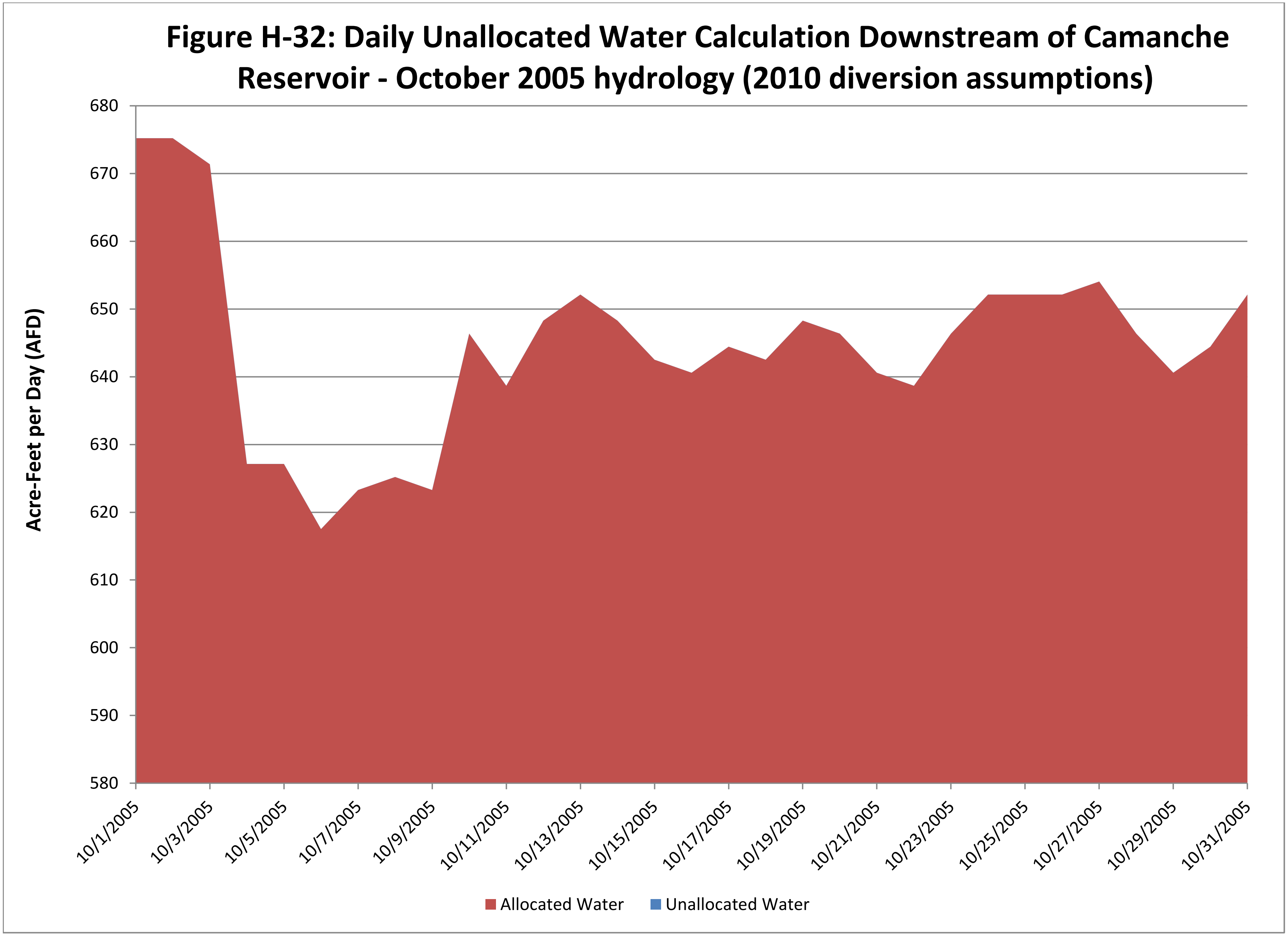


Figure H-32: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - October 2005 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
680
670
660
650
640
630
620
610
600
590
580
10/1/2005
10/3/2005
10/5/2005
10/7/2005
10/9/2005
10/11/2005
10/13/2005
10/15/2005
10/17/2005
10/19/2005
10/21/2005
10/23/2005
10/25/2005
10/27/2005
10/29/2005
10/31/2005
Allocated Water
Unallocated Water

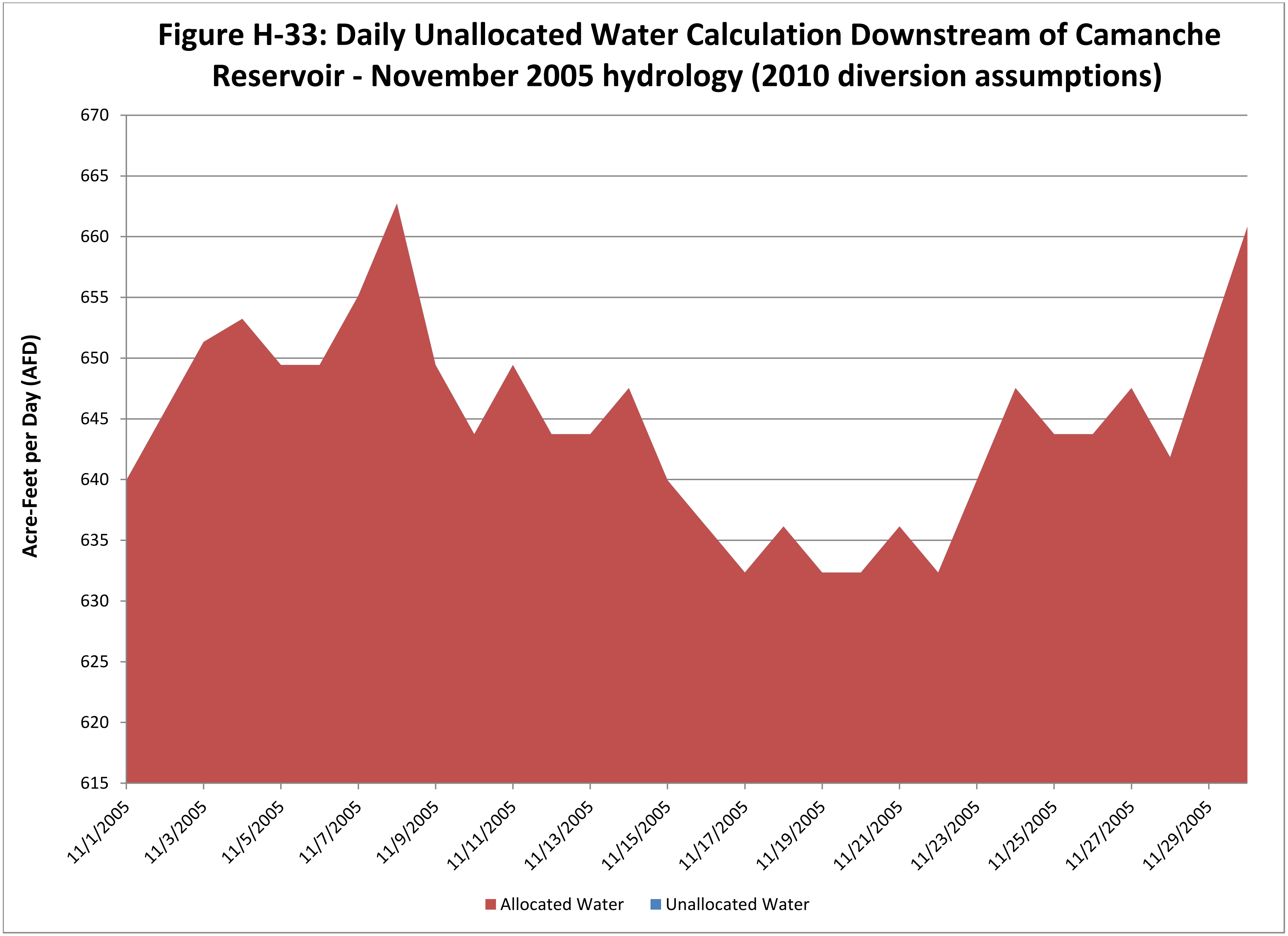


Figure H-33: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - November 2005 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
670
665
660
655
650
645
640
635
630
625
620
615
11/1/2005
11/3/2005
11/5/2005
11/7/2005
11/9/2005
11/11/2005
11/13/2005
11/15/2005
11/17/2005
11/19/2005
11/21/2005
11/23/2005
11/25/2005
11/27/2005
11/29/2005
Allocated Water
Unallocated Water

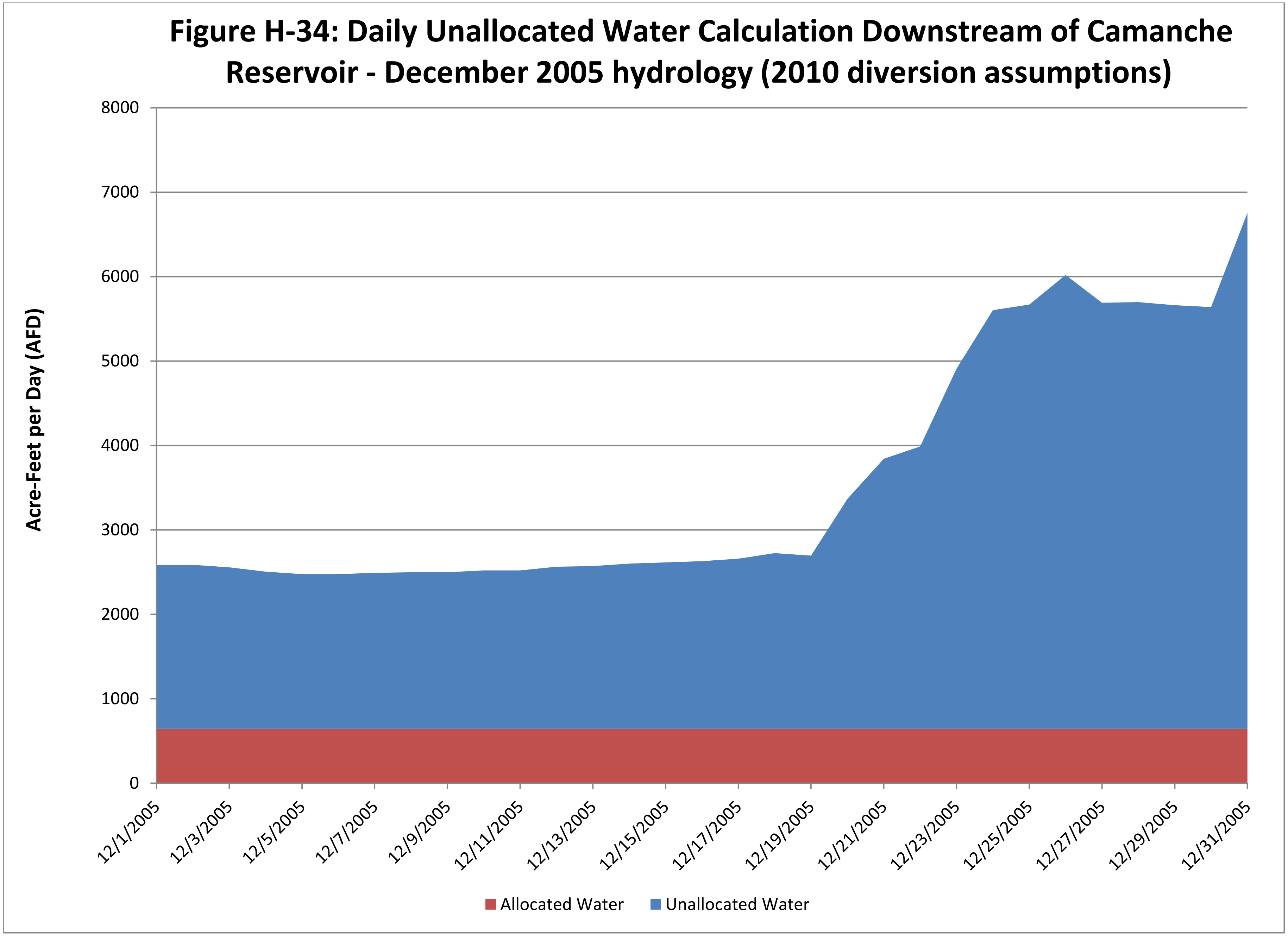


Figure H-34: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - December 2005 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
8000
7000
6000
5000
4000
3000
2000
1000
0
12/1/2005
12/3/2005
12/5/2005
12/7/2005
12/9/2005
12/11/2005
12/13/2005
12/15/2005
12/17/2005
12/19/2005
12/21/2005
12/23/2005
12/25/2005
12/27/2005
12/29/2005
12/31/2005
Allocated Water
Unallocated Water

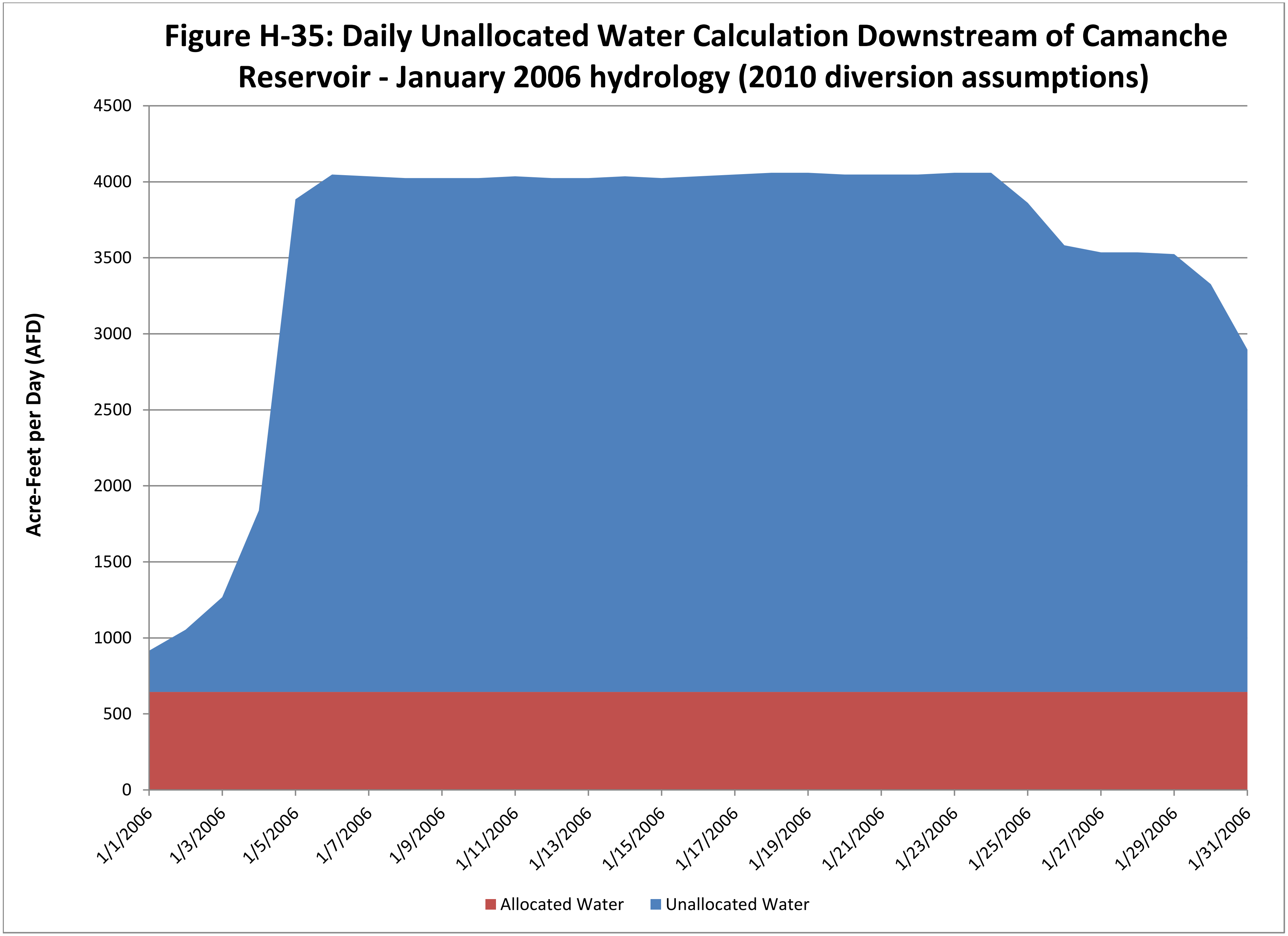


Figure H-35: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - January 2006 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1/1/2006
1/3/2006
1/5/2006
1/7/2006
1/9/2006
1/11/2006
1/13/2006
1/15/2006
1/17/2006
1/19/2006
1/21/2006
1/23/2006
1/25/2006
1/27/2006
1/29/2006
1/31/2006
Allocated Water
Unallocated Water

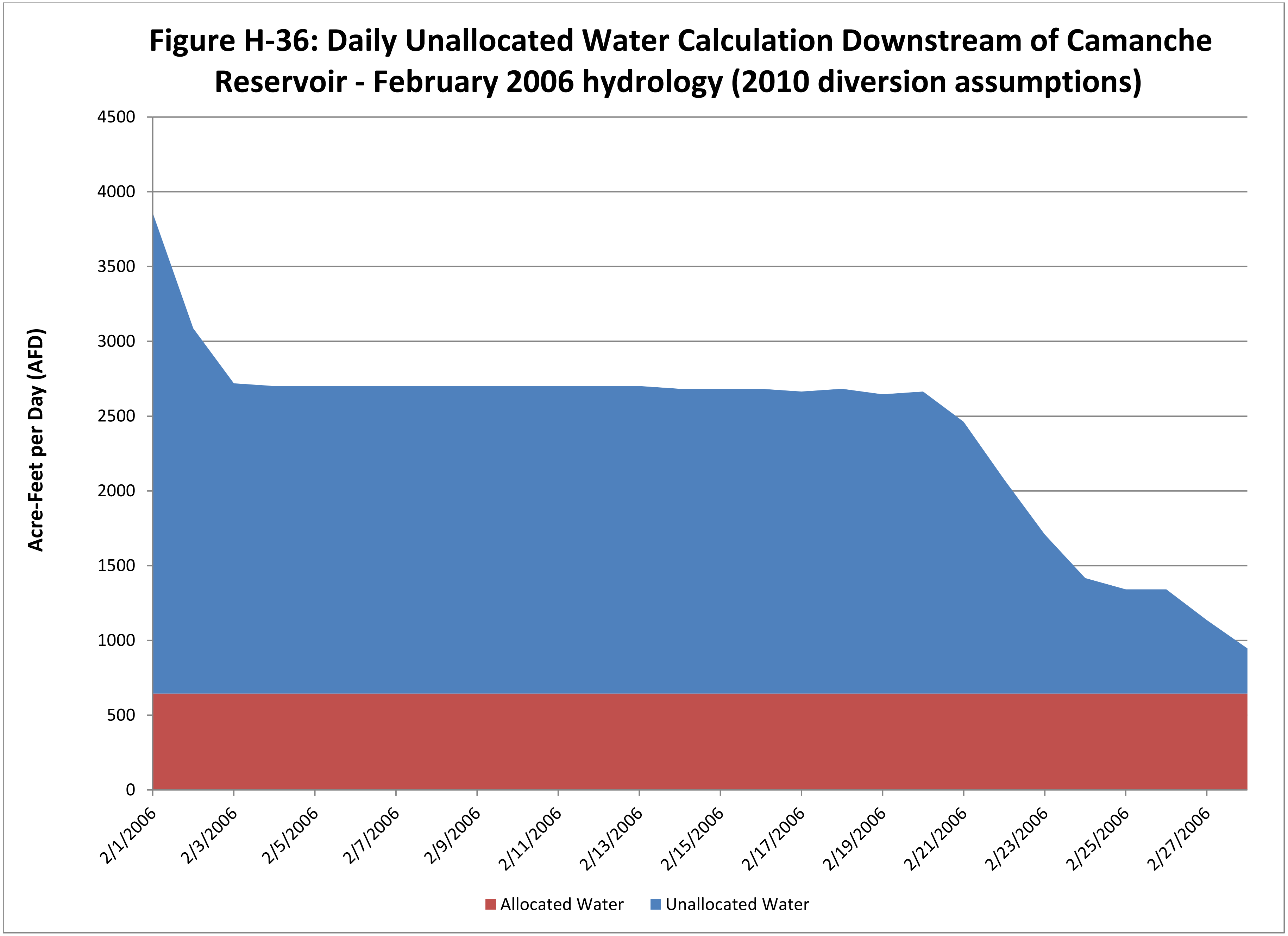


Figure H-36: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - February 2006 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
2/1/2006
2/3/2006
2/5/2006
2/7/2006
2/9/2006
2/11/2006
2/13/2006
2/15/2006
2/17/2006
2/19/2006
2/21/2006
2/23/2006
2/25/2006
2/27/2006
Allocated Water
Unallocated Water

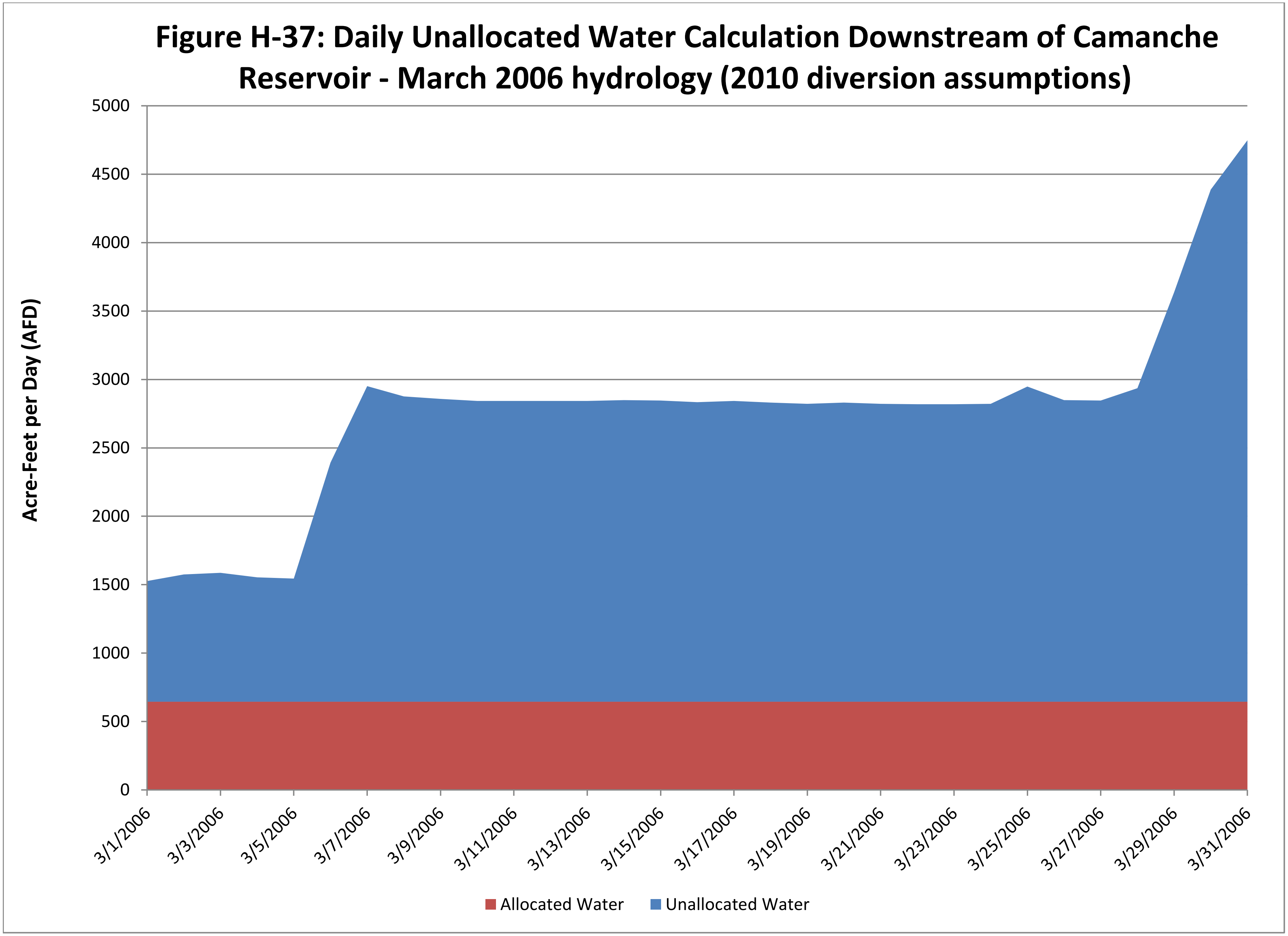


Figure H-37: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - March 2006 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
3/1/2006
3/3/2006
3/5/2006
3/7/2006
3/9/2006
3/11/2006
3/13/2006
3/15/2006
3/17/2006
3/19/2006
3/21/2006
3/23/2006
3/25/2006
3/27/2006
3/29/2006
3/31/2006
Allocated Water
Unallocated Water

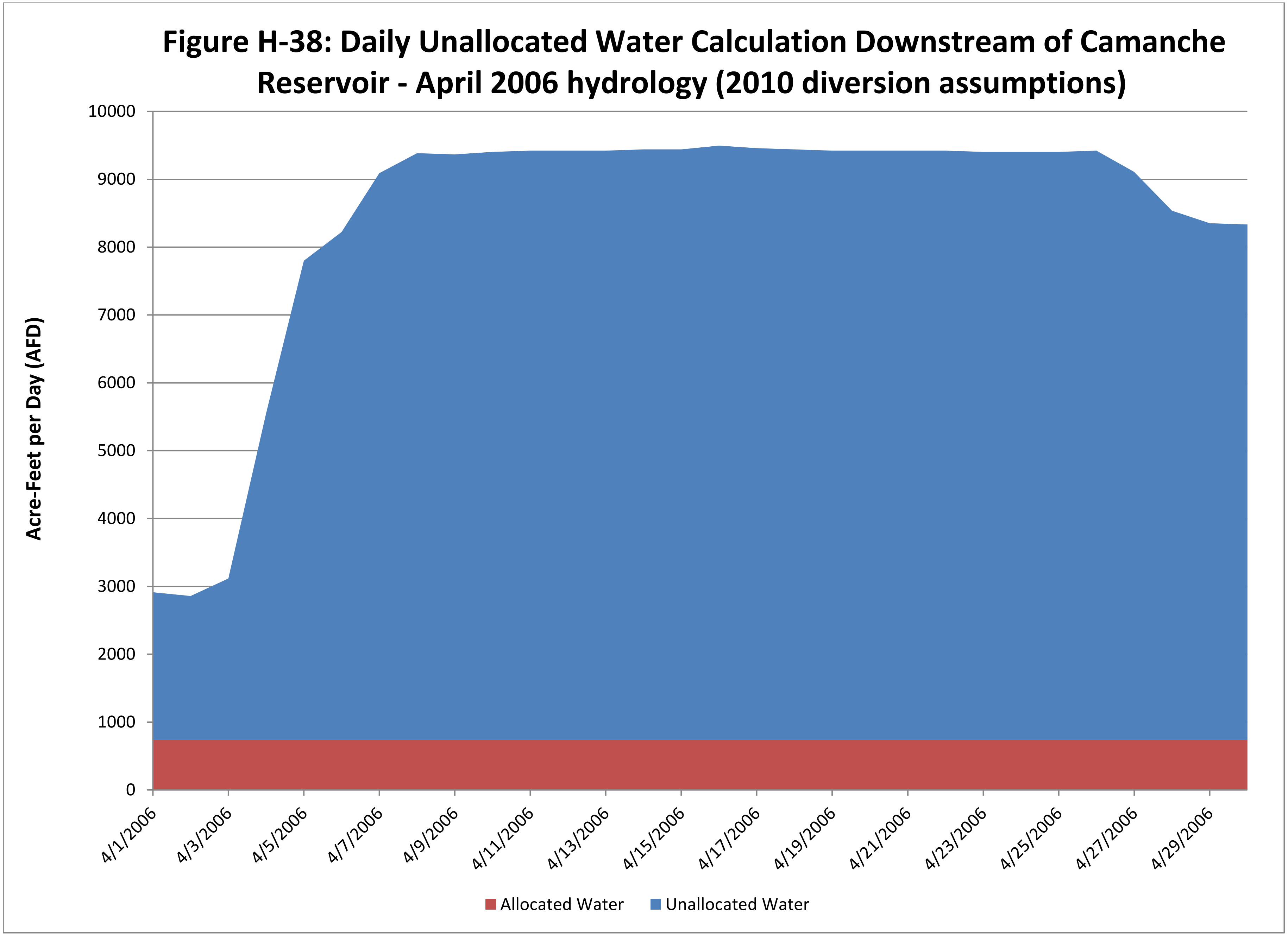


Figure H-38: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - April 2006 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4/1/2006
4/3/2006
4/5/2006
4/7/2006
4/9/2006
4/11/2006
4/13/2006
4/15/2006
4/17/2006
4/19/2006
4/21/2006
4/23/2006
4/25/2006
4/27/2006
4/29/2006
Allocated Water
Unallocated Water

Figure H-39: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - May 2006 hydrology (2010 diversion assumptions)

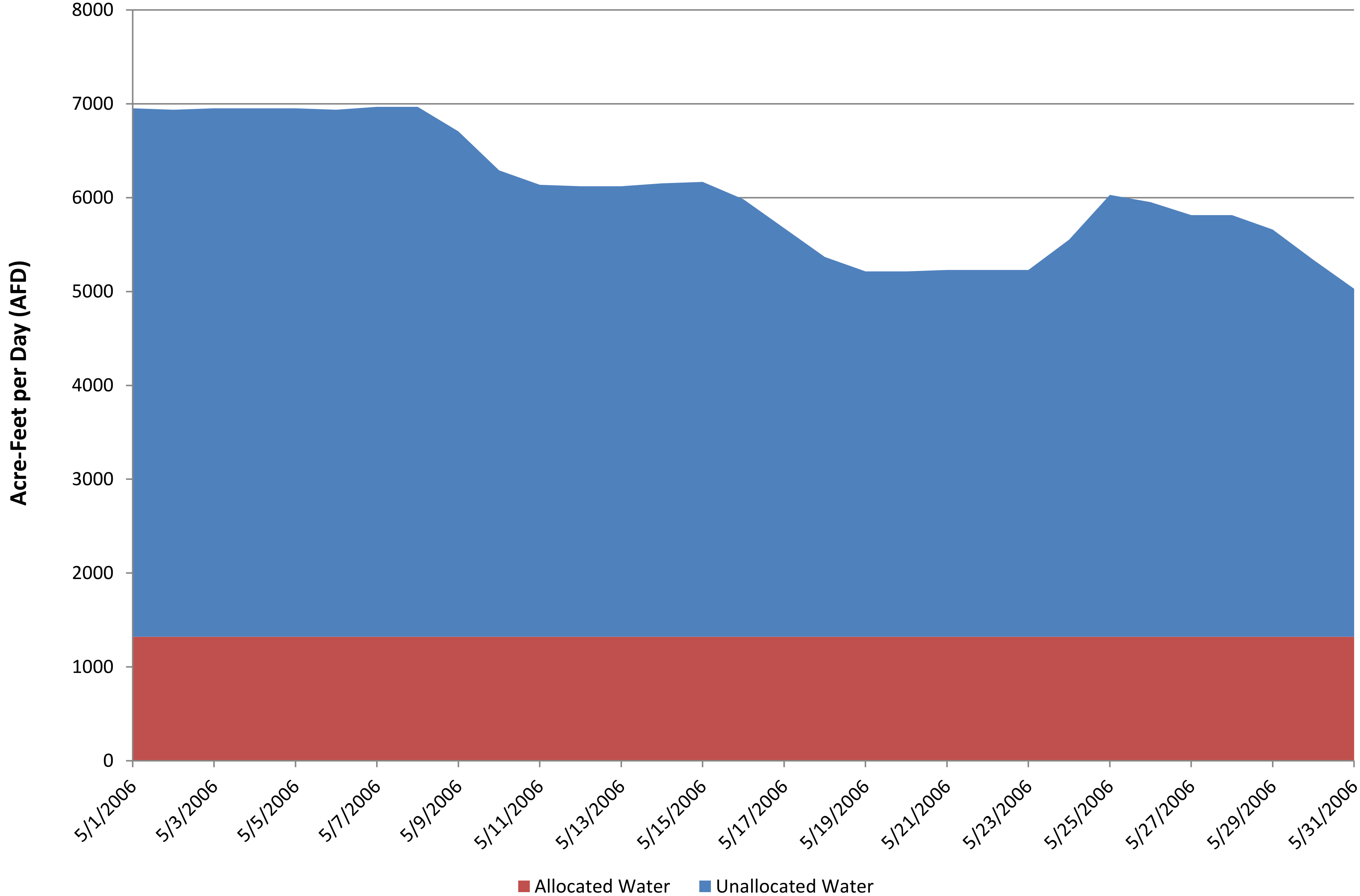
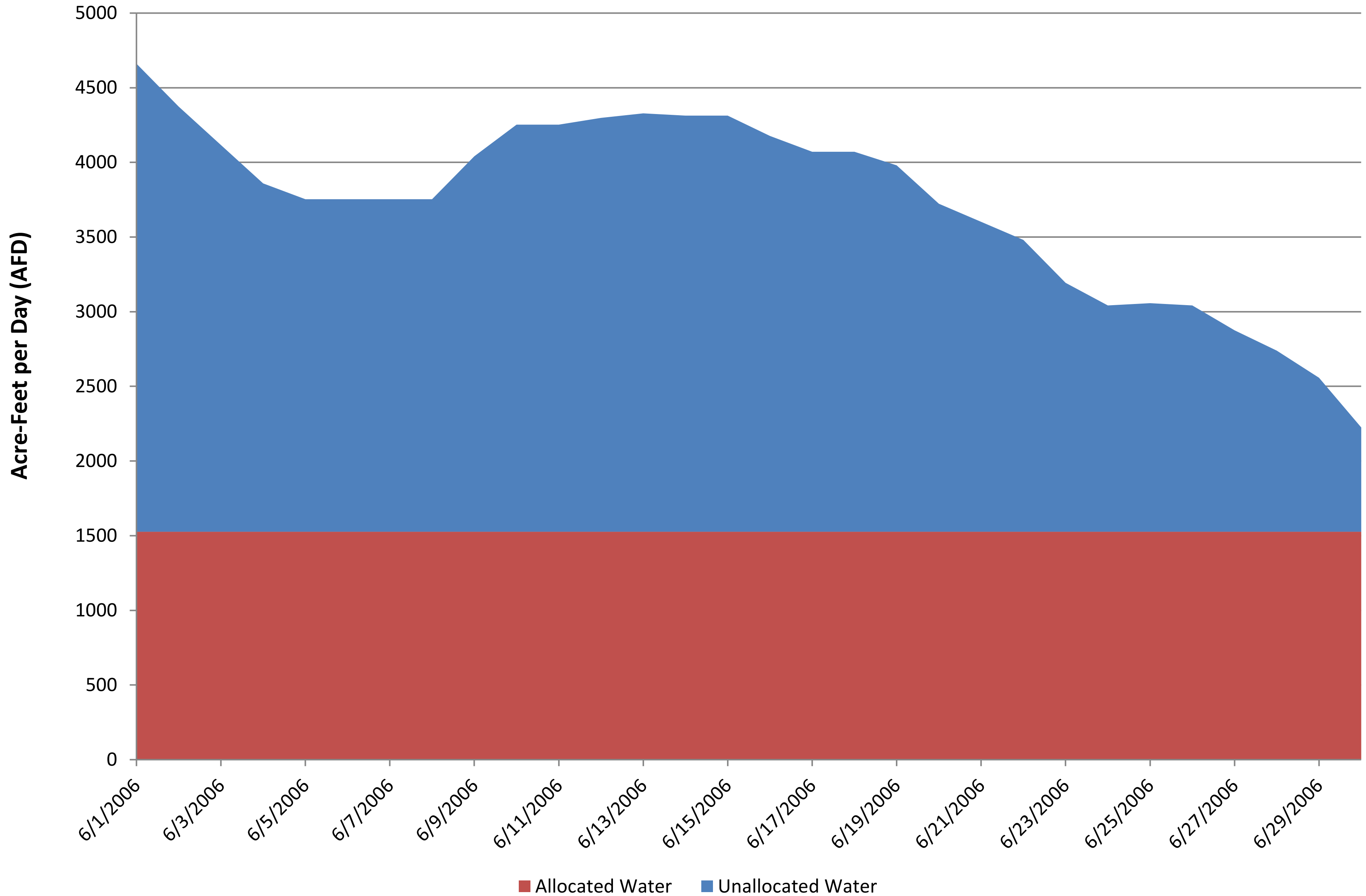


Figure H-40: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - June 2006 hydrology (2010 diversion assumptions)



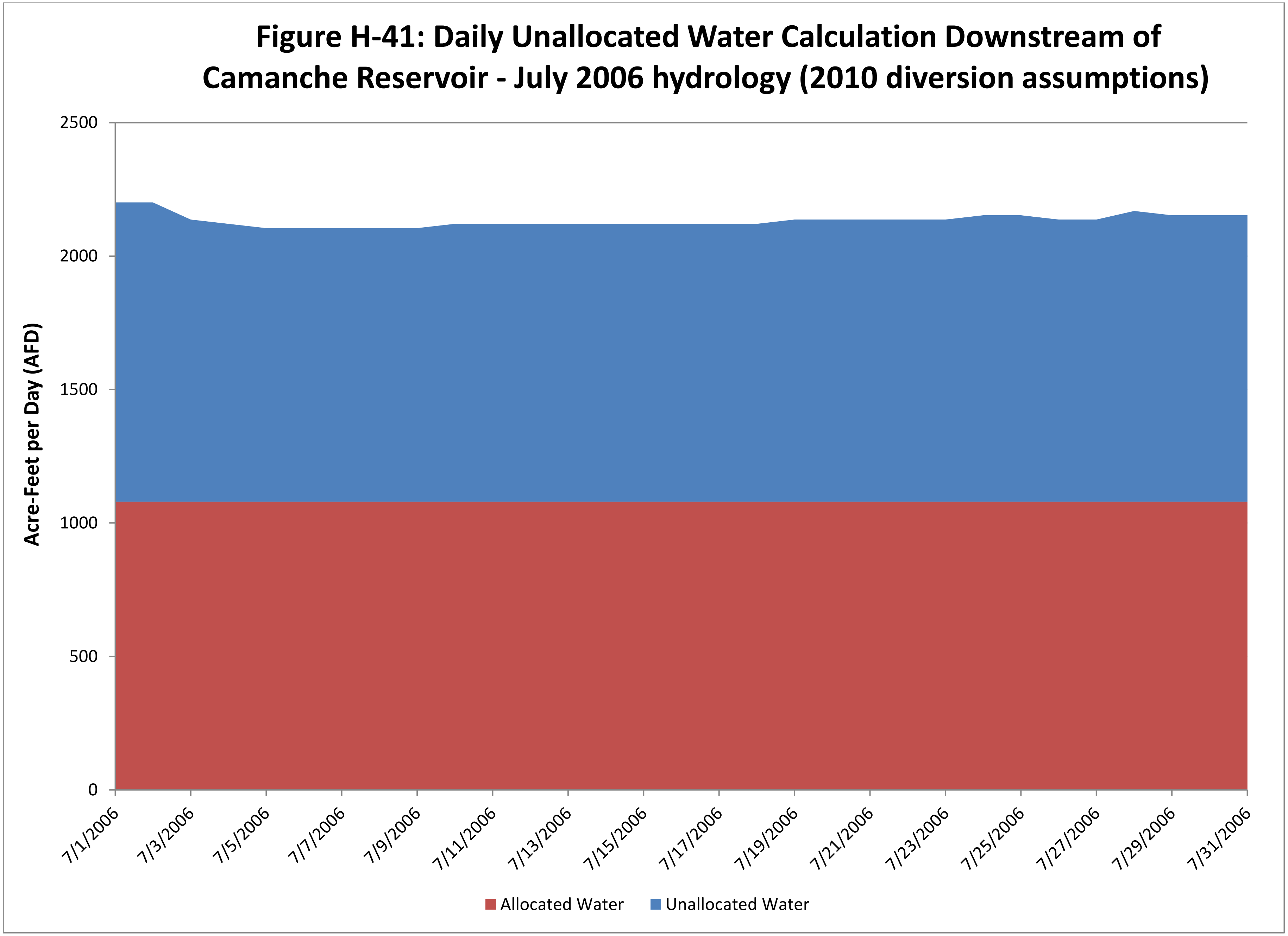


Figure H-41: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - July 2006 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
2500
2000
1500
1000
500
0
7/1/2006
7/3/2006
7/5/2006
7/7/2006
7/9/2006
7/11/2006
7/13/2006
7/15/2006
7/17/2006
7/19/2006
7/21/2006
7/23/2006
7/25/2006
7/27/2006
7/29/2006
7/31/2006
Allocated Water
Unallocated Water

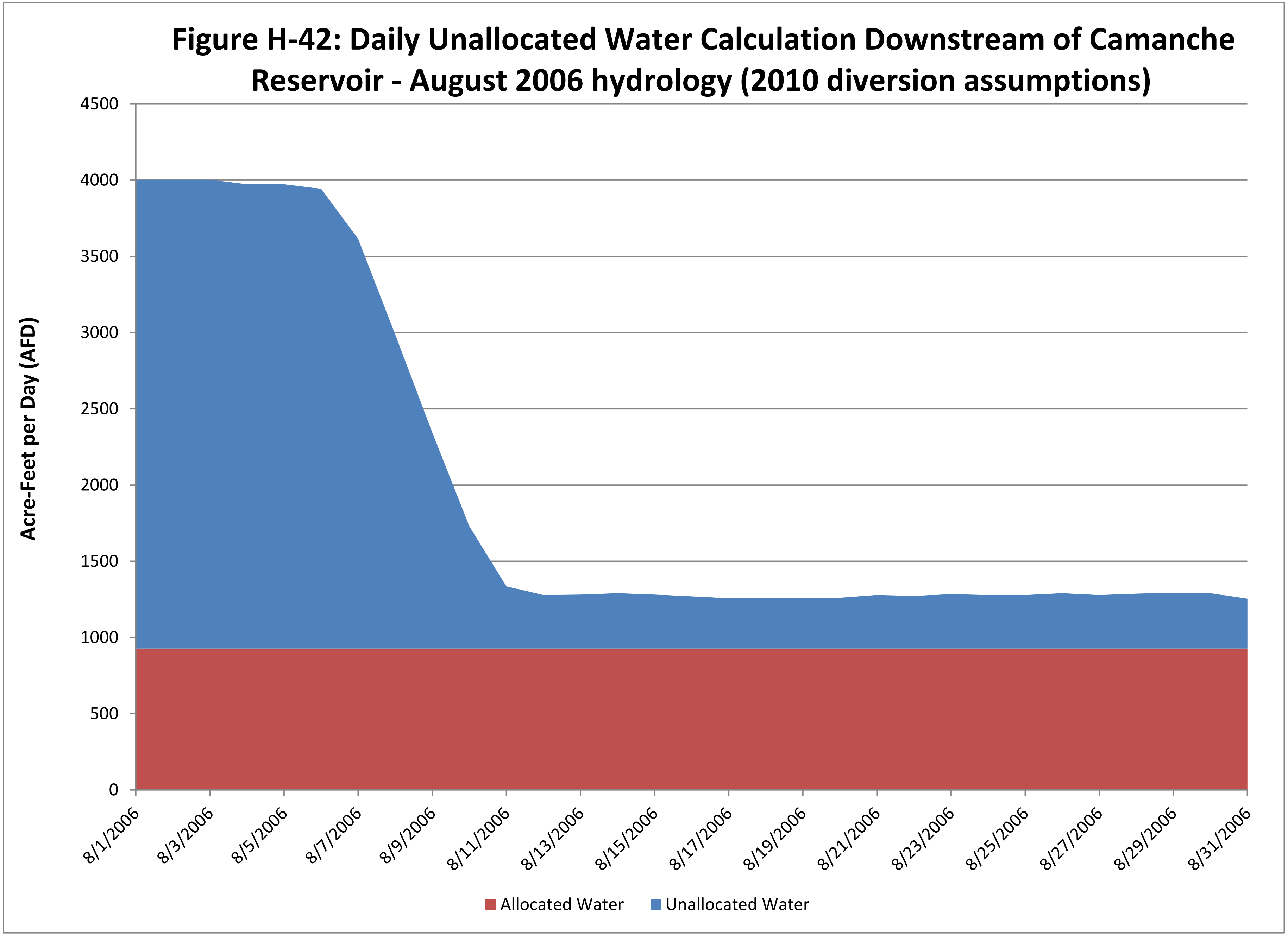


Figure H-42: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - August 2006 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
8/1/2006
8/3/2006
8/5/2006
8/7/2006
8/9/2006
8/11/2006
8/13/2006
8/15/2006
8/17/2006
8/19/2006
8/21/2006
8/23/2006
8/25/2006
8/27/2006
8/29/2006
8/31/2006
Allocated Water
Unallocated Water

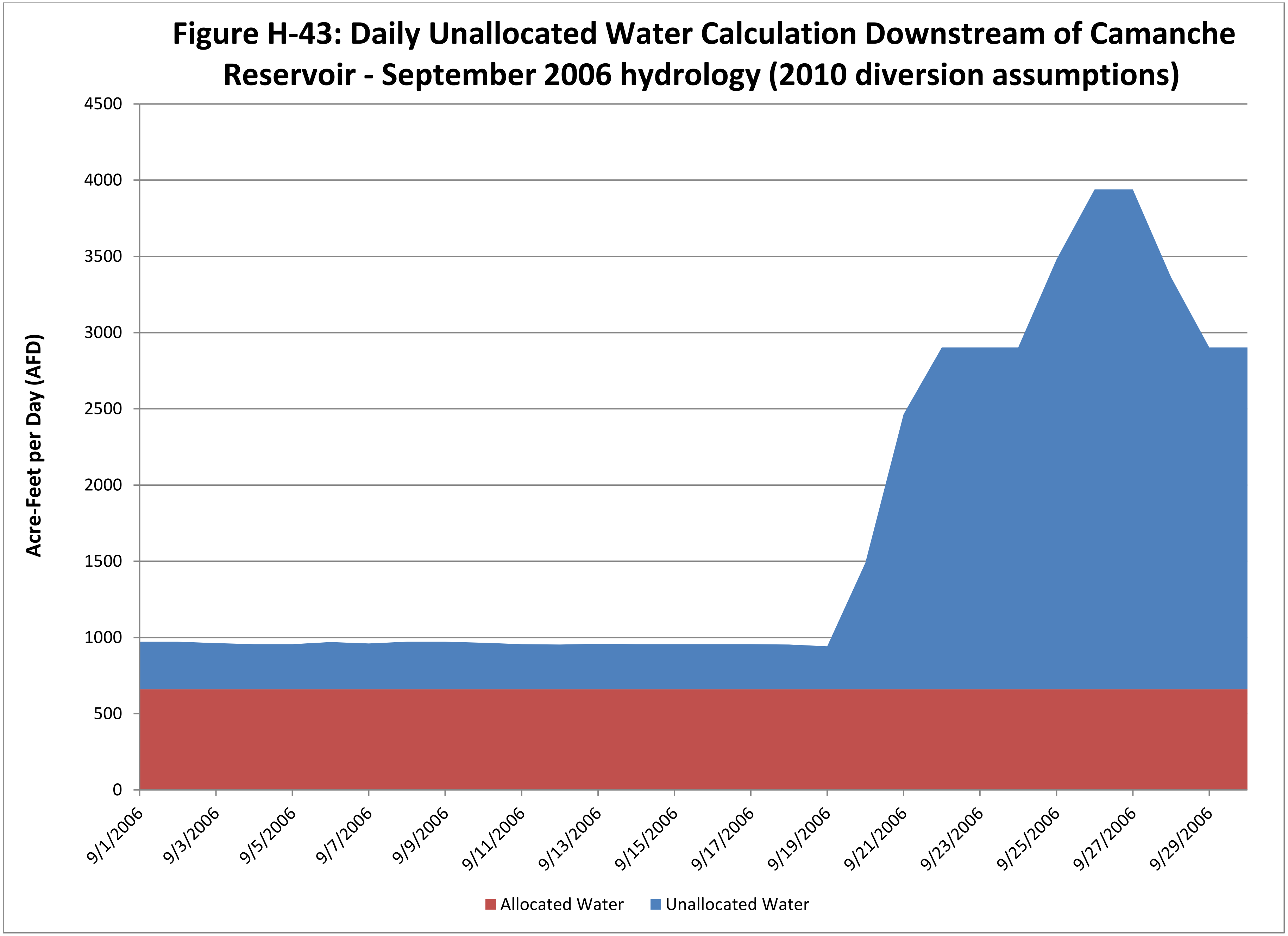


Figure H-43: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - September 2006 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
9/1/2006
9/3/2006
9/5/2006
9/7/2006
9/9/2006
9/11/2006
9/13/2006
9/15/2006
9/17/2006
9/19/2006
9/21/2006
9/23/2006
9/25/2006
9/27/2006
9/29/2006
Allocated Water
Unallocated Water

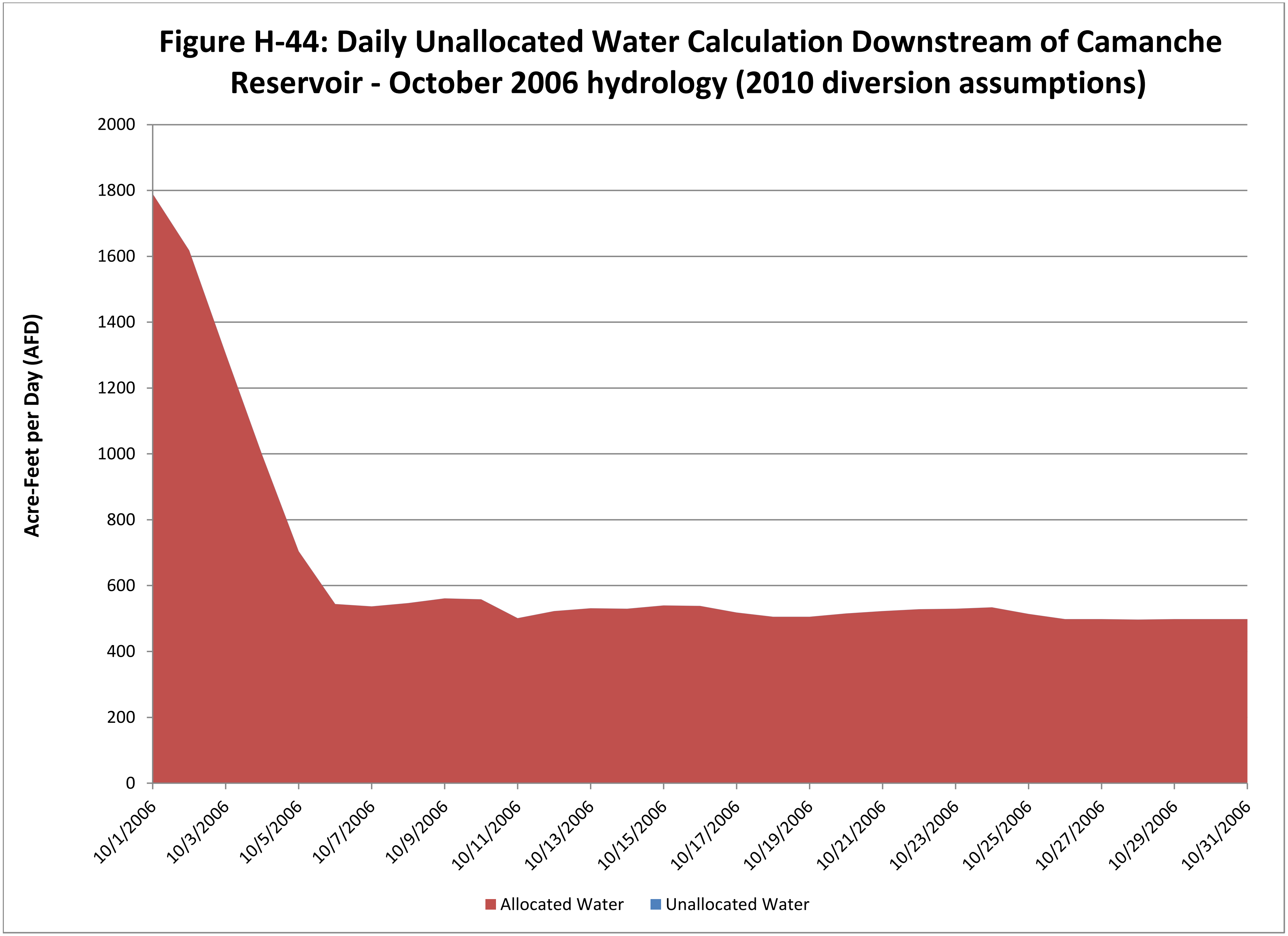


Figure H-44: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - October 2006 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
10/1/2006
10/3/2006
10/5/2006
10/7/2006
10/9/2006
10/11/2006
10/13/2006
10/15/2006
10/17/2006
10/19/2006
10/21/2006
10/23/2006
10/25/2006
10/27/2006
10/29/2006
10/31/2006
Allocated Water
Unallocated Water

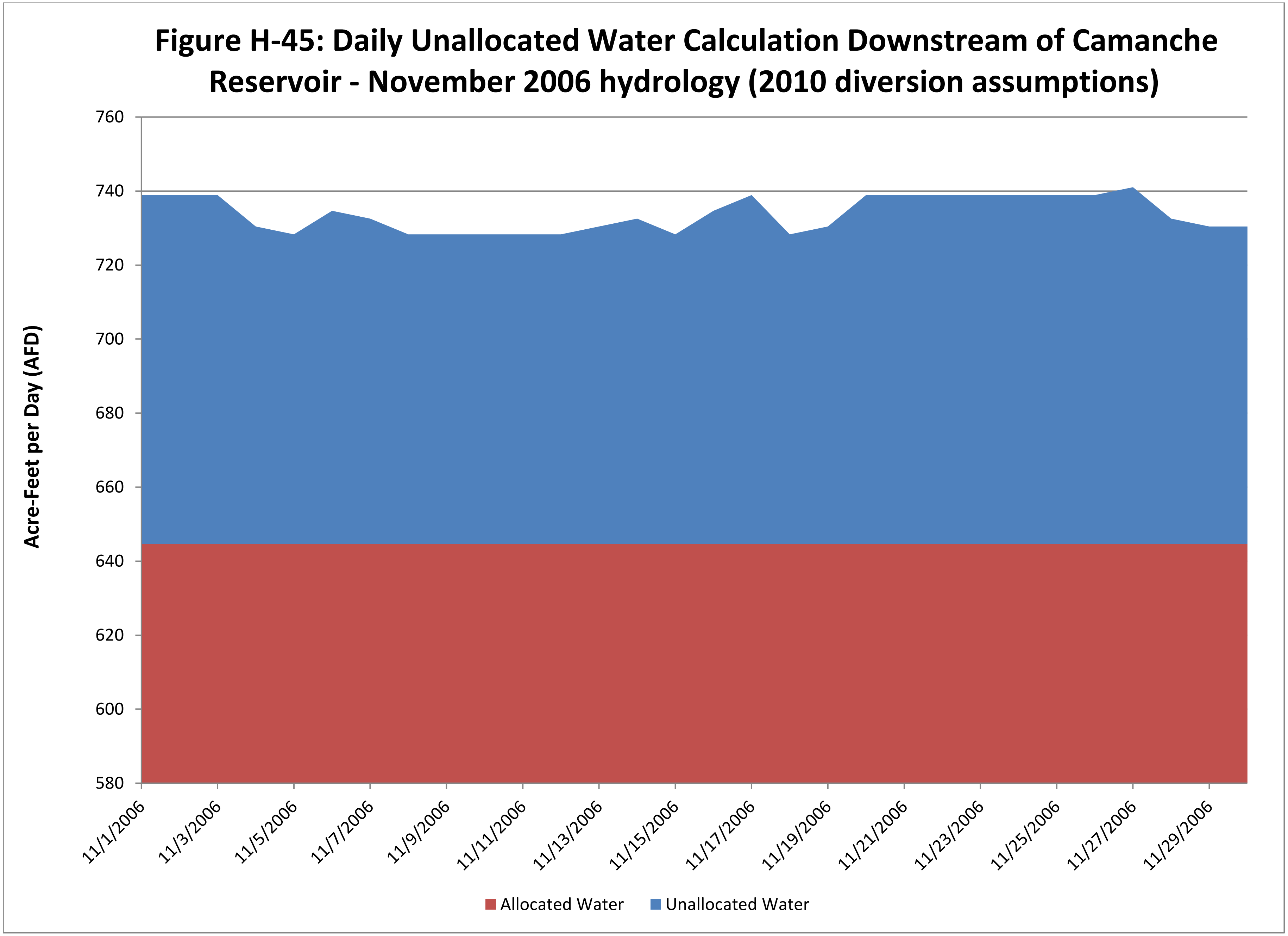


Figure H-45: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - November 2006 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
760
740
720
700
680
660
640
620
600
580
11/1/2006
11/3/2006
11/5/2006
11/7/2006
11/9/2006
11/11/2006
11/13/2006
11/15/2006
11/17/2006
11/19/2006
11/21/2006
11/23/2006
11/25/2006
11/27/2006
11/29/2006
Allocated Water
Unallocated Water

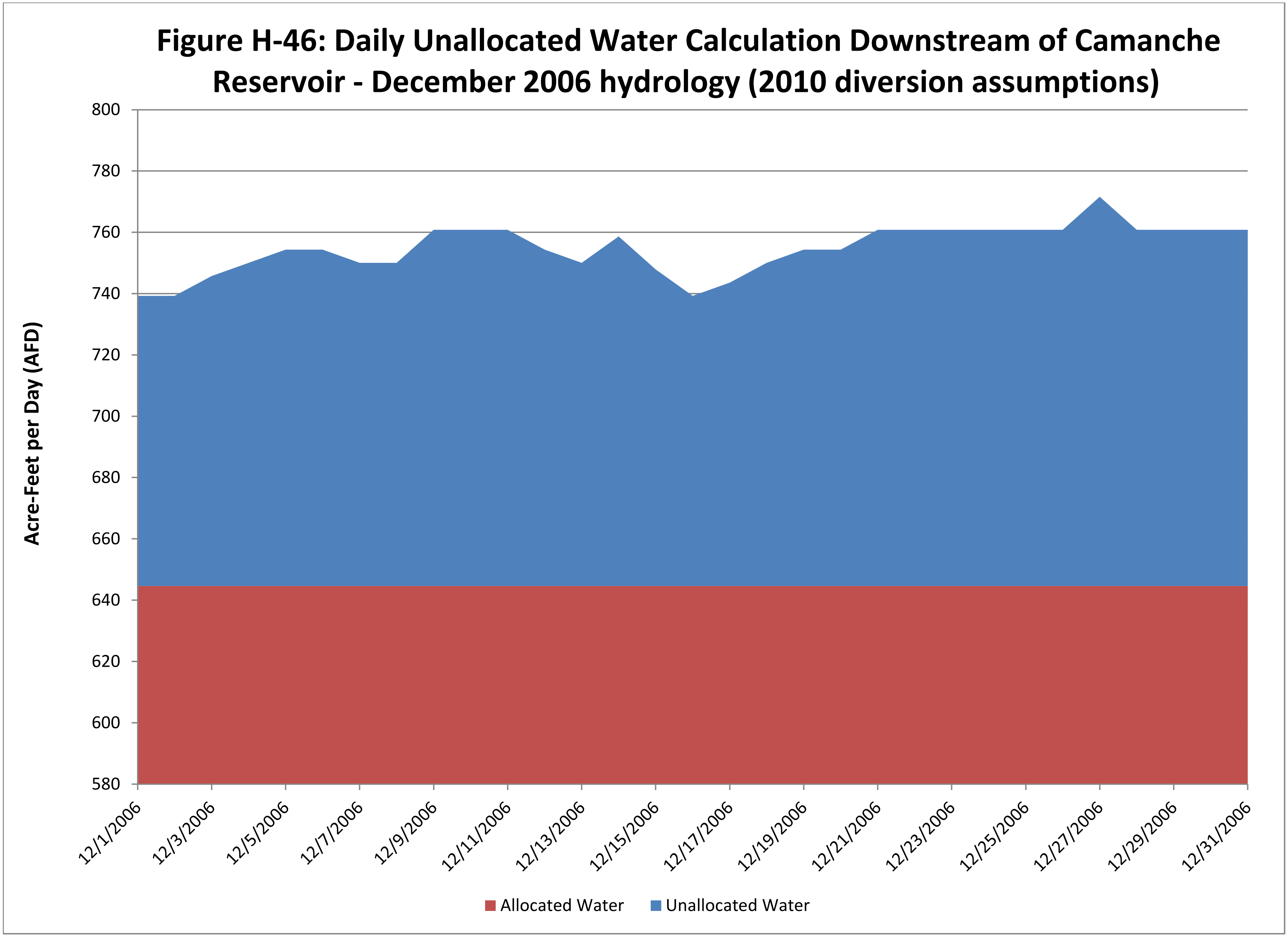


Figure H-46: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - December 2006 hydrology (2010 diversion assumptions)
Acre-Feet per Day (AFD)
800
780
760
740
720
700
680
660
640
620
600
580
12/1/2006
12/3/2006
12/5/2006
12/7/2006
12/9/2006
12/11/2006
12/13/2006
12/15/2006
12/17/2006
12/19/2006
12/21/2006
12/23/2006
12/25/2006
12/27/2006
12/29/2006
12/31/2006
Allocated Water
Unallocated Water

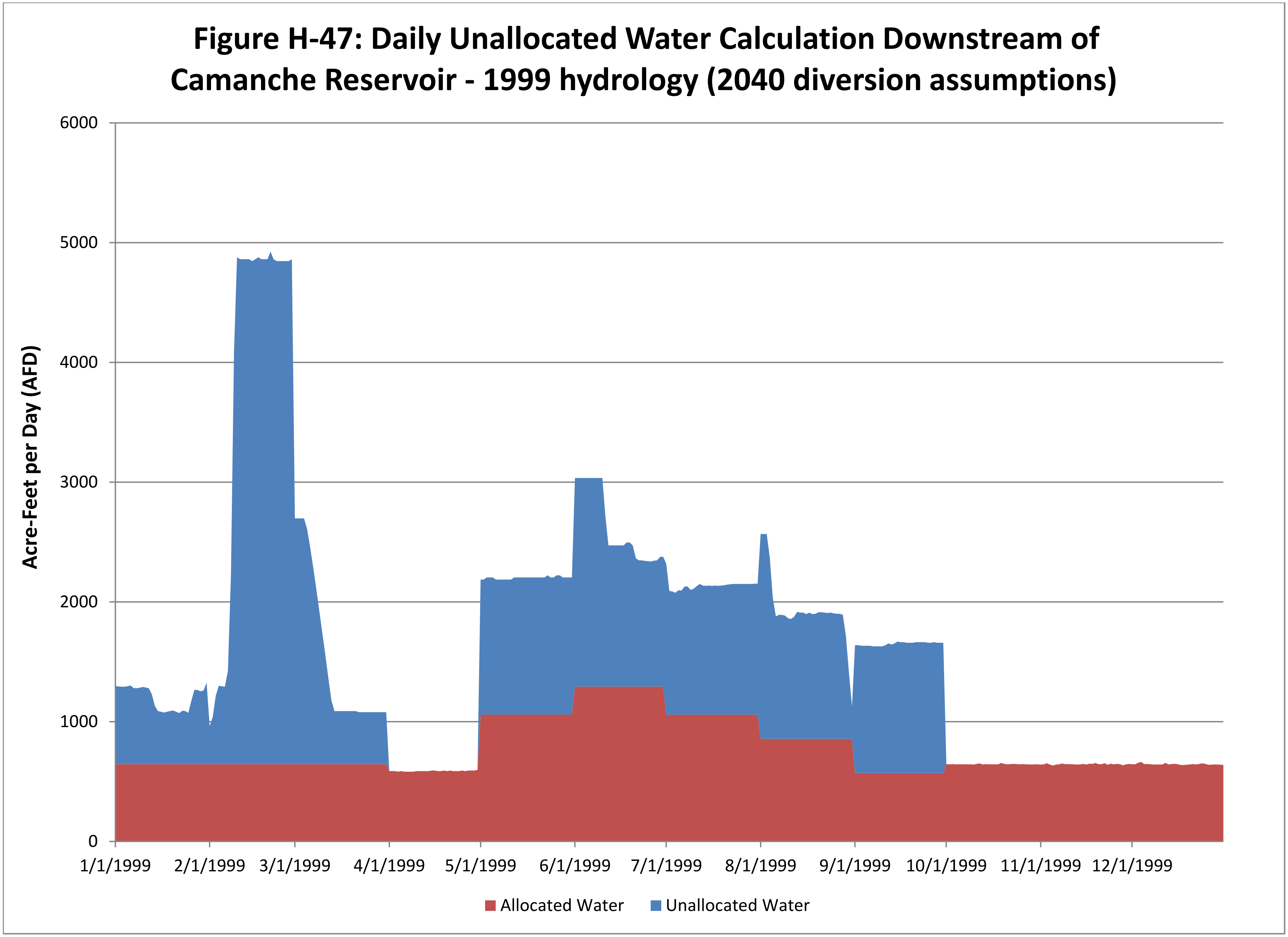


Figure H-47: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 1999 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
6000
5000
4000
3000
2000
1000
0
1/1/1999
2/1/1999
3/1/1999
4/1/1999
5/1/1999
6/1/1999
7/1/1999
8/1/1999
9/1/1999
10/1/1999
11/1/1999
12/1/1999
Allocated Water
Unallocated Water

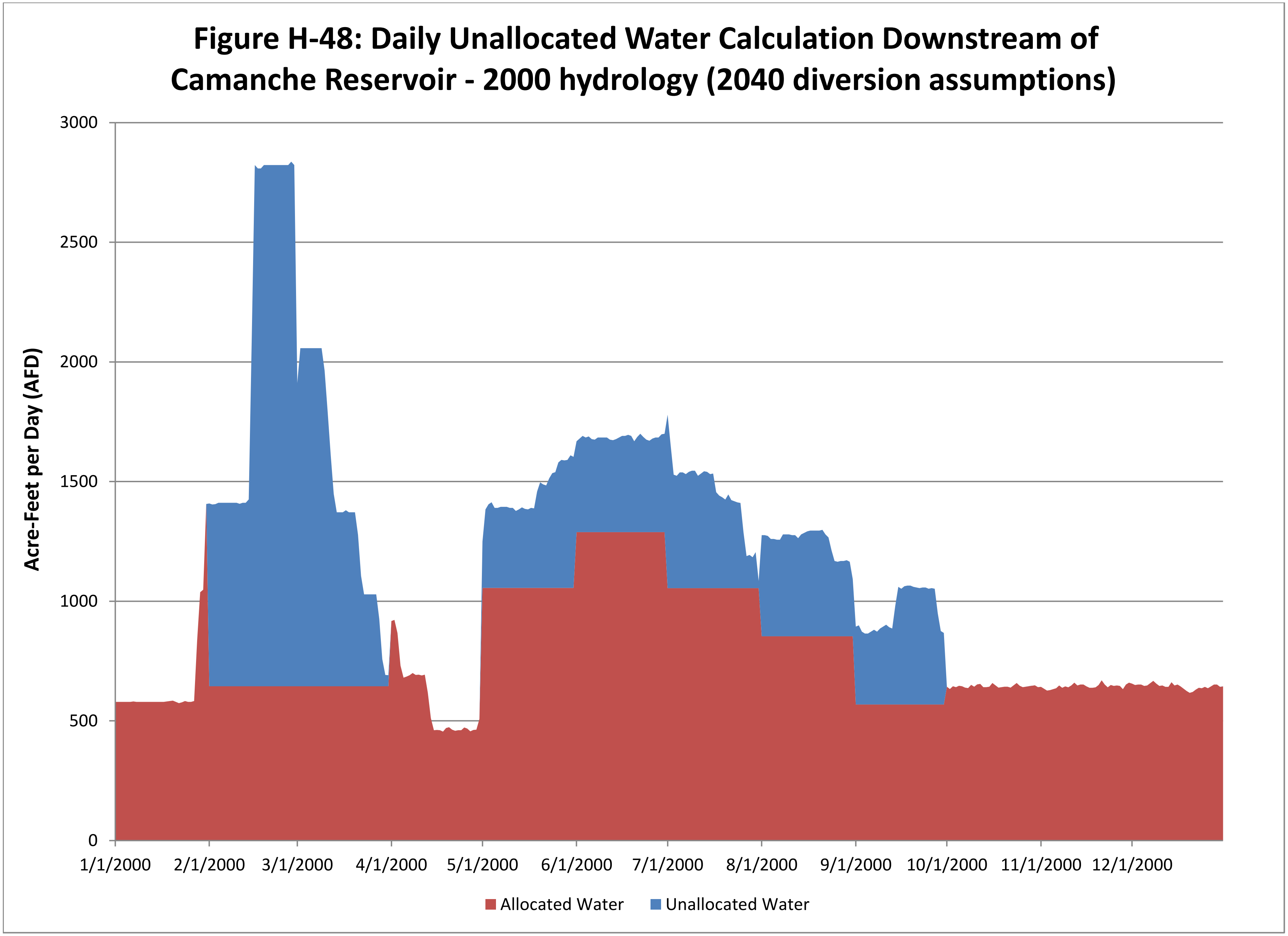
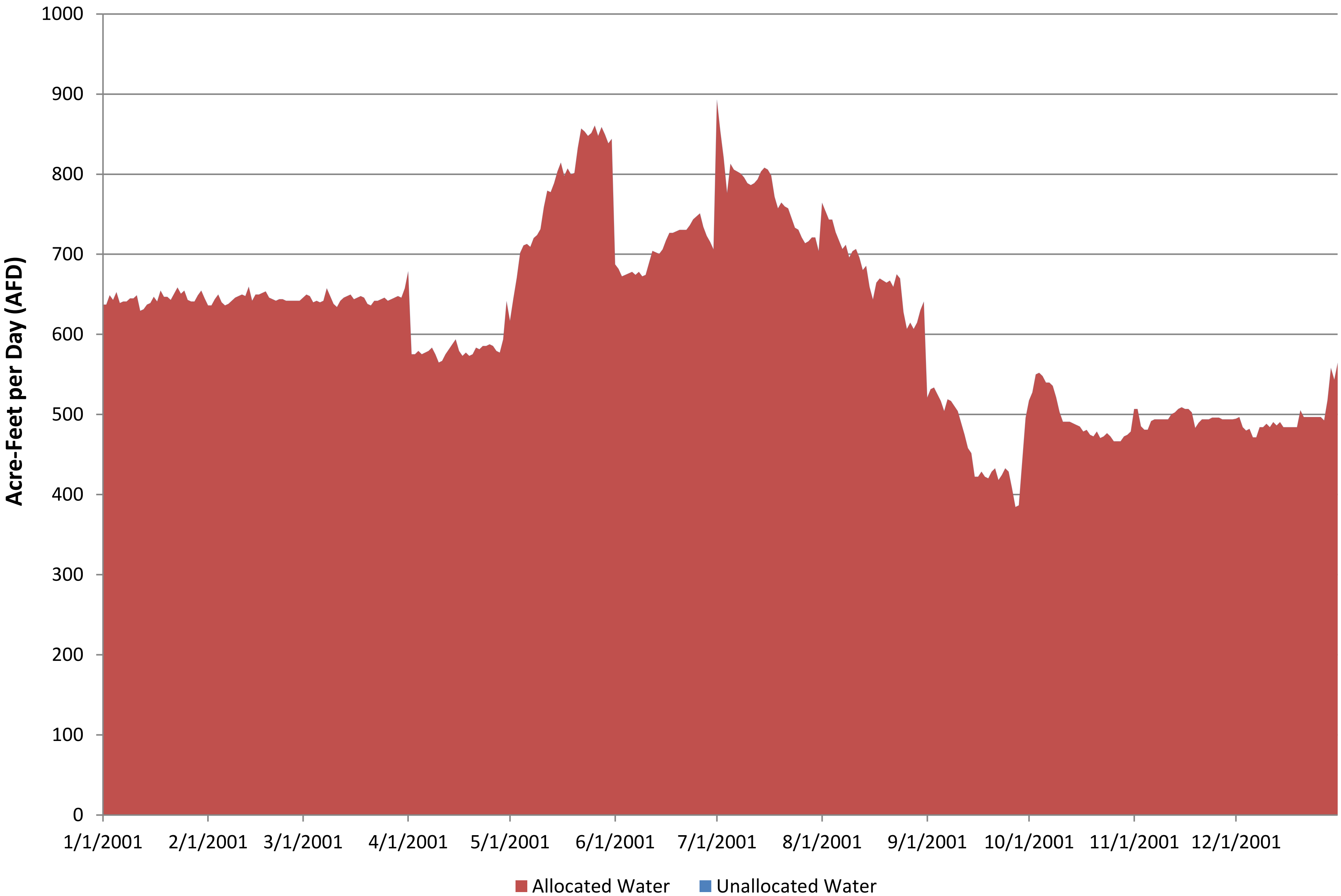


Figure H-48: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2000 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
3000
2500
2000
1500
1000
500
0
1/1/2000
2/1/2000
3/1/2000
4/1/2000
5/1/2000
6/1/2000
7/1/2000
8/1/2000
9/1/2000
10/1/2000
11/1/2000
12/1/2000
Allocated Water
Unallocated Water

Figure H-49: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2001 hydrology (2040 diversion assumptions)



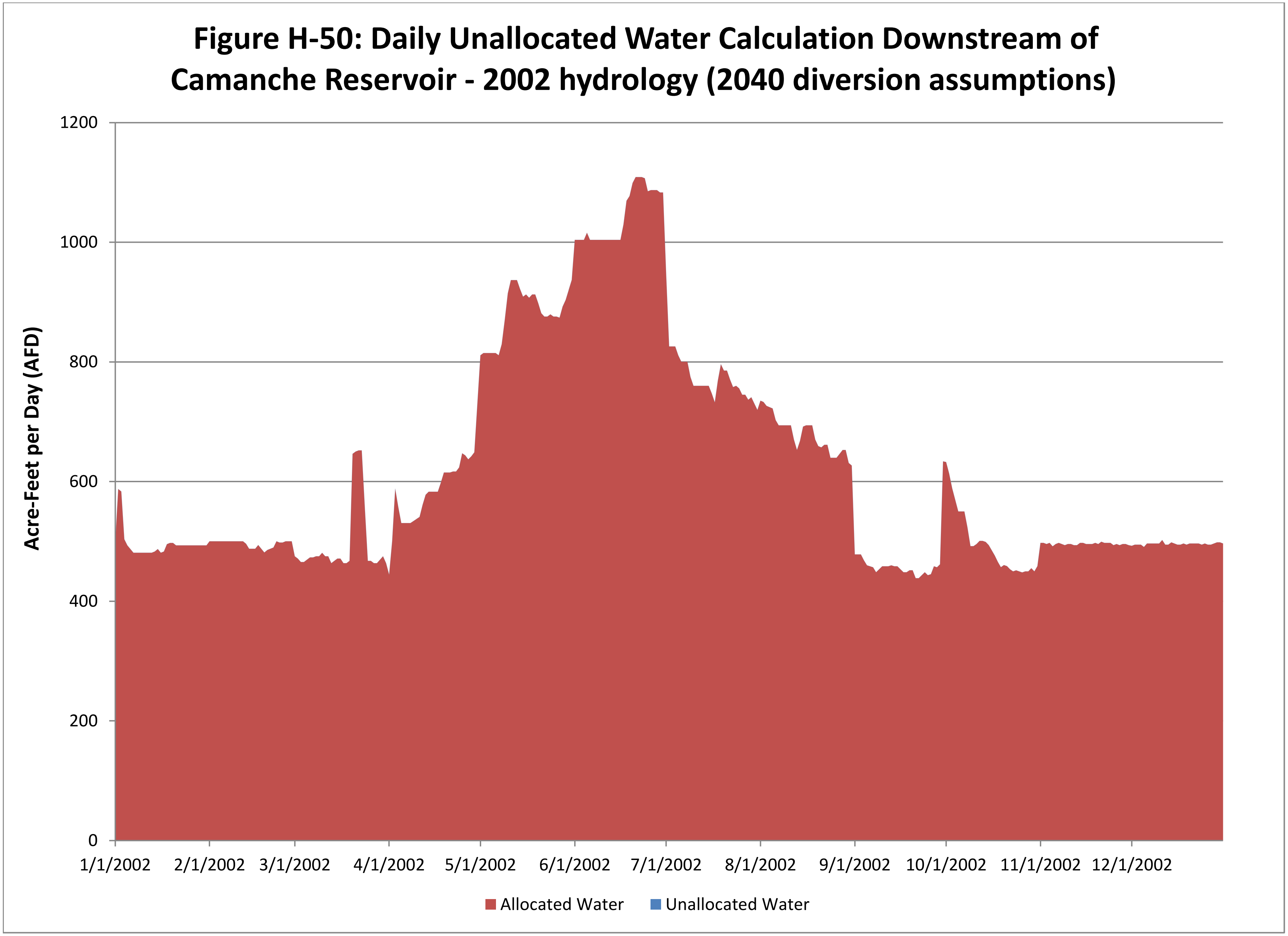


Figure H-50: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2002 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
1200
1000
800
600
400
200
0
1/1/2002
2/1/2002
3/1/2002
4/1/2002
5/1/2002
6/1/2002
7/1/2002
8/1/2002
9/1/2002
10/1/2002
11/1/2002
12/1/2002
Allocated Water
Unallocated Water

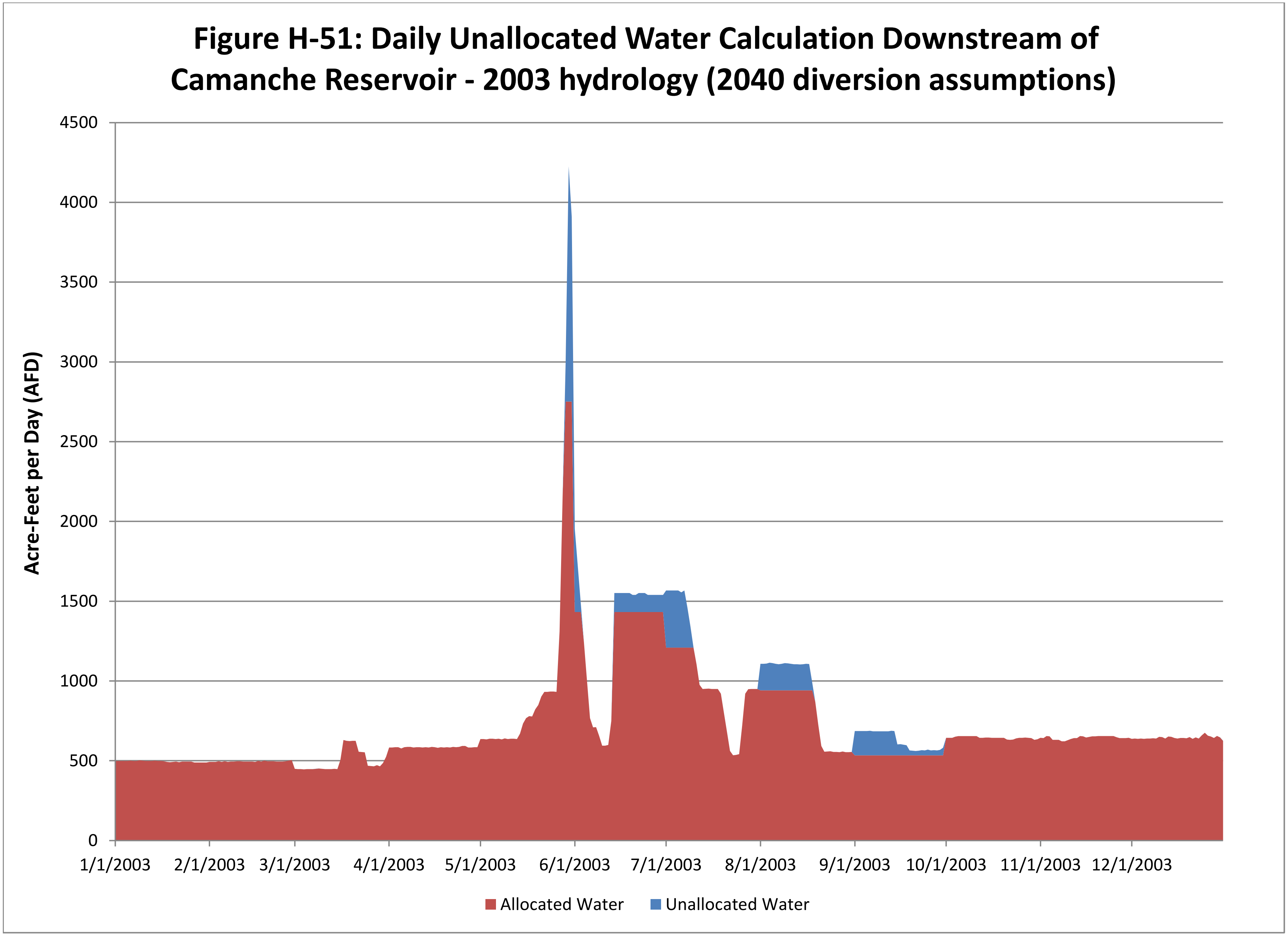


Figure H-51: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2003 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/2003
12/1/2003
Allocated Water
Unallocated Water

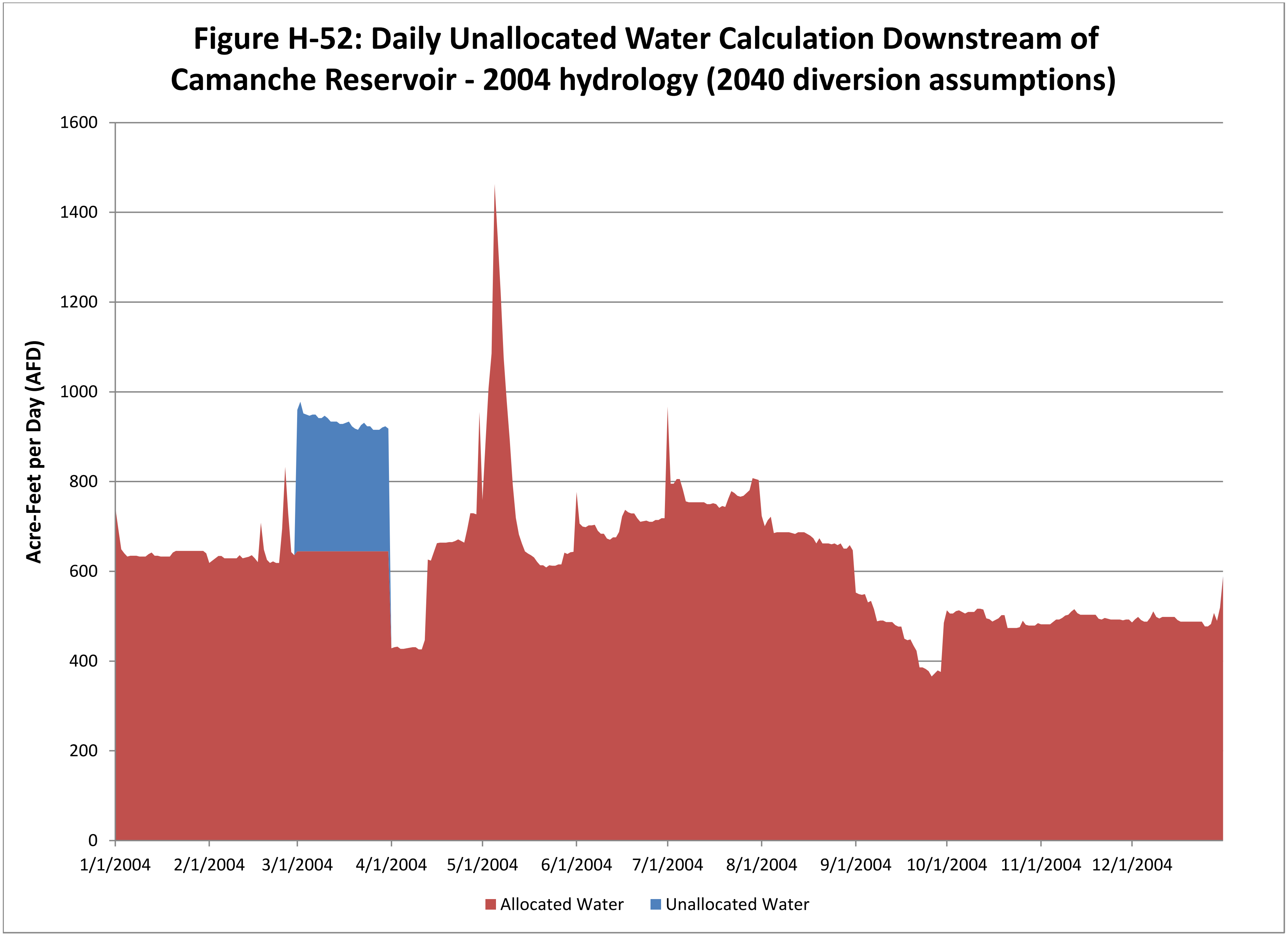


Figure H-52: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2004 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
1600
1400
1200
1000
800
600
400
200
0
1/1/2004
2/1/2004
3/1/2004
4/1/2004
5/1/2004
6/1/2004
7/1/2004
8/1/2004
9/1/2004
10/1/2004
11/1/2004
12/1/2004
Allocated Water
Unallocated Water

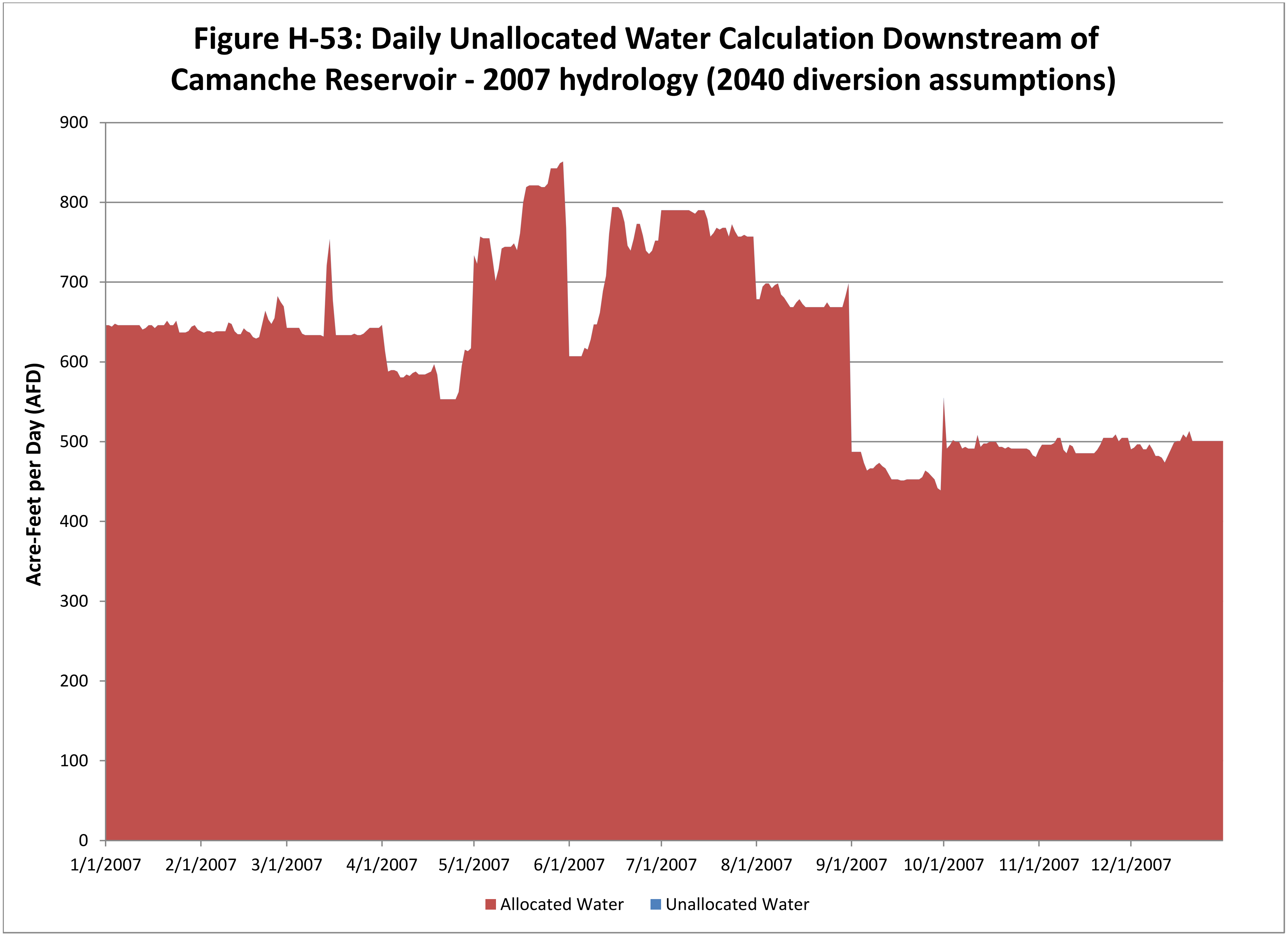


Figure H-53: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2007 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
900
800
700
600
500
400
300
200
100
0
1/1/2007
2/1/2007
3/1/2007
4/1/2007
5/1/2007
6/1/2007
7/1/2007
8/1/2007
9/1/2007
10/1/2007
11/1/2007
12/1/2007
Allocated Water
Unallocated Water

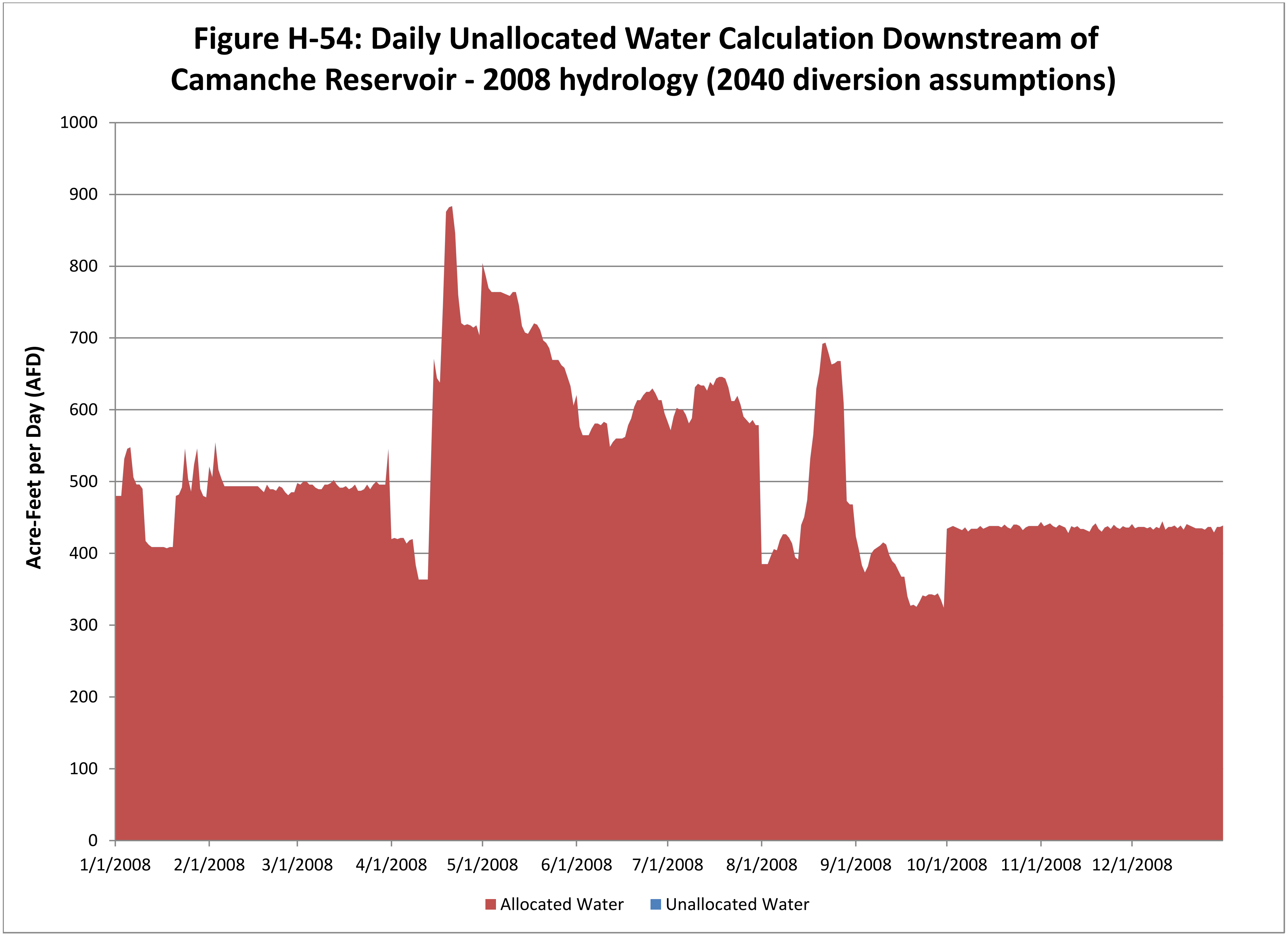


Figure H-54: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2008 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
1000
900
800
700
600
500
400
300
200
100
0
1/1/2008
2/1/2008
3/1/2008
4/1/2008
5/1/2008
6/1/2008
7/1/2008
8/1/2008
9/1/2008
10/1/2008
11/1/2008
12/1/2008
Allocated Water
Unallocated Water

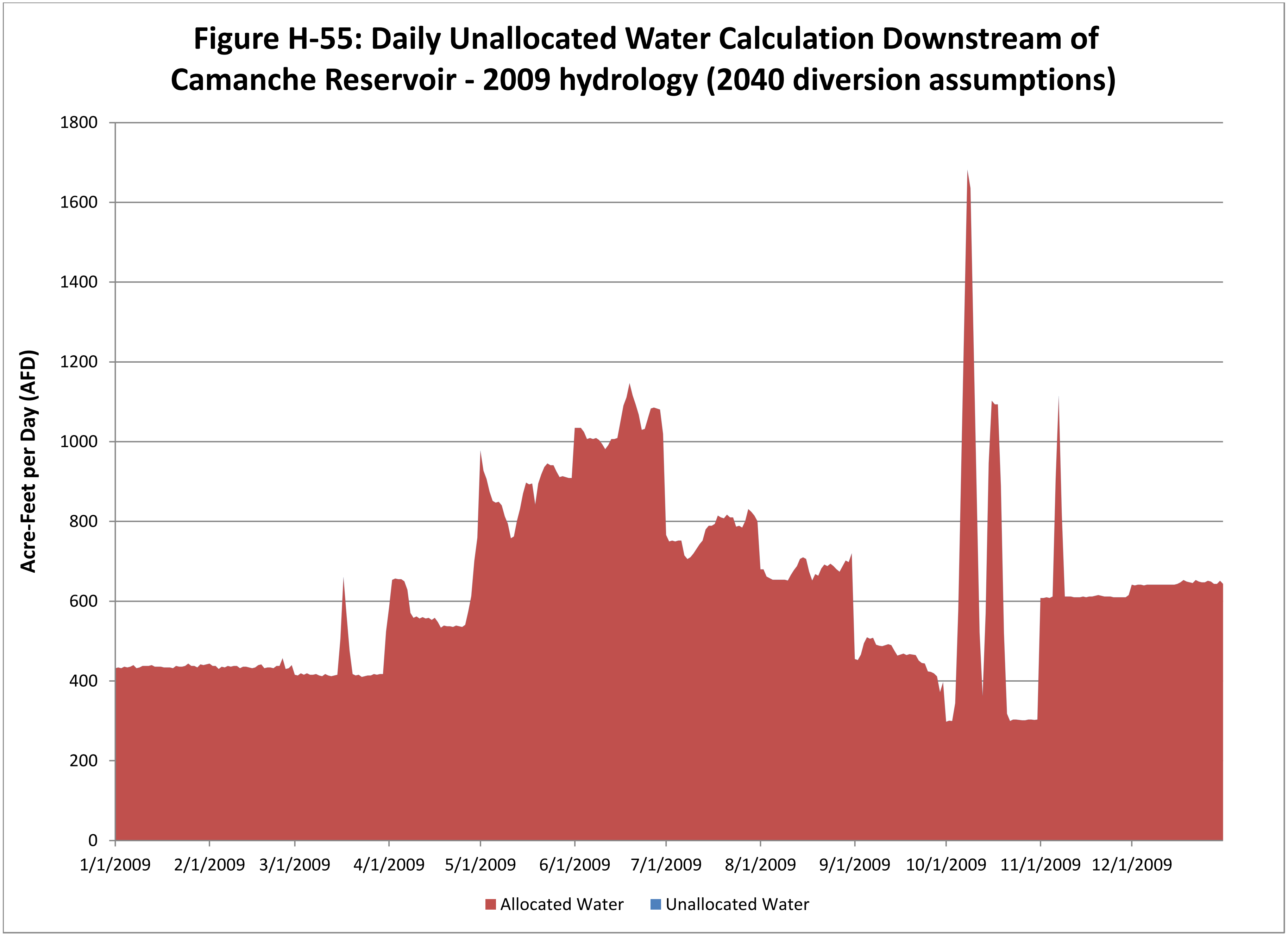
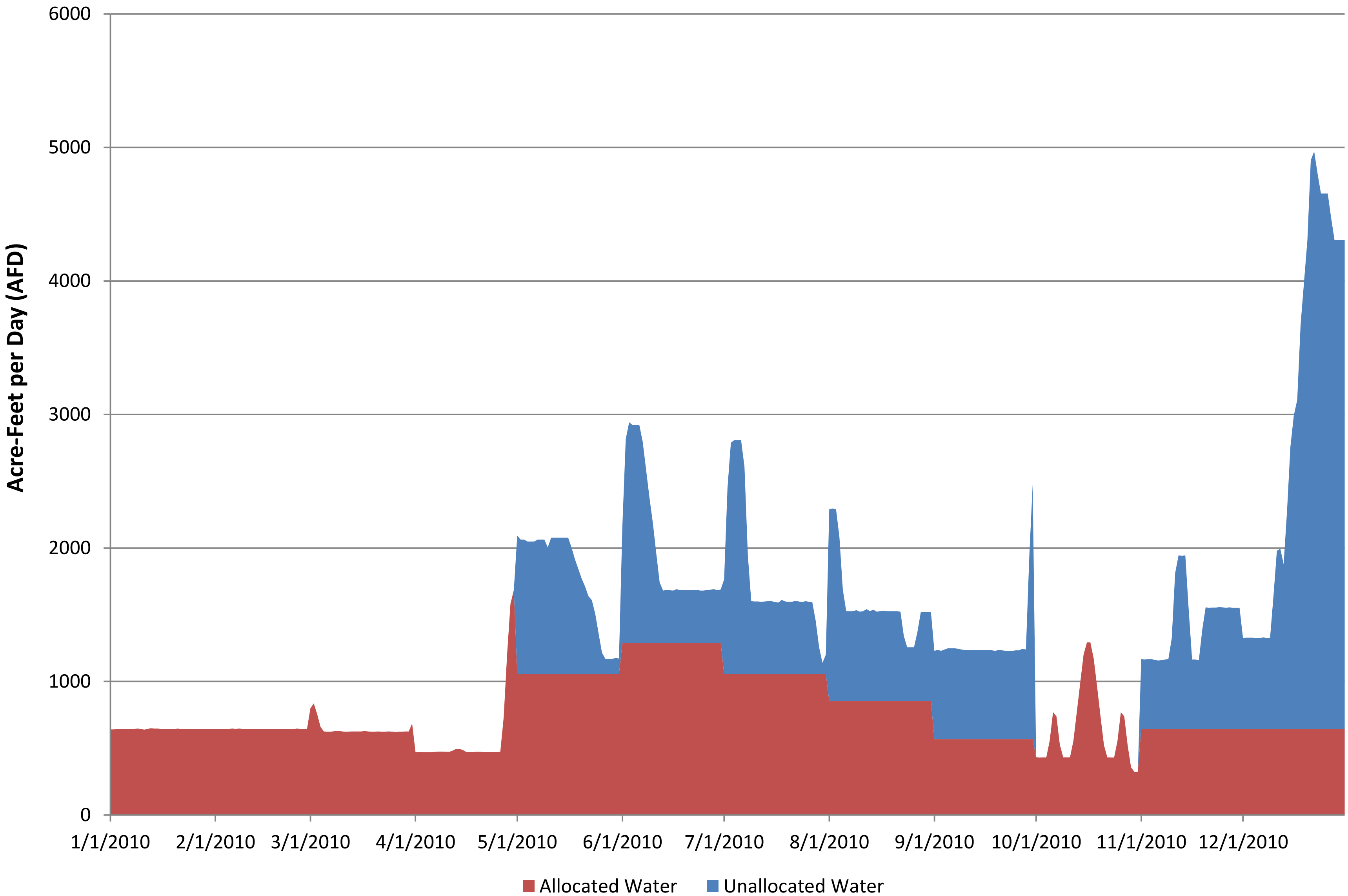


Figure H-55: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2009 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
1800
1600
1400
1200
1000
800
600
400
200
0
1/1/2009
2/1/2009
3/1/2009
4/1/2009
5/1/2009
6/1/2009
7/1/2009
8/1/2009
9/1/2009
10/1/2009
11/1/2009
12/1/2009
Allocated Water
Unallocated Water

Figure H-56: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - 2010 hydrology (2040 diversion assumptions)



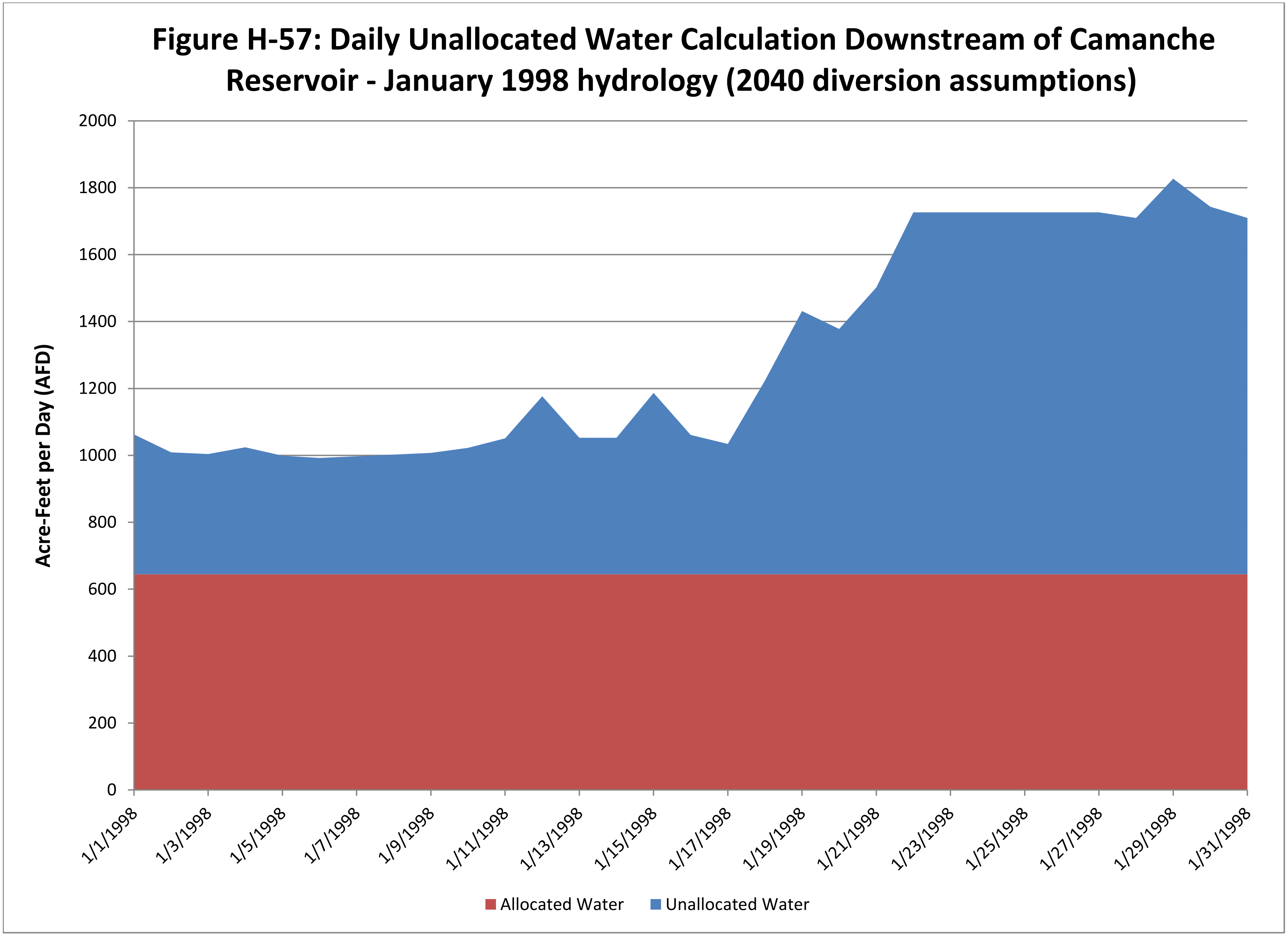


Figure H-57: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - January 1998 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1/1/1998
1/3/1998
1/5/1998
1/7/1998
1/9/1998
1/11/1998
1/13/1998
1/15/1998
1/17/1998
1/19/1998
1/21/1998
1/23/1998
1/25/1998
1/27/1998
1/29/1998
1/31/1998
Allocated Water
Unallocated Water

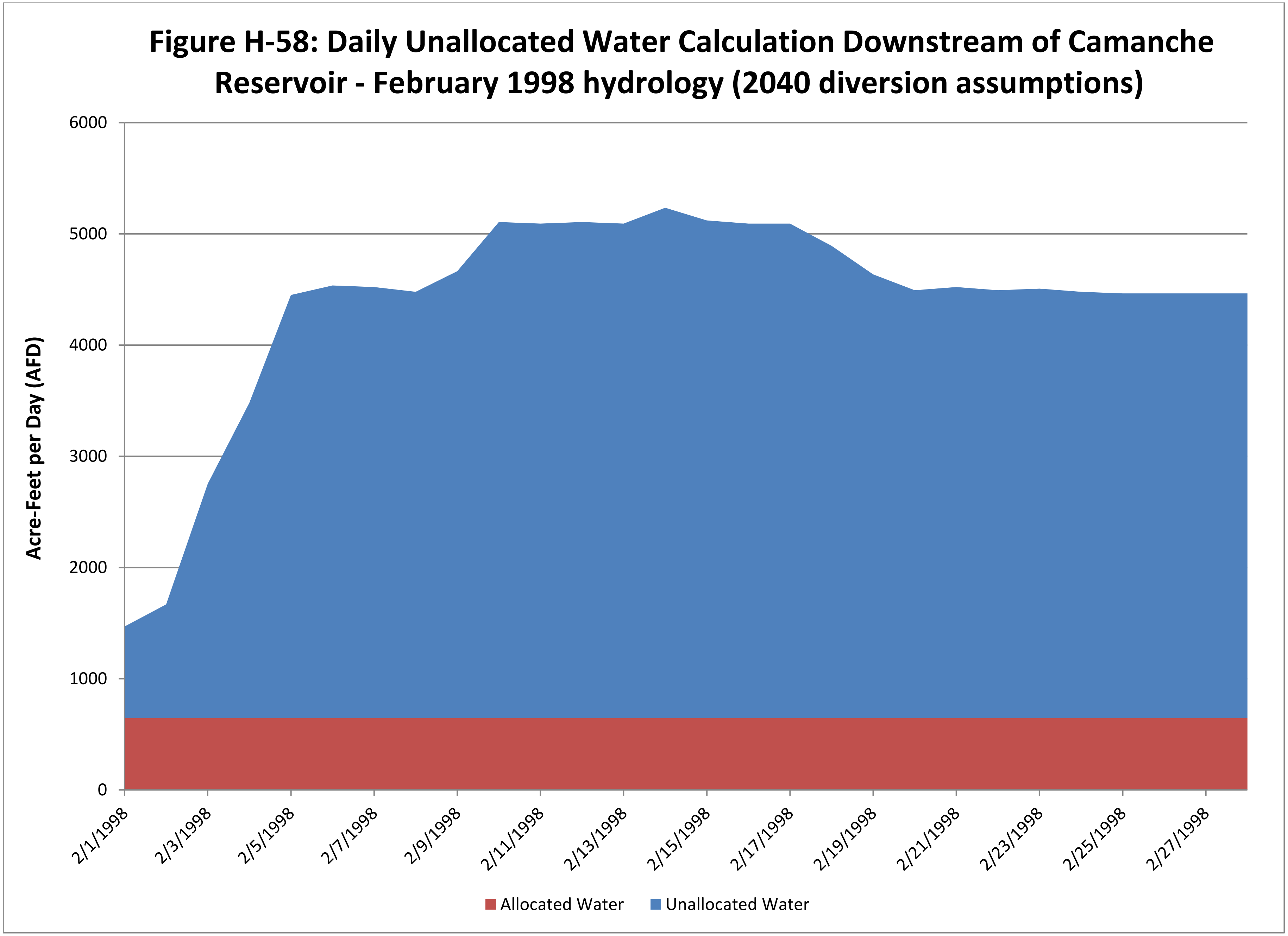
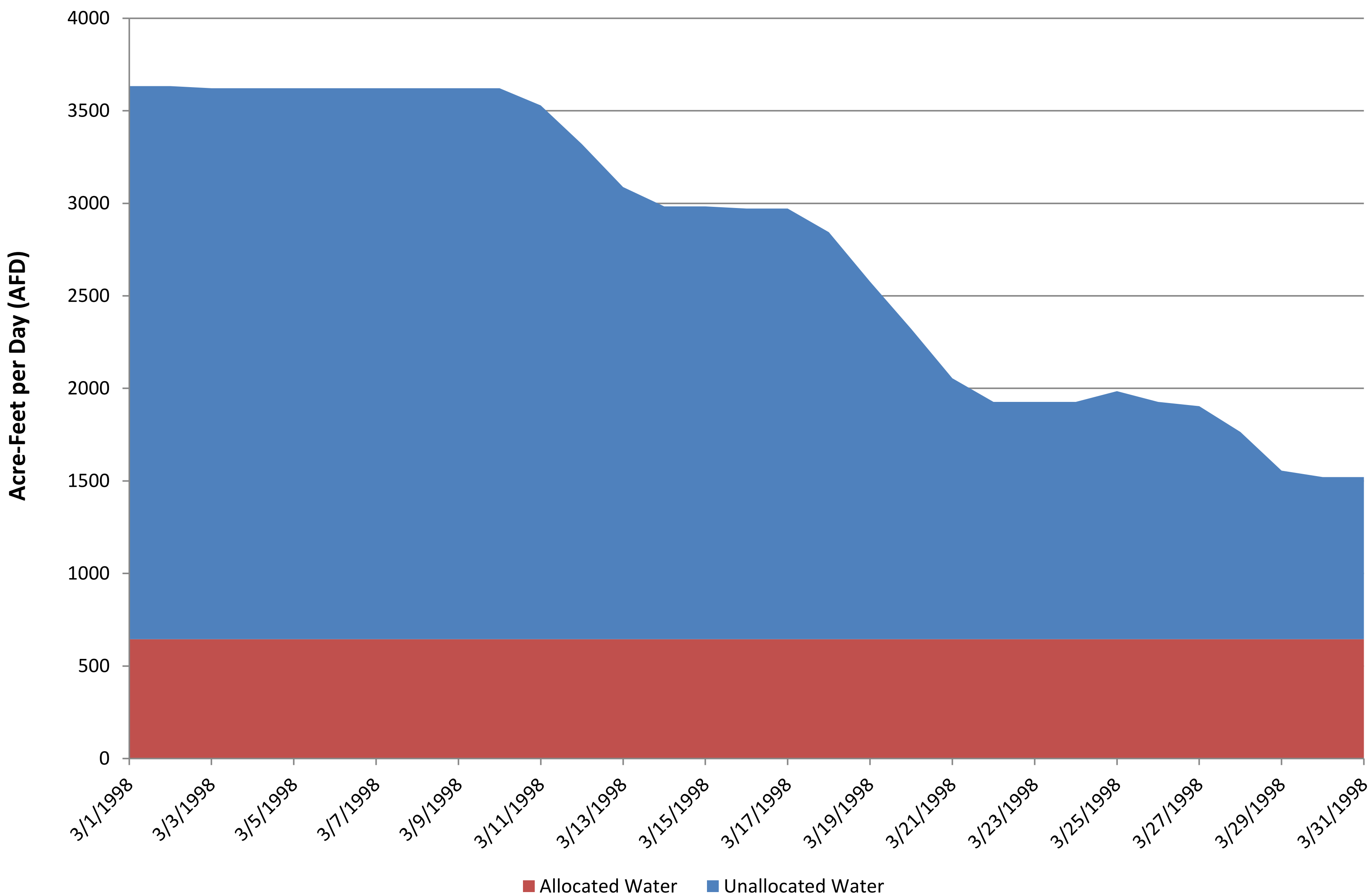


Figure H-58: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - February 1998 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
6000
5000
4000
3000
2000
1000
0
2/1/1998
2/3/1998
2/5/1998
2/7/1998
2/9/1998
2/11/1998
2/13/1998
2/15/1998
2/17/1998
2/19/1998
2/21/1998
2/23/1998
2/25/1998
2/27/1998
Allocated Water
Unallocated Water

Figure H-59: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - March 1998 hydrology (2040 diversion assumptions)



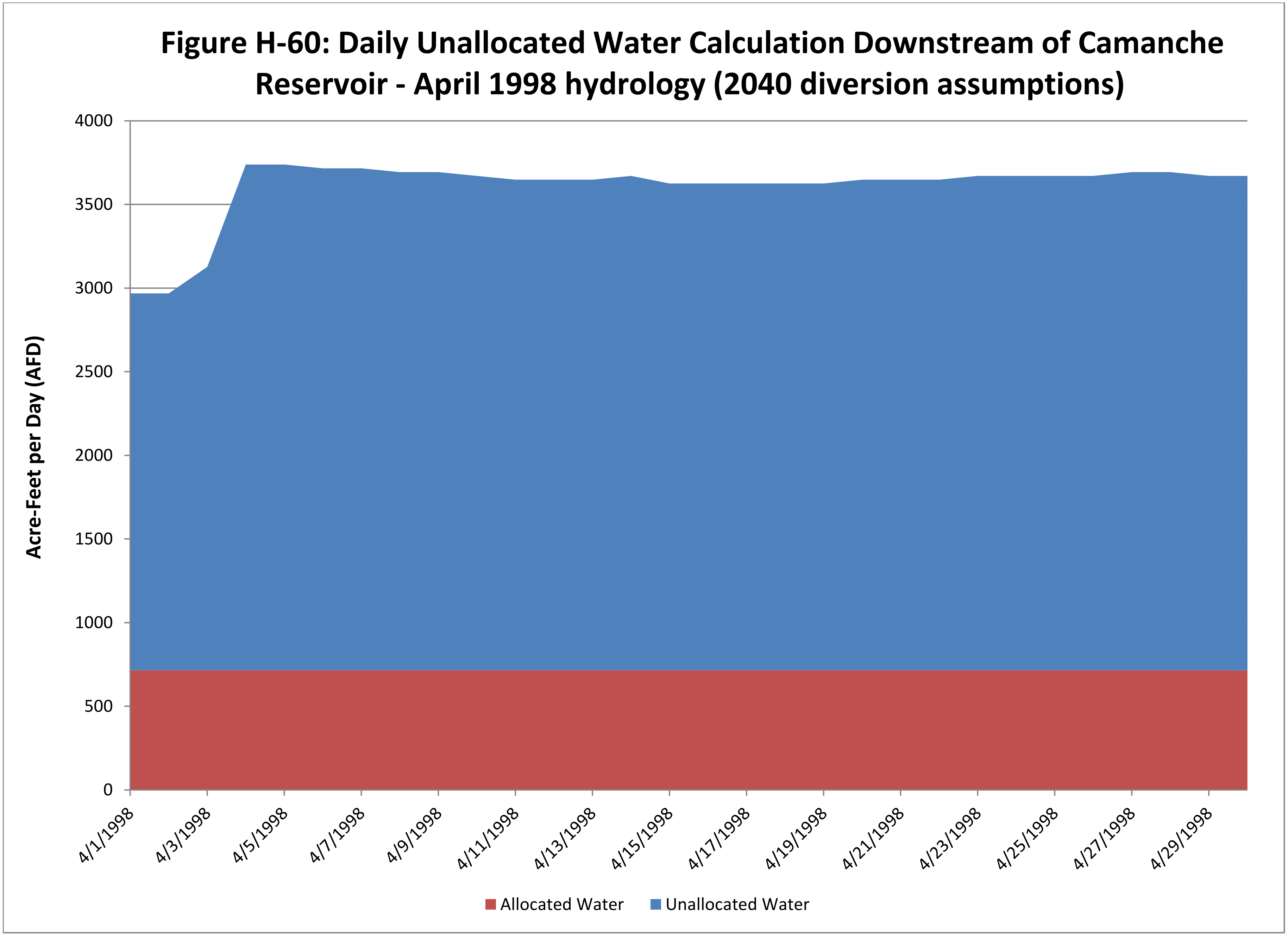


Figure H-60: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - April 1998 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
4/1/1998
4/3/1998
4/5/1998
4/7/1998
4/9/1998
4/11/1998
4/13/1998
4/15/1998
4/17/1998
4/19/1998
4/21/1998
4/23/1998
4/25/1998
4/27/1998
4/29/1998
Allocated Water
Unallocated Water

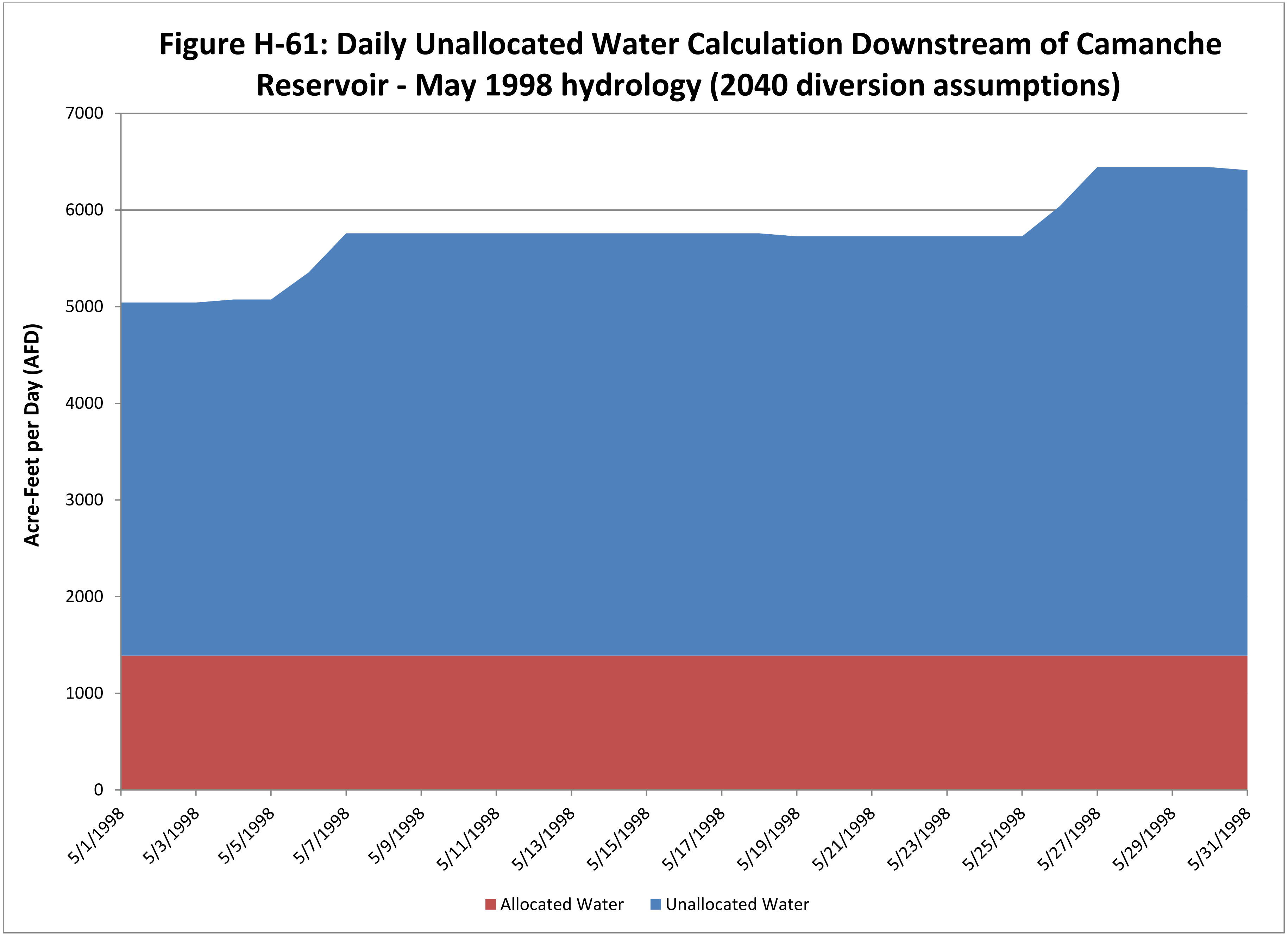


Figure H-61: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - May 1998 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
7000
6000
5000
4000
3000
2000
1000
0
5/1/1998
5/3/1998
5/5/1998
5/7/1998
5/9/1998
5/11/1998
5/13/1998
5/15/1998
5/17/1998
5/19/1998
5/21/1998
5/23/1998
5/25/1998
5/27/1998
5/29/1998
5/31/1998
Allocated Water
Unallocated Water

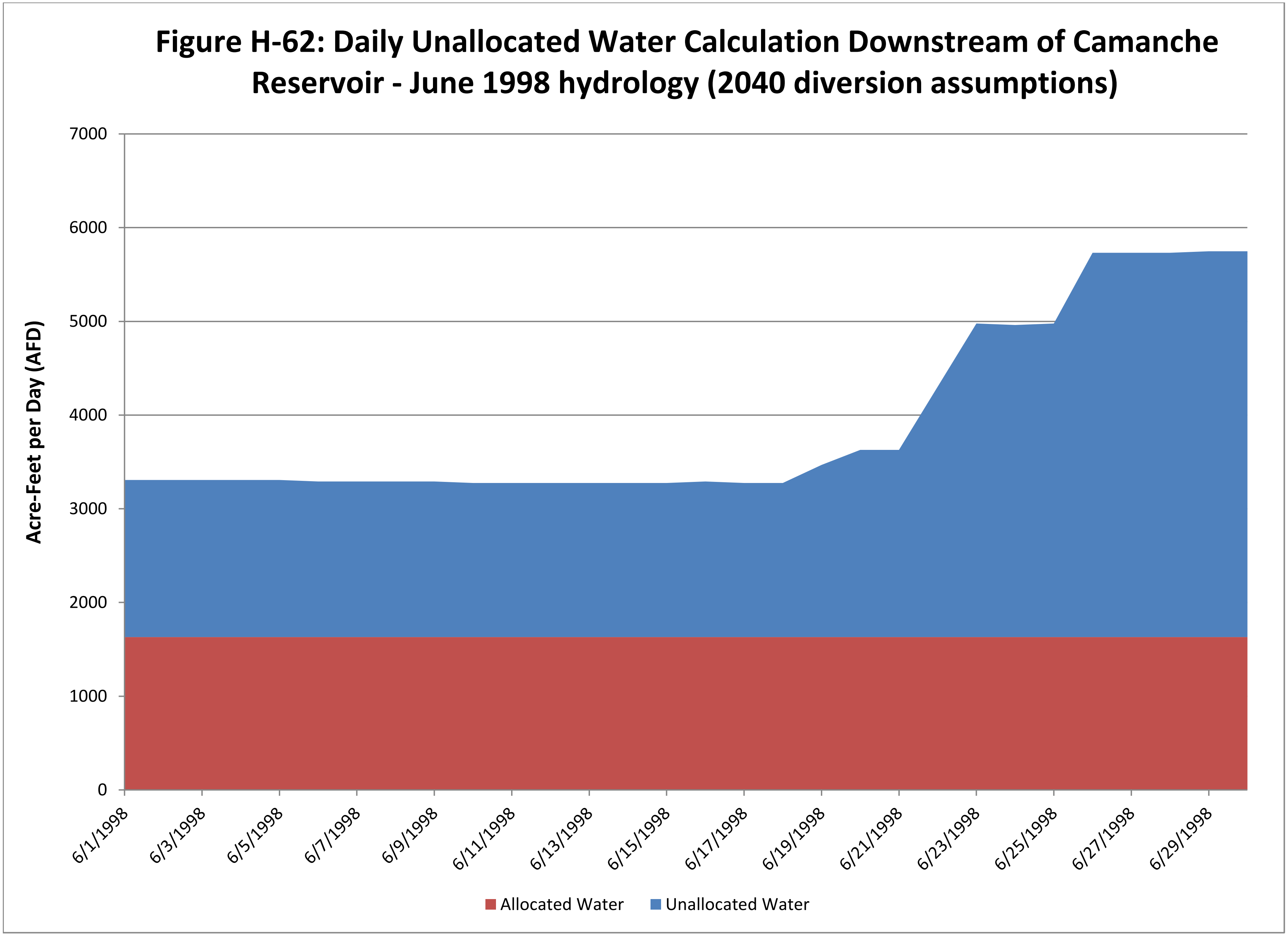


Figure H-62: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - June 1998 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
7000
6000
5000
4000
3000
2000
1000
0
6/1/1998
6/3/1998
6/5/1998
6/7/1998
6/9/1998
6/11/1998
6/13/1998
6/15/1998
6/17/1998
6/19/1998
6/21/1998
6/23/1998
6/25/1998
6/27/1998
6/29/1998
Allocated Water
Unallocated Water

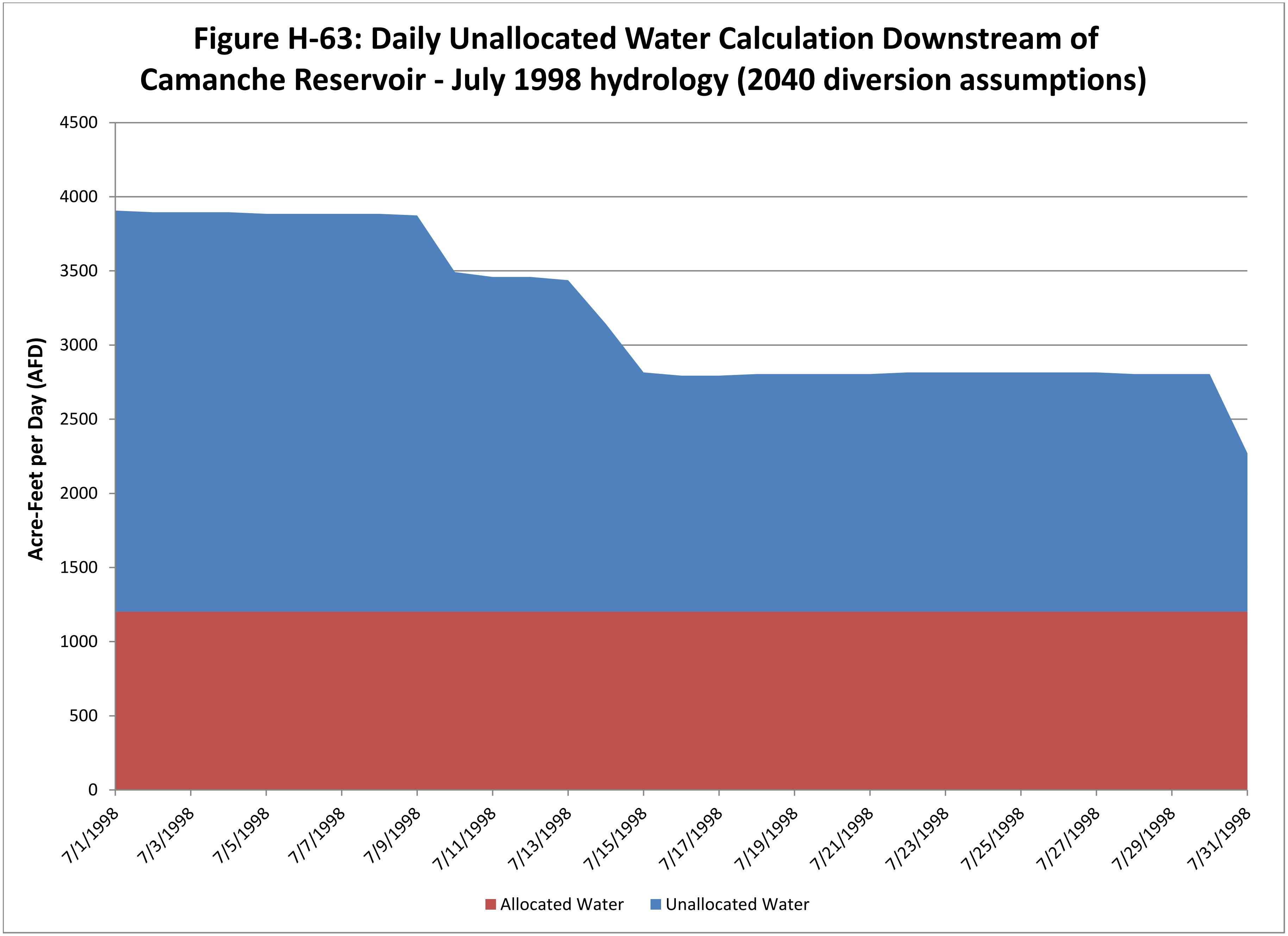


Figure H-63: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - July 1998 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
7/1/1998
7/3/1998
7/5/1998
7/7/1998
7/9/1998
7/11/1998
7/13/1998
7/15/1998
7/17/1998
7/19/1998
7/21/1998
7/23/1998
7/25/1998
7/27/1998
7/29/1998
7/31/1998
Allocated Water
Unallocated Water

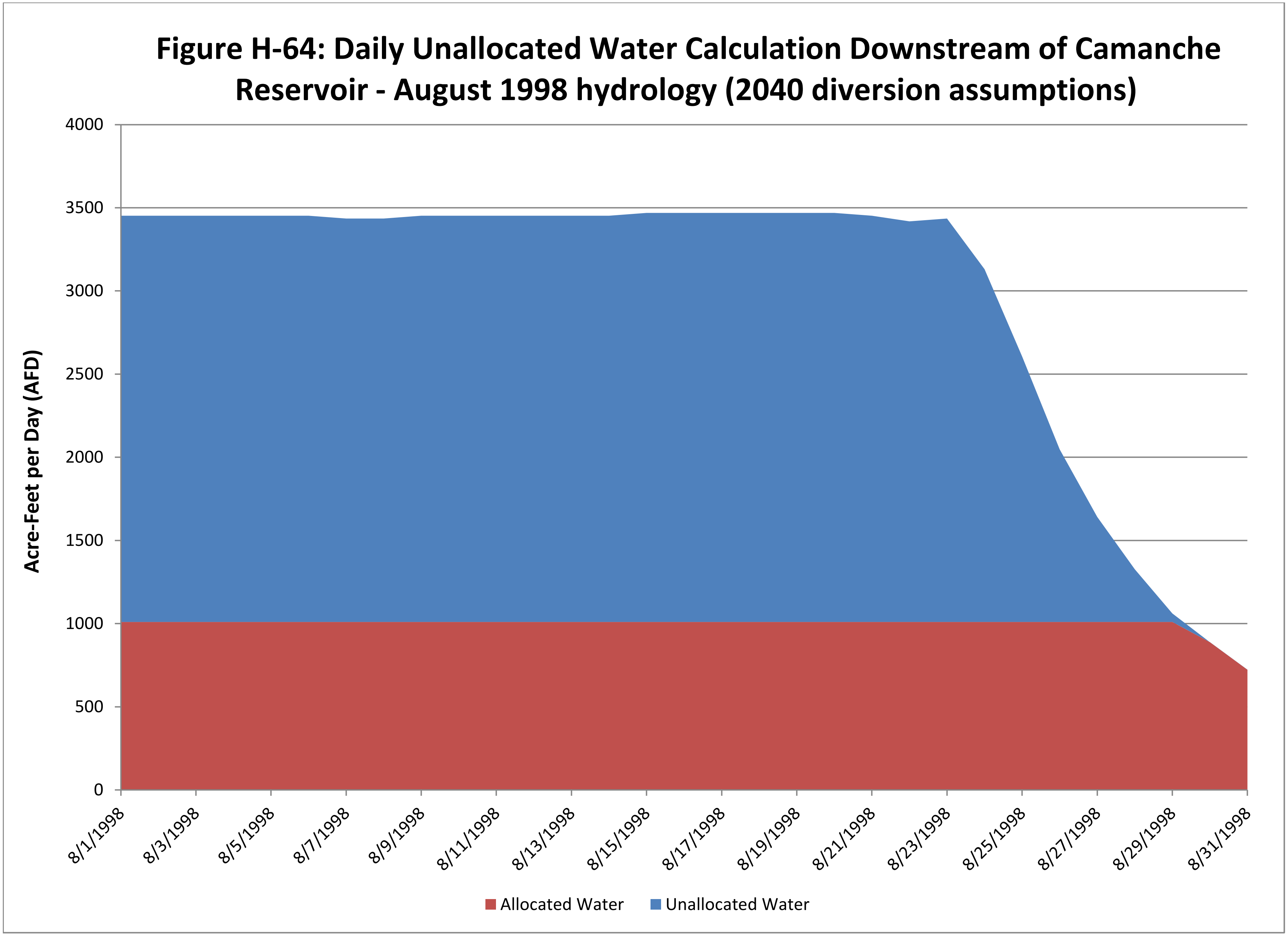


Figure H-64: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - August 1998 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
8/1/1998
8/3/1998
8/5/1998
8/7/1998
8/9/1998
8/11/1998
8/13/1998
8/15/1998
8/17/1998
8/19/1998
8/21/1998
8/23/1998
8/25/1998
8/27/1998
8/29/1998
8/31/1998
Allocated Water
Unallocated Water

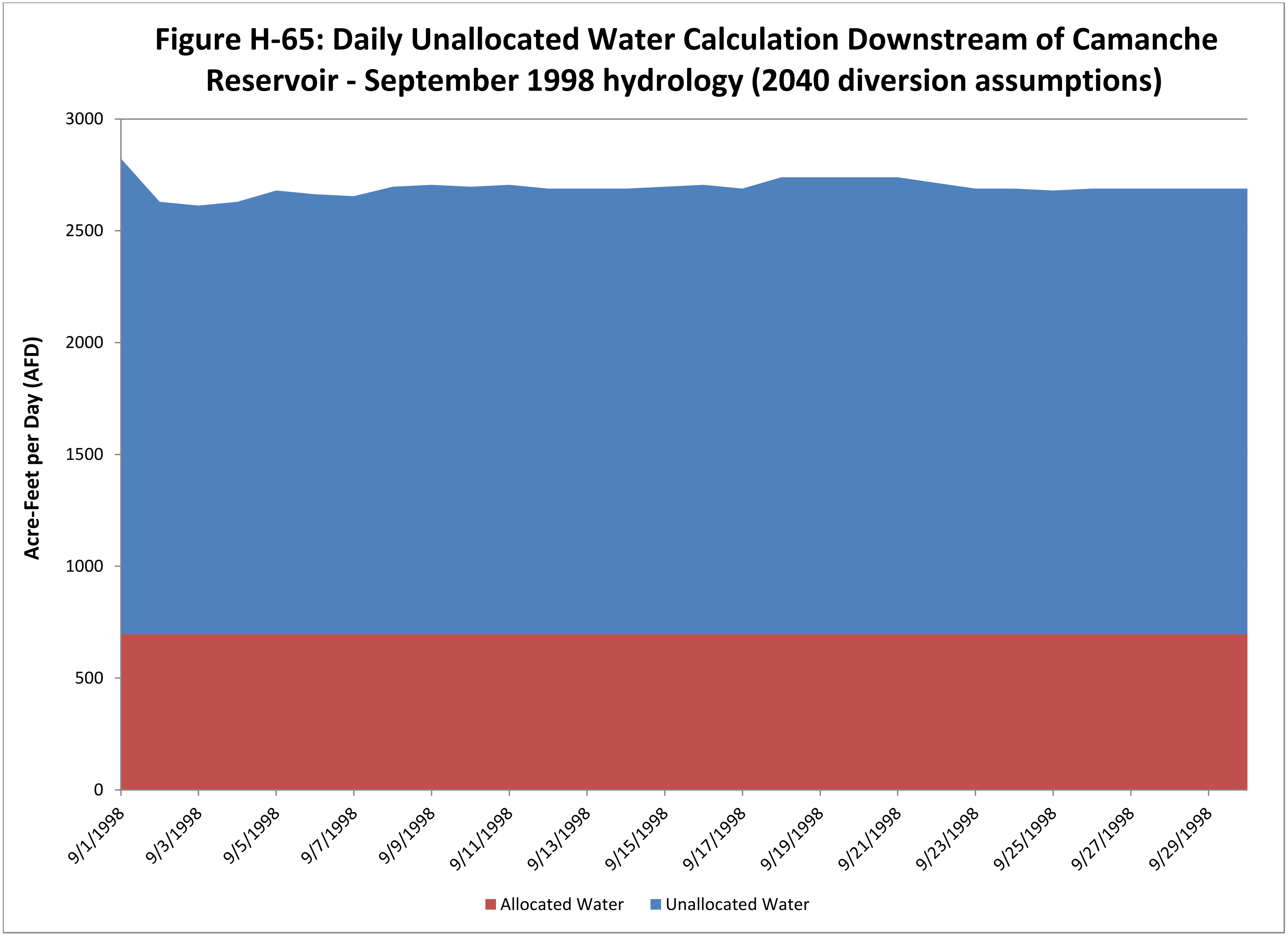


Figure H-65: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - September 1998 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
3000
2500
2000
1500
1000
500
0
9/1/1998
9/3/1998
9/5/1998
9/7/1998
9/9/1998
9/11/1998
9/13/1998
9/15/1998
9/17/1998
9/19/1998
9/21/1998
9/23/1998
9/25/1998
9/27/1998
9/29/1998
Allocated Water
Unallocated Water

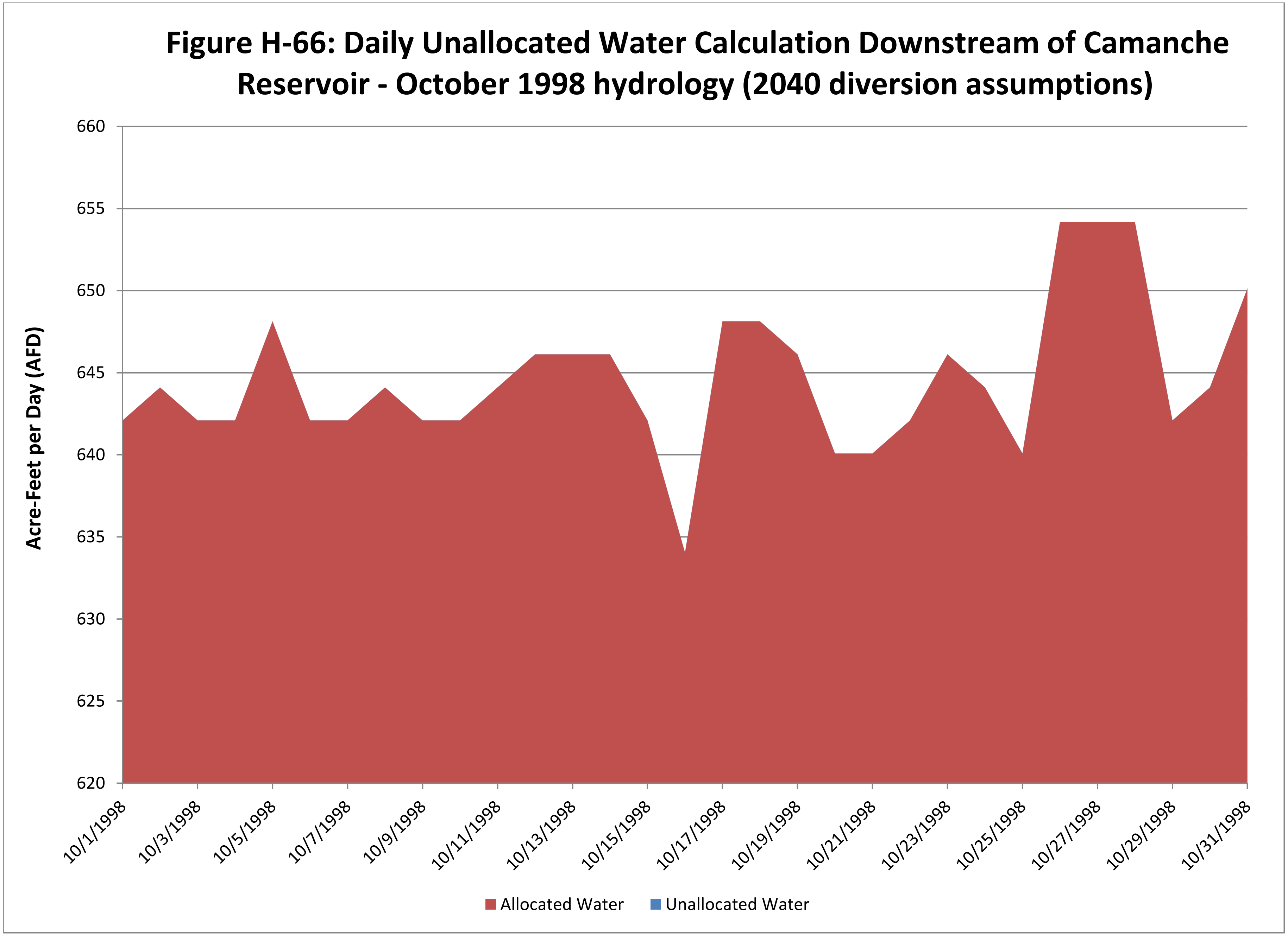


Figure H-66: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - October 1998 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
660
655
650
645
640
635
630
625
620
10/1/1998
10/3/1998
10/5/1998
10/7/1998
10/9/1998
10/11/1998
10/13/1998
10/15/1998
10/17/1998
10/19/1998
10/21/1998
10/23/1998
10/25/1998
10/27/1998
10/29/1998
10/31/1998
Allocated Water
Unallocated Water

Figure H-67: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - November 1998 hydrology (2040 diversion assumptions)

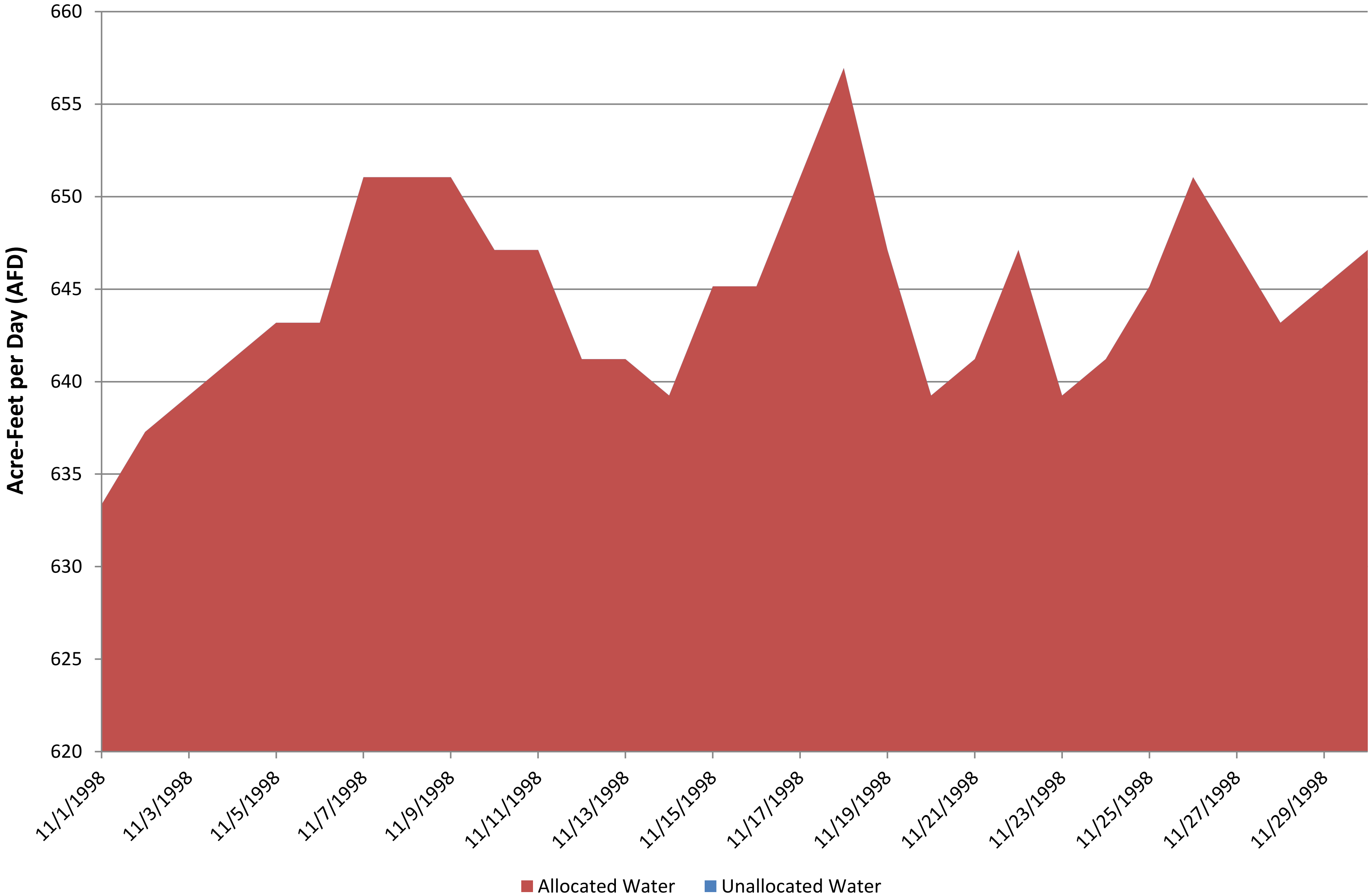


Figure H-68: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - December 1998 hydrology (2040 diversion assumptions)

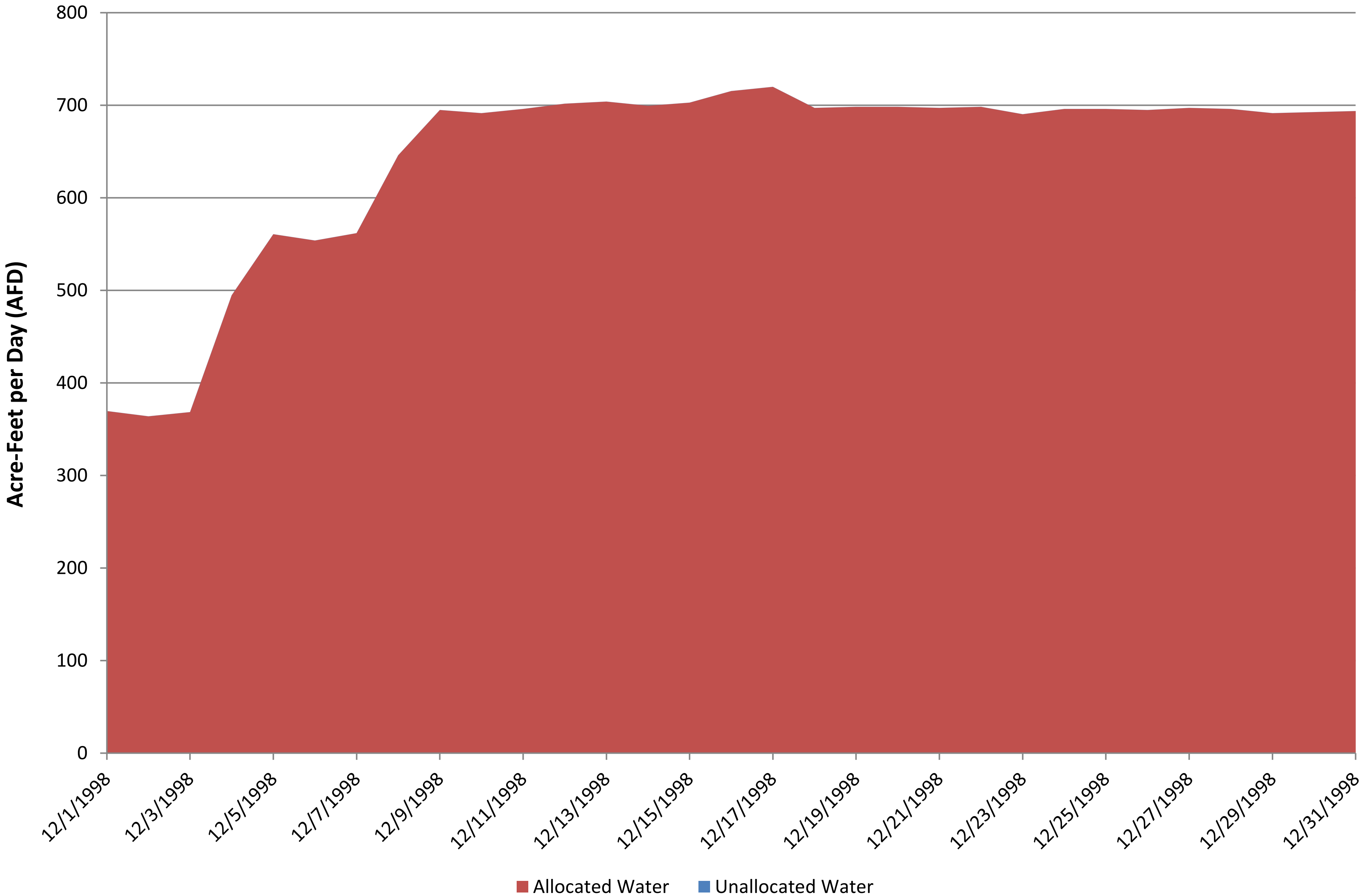
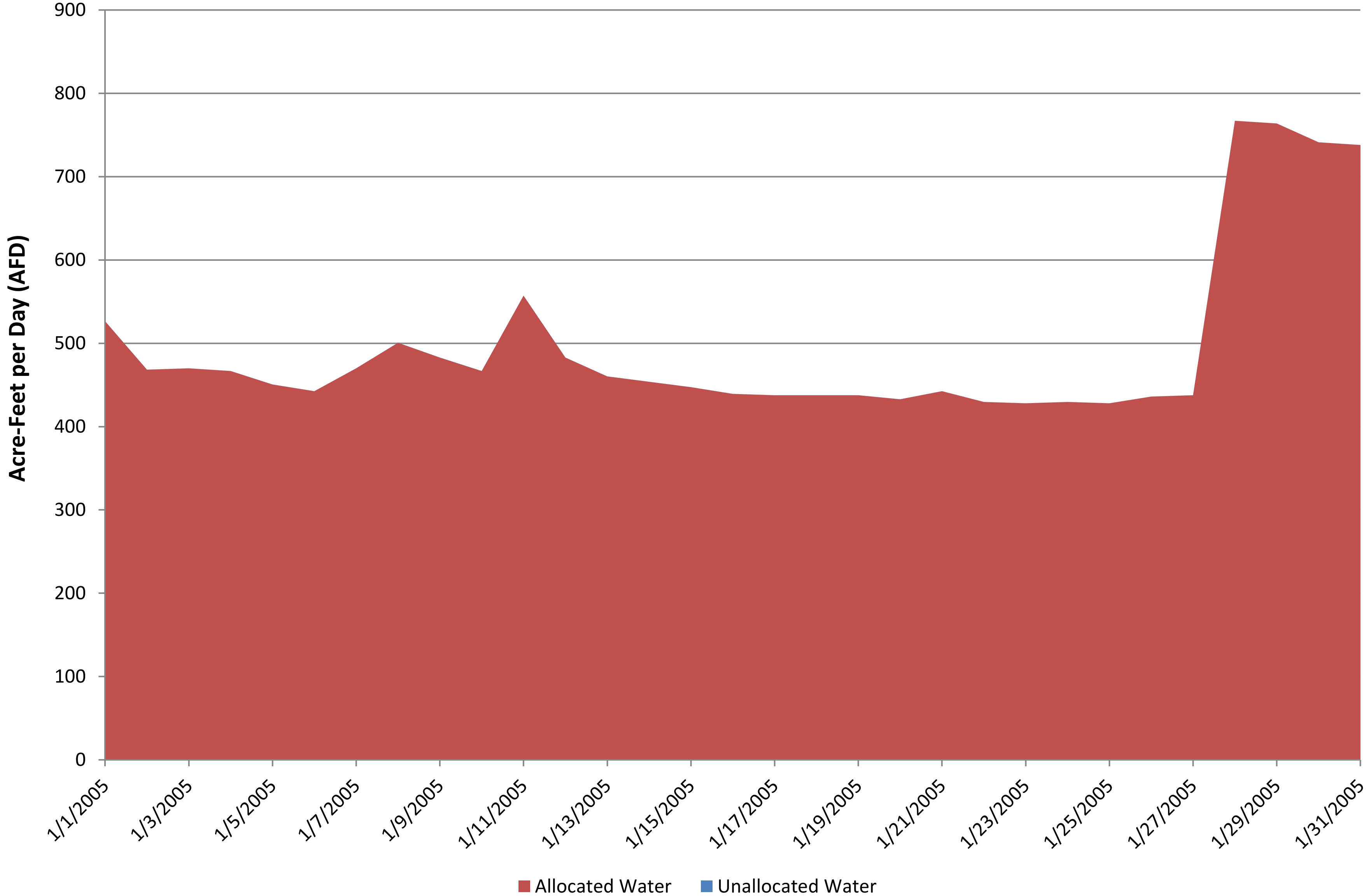


Figure H-69: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - January 2005 hydrology (2040 diversion assumptions)



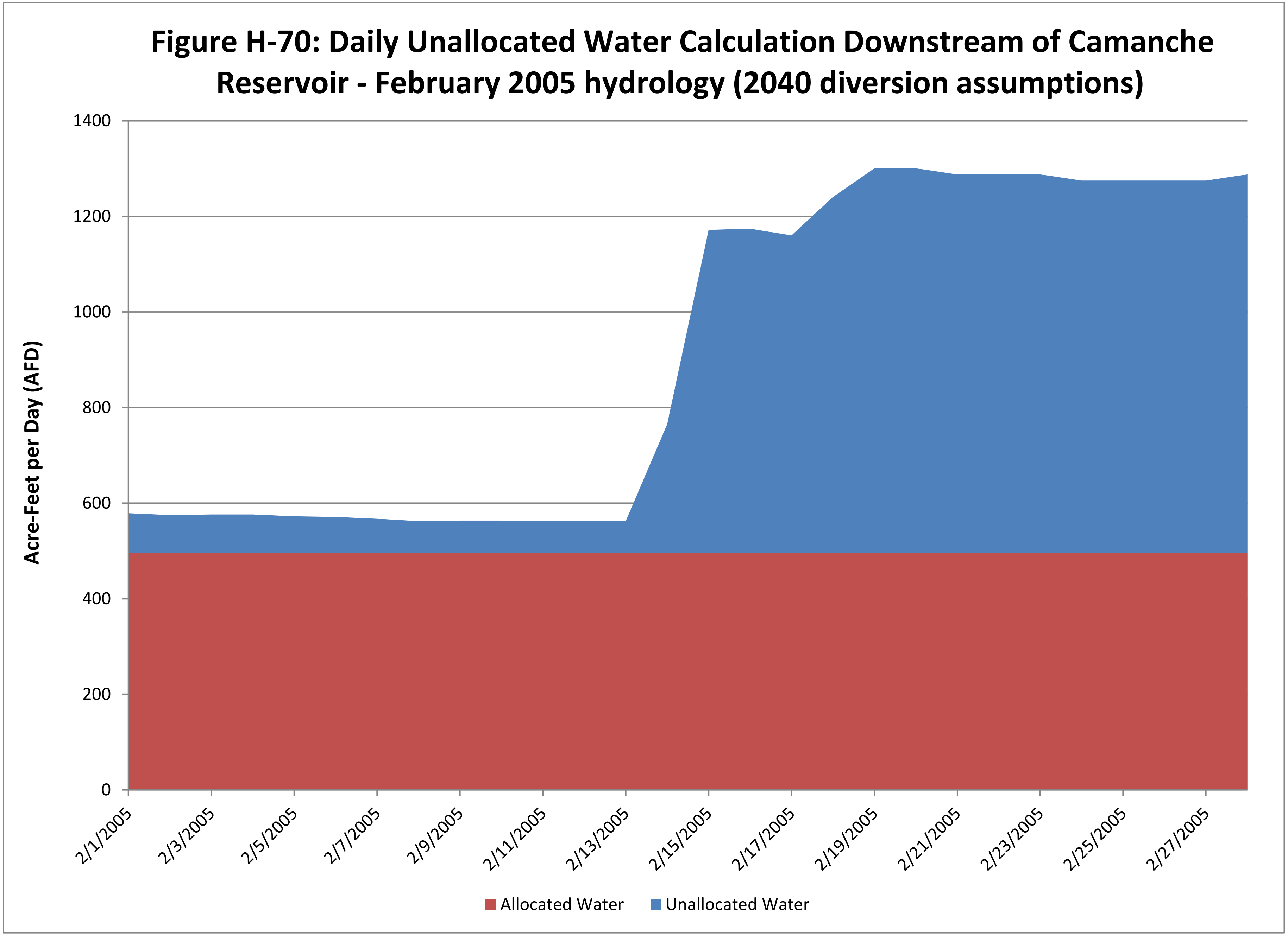


Figure H-70: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - February 2005 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
1400
1200
1000
800
600
400
200
0
2/1/2005
2/3/2005
2/5/2005
2/7/2005
2/9/2005
2/11/2005
2/13/2005
2/15/2005
2/17/2005
2/19/2005
2/21/2005
2/23/2005
2/25/2005
2/27/2005
Allocated Water
Unallocated Water

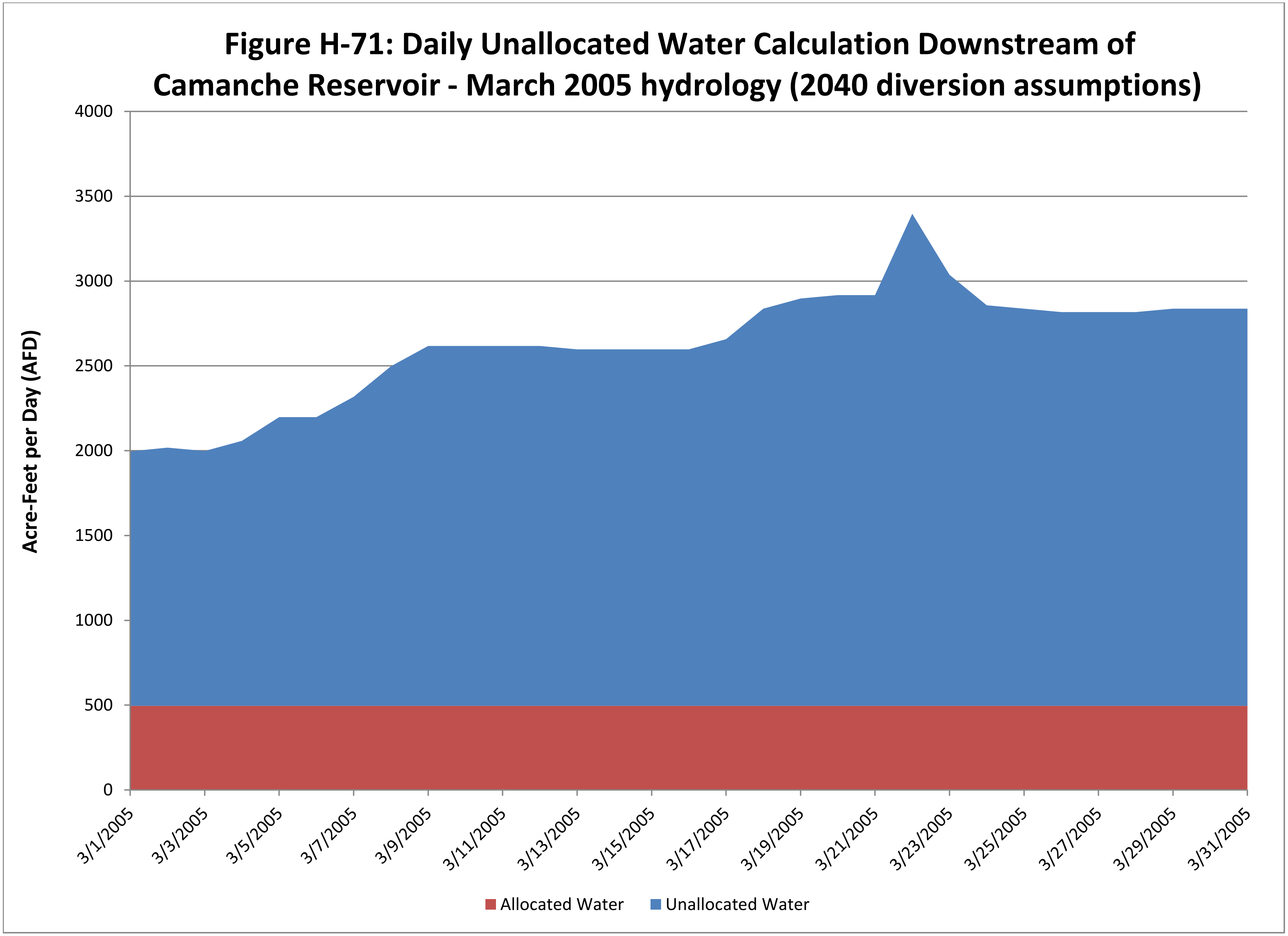


Figure H-71: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - March 2005 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
3/1/2005
3/3/2005
3/5/2005
3/7/2005
3/9/2005
3/11/2005
3/13/2005
3/15/2005
3/17/2005
3/19/2005
3/21/2005
3/23/2005
3/25/2005
3/27/2005
3/29/2005
3/31/2005
Allocated Water
Unallocated Water

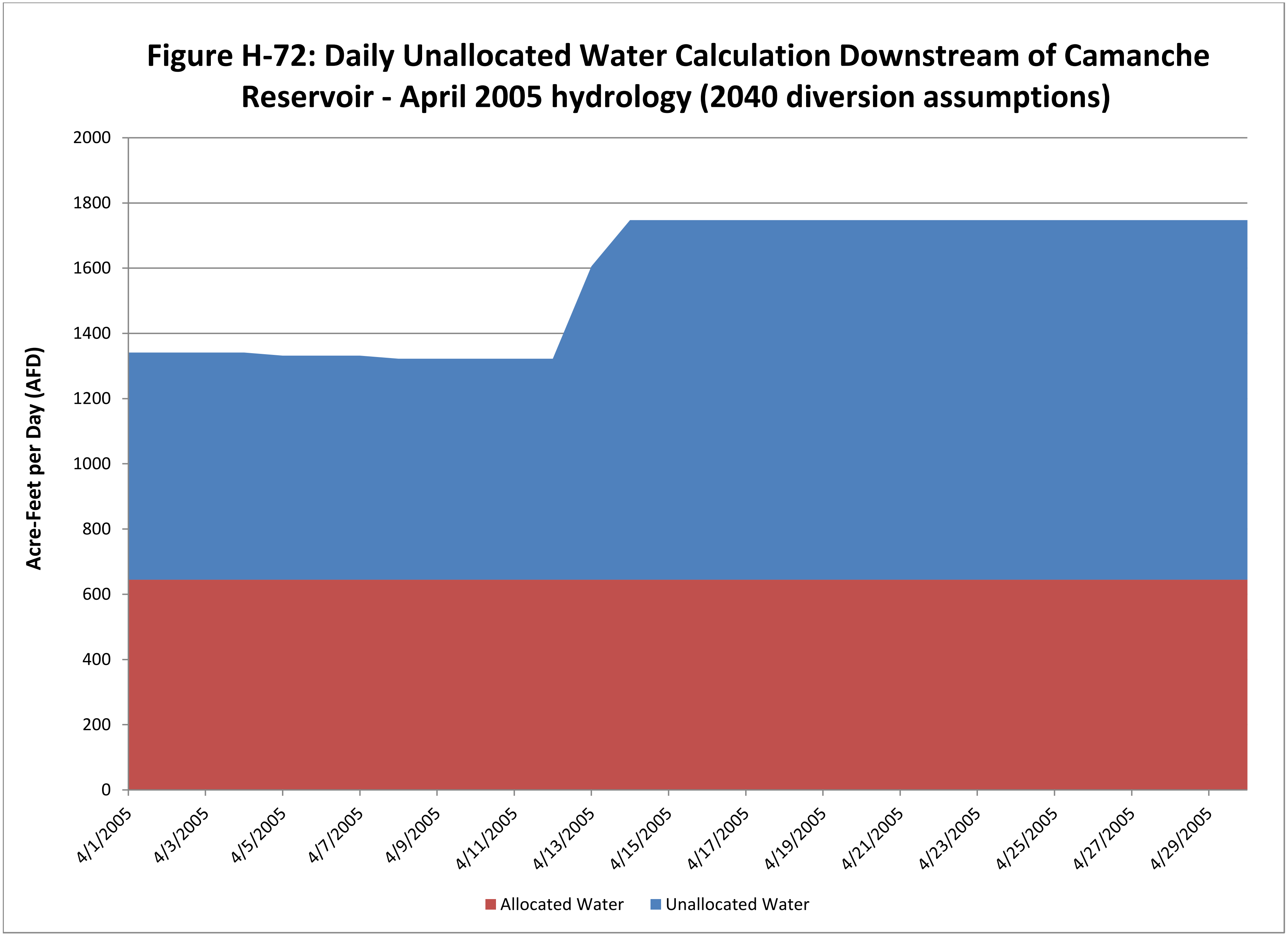


Figure H-72: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - April 2005 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
4/1/2005
4/3/2005
4/5/2005
4/7/2005
4/9/2005
4/11/2005
4/13/2005
4/15/2005
4/17/2005
4/19/2005
4/21/2005
4/23/2005
4/25/2005
4/27/2005
4/29/2005
Allocated Water
Unallocated Water

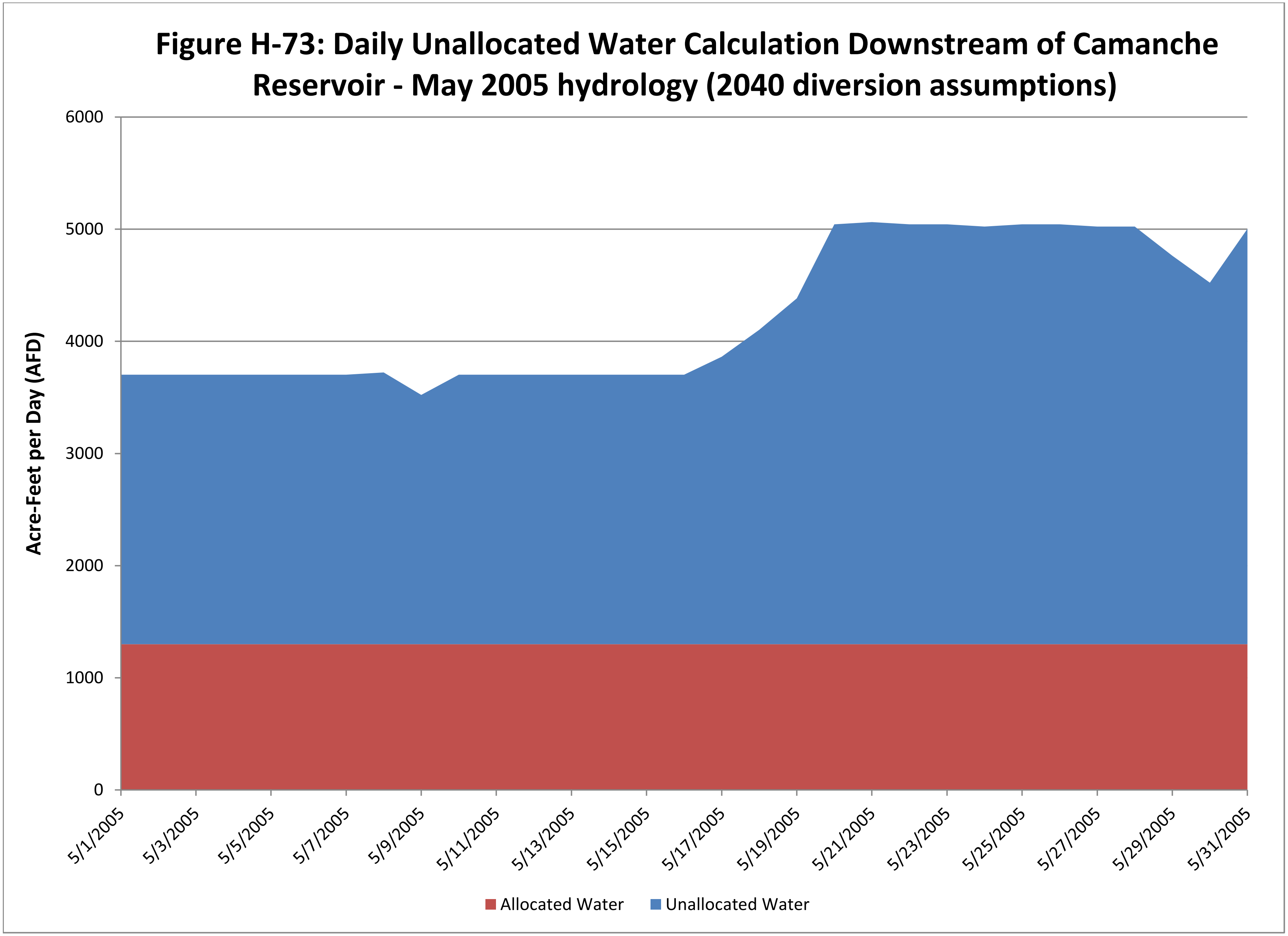


Figure H-73: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - May 2005 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
6000
5000
4000
3000
2000
1000
0
5/1/2005
5/3/2005
5/5/2005
5/7/2005
5/9/2005
5/11/2005
5/13/2005
5/15/2005
5/17/2005
5/19/2005
5/21/2005
5/23/2005
5/25/2005
5/27/2005
5/29/2005
5/31/2005
Allocated Water
Unallocated Water

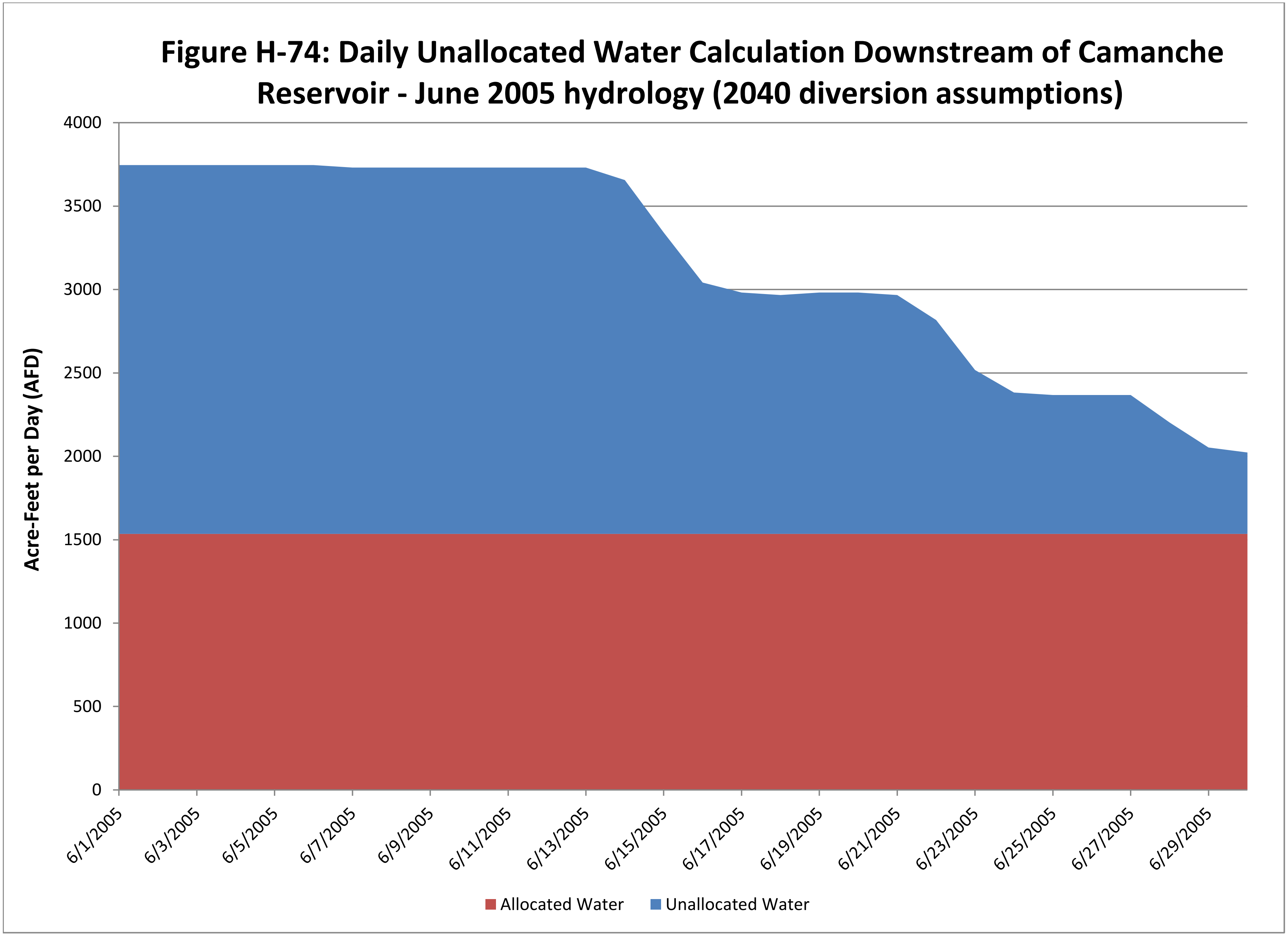


Figure H-74: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - June 2005 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
6/1/2005
6/3/2005
6/5/2005
6/7/2005
6/9/2005
6/11/2005
6/13/2005
6/15/2005
6/17/2005
6/19/2005
6/21/2005
6/23/2005
6/25/2005
6/27/2005
6/29/2005
Allocated Water
Unallocated Water

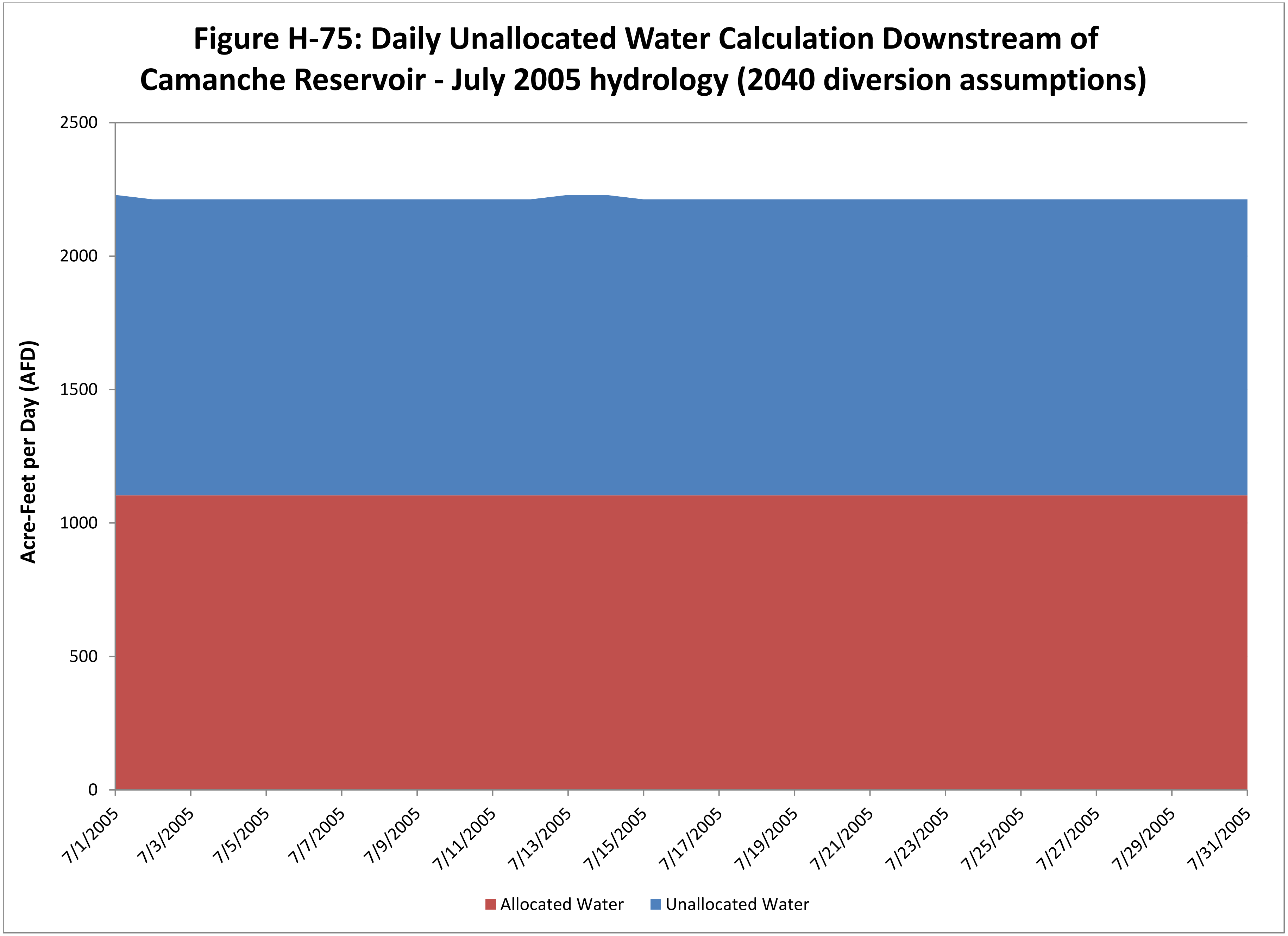


Figure H-75: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - July 2005 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
2500
2000
1500
1000
500
0
7/1/2005
7/3/2005
7/5/2005
7/7/2005
7/9/2005
7/11/2005
7/13/2005
7/15/2005
7/17/2005
7/19/2005
7/21/2005
7/23/2005
7/25/2005
7/27/2005
7/29/2005
7/31/2005
Allocated Water
Unallocated Water

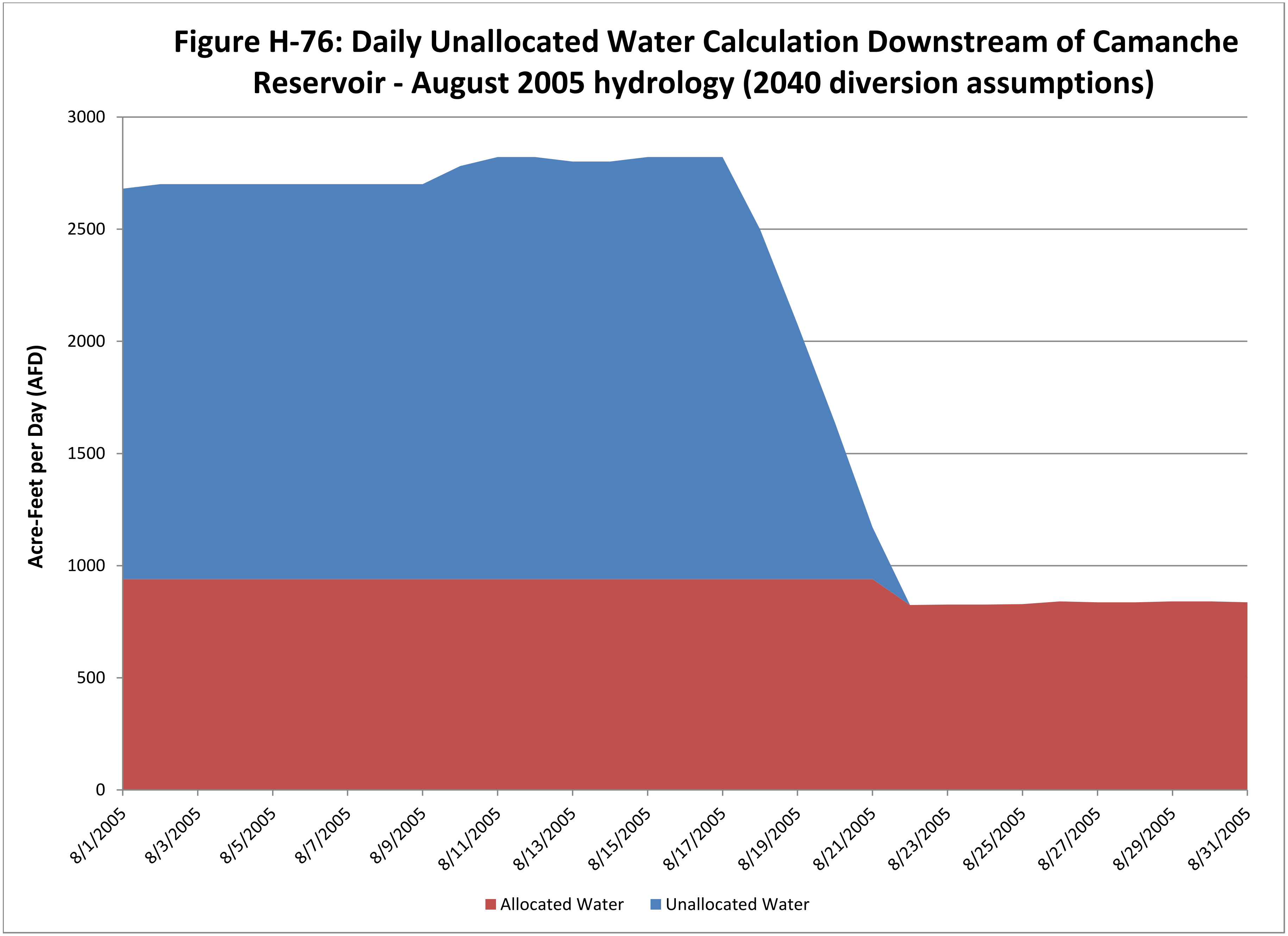
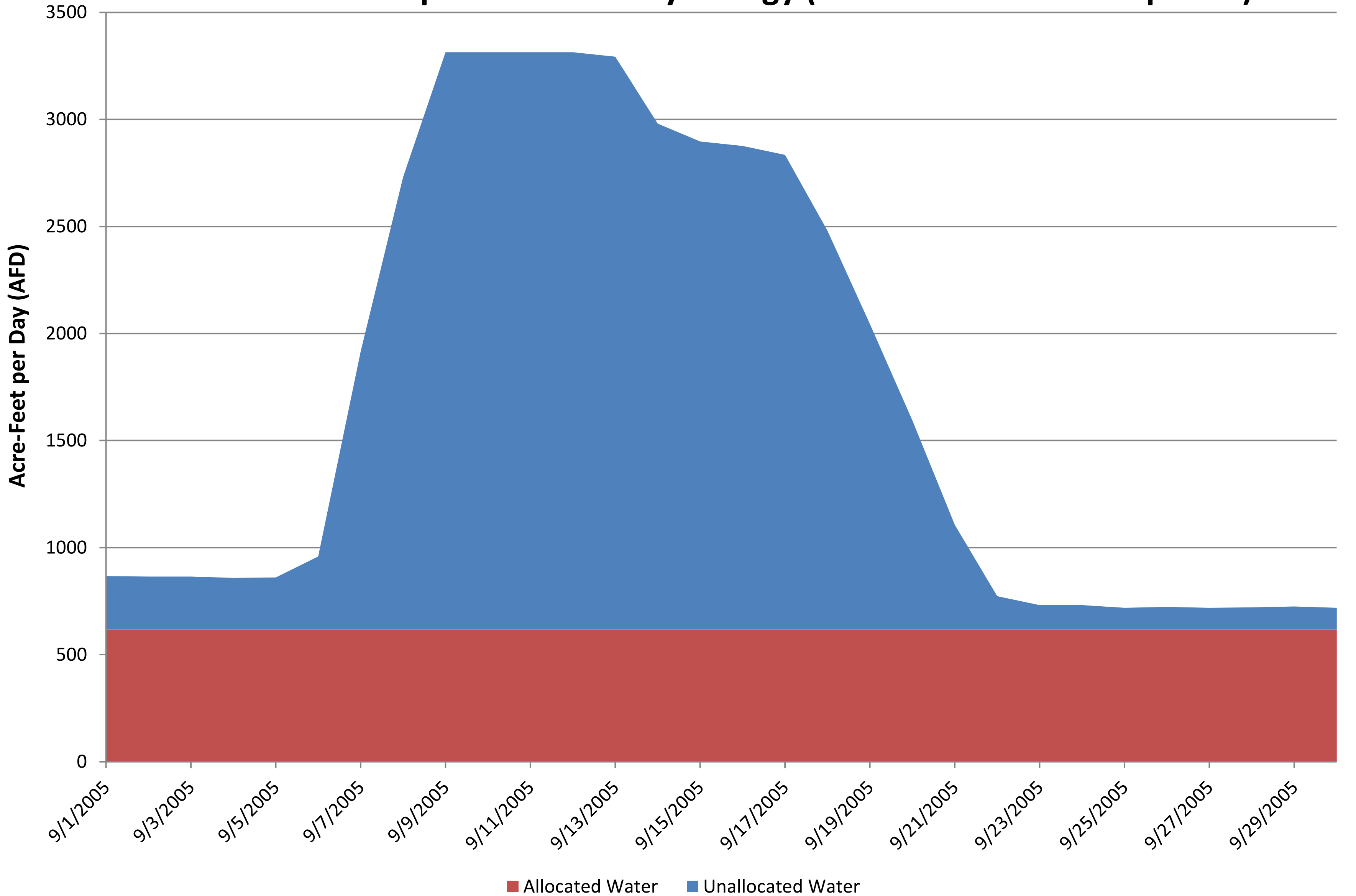


Figure H-76: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - August 2005 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
3000
2500
2000
1500
1000
500
0
8/1/2005
8/3/2005
8/5/2005
8/7/2005
8/9/2005
8/11/2005
8/13/2005
8/15/2005
8/17/2005
8/19/2005
8/21/2005
8/23/2005
8/25/2005
8/27/2005
8/29/2005
8/31/2005
Allocated Water
Unallocated Water

Figure H-77: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - September 2005 hydrology (2040 diversion assumptions)



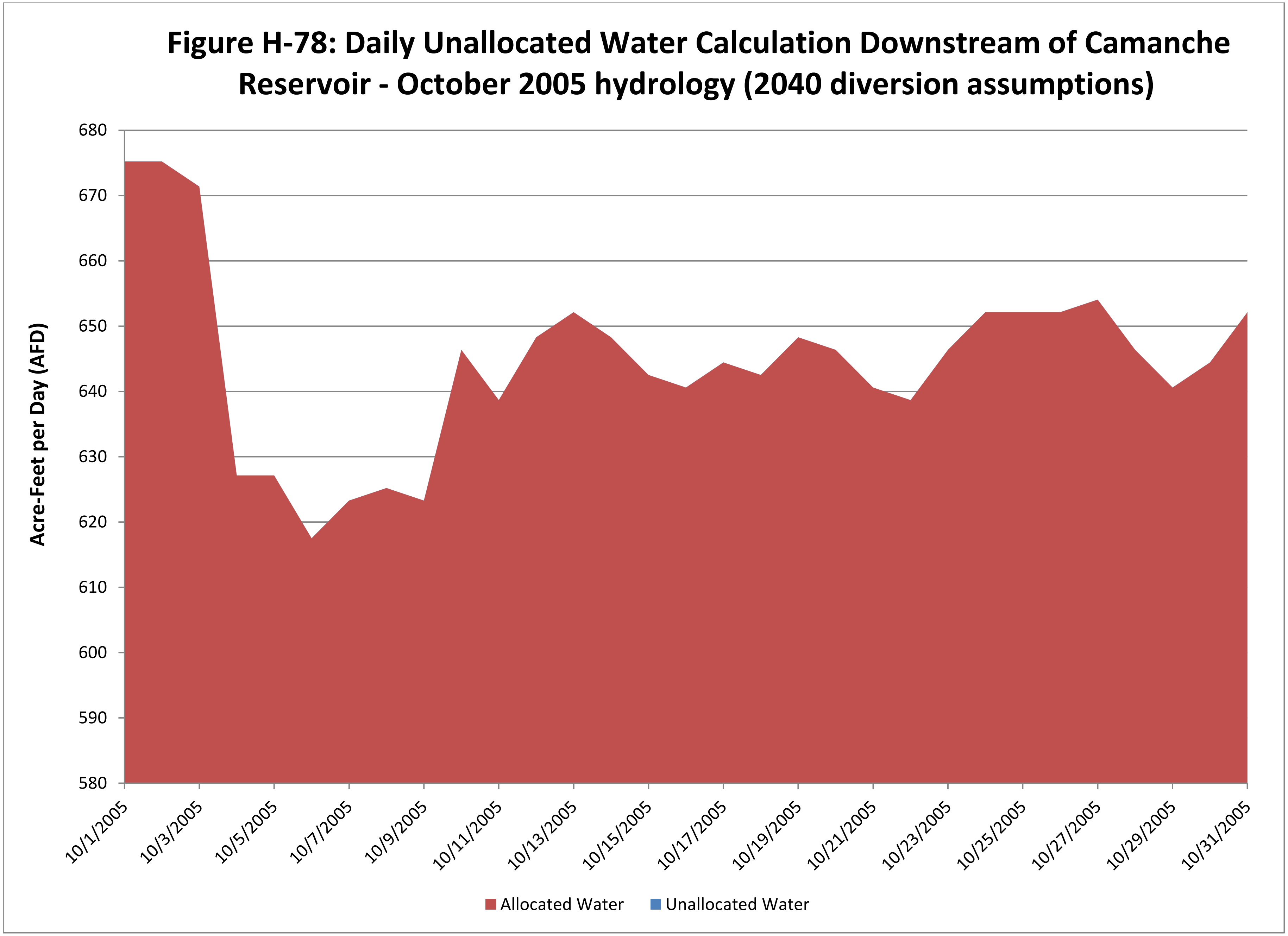


Figure H-78: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - October 2005 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
680
670
660
650
640
630
620
610
600
590
580
10/1/2005
10/3/2005
10/5/2005
10/7/2005
10/9/2005
10/11/2005
10/13/2005
10/15/2005
10/17/2005
10/19/2005
10/21/2005
10/23/2005
10/25/2005
10/27/2005
10/29/2005
10/31/2005
Allocated Water
Unallocated Water

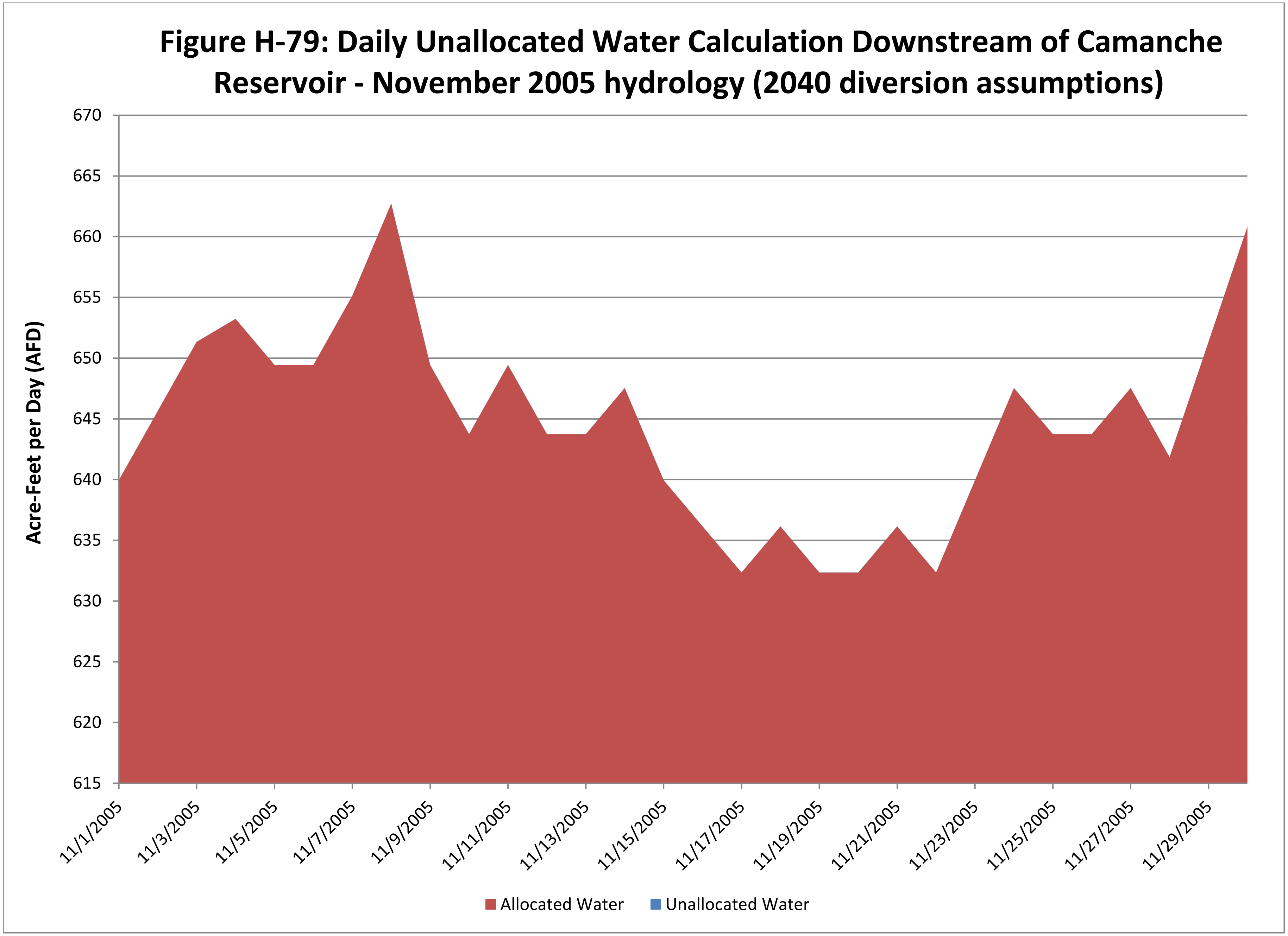
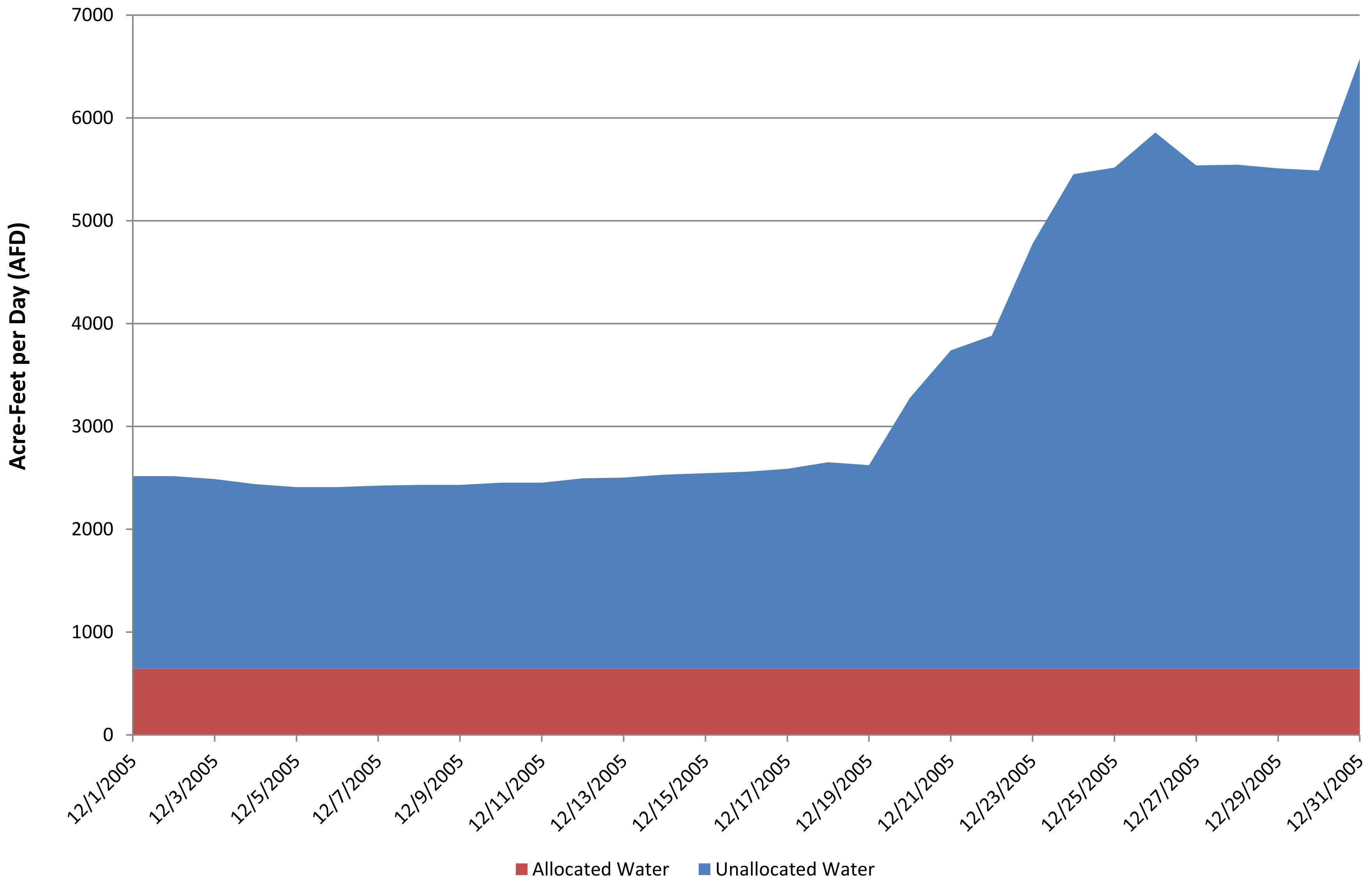


Figure H-79: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - November 2005 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
670
665
660
655
650
645
640
635
630
625
620
615
11/1/2005
11/3/2005
11/5/2005
11/7/2005
11/9/2005
11/11/2005
11/13/2005
11/15/2005
11/17/2005
11/19/2005
11/21/2005
11/23/2005
11/25/2005
11/27/2005
11/29/2005
Allocated Water
Unallocated Water

Figure H-80: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - December 2005 hydrology (2040 diversion assumptions)



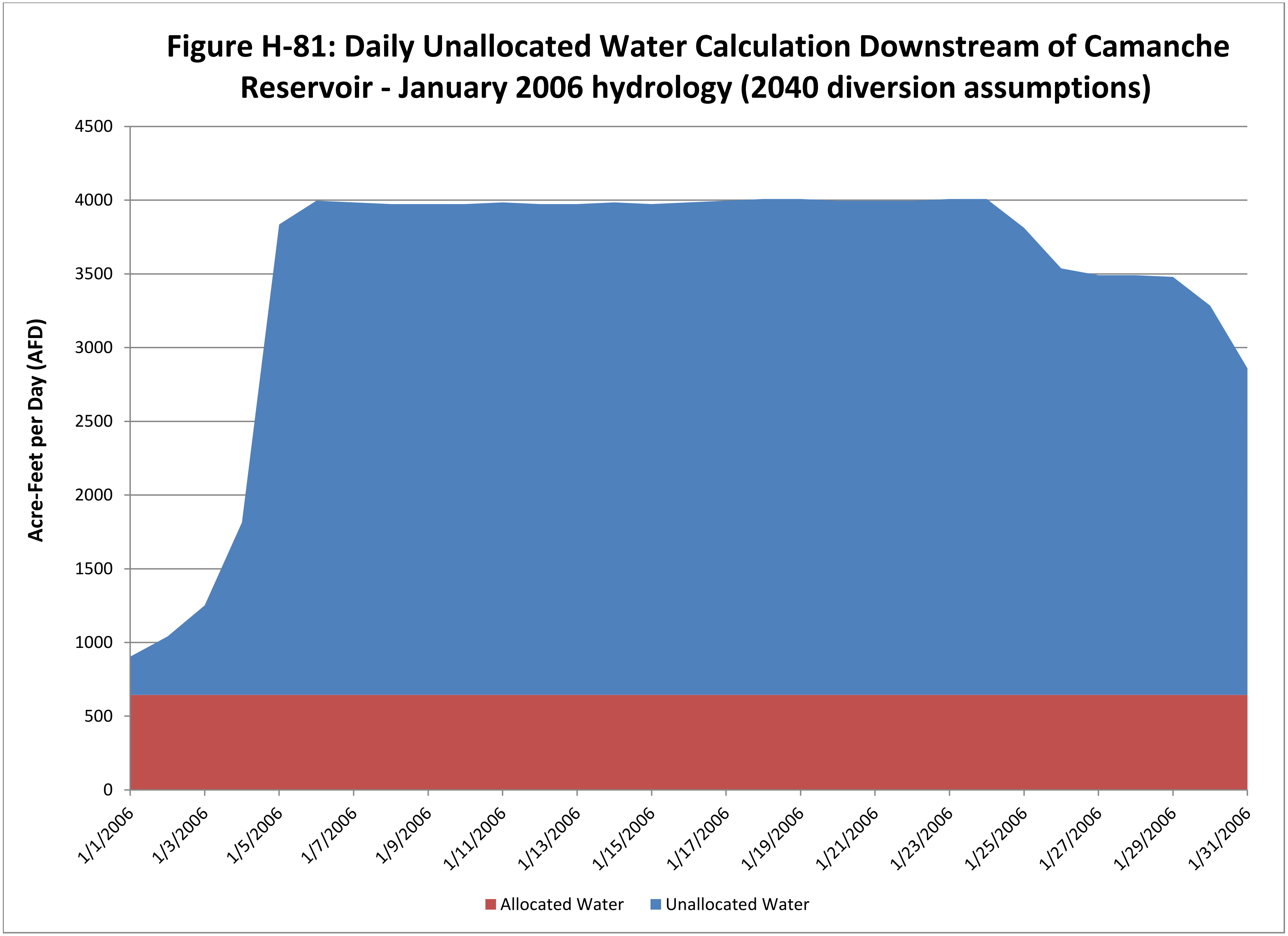


Figure H-81: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - January 2006 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1/1/2006
1/3/2006
1/5/2006
1/7/2006
1/9/2006
1/11/2006
1/13/2006
1/15/2006
1/17/2006
1/19/2006
1/21/2006
1/23/2006
1/25/2006
1/27/2006
1/29/2006
1/31/2006
Allocated Water
Unallocated Water

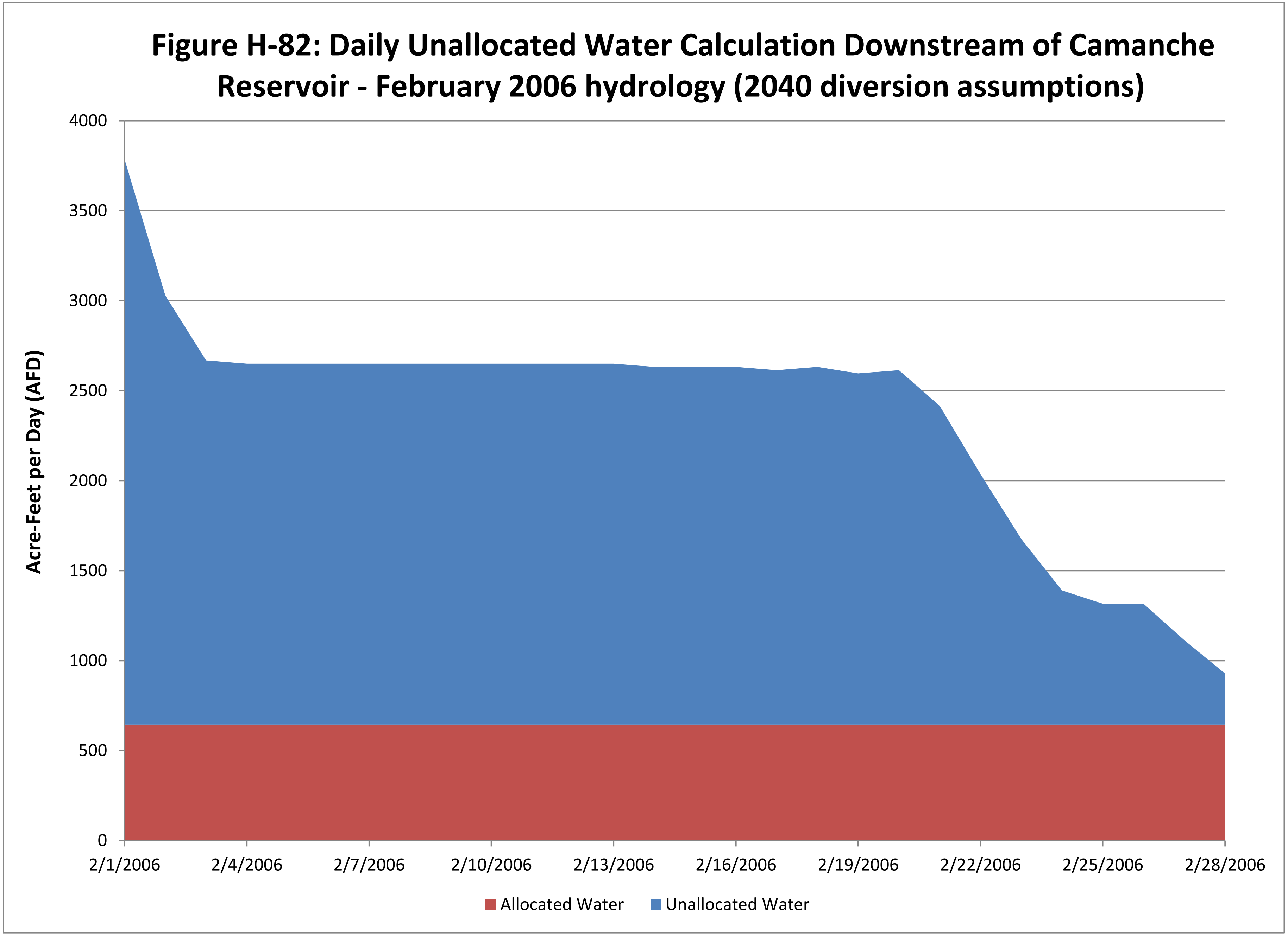


Figure H-82: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - February 2006 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
2/1/2006
2/4/2006
2/7/2006
2/10/2006
2/13/2006
2/16/2006
2/19/2006
2/22/2006
2/25/2006
2/28/2006
Allocated Water
Unallocated Water

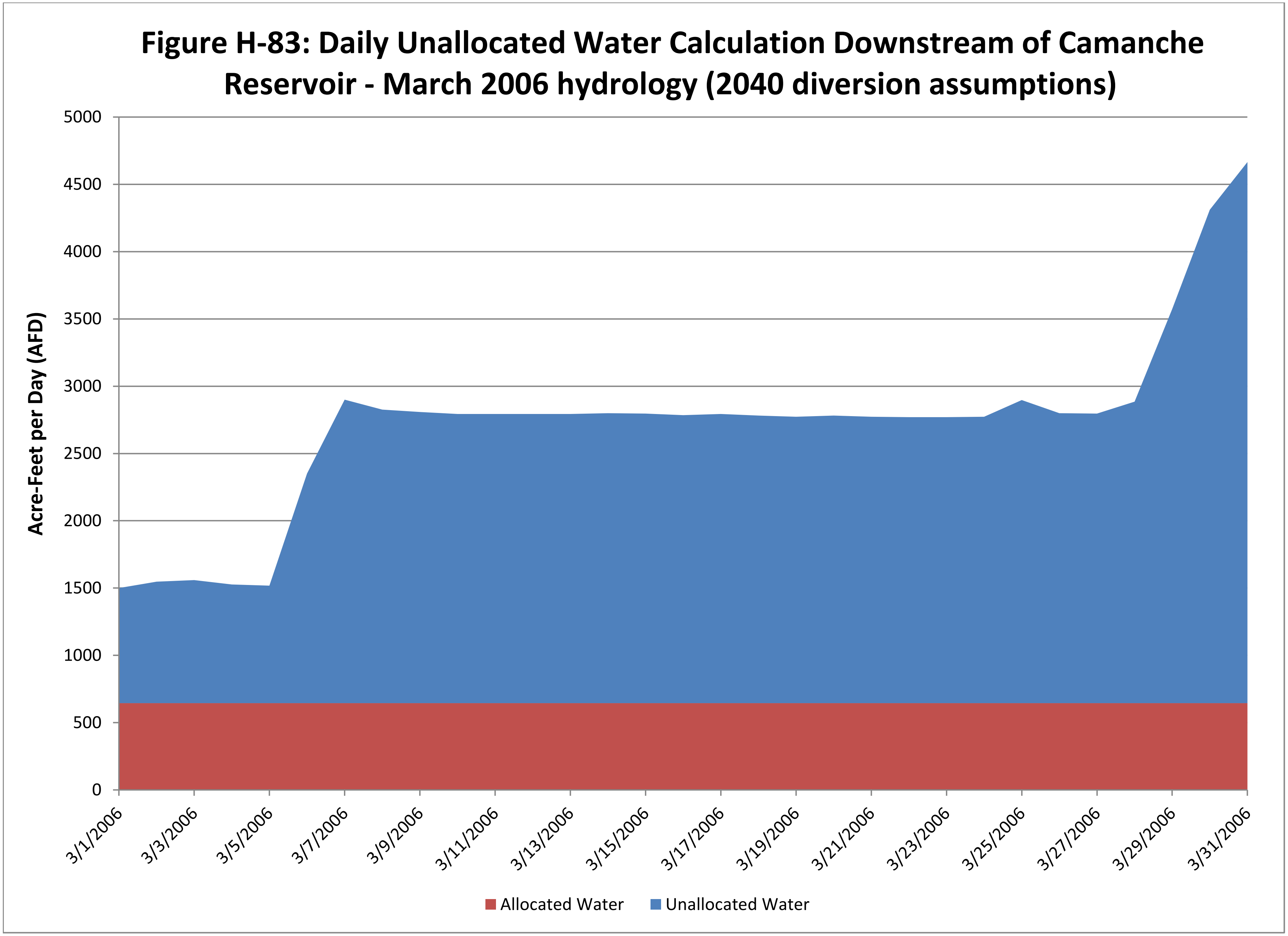
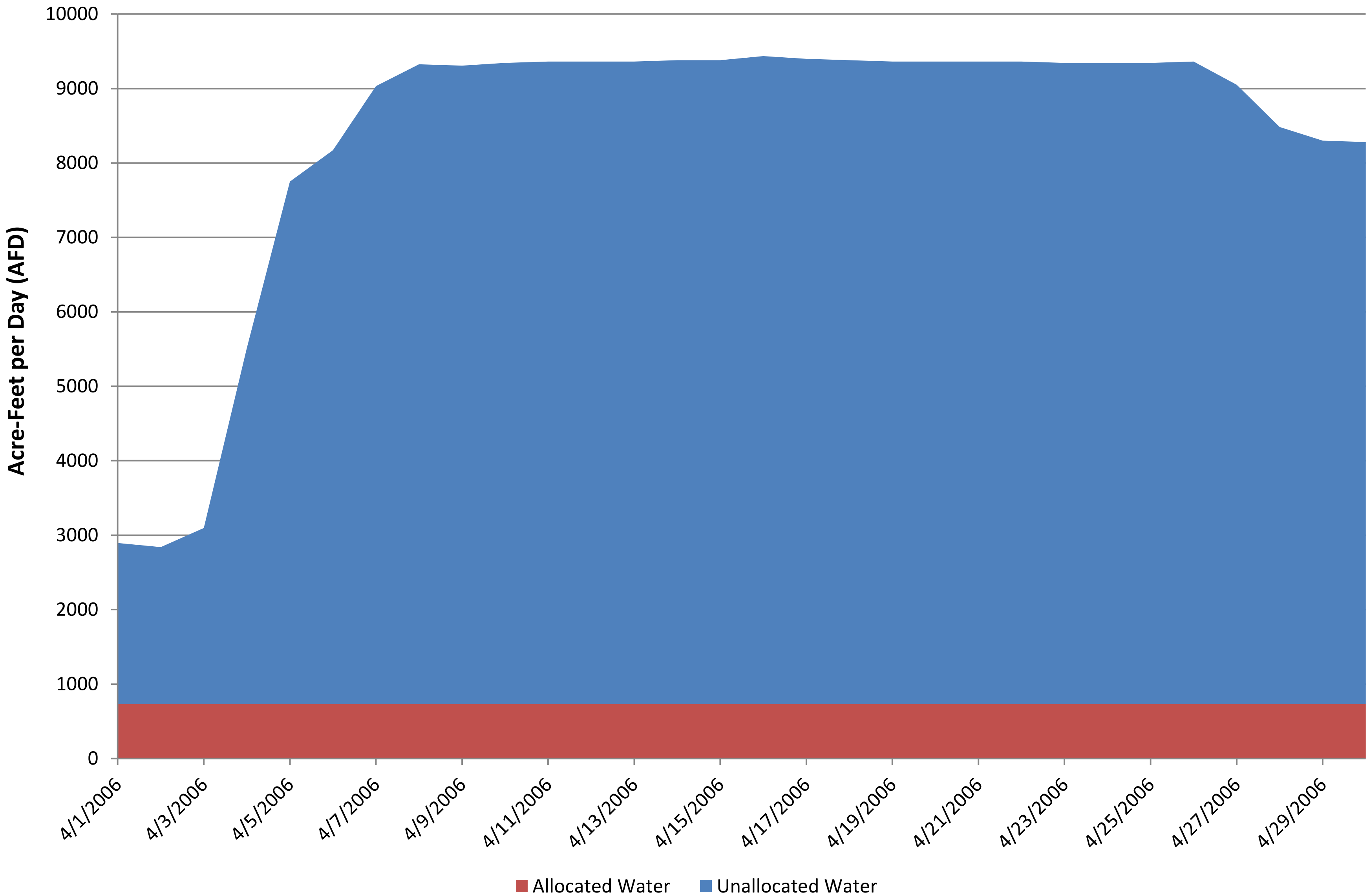


Figure H-83: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - March 2006 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
3/1/2006
3/3/2006
3/5/2006
3/7/2006
3/9/2006
3/11/2006
3/13/2006
3/15/2006
3/17/2006
3/19/2006
3/21/2006
3/23/2006
3/25/2006
3/27/2006
3/29/2006
3/31/2006
Allocated Water
Unallocated Water

Figure H-84: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - April 2006 hydrology (2040 diversion assumptions)



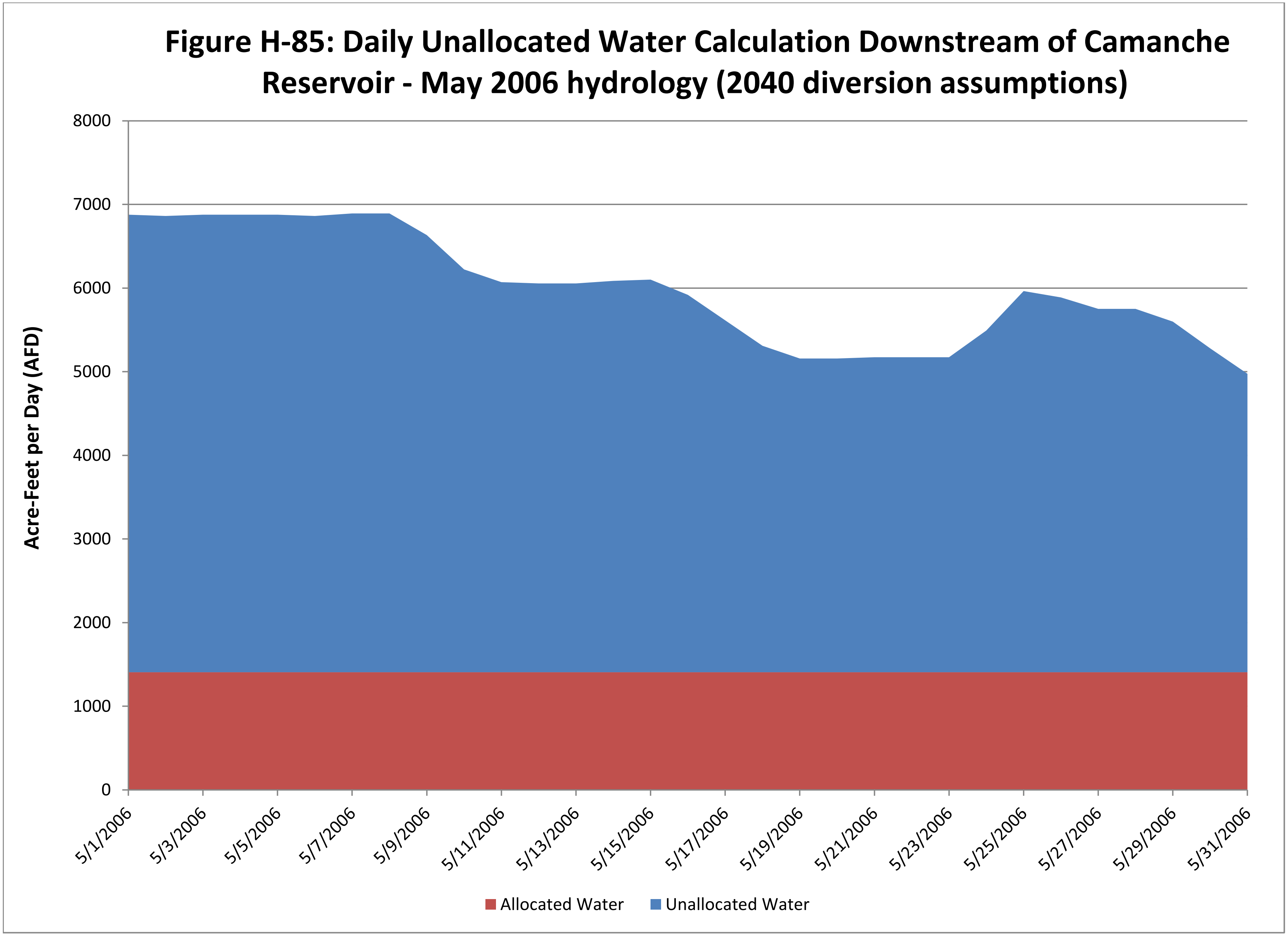


Figure H-85: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - May 2006 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
8000
7000
6000
5000
4000
3000
2000
1000
0
5/1/2006
5/3/2006
5/5/2006
5/7/2006
5/9/2006
5/11/2006
5/13/2006
5/15/2006
5/17/2006
5/19/2006
5/21/2006
5/23/2006
5/25/2006
5/27/2006
5/29/2006
5/31/2006
Allocated Water
Unallocated Water

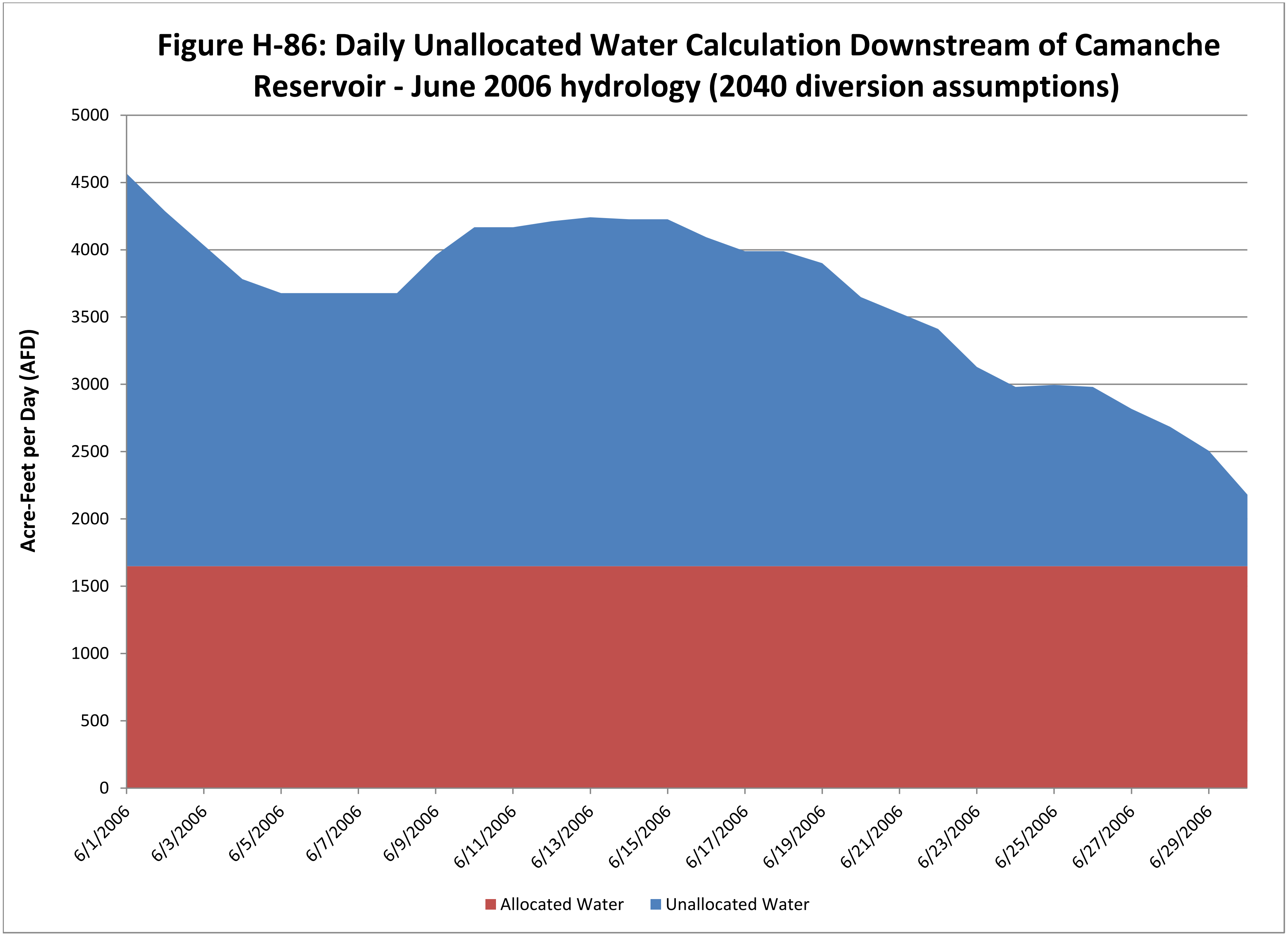


Figure H-86: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - June 2006 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
6/1/2006
6/3/2006
6/5/2006
6/7/2006
6/9/2006
6/11/2006
6/13/2006
6/15/2006
6/17/2006
6/19/2006
6/21/2006
6/23/2006
6/25/2006
6/27/2006
6/29/2006
Allocated Water
Unallocated Water

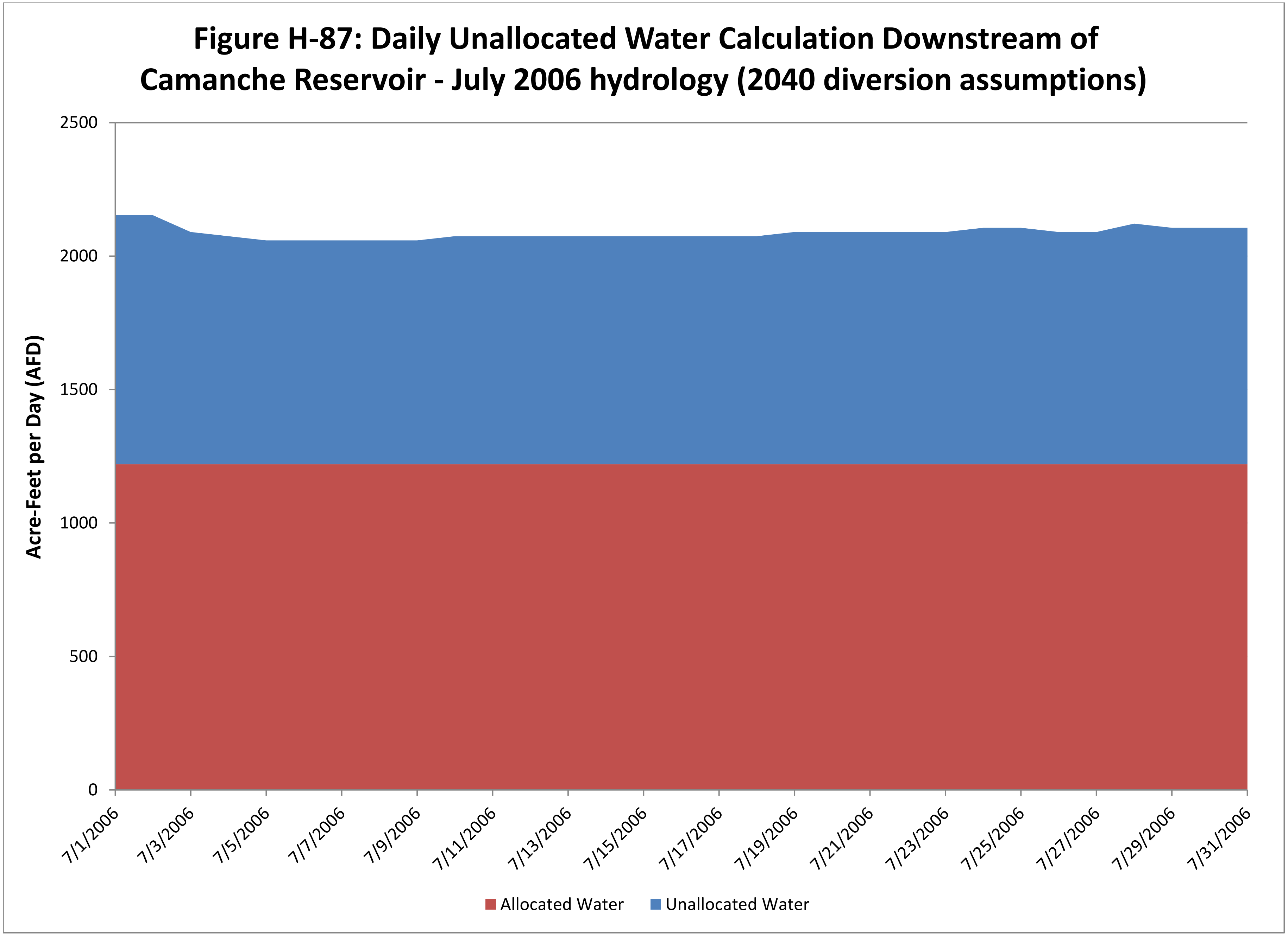


Figure H-87: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - July 2006 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
2500
2000
1500
1000
500
0
7/1/2006
7/3/2006
7/5/2006
7/7/2006
7/9/2006
7/11/2006
7/13/2006
7/15/2006
7/17/2006
7/19/2006
7/21/2006
7/23/2006
7/25/2006
7/27/2006
7/29/2006
7/31/2006
Allocated Water
Unallocated Water

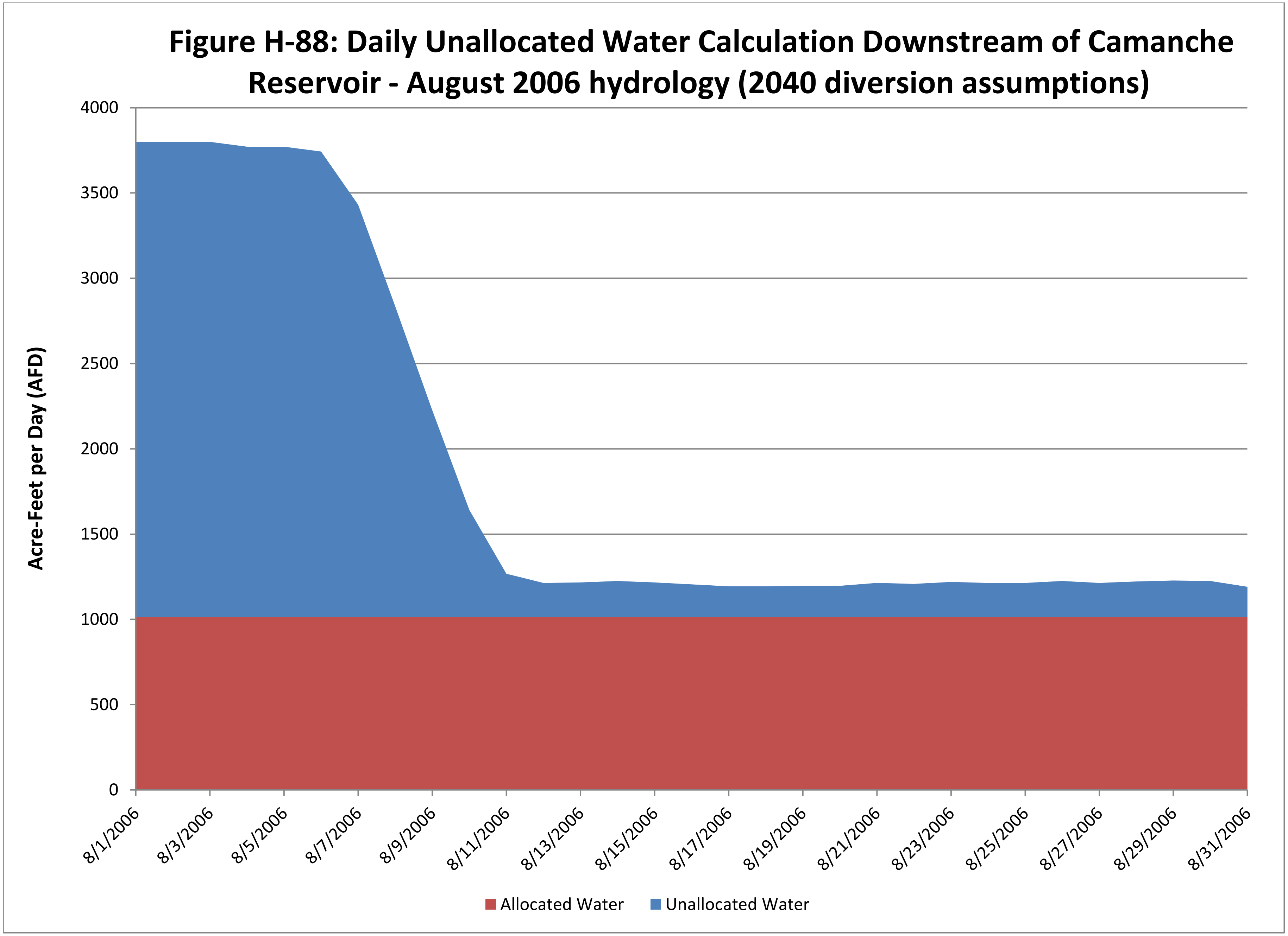


Figure H-88: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - August 2006 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
8/1/2006
8/3/2006
8/5/2006
8/7/2006
8/9/2006
8/11/2006
8/13/2006
8/15/2006
8/17/2006
8/19/2006
8/21/2006
8/23/2006
8/25/2006
8/27/2006
8/29/2006
8/31/2006
Allocated Water
Unallocated Water

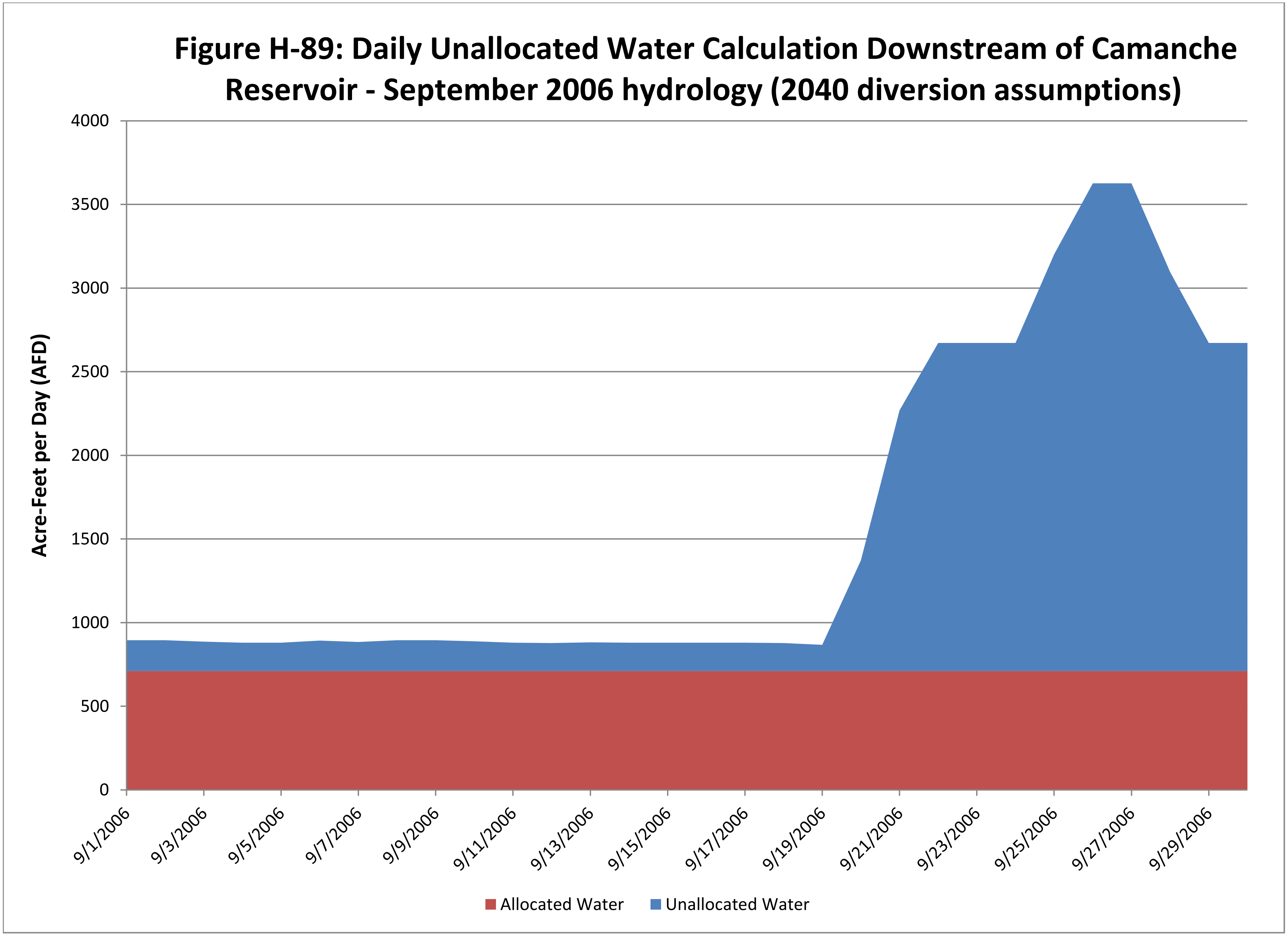


Figure H-89: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - September 2006 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
4000
3500
3000
2500
2000
1500
1000
500
0
9/1/2006
9/3/2006
9/5/2006
9/7/2006
9/9/2006
9/11/2006
9/13/2006
9/15/2006
9/17/2006
9/19/2006
9/21/2006
9/23/2006
9/25/2006
9/27/2006
9/29/2006
Allocated Water
Unallocated Water

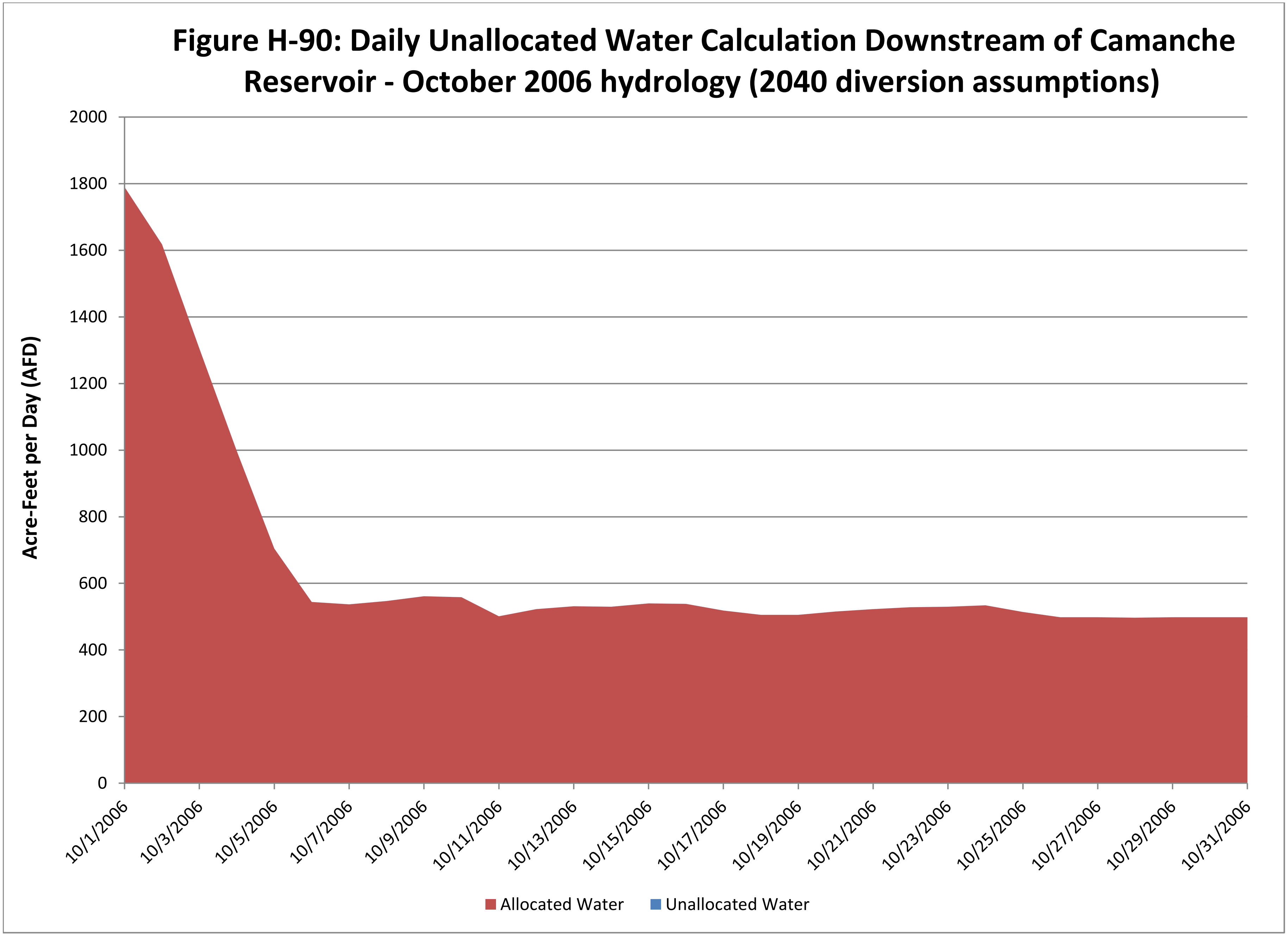


Figure H-90: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - October 2006 hydrology (2040 diversion assumptions)
Acre-Feet per Day (AFD)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
10/1/2006
10/3/2006
10/5/2006
10/7/2006
10/9/2006
10/11/2006
10/13/2006
10/15/2006
10/17/2006
10/19/2006
10/21/2006
10/23/2006
10/25/2006
10/27/2006
10/29/2006
10/31/2006
Allocated Water
Unallocated Water

Figure H-91: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - November 2006 hydrology (2040 diversion assumptions)

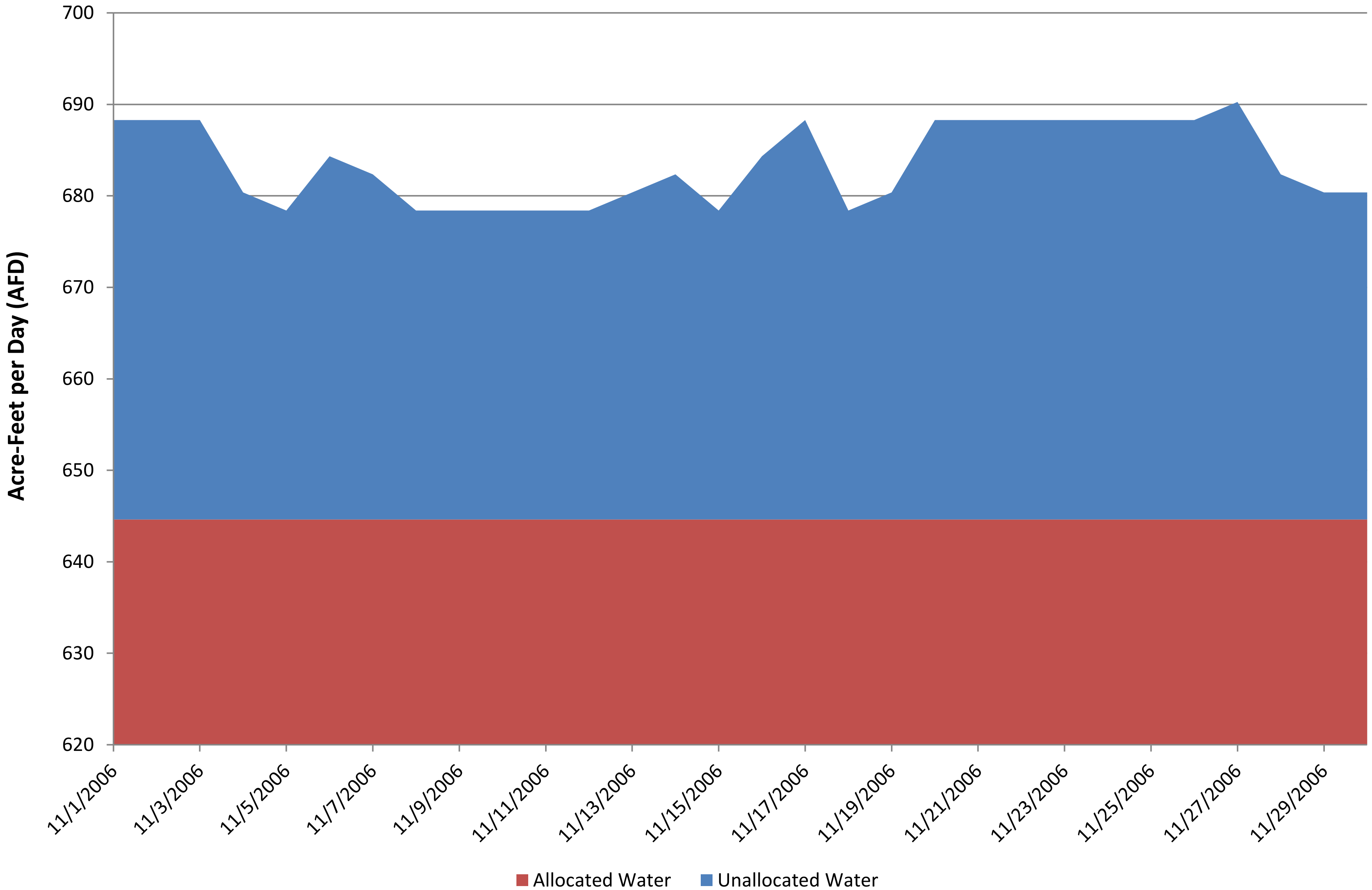
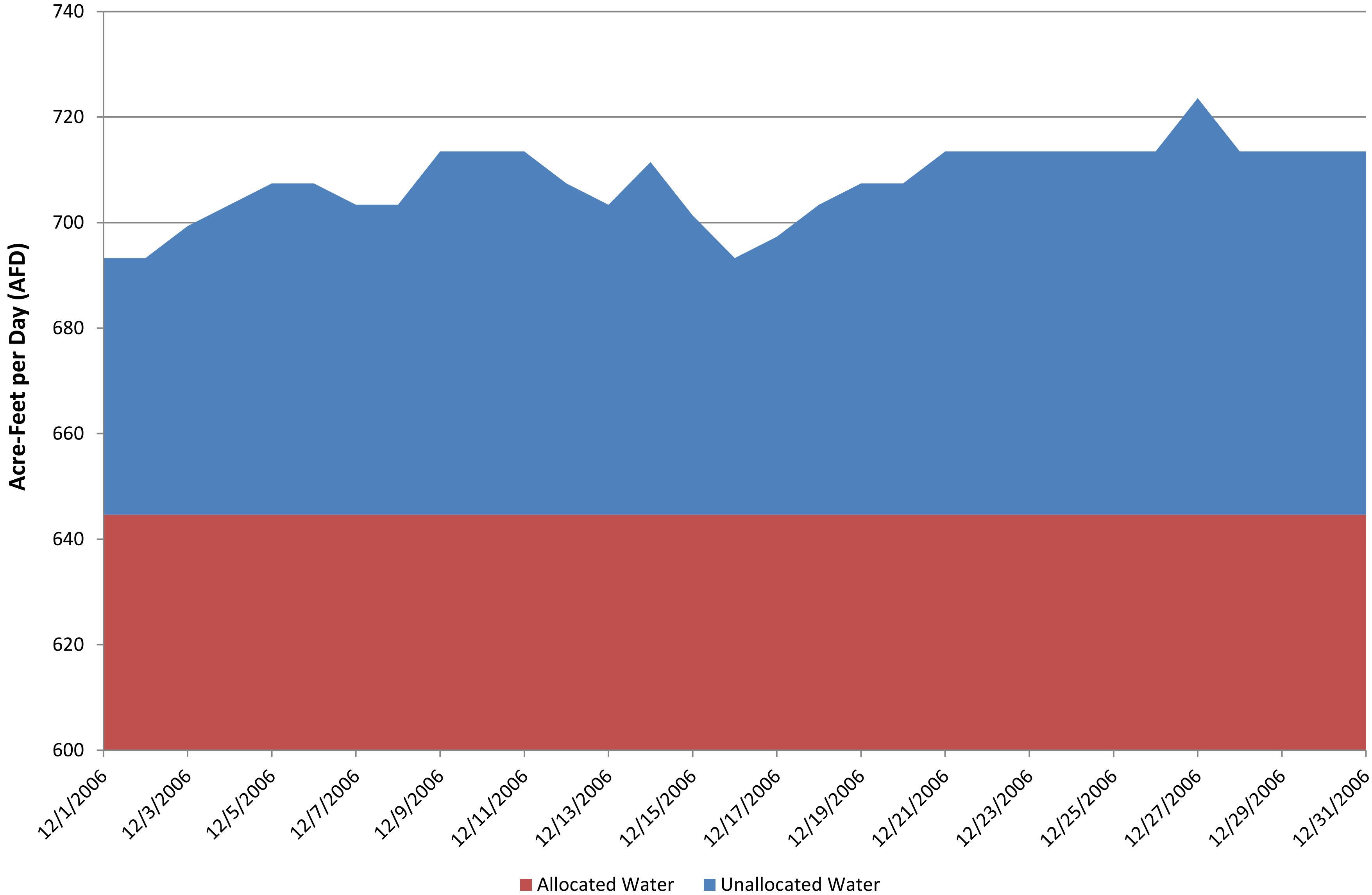


Figure H-92: Daily Unallocated Water Calculation Downstream of Camanche Reservoir - December 2006 hydrology (2040 diversion assumptions)



Appendix I: Riparian Diversions as Modeled in MOCASIM

Appendix I shows the riparian diversions at Highway 99, Woodbridge Dam, and Interstate 5. Results indicate that diversions are greatest from May through July.

Table I-1: Riparian Diversions Above Highway 99 (TAF)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1954	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1955	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1956	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1957	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1958	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1959	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1960	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1961	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1962	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1963	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1964	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1965	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1966	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1967	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1968	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1969	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1970	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1971	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1972	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1973	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1974	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1975	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.4	13.4
1976	0.1	0.1	0.3	0.8	2.1	3.1	1.5	1.0	0.5	0.5	0.2	0.4	10.4
1977	0.1	0.1	0.3	0.8	2.1	3.1	1.5	1.0	0.5	0.5	0.2	0.3	10.4
1978	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1979	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1980	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1981	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1982	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1983	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1984	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1985	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1986	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4

Table I-1: Riparian Diversions Above Highway 99 (TAF)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1987	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.4	13.4
1988	0.1	0.1	0.3	0.8	2.1	3.1	1.5	1.0	0.5	0.5	0.2	0.3	10.4
1989	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1990	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1991	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1992	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1993	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1994	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1995	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1996	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1997	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1998	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
1999	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
2000	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
2001	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
2002	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
2003	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
2004	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
2005	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
2006	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
2007	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
2008	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
2009	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.3	13.4
2010	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.4	13.4
Ave	0.1	0.1	0.3	0.8	2.1	3.1	2.9	1.9	0.9	0.5	0.2	0.3	13.2
Max	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.4	13.4
Min	0.1	0.1	0.3	0.8	2.1	3.1	1.5	1.0	0.5	0.5	0.2	0.3	10.4

*Note: Riparian diversions are the same for both the 2010 and 2040 baseline cases.

Table I-2: Riparian Diversions Above Woodbridge Diversion Dam (TAF)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1954	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1955	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1956	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1957	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1958	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1959	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1960	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1961	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1962	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1963	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1964	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1965	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1966	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1967	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1968	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1969	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1970	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1971	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1972	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1973	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1974	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1975	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1976	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.8
1977	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.8
1978	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1979	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1980	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1981	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1982	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1983	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1984	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1985	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1986	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0

Table I-2: Riparian Diversions Above Woodbridge Diversion Dam (TAF)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1987	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1988	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.8
1989	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1990	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1991	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1992	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1993	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1994	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1995	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1996	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1997	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1998	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
1999	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
2000	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
2001	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
2002	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
2003	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
2004	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
2005	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
2006	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
2007	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
2008	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
2009	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
2010	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
Ave	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.1	0.1	0.0	0.0	0.0	1.0
Max	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	1.0
Min	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.8

*Note: Riparian diversions are the same for both the 2010 and 2040 baseline cases.

Table I-3: Riparian Diversions Above Interstate 5 (TAF)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1954	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1955	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1956	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1957	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1958	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1959	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1960	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1961	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1962	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1963	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1964	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1965	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1966	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1967	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1968	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1969	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1970	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1971	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1972	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1973	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1974	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1975	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1976	0.0	0.0	0.1	0.4	1.0	1.4	0.7	0.4	0.2	0.2	0.1	0.2	4.8
1977	0.0	0.0	0.1	0.4	1.0	1.4	0.7	0.4	0.2	0.2	0.1	0.2	4.8
1978	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1979	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1980	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1981	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1982	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1983	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1984	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1985	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1986	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2

Table I-3: Riparian Diversions Above Interstate 5 (TAF)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1987	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1988	0.0	0.0	0.1	0.4	1.0	1.4	0.7	0.4	0.2	0.2	0.1	0.2	4.8
1989	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1990	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1991	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1992	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1993	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1994	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1995	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1996	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1997	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1998	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
1999	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
2000	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
2001	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
2002	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
2003	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
2004	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
2005	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
2006	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
2007	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
2008	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
2009	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
2010	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
Ave	0.0	0.0	0.1	0.4	1.0	1.4	1.3	0.9	0.4	0.2	0.1	0.2	6.1
Max	0.0	0.0	0.1	0.4	1.0	1.4	1.4	0.9	0.4	0.2	0.1	0.2	6.2
Min	0.0	0.0	0.1	0.4	1.0	1.4	0.7	0.4	0.2	0.2	0.1	0.2	4.8

*Note: Riparian diversions are the same for both the 2010 and 2040 baseline cases.

Appendix J: Unallocated Flow below Camanche as Modeled in MOCASIM

Appendix J shows unallocated water below Camanche for the 2010 and 2040 baselines. Results indicate that there is generally more unallocated water in the months from January to May, and that there is more unallocated water in the 2010 baseline than in the 2040 baseline.

Table J-1: 2010 Unallocated Water below Camanche (TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	24.7	0.0	0.0	0.0	23.3	22.5	23.3	23.3	22.5	0.0	0.0	0.0	139.5
1954	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	2.4
1955	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	121.0	121.0
1956	167.0	53.6	7.1	1.6	113.5	66.4	42.9	42.9	41.5	0.0	0.0	0.0	536.6
1957	0.0	0.0	0.0	0.0	11.2	10.8	11.2	11.2	10.8	0.0	0.0	0.0	55.3
1958	0.0	47.9	48.0	95.2	133.5	71.4	48.3	48.3	46.7	0.0	0.0	0.0	539.1
1959	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1960	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1961	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1962	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1963	0.0	62.3	0.0	0.0	77.3	50.4	37.9	37.9	36.7	0.0	23.0	0.0	325.5
1964	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	229.4	229.4
1965	128.3	35.1	0.0	12.2	50.7	49.1	50.7	50.7	49.1	0.0	19.2	2.8	447.8
1966	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7
1967	25.7	16.3	48.8	55.0	165.1	60.0	62.0	62.0	60.0	0.0	0.0	0.0	554.8
1968	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1969	149.1	78.2	39.8	123.6	176.8	67.8	51.9	51.9	50.3	0.0	0.0	9.9	799.4
1970	195.8	42.7	16.4	0.0	15.4	14.9	15.4	15.4	14.9	0.0	21.7	32.7	385.3
1971	26.9	17.5	17.8	0.0	26.4	25.6	26.4	26.4	25.6	0.0	4.9	7.3	204.8
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	45.6	57.0	27.5	0.0	28.9	27.9	28.9	28.9	27.9	0.0	64.4	39.2	376.3
1974	68.3	0.0	38.6	25.7	50.5	42.9	44.3	44.3	42.9	0.0	0.0	0.0	357.5
1975	0.0	0.0	0.0	0.0	50.7	49.0	50.7	50.7	49.0	0.0	4.6	0.0	254.8
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	20.3	19.6	20.3	20.3	19.6	0.0	0.0	0.0	100.0
1979	0.0	5.7	22.8	0.1	25.6	24.8	25.6	25.6	24.8	0.0	0.0	0.0	155.1
1980	178.1	124.3	17.6	0.0	55.4	47.5	49.1	49.1	47.5	0.0	0.0	0.0	568.6
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.2	87.2
1982	79.1	155.0	99.4	198.6	153.0	60.6	62.7	62.7	60.6	0.0	66.4	90.7	1,088.9
1983	70.6	113.7	198.8	93.3	237.8	169.8	100.7	100.7	97.4	0.0	122.3	151.3	1,456.5
1984	77.3	37.4	8.2	0.0	30.3	29.3	30.3	30.3	29.3	0.0	16.6	0.8	289.9
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	285.4	157.4	8.0	80.5	34.4	35.5	35.5	34.4	0.0	0.0	0.0	670.9

Table J-1: 2010 Unallocated Water below Camanche (TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	35.8	34.7	35.8	35.8	34.7	0.0	0.0	0.0	176.8
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	33.2	167.0	138.0	242.1	89.5	78.3	78.3	75.8	0.0	0.0	0.0	902.3
1996	0.0	111.1	52.9	9.2	92.0	27.8	28.7	28.7	27.8	0.0	18.1	129.3	525.7
1997	359.2	74.9	12.8	0.0	12.7	12.3	12.7	12.7	12.3	0.0	10.2	0.0	520.1
1998	23.5	106.1	67.3	88.1	139.6	74.8	67.7	67.7	65.6	0.0	0.8	0.0	701.3
1999	20.9	90.4	29.0	0.0	41.3	46.2	39.2	39.2	38.0	0.0	0.0	0.0	344.3
2000	0.0	48.4	26.9	0.0	18.4	17.8	18.4	18.4	17.8	0.0	0.0	0.0	166.2
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.1	0.0	0.0	16.7	16.2	16.7	16.7	16.2	0.0	0.0	0.0	82.6
2004	0.0	3.2	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.1
2005	0.0	31.9	67.6	29.6	95.3	54.3	40.0	40.0	38.7	0.0	0.0	91.6	489.0
2006	90.0	49.8	65.7	230.8	146.7	65.9	32.7	32.7	31.6	0.0	2.7	3.4	751.9
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.0	0.0	0.0	5.0	4.8	5.0	5.0	4.8	0.0	0.0	0.0	24.7
2010	0.0	0.0	0.0	0.0	31.6	30.6	31.6	31.6	30.6	0.0	25.1	74.4	255.4
Ave	29.9	29.0	21.6	19.1	41.4	24.5	21.1	21.1	20.4	0.0	6.9	18.5	253.5
Max	359.2	285.4	198.8	230.8	242.1	169.8	100.7	100.7	97.4	0.0	122.3	229.4	1,456.5
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table J-2: 2040 Unallocated Water below Camanche (TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	23.3	0.0	0.0	0.0	16.5	16.0	16.5	16.5	16.0	0.0	0.0	0.0	105.0
1954	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1955	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	108.1	108.1
1956	165.6	52.3	5.6	0.2	108.8	60.5	37.1	37.1	35.9	0.0	0.0	0.0	503.0
1957	0.0	0.0	0.0	0.0	4.0	3.9	4.0	4.0	3.9	0.0	0.0	0.0	19.7
1958	0.0	42.2	46.5	93.8	128.9	65.5	42.5	42.5	41.1	0.0	0.0	0.0	502.9
1959	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1960	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1961	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1962	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1963	0.0	105.9	0.0	0.0	64.0	43.9	31.6	31.6	30.5	0.0	21.5	0.0	329.0
1964	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	193.3	193.3
1965	126.9	33.8	0.0	9.1	45.4	43.6	45.0	45.0	43.6	0.0	17.7	1.3	411.3
1966	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
1967	4.4	15.1	47.3	53.7	160.6	54.5	56.3	56.3	54.5	0.0	0.0	0.0	502.6
1968	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1969	142.3	77.0	38.5	122.2	172.2	61.9	46.2	46.2	44.7	0.0	0.0	6.9	758.2
1970	194.4	41.4	14.9	0.0	9.4	9.1	9.4	9.4	9.1	0.0	20.2	31.3	348.8
1971	25.5	16.2	16.3	0.0	20.3	19.6	20.3	20.3	19.6	0.0	3.4	5.9	167.2
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	22.8	55.7	26.0	0.0	23.2	22.5	23.2	23.2	22.5	0.0	62.9	37.7	319.9
1974	66.9	0.0	35.8	24.1	45.8	37.2	38.4	38.4	37.2	0.0	0.0	0.0	323.8
1975	0.0	0.0	0.0	0.0	43.1	41.7	43.1	43.1	41.7	0.0	3.1	0.0	215.7
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	5.9	5.7	5.9	5.9	5.7	0.0	0.0	0.0	29.2
1979	0.0	0.0	21.3	0.0	19.5	18.8	19.5	19.5	18.8	0.0	0.0	0.0	117.4
1980	173.8	123.0	16.1	0.0	49.3	41.8	43.2	43.2	41.8	0.0	0.0	0.0	532.2
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	72.3	72.3
1982	77.7	153.7	97.9	197.0	148.1	54.8	56.6	56.6	54.8	0.0	64.9	89.3	1,051.2
1983	69.2	112.5	197.3	91.7	232.8	163.7	94.7	94.7	91.6	0.0	120.8	149.9	1,418.9
1984	75.9	36.1	6.8	0.0	24.1	23.3	24.1	24.1	23.3	0.0	15.1	0.0	252.9
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table J-2: 2040 Unallocated Water below Camanche (TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1986	0.0	260.7	155.9	6.8	76.0	28.9	29.9	29.9	28.9	0.0	0.0	0.0	616.9
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	24.8	24.0	24.8	24.8	24.0	0.0	0.0	0.0	122.3
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	18.7	165.7	136.5	237.3	83.5	72.5	72.5	70.1	0.0	0.0	0.0	856.7
1996	0.0	105.4	51.4	7.8	87.4	22.2	22.9	22.9	22.2	0.0	16.6	127.9	486.6
1997	357.8	73.7	11.3	0.0	6.8	6.6	6.8	6.8	6.6	0.0	8.7	0.0	485.2
1998	20.6	104.8	65.9	86.7	134.9	68.9	61.9	61.9	59.9	0.0	0.0	0.0	665.7
1999	17.3	89.2	27.5	0.0	35.4	40.1	33.4	33.4	32.4	0.0	0.0	0.0	308.8
2000	0.0	42.7	25.4	0.0	12.2	11.9	12.2	12.2	11.9	0.0	0.0	0.0	128.5
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	2.9	2.8	2.9	2.9	2.8	0.0	0.0	0.0	14.2
2004	0.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0
2005	0.0	11.9	66.1	27.9	90.8	48.6	34.4	34.4	33.3	0.0	0.0	88.7	436.1
2006	88.6	48.5	64.3	229.4	142.0	60.0	26.9	26.9	26.0	0.0	1.2	2.0	715.7
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.0	0.0	0.0	0.0	22.7	22.0	22.7	22.7	22.0	0.0	23.6	72.9	208.7
Ave	28.5	27.9	20.9	18.7	37.9	20.8	17.4	17.4	16.8	0.0	6.5	17.0	230.0
Max	357.8	260.7	197.3	229.4	237.3	163.7	94.7	94.7	91.6	0.0	120.8	193.3	1,418.9
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix K: Relevant Tables and Figures in Cubic Feet per Second (cfs)

Appendix K presents data for all relevant figures and tables from Appendices D through J in cubic feet per second (cfs) rather than in acre-feet. The values stated provide the average flow in cfs over the time period specified (year, month, etc.). One acre-foot per year is equivalent to 0.00138 cfs.

Table K-1: Presented as Table 19: Diversion Assumptions for Current (2010) and Future (2040) Baselines
Values shown provide flow in cubic feet per second (cfs) averaged over the year

Agency	2010 Baseline Diversions (cfs)	2040 Baseline Diversions (cfs)
Amador Water Agency (AWA)[1]	11	19
Calaveras County Water District (CCWD)[2]	3	3
Calaveras Public Utility District (CPUD)[3]	2	4
East Bay Municipal Utility District (EBMUD)[4]	334	355
Jackson Valley Irrigation District (JVID)[5]	5	4
North San Joaquin Water Conservation District (NSJWCD)[6]	4	28
Woodbridge Irrigation District (WID)[7]	99	99
TOTAL	**459**	**512**

[1] 2010 diversions reflect 97% of historic and projected reported total water use in the AWA 2010 Urban Water Management Plan (UWMP), as 97% of supply is surface water from the Mokelumne River. Projected 2040 diversions are extrapolated from the AWA 2010 UWMP, which reports projected demands through 2030. It is understood that demand may differ in the future from what is presented here depending on actual growth and water use in the AWA service area.

[2] Historic and projected diversions reflect actual and projected data presented in the CCWD 2010 UWMP. It should be noted that projected 2040 use could change significantly in future years, and projections are expected to increase in the 2015 UWMP. However, these are the best available projections currently.

[3] CPUD diversions are confirmed by CPUD and are based on the 2008 Master Plan and 2008-2013 usage summary.

[4] EBMUD 2010 and 2040 diversions based on information provided by the EBMUD Water Resources Division for Mokelumne Supplies.

[5] JVID shares a 5,000 AF right under CAWP with AWA and can currently take up to 3,850 AF. AWA anticipates increasing their portion of the right from 1,250 AF to 2,200 AF, which will decrease JVID's portion to 2,800 AF by 2040.

[6] NSJWCD 2010 diversion reflects actual diversions in 2010. Projected 2040 diversions based on capacity and projected demand.

[7] WID can currently take 60,000 AFY, plus additional spill (which is used for irrigation). In recent years, WID has reported diverting 72,000 AFY. The additional spill is obtainable under WID's combined pre 1914 water rights (1886) and the State Water Resources Control Board (SWRCB) licenses 5945 and 8214. WID's simultaneous diversion under License 5945 and the pre-1914 right may not exceed 300 cfs. WID's water right under License 8214 allows 114 cfs to be diverted from the Mokelumne. All combined, diversions cannot exceed 414.4 cfs.

Table K-2: Presented as Table E-8: Unallocated, Regulated, and Natural Flow Comparison for January through July below Camanche (2010) (in TAF)*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	January			February			March			April			May			June			July		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1953	410.0	1,011.5	1,137.9	0.0	679.8	528.8	0.0	747.6	855.0	0.0	1,033.0	2,176.7	386.2	1,262.7	2,515.8	373.8	2,067.0	2,641.7	386.2	918.0	660.1
1954	0.0	635.1	431.9	0.0	629.2	618.5	0.0	940.6	1,470.8	0.0	1,219.2	2,626.1	8.0	1,471.7	2,720.6	7.8	705.3	707.1	8.0	539.8	223.3
1955	0.0	496.5	532.1	0.0	447.3	458.3	0.0	616.7	656.3	0.0	496.4	1,128.5	0.0	808.4	2,855.4	0.0	886.0	1,619.6	0.0	560.6	185.7
1956	2,772.2	2,971.2	3,441.7	889.8	1,640.0	1,289.2	118.0	1,586.5	1,301.7	26.7	1,619.9	1,959.0	1,883.8	3,191.1	4,581.2	1,102.4	3,270.4	3,408.9	712.3	856.1	701.8
1957	0.0	605.1	249.8	0.0	677.2	942.6	0.0	813.6	1,513.8	0.0	700.6	1,522.3	186.0	1,553.3	2,993.7	180.0	2,149.1	2,219.6	186.0	563.5	243.9
1958	0.0	797.9	431.4	794.3	1,329.4	1,446.7	796.7	1,563.2	1,725.3	1,579.5	2,368.9	3,275.1	2,216.6	3,341.8	5,860.1	1,184.9	3,574.8	3,691.5	801.2	1,029.0	875.1
1959	0.0	654.6	525.1	0.0	743.5	706.0	0.0	675.6	904.0	0.0	399.4	1,646.5	0.0	445.3	1,514.4	0.0	514.3	583.9	0.0	546.0	50.0
1960	0.0	340.8	139.1	0.0	567.8	829.3	0.0	516.3	1,266.5	0.0	518.0	1,757.0	0.0	961.6	2,042.8	0.0	897.8	698.1	0.0	522.5	61.7
1961	0.0	387.2	128.7	0.0	252.6	326.2	0.0	292.5	487.8	0.0	307.2	1,213.1	0.0	367.4	1,749.7	0.0	503.5	563.1	0.0	518.7	23.8
1962	0.0	344.3	146.7	0.0	908.5	1,216.8	0.0	843.4	832.6	0.0	1,450.3	2,905.2	0.0	1,151.1	2,727.1	0.0	2,183.8	2,329.1	0.0	654.5	281.7
1963	0.0	780.0	721.1	1,034.1	1,371.8	2,822.3	0.0	767.9	762.5	0.0	1,741.3	2,170.7	1,283.0	3,569.3	4,496.0	837.2	2,322.0	2,335.7	629.0	699.9	456.1
1964	0.0	781.4	413.7	0.0	616.6	367.9	0.0	564.6	526.3	0.0	529.6	1,418.3	0.0	541.7	2,413.6	0.0	562.3	1,165.7	0.0	607.8	147.0
1965	2,129.0	2,684.8	2,577.1	582.9	1,435.0	1,204.2	0.0	1,225.5	1,055.1	202.3	1,890.5	2,696.4	841.9	2,239.3	3,405.8	814.7	2,687.6	2,800.0	841.9	952.6	761.3
1966	44.4	682.4	390.7	0.0	388.7	380.5	0.0	701.8	1,153.7	0.0	858.7	2,264.0	0.0	771.9	2,105.1	0.0	453.9	750.9	0.0	554.2	72.8
1967	427.3	1,128.8	1,074.1	271.0	909.0	964.7	809.5	1,657.2	2,041.7	912.8	1,816.5	1,933.1	2,740.9	2,700.1	4,930.6	995.4	4,158.1	4,952.3	1,028.5	2,139.6	2,073.8
1968	0.0	651.3	334.6	0.0	763.9	1,204.0	0.0	759.7	1,037.3	0.0	627.5	1,452.7	0.0	499.5	1,924.6	0.0	630.4	596.7	0.0	516.7	65.2
1969	2,475.3	2,693.1	3,351.5	1,298.7	1,719.4	1,756.4	660.3	1,617.6	1,477.2	2,051.7	2,471.7	3,498.6	2,935.3	4,695.4	6,351.3	1,125.1	3,661.6	3,881.4	862.1	1,193.9	1,021.1
1970	3,249.9	2,693.0	4,029.4	709.0	1,404.2	1,340.0	272.4	1,660.8	1,416.9	0.0	1,124.9	1,260.9	255.5	1,921.2	3,108.1	247.3	1,996.2	1,952.5	255.5	759.1	306.0
1971	446.0	1,082.1	945.7	289.9	1,020.9	817.3	294.8	1,286.2	1,202.9	0.0	1,216.7	1,792.5	438.9	1,106.9	2,836.9	424.7	2,142.5	3,019.1	438.9	994.5	524.8
1972	0.0	609.6	339.1	0.0	494.8	543.9	0.0	954.4	1,661.3	0.0	815.0	1,333.7	0.0	659.3	2,667.3	0.0	1,187.3	1,126.4	0.0	636.7	115.9
1973	756.6	1,276.0	1,320.8	946.5	1,315.9	1,252.6	457.0	1,319.3	1,142.7	0.0	1,288.7	2,095.9	479.4	2,291.6	4,644.0	463.9	1,701.8	1,793.5	479.4	778.6	167.4
1974	1,133.4	1,515.4	1,881.3	0.0	1,055.9	622.2	640.1	1,958.4	2,032.5	426.9	1,902.2	2,345.0	838.4	2,330.2	4,156.0	712.0	2,337.7	2,471.8	735.7	1,033.0	592.5
1975	0.0	470.3	296.5	0.0	617.1	693.5	0.0	1,246.5	1,418.2	0.0	1,217.7	1,185.2	841.3	1,805.6	4,252.5	814.2	2,956.2	3,877.6	841.3	1,122.9	688.4
1976	0.0	468.3	165.5	0.0	224.2	229.6	0.0	271.5	467.4	0.0	280.2	735.9	0.0	308.0	1,192.7	0.0	281.8	130.6	0.0	284.7	23.0
1977	0.0	184.0	67.1	0.0	100.1	107.6	0.0	124.6	152.3	0.0	226.8	596.0	0.0	304.0	715.4	0.0	269.0	421.1	0.0	280.7	27.0
1978	0.0	1,199.5	1,471.3	0.0	1,089.3	1,017.9	0.0	1,610.8	2,147.4	0.0	1,891.8	2,529.4	336.4	1,882.9	3,950.0	325.6	3,174.6	3,580.3	336.4	1,122.8	839.6
1979	0.0	815.4	789.7	93.8	816.4	784.5	379.2	1,355.2	1,565.1	1.6	1,435.2	2,005.1	425.3	1,968.1	4,346.5	411.6	1,530.6	1,565.3	425.3	655.3	202.5
1980	2,957.2	2,779.6	4,122.8	2,062.7	2,553.1	2,783.7	292.0	1,896.2	1,646.6	0.0	1,448.7	2,205.1	919.8	2,213.8	3,372.7	788.4	2,836.9	2,911.7	814.7	1,308.9	1,134.3
1981	0.0	696.9	308.1	0.0	576.9	447.8	0.0	576.8	780.6	0.0	690.6	1,842.2	0.0	532.0	2,097.9	0.0	536.5	532.8	0.0	572.4	6.5
1982	1,312.9	1,817.5	1,697.3	2,572.2	2,759.9	3,426.1	1,649.8	2,599.6	2,556.3	3,296.5	4,070.4	5,036.3	2,540.3	4,769.9	5,214.4	1,006.8	3,021.0	3,096.3	1,040.3	1,309.8	921.7
1983	1,172.5	1,981.0	1,694.4	1,888.2	2,505.2	2,395.6	3,300.6	4,038.8	4,447.6	1,549.2	2,329.6	2,372.5	3,946.7	3,497.9	5,316.3	2,819.1	6,182.6	6,306.5	1,671.0	3,471.9	3,425.9
1984	1,283.5	1,899.2	1,451.9	621.3	1,466.0	934.4	136.9	1,606.3	1,411.0	0.0	1,330.4	1,437.4	502.7	2,413.6	3,615.2	486.5	1,823.2	1,646.0	502.7	977.3	294.0
1985	0.0	409.0	262.0	0.0	587.1	464.9	0.0	849.7	691.3	0.0	1,032.4	2,152.2	0.0	545.7	2,357.1	0.0	508.5	567.0	0.0	519.3	71.5
1986	0.0	877.6	1,144.9	4,736.8	4,421.5	5,649.6	2,612.1	3,193.5	4,312.4	132.4	2,076.0	2,361.3	1,335.8	3,222.3	3,554.9	570.3	2,211.6	2,367.3	589.3	761.1	406.8
1987	0.0	426.1	130.7	0.0	297.9	352.4	0.0	420.0	691.8	0.0	372.4	1,413.3	0.0	296.3	1,324.1	0.0	367.7	193.0	0.0	550.6	36.4
1988	0.0	367.6	296.5	0.0	247.2	333.3	0.0	291.3	689.2	0.0	320.8	1,123.3	0.0	390.2	1,133.8	0.0	457.2	375.6	0.0	480.1	61.9
1989	0.0	231.5	183.1	0.0	250.2	413.0	0.0	1,011.8	2,405.4	0.0	1,353.0	2,519.5	0.0	1,770.6	2,163.7	0.0	1,174.3	1,050.5	0.0	588.3	105.8

Table K-2: Presented as Table E-8: Unallocated, Regulated, and Natural Flow Comparison for January through July below Camanche (2010) (in TAF)*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	January			February			March			April			May			June			July		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1990	0.0	552.9	287.7	0.0	378.3	307.1	0.0	552.6	982.3	0.0	405.3	1,620.0	0.0	554.7	1,197.6	0.0	575.7	563.5	0.0	553.6	60.2
1991	0.0	80.9	59.2	0.0	136.0	67.2	0.0	380.1	855.6	0.0	438.7	1,108.7	0.0	512.2	2,218.3	0.0	733.1	1,323.6	0.0	565.9	146.0
1992	0.0	387.7	167.1	0.0	486.1	690.8	0.0	661.9	893.1	0.0	408.3	1,785.3	0.0	360.9	944.7	0.0	309.9	140.6	0.0	513.3	146.1
1993	0.0	1,261.6	1,745.8	0.0	1,225.5	1,150.2	0.0	2,003.0	2,577.7	0.0	1,726.0	2,481.0	594.6	2,940.2	4,529.3	575.4	2,951.0	3,157.6	594.6	891.6	717.3
1994	0.0	345.5	165.1	0.0	269.7	286.9	0.0	312.6	722.0	0.0	293.9	1,294.2	0.0	370.2	1,563.9	0.0	488.8	462.4	0.0	399.3	36.0
1995	0.0	1,825.1	2,404.6	551.0	1,218.5	1,214.2	2,772.7	3,386.5	4,206.0	2,291.2	2,728.3	3,135.1	4,018.2	4,159.5	5,516.9	1,485.2	5,026.4	5,265.0	1,300.4	3,035.6	3,234.1
1996	0.0	740.7	908.6	1,844.7	1,896.2	2,753.8	877.5	2,157.7	2,187.3	152.7	1,977.1	2,537.8	1,527.8	3,785.6	4,313.2	461.7	1,892.7	1,946.4	477.1	759.4	415.5
1997	5,962.7	5,790.2	7,348.6	1,243.7	1,869.2	1,445.0	212.2	1,574.0	1,411.8	0.0	1,580.3	2,063.8	211.6	2,460.3	2,903.7	204.8	1,360.4	1,158.8	211.6	660.6	185.9
1998	390.1	1,038.6	1,370.6	1,760.9	2,053.2	2,342.7	1,118.0	2,112.3	2,650.9	1,462.2	2,057.8	2,642.5	2,317.9	2,683.3	3,704.9	1,242.1	4,694.5	5,797.6	1,124.4	2,247.8	2,286.5
1999	346.5	1,148.3	1,016.4	1,501.1	1,990.0	2,172.9	481.7	1,505.9	1,383.3	0.0	1,448.2	1,867.7	686.1	2,055.4	4,062.9	767.2	2,575.1	2,755.4	651.4	994.4	470.5
2000	0.0	847.0	1,032.6	802.9	1,374.5	1,882.1	446.4	1,562.4	1,589.0	0.0	1,132.7	2,233.9	305.8	2,133.0	3,439.5	295.9	1,384.1	1,148.2	305.8	855.6	164.9
2001	0.0	327.9	212.4	0.0	301.8	347.2	0.0	633.5	1,061.2	0.0	896.7	1,488.7	0.0	742.0	2,329.1	0.0	539.3	203.4	0.0	572.3	67.2
2002	0.0	897.6	722.5	0.0	605.7	611.3	0.0	1,158.2	1,099.0	0.0	1,097.6	2,190.9	0.0	889.3	2,674.6	0.0	1,019.6	1,039.7	0.0	531.5	170.3
2003	0.0	948.9	633.9	1.5	825.2	550.9	0.0	799.7	946.6	0.0	992.2	1,603.1	277.4	1,758.0	3,592.1	268.4	2,055.2	2,196.7	277.4	599.8	268.5
2004	0.0	859.7	378.4	53.0	832.0	812.9	215.0	1,306.8	1,843.6	0.0	785.9	2,018.2	0.0	473.1	1,926.8	0.0	793.7	500.3	0.0	542.2	74.6
2005	0.0	1,392.7	1,200.9	529.7	1,300.5	1,081.3	1,121.7	2,055.3	1,968.6	490.6	2,027.2	2,084.3	1,581.5	3,006.3	5,317.4	900.9	2,817.1	3,298.9	664.2	1,219.9	827.0
2006	1,494.3	1,824.8	2,353.4	826.1	1,325.7	1,591.1	1,091.3	2,650.9	2,182.4	3,830.7	4,846.6	5,190.4	2,435.1	4,874.6	5,916.9	1,093.4	3,170.1	3,182.1	542.6	1,172.0	551.3
2007	0.0	544.0	301.9	0.0	593.4	891.9	0.0	774.9	1,237.1	0.0	481.5	1,638.7	0.0	590.3	1,590.0	0.0	472.1	286.5	0.0	534.9	113.0
2008	0.0	493.9	368.0	0.0	512.3	463.3	0.0	771.2	840.5	0.0	479.5	1,373.9	0.0	672.0	2,374.6	0.0	589.7	849.2	0.0	403.6	93.2
2009	0.0	696.4	527.5	0.0	638.5	751.7	0.0	1,325.1	1,710.6	0.0	1,159.1	1,883.5	83.1	2,653.6	4,035.4	80.4	958.5	898.2	83.1	661.6	161.9
2010	0.0	759.0	443.4	0.0	707.6	514.3	0.0	984.9	974.8	0.0	1,355.0	1,723.8	524.3	1,941.7	2,830.2	507.4	2,207.3	3,910.8	524.3	808.3	505.2

* Unallocated water is simulated below Camanche and regulated and unimpaired flow is simulated at Mokelumne Hill.

Table K-3: Presented as Table E-9: Unallocated, Regulated, and Natural Flow Comparison for August through December below Camanche (2010) (in TAF)*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	August			September			October			November			December			Total		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1953	386.2	622.5	66.6	373.8	630.7	37.2	0.0	699.3	94.4	0.0	652.7	188.7	0.0	630.9	244.5	2,316.3	10,955.6	11,147.5
1954	8.0	578.8	0.0	7.8	610.5	38.6	0.0	633.0	67.5	0.0	681.0	131.0	0.0	575.2	474.7	39.7	9,219.4	9,510.1
1955	0.0	571.6	45.9	0.0	541.3	15.0	0.0	559.3	39.5	0.0	560.9	96.2	2,008.1	2,710.2	4,312.9	2,008.1	9,255.1	11,945.4
1956	712.3	614.4	108.7	689.4	570.5	72.8	0.0	665.3	151.0	0.0	714.6	177.9	0.0	751.0	219.5	8,907.0	18,451.1	17,413.3
1957	186.0	523.2	40.0	180.0	537.6	38.9	0.0	660.8	67.2	0.0	723.3	119.6	0.0	723.0	267.1	917.8	10,230.4	10,218.4
1958	801.2	745.6	144.6	775.3	595.4	61.5	0.0	664.2	65.1	0.0	636.5	92.0	0.0	561.8	82.2	8,949.7	17,208.5	17,750.5
1959	0.0	543.3	2.4	0.0	513.1	77.0	0.0	541.4	36.9	0.0	507.8	31.8	0.0	534.7	54.0	0.0	6,619.0	6,132.2
1960	0.0	528.1	0.0	0.0	510.6	17.3	0.0	516.6	8.2	0.0	500.2	110.2	0.0	529.4	179.2	0.0	6,909.6	7,109.5
1961	0.0	500.0	0.0	0.0	500.5	4.2	0.0	514.4	6.6	0.0	317.0	63.0	0.0	311.7	172.1	0.0	4,772.5	4,738.2
1962	0.0	618.7	39.3	0.0	568.8	0.4	0.0	669.4	331.9	0.0	627.5	113.2	0.0	629.0	307.4	0.0	10,649.3	11,231.7
1963	629.0	645.4	47.2	608.7	607.1	56.4	0.0	633.6	115.7	381.9	691.8	770.7	0.0	725.1	397.5	5,403.0	14,555.2	15,151.7
1964	0.0	585.8	34.0	0.0	575.2	40.7	0.0	609.6	73.2	0.0	711.4	259.0	3,807.8	3,365.5	5,237.0	3,807.8	10,051.5	12,096.4
1965	841.9	753.3	346.9	814.7	931.2	115.9	0.0	931.4	88.4	318.4	946.1	440.4	46.3	771.4	363.1	7,434.1	17,448.6	15,854.4
1966	0.0	557.6	17.3	0.0	601.7	30.9	0.0	554.2	24.5	0.0	668.2	292.8	0.0	1,191.3	1,199.4	44.4	7,984.7	8,682.5
1967	1,028.5	672.7	231.6	995.4	639.6	87.2	0.0	658.0	89.0	0.0	662.8	118.0	0.0	667.7	183.2	9,209.4	17,810.1	18,679.3
1968	0.0	525.3	42.1	0.0	537.7	16.8	0.0	543.8	75.6	0.0	665.3	572.9	0.0	739.7	396.6	0.0	7,460.7	7,719.0
1969	862.1	830.3	116.4	834.3	776.0	62.1	0.0	804.8	184.3	0.0	659.2	195.2	164.6	910.4	1,090.2	13,269.4	22,033.4	22,985.8
1970	255.5	589.5	64.1	247.3	567.9	5.8	0.0	608.1	47.6	359.8	871.3	516.4	543.5	1,237.0	893.6	6,395.5	15,433.1	14,941.3
1971	438.9	905.1	55.9	424.7	688.6	9.0	0.0	736.2	52.7	81.3	552.0	200.4	121.8	688.4	494.9	3,399.8	12,420.1	11,952.2
1972	0.0	567.0	15.4	0.0	561.9	15.5	0.0	622.2	72.3	0.0	659.0	187.8	0.0	764.6	641.0	0.0	8,531.8	8,719.6
1973	479.4	575.2	25.7	463.9	576.9	0.2	0.0	643.3	105.3	1,069.6	911.3	1,421.1	650.2	1,261.2	1,225.1	6,245.8	13,939.7	15,194.5
1974	735.7	937.0	96.6	712.0	740.6	14.9	0.0	594.7	51.8	0.0	509.2	87.1	0.0	547.0	188.0	5,934.2	15,461.3	14,539.6
1975	841.3	925.4	123.4	814.2	878.5	48.4	0.0	760.0	363.6	77.1	690.6	380.7	0.0	647.6	199.2	4,229.5	13,338.5	13,527.3
1976	0.0	295.5	71.2	0.0	285.5	35.8	0.0	204.8	32.9	0.0	203.1	41.3	0.0	150.8	31.8	0.0	3,258.2	3,157.6
1977	0.0	273.0	22.7	0.0	291.1	22.5	0.0	18.4	13.7	0.0	48.5	57.2	0.0	393.1	489.7	0.0	2,513.4	2,692.5
1978	336.4	880.0	62.2	325.6	675.7	225.5	0.0	611.7	35.9	0.0	570.5	86.8	0.0	524.9	145.6	1,660.4	15,234.6	16,091.7
1979	425.3	599.4	52.1	411.6	531.6	3.0	0.0	578.5	149.5	0.0	646.0	300.0	0.0	804.0	330.5	2,573.9	11,735.8	12,093.9
1980	814.7	611.1	123.4	788.4	574.5	48.8	0.0	586.1	41.0	0.0	552.2	49.2	0.0	629.5	134.2	9,438.0	17,990.6	18,573.6
1981	0.0	475.2	8.5	0.0	499.6	8.8	0.0	581.7	92.6	0.0	747.0	1,297.8	1,447.0	1,385.0	2,201.5	1,447.0	7,870.5	9,625.0
1982	1,040.3	919.7	131.9	1,006.8	714.7	226.9	0.0	788.0	1,124.8	1,102.7	1,385.4	1,025.2	1,506.3	2,025.4	1,811.9	18,074.9	26,181.2	26,269.2
1983	1,671.0	1,162.5	514.4	1,617.1	956.9	279.6	0.0	931.6	173.3	2,030.8	1,928.6	2,658.5	2,512.1	2,980.2	3,126.9	24,178.5	31,966.7	32,711.3
1984	502.7	832.6	59.0	486.5	587.4	21.7	0.0	647.9	78.0	275.6	768.2	516.6	13.5	716.5	275.1	4,811.8	15,068.5	11,740.3
1985	0.0	573.4	24.5	0.0	565.3	44.4	0.0	616.3	31.9	0.0	657.5	195.6	0.0	659.9	419.1	0.0	7,524.0	7,281.3
1986	589.3	641.7	111.7	570.3	617.8	32.5	0.0	629.9	26.5	0.0	627.4	27.3	0.0	552.4	58.0	11,136.4	19,832.9	20,053.2
1987	0.0	536.2	11.7	0.0	475.1	11.2	0.0	250.8	29.9	0.0	229.1	33.8	0.0	302.4	58.0	0.0	4,524.5	4,286.3
1988	0.0	402.5	13.1	0.0	350.3	10.9	0.0	236.9	3.4	0.0	220.6	157.8	0.0	227.1	156.3	0.0	3,991.8	4,355.1
1989	0.0	535.1	29.7	0.0	560.3	61.1	0.0	400.6	168.6	0.0	612.5	211.9	0.0	590.6	170.4	0.0	9,078.8	9,482.7

Table K-3: Presented as Table E-9: Unallocated, Regulated, and Natural Flow Comparison for August through December below Camanche (2010) (in TAF)*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	August			September			October			November			December			Total		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1990	0.0	492.9	16.4	0.0	479.7	6.8	0.0	538.4	6.1	0.0	154.3	15.7	0.0	204.2	52.2	0.0	5,442.7	5,115.8
1991	0.0	495.5	32.9	0.0	494.8	0.0	0.0	553.4	94.0	0.0	566.2	143.2	0.0	521.4	144.8	0.0	5,478.0	6,193.5
1992	0.0	500.9	19.7	0.0	337.7	36.0	0.0	332.6	36.8	0.0	255.0	89.3	0.0	408.3	310.9	0.0	4,962.7	5,260.4
1993	594.6	900.2	162.9	575.4	587.7	66.6	0.0	673.9	72.1	0.0	532.9	43.6	0.0	537.9	67.5	2,934.6	16,231.6	16,771.6
1994	0.0	440.7	21.8	0.0	553.5	18.7	0.0	555.0	48.2	0.0	240.2	251.9	0.0	546.6	340.8	0.0	4,815.8	5,211.9
1995	1,300.4	847.0	504.7	1,258.5	786.0	124.9	0.0	842.4	78.0	0.0	564.7	73.2	0.0	607.5	519.6	14,977.7	25,027.7	26,276.4
1996	477.1	741.6	100.7	461.7	577.9	39.1	0.0	553.1	0.0	300.4	884.2	670.3	2,146.7	2,349.0	2,685.3	8,727.3	18,315.2	18,558.1
1997	211.6	689.3	75.8	204.8	614.0	54.8	0.0	660.6	37.0	170.0	695.5	147.7	0.0	467.0	191.9	8,633.0	18,421.5	17,024.9
1998	1,124.4	976.6	264.3	1,088.2	832.0	134.0	0.0	709.9	125.0	13.3	696.0	293.4	0.0	819.8	422.3	11,641.6	20,921.8	22,034.5
1999	651.4	691.1	126.8	630.3	628.1	58.0	0.0	588.8	26.6	0.0	660.6	164.2	0.0	574.3	138.0	5,715.7	14,860.1	14,242.6
2000	305.8	722.1	27.3	295.9	552.1	68.9	0.0	575.8	86.8	0.0	604.9	103.8	0.0	578.0	93.1	2,758.5	12,322.1	11,870.0
2001	0.0	532.2	38.2	0.0	466.8	60.0	0.0	427.1	0.0	0.0	336.6	232.0	0.0	617.1	542.0	0.0	6,393.4	6,581.5
2002	0.0	523.6	28.6	0.0	497.9	0.0	0.0	531.0	19.8	0.0	567.6	332.1	0.0	677.6	376.5	0.0	8,997.2	9,265.2
2003	277.4	548.9	16.7	268.4	583.4	14.5	0.0	595.0	12.8	0.0	532.9	65.6	0.0	783.1	506.4	1,370.5	11,022.3	10,407.9
2004	0.0	568.5	5.7	0.0	514.4	0.0	0.0	292.6	160.8	0.0	547.5	195.7	0.0	751.7	408.4	268.0	8,267.9	8,325.3
2005	664.2	818.0	89.5	642.8	681.1	28.1	0.0	542.7	104.5	0.0	621.5	140.7	1,521.0	1,741.0	2,132.8	8,116.7	18,223.3	18,273.9
2006	542.6	887.2	118.7	525.1	529.9	75.9	0.0	571.8	104.8	44.4	615.3	238.5	56.7	758.5	333.0	12,482.3	23,227.2	21,838.6
2007	0.0	517.5	23.1	0.0	495.8	43.0	0.0	351.4	10.3	0.0	544.4	50.1	0.0	419.4	115.3	0.0	6,319.4	6,300.8
2008	0.0	478.3	42.5	0.0	342.8	53.0	0.0	515.1	3.9	0.0	536.1	226.0	0.0	478.3	127.1	0.0	6,272.9	6,815.2
2009	83.1	579.6	54.7	80.4	422.7	26.5	0.0	442.6	66.7	0.0	471.5	49.4	0.0	572.8	178.6	410.0	10,582.0	10,344.7
2010	524.3	476.1	36.6	507.4	346.3	23.7	0.0	700.5	527.4	416.8	667.1	417.8	1,234.4	1,991.9	2,047.7	4,238.8	12,945.8	13,955.8

* Unallocated water is simulated below Camanche and regulated and unimpaired flow is simulated at Mokelumne Hill.

Table K-4: Presented as Table E-10: Unallocated, Regulated, and Natural Flow Comparison for January through July below Camanche (2040) (in TAF)*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	January			February			March			April			May			June			July		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1953	386.8	1,011.5	1,137.9	0.0	679.8	528.8	0.0	747.6	855.0	0.0	1,033.0	2,176.7	274.7	1,262.7	2,515.8	265.8	2,067.0	2,641.7	274.7	918.0	660.1
1954	0.0	635.1	431.9	0.0	629.2	618.5	0.0	940.6	1,470.8	0.0	1,219.2	2,626.1	0.0	1,471.7	2,720.6	0.0	705.3	707.1	0.0	539.8	223.3
1955	0.0	496.5	532.1	0.0	447.3	458.3	0.0	616.7	656.3	0.0	496.4	1,128.5	0.0	808.4	2,855.4	0.0	886.0	1,619.6	0.0	560.6	185.7
1956	2,749.0	2,971.2	3,441.7	868.2	1,640.0	1,289.2	93.3	1,586.5	1,301.7	3.0	1,619.9	1,959.0	1,805.6	3,191.1	4,581.2	1,003.8	3,270.4	3,408.9	615.8	856.1	701.8
1957	0.0	605.1	249.8	0.0	677.2	942.6	0.0	813.6	1,513.8	0.0	700.6	1,522.3	66.3	1,553.3	2,993.7	64.1	2,149.1	2,219.6	66.3	563.5	243.9
1958	0.0	797.9	431.4	700.4	1,329.4	1,446.7	772.0	1,563.2	1,725.3	1,556.3	2,368.9	3,275.1	2,139.0	3,341.8	5,860.1	1,086.9	3,574.8	3,691.5	705.3	1,029.0	875.1
1959	0.0	654.6	525.1	0.0	743.5	706.0	0.0	675.6	904.0	0.0	399.4	1,646.5	0.0	445.3	1,514.4	0.0	514.3	583.9	0.0	546.0	50.0
1960	0.0	340.8	139.1	0.0	567.8	829.3	0.0	516.3	1,266.5	0.0	518.0	1,757.0	0.0	961.6	2,042.8	0.0	897.8	698.1	0.0	522.5	61.7
1961	0.0	387.2	128.7	0.0	252.6	326.2	0.0	292.5	487.8	0.0	307.2	1,213.1	0.0	367.4	1,749.7	0.0	503.5	563.1	0.0	518.7	23.8
1962	0.0	344.3	146.7	0.0	908.5	1,216.8	0.0	843.4	832.6	0.0	1,450.3	2,905.2	0.0	1,151.1	2,727.1	0.0	2,183.8	2,329.1	0.0	654.5	281.7
1963	0.0	780.0	721.1	1,758.6	1,371.8	2,822.3	0.0	767.9	762.5	0.0	1,741.3	2,170.7	1,062.9	3,569.3	4,496.0	729.4	2,322.0	2,335.7	523.8	699.9	456.1
1964	0.0	781.4	413.7	0.0	616.6	367.9	0.0	564.6	526.3	0.0	529.6	1,418.3	0.0	541.7	2,413.6	0.0	562.3	1,165.7	0.0	607.8	147.0
1965	2,105.8	2,684.8	2,577.1	561.8	1,435.0	1,204.2	0.0	1,225.5	1,055.1	150.9	1,890.5	2,696.4	754.3	2,239.3	3,405.8	723.0	2,687.6	2,800.0	747.1	952.6	761.3
1966	21.2	682.4	390.7	0.0	388.7	380.5	0.0	701.8	1,153.7	0.0	858.7	2,264.0	0.0	771.9	2,105.1	0.0	453.9	750.9	0.0	554.2	72.8
1967	73.6	1,128.8	1,074.1	249.9	909.0	964.7	784.8	1,657.2	2,041.7	892.2	1,816.5	1,933.1	2,666.1	2,700.1	4,930.6	903.9	4,158.1	4,952.3	934.1	2,139.6	2,073.8
1968	0.0	651.3	334.6	0.0	763.9	1,204.0	0.0	759.7	1,037.3	0.0	627.5	1,452.7	0.0	499.5	1,924.6	0.0	630.4	596.7	0.0	516.7	65.2
1969	2,361.9	2,693.1	3,351.5	1,277.6	1,719.4	1,756.4	639.8	1,617.6	1,477.2	2,029.2	2,471.7	3,498.6	2,858.6	4,695.4	6,351.3	1,028.0	3,661.6	3,881.4	767.0	1,193.9	1,021.1
1970	3,226.6	2,693.0	4,029.4	687.8	1,404.2	1,340.0	247.7	1,660.8	1,416.9	0.0	1,124.9	1,260.9	156.8	1,921.2	3,108.1	151.7	1,996.2	1,952.5	156.8	759.1	306.0
1971	422.7	1,082.1	945.7	268.8	1,020.9	817.3	270.1	1,286.2	1,202.9	0.0	1,216.7	1,792.5	336.4	1,106.9	2,836.9	325.5	2,142.5	3,019.1	336.4	994.5	524.8
1972	0.0	609.6	339.1	0.0	494.8	543.9	0.0	954.4	1,661.3	0.0	815.0	1,333.7	0.0	659.3	2,667.3	0.0	1,187.3	1,126.4	0.0	636.7	115.9
1973	379.1	1,276.0	1,320.8	925.4	1,315.9	1,252.6	432.3	1,319.3	1,142.7	0.0	1,288.7	2,095.9	385.7	2,291.6	4,644.0	373.2	1,701.8	1,793.5	385.7	778.6	167.4
1974	1,110.2	1,515.4	1,881.3	0.0	1,055.9	622.2	594.3	1,958.4	2,032.5	400.1	1,902.2	2,345.0	760.2	2,330.2	4,156.0	617.3	2,337.7	2,471.8	637.9	1,033.0	592.5
1975	0.0	470.3	296.5	0.0	617.1	693.5	0.0	1,246.5	1,418.2	0.0	1,217.7	1,185.2	715.1	1,805.6	4,252.5	692.0	2,956.2	3,877.6	715.1	1,122.9	688.4
1976	0.0	468.3	165.5	0.0	224.2	229.6	0.0	271.5	467.4	0.0	280.2	735.9	0.0	308.0	1,192.7	0.0	281.8	130.6	0.0	284.7	23.0
1977	0.0	184.0	67.1	0.0	100.1	107.6	0.0	124.6	152.3	0.0	226.8	596.0	0.0	304.0	715.4	0.0	269.0	421.1	0.0	280.7	27.0
1978	0.0	1,199.5	1,471.3	0.0	1,089.3	1,017.9	0.0	1,610.8	2,147.4	0.0	1,891.8	2,529.4	98.1	1,882.9	3,950.0	94.9	3,174.6	3,580.3	98.1	1,122.8	839.6
1979	0.0	815.4	789.7	0.0	816.4	784.5	354.4	1,355.2	1,565.1	0.0	1,435.2	2,005.1	323.2	1,968.1	4,346.5	312.7	1,530.6	1,565.3	323.2	655.3	202.5
1980	2,884.6	2,779.6	4,122.8	2,041.0	2,553.1	2,783.7	267.3	1,896.2	1,646.6	0.0	1,448.7	2,205.1	818.9	2,213.8	3,372.7	694.3	2,836.9	2,911.7	717.4	1,308.9	1,134.3
1981	0.0	696.9	308.1	0.0	576.9	447.8	0.0	576.8	780.6	0.0	690.6	1,842.2	0.0	532.0	2,097.9	0.0	536.5	532.8	0.0	572.4	6.5
1982	1,289.7	1,817.5	1,697.3	2,551.1	2,759.9	3,426.1	1,625.1	2,599.6	2,556.3	3,269.7	4,070.4	5,036.3	2,458.8	4,769.9	5,214.4	909.0	3,021.0	3,096.3	939.3	1,309.8	921.7
1983	1,149.3	1,981.0	1,694.4	1,867.1	2,505.2	2,395.6	3,276.0	4,038.8	4,447.6	1,522.5	2,329.6	2,372.5	3,865.3	3,497.9	5,316.3	2,717.2	6,182.6	6,306.5	1,571.3	3,471.9	3,425.9
1984	1,260.2	1,899.2	1,451.9	599.6	1,466.0	934.4	112.3	1,606.3	1,411.0	0.0	1,330.4	1,437.4	400.2	2,413.6	3,615.2	387.3	1,823.2	1,646.0	400.2	977.3	294.0
1985	0.0	409.0	262.0	0.0	587.1	464.9	0.0	849.7	691.3	0.0	1,032.4	2,152.2	0.0	545.7	2,357.1	0.0	508.5	567.0	0.0	519.3	71.5
1986	0.0	877.6	1,144.9	4,328.1	4,421.5	5,649.6	2,587.4	3,193.5	4,312.4	112.5	2,076.0	2,361.3	1,261.8	3,222.3	3,554.9	479.7	2,211.6	2,367.3	495.7	761.1	406.8
1987	0.0	426.1	130.7	0.0	297.9	352.4	0.0	420.0	691.8	0.0	372.4	1,413.3	0.0	296.3	1,324.1	0.0	367.7	193.0	0.0	550.6	36.4
1988	0.0	367.6	296.5	0.0	247.2	333.3	0.0	291.3	689.2	0.0	320.8	1,123.3	0.0	390.2	1,133.8	0.0	457.2	375.6	0.0	480.1	61.9

Table K-4: Presented as Table E-10: Unallocated, Regulated, and Natural Flow Comparison for January through July below Camanche (2040) (in TAF)*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	January			February			March			April			May			June			July		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1989	0.0	231.5	183.1	0.0	250.2	413.0	0.0	1,011.8	2,405.4	0.0	1,353.0	2,519.5	0.0	1,770.6	2,163.7	0.0	1,174.3	1,050.5	0.0	588.3	105.8
1990	0.0	552.9	287.7	0.0	378.3	307.1	0.0	552.6	982.3	0.0	405.3	1,620.0	0.0	554.7	1,197.6	0.0	575.7	563.5	0.0	553.6	60.2
1991	0.0	80.9	59.2	0.0	136.0	67.2	0.0	380.1	855.6	0.0	438.7	1,108.7	0.0	512.2	2,218.3	0.0	733.1	1,323.6	0.0	565.9	146.0
1992	0.0	387.7	167.1	0.0	486.1	690.8	0.0	661.9	893.1	0.0	408.3	1,785.3	0.0	360.9	944.7	0.0	309.9	140.6	0.0	513.3	146.1
1993	0.0	1,261.6	1,745.8	0.0	1,225.5	1,150.2	0.0	2,003.0	2,577.7	0.0	1,726.0	2,481.0	411.2	2,940.2	4,529.3	397.9	2,951.0	3,157.6	411.2	891.6	717.3
1994	0.0	345.5	165.1	0.0	269.7	286.9	0.0	312.6	722.0	0.0	293.9	1,294.2	0.0	370.2	1,563.9	0.0	488.8	462.4	0.0	399.3	36.0
1995	0.0	1,825.1	2,404.6	310.5	1,218.5	1,214.2	2,749.9	3,386.5	4,206.0	2,266.4	2,728.3	3,135.1	3,938.9	4,159.5	5,516.9	1,385.4	5,026.4	5,265.0	1,202.7	3,035.6	3,234.1
1996	0.0	740.7	908.6	1,750.2	1,896.2	2,753.8	852.8	2,157.7	2,187.3	130.0	1,977.1	2,537.8	1,450.7	3,785.6	4,313.2	368.1	1,892.7	1,946.4	380.3	759.4	415.5
1997	5,939.4	5,790.2	7,348.6	1,222.6	1,869.2	1,445.0	187.6	1,574.0	1,411.8	0.0	1,580.3	2,063.8	113.3	2,460.3	2,903.7	109.6	1,360.4	1,158.8	113.3	660.6	185.9
1998	342.6	1,038.6	1,370.6	1,739.7	2,053.2	2,342.7	1,093.3	2,112.3	2,650.9	1,438.9	2,057.8	2,642.5	2,240.2	2,683.3	3,704.9	1,143.9	4,694.5	5,797.6	1,028.3	2,247.8	2,286.5
1999	287.3	1,148.3	1,016.4	1,480.0	1,990.0	2,172.9	457.0	1,505.9	1,383.3	0.0	1,448.2	1,867.7	587.9	2,055.4	4,062.9	666.1	2,575.1	2,755.4	555.2	994.4	470.5
2000	0.0	847.0	1,032.6	708.2	1,374.5	1,882.1	421.8	1,562.4	1,589.0	0.0	1,132.7	2,233.9	203.3	2,133.0	3,439.5	196.7	1,384.1	1,148.2	203.3	855.6	164.9
2001	0.0	327.9	212.4	0.0	301.8	347.2	0.0	633.5	1,061.2	0.0	896.7	1,488.7	0.0	742.0	2,329.1	0.0	539.3	203.4	0.0	572.3	67.2
2002	0.0	897.6	722.5	0.0	605.7	611.3	0.0	1,158.2	1,099.0	0.0	1,097.6	2,190.9	0.0	889.3	2,674.6	0.0	1,019.6	1,039.7	0.0	531.5	170.3
2003	0.0	948.9	633.9	0.0	825.2	550.9	0.0	799.7	946.6	0.0	992.2	1,603.1	47.8	1,758.0	3,592.1	46.3	2,055.2	2,196.7	47.8	599.8	268.5
2004	0.0	859.7	378.4	0.0	832.0	812.9	148.8	1,306.8	1,843.6	0.0	785.9	2,018.2	0.0	473.1	1,926.8	0.0	793.7	500.3	0.0	542.2	74.6
2005	0.0	1,392.7	1,200.9	197.1	1,300.5	1,081.3	1,097.0	2,055.3	1,968.6	463.9	2,027.2	2,084.3	1,507.2	3,006.3	5,317.4	806.1	2,817.1	3,298.9	571.5	1,219.9	827.0
2006	1,471.0	1,824.8	2,353.4	804.9	1,325.7	1,591.1	1,066.7	2,650.9	2,182.4	3,807.5	4,846.6	5,190.4	2,357.5	4,874.6	5,916.9	995.3	3,170.1	3,182.1	446.6	1,172.0	551.3
2007	0.0	544.0	301.9	0.0	593.4	891.9	0.0	774.9	1,237.1	0.0	481.5	1,638.7	0.0	590.3	1,590.0	0.0	472.1	286.5	0.0	534.9	113.0
2008	0.0	493.9	368.0	0.0	512.3	463.3	0.0	771.2	840.5	0.0	479.5	1,373.9	0.0	672.0	2,374.6	0.0	589.7	849.2	0.0	403.6	93.2
2009	0.0	696.4	527.5	0.0	638.5	751.7	0.0	1,325.1	1,710.6	0.0	1,159.1	1,883.5	0.0	2,653.6	4,035.4	0.0	958.5	898.2	0.0	661.6	161.9
2010	0.0	759.0	443.4	0.0	707.6	514.3	0.0	984.9	974.8	0.0	1,355.0	1,723.8	377.3	1,941.7	2,830.2	365.1	2,207.3	3,910.8	377.3	808.3	505.2

* Unallocated water is simulated below Camanche and regulated and unimpaired flow is simulated at Mokelumne Hill.

Table K-5: Presented as Table E-11: Unallocated, Regulated, and Natural Flow Comparison for August through December below Camanche (2040) (in TAF)*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	August			September			October			November			December			Total		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1953	274.7	622.5	66.6	265.8	630.7	37.2	0.0	699.3	94.4	0.0	652.7	188.7	0.0	630.9	244.5	1,742.3	10,955.6	11,147.5
1954	0.0	578.8	0.0	0.0	610.5	38.6	0.0	633.0	67.5	0.0	681.0	131.0	0.0	575.2	474.7	0.0	9,219.4	9,510.1
1955	0.0	571.6	45.9	0.0	541.3	15.0	0.0	559.3	39.5	0.0	560.9	96.2	1,794.7	2,710.2	4,312.9	1,794.7	9,255.1	11,945.4
1956	615.8	614.4	108.7	596.0	570.5	72.8	0.0	665.3	151.0	0.0	714.6	177.9	0.0	751.0	219.5	8,350.4	18,451.1	17,413.3
1957	66.3	523.2	40.0	64.1	537.6	38.9	0.0	660.8	67.2	0.0	723.3	119.6	0.0	723.0	267.1	327.2	10,230.4	10,218.4
1958	705.3	745.6	144.6	682.5	595.4	61.5	0.0	664.2	65.1	0.0	636.5	92.0	0.0	561.8	82.2	8,347.7	17,208.5	17,750.5
1959	0.0	543.3	2.4	0.0	513.1	77.0	0.0	541.4	36.9	0.0	507.8	31.8	0.0	534.7	54.0	0.0	6,619.0	6,132.2
1960	0.0	528.1	0.0	0.0	510.6	17.3	0.0	516.6	8.2	0.0	500.2	110.2	0.0	529.4	179.2	0.0	6,909.6	7,109.5
1961	0.0	500.0	0.0	0.0	500.5	4.2	0.0	514.4	6.6	0.0	317.0	63.0	0.0	311.7	172.1	0.0	4,772.5	4,738.2
1962	0.0	618.7	39.3	0.0	568.8	0.4	0.0	669.4	331.9	0.0	627.5	113.2	0.0	629.0	307.4	0.0	10,649.3	11,231.7
1963	523.8	645.4	47.2	506.9	607.1	56.4	0.0	633.6	115.7	356.9	691.8	770.7	0.0	725.1	397.5	5,462.2	14,555.2	15,151.7
1964	0.0	585.8	34.0	0.0	575.2	40.7	0.0	609.6	73.2	0.0	711.4	259.0	3,209.5	3,365.5	5,237.0	3,209.5	10,051.5	12,096.4
1965	747.1	753.3	346.9	723.0	931.2	115.9	0.0	931.4	88.4	293.3	946.1	440.4	22.1	771.4	363.1	6,828.3	17,448.6	15,854.4
1966	0.0	557.6	17.3	0.0	601.7	30.9	0.0	554.2	24.5	0.0	668.2	292.8	0.0	1,191.3	1,199.4	21.2	7,984.7	8,682.5
1967	934.1	672.7	231.6	903.9	639.6	87.2	0.0	658.0	89.0	0.0	662.8	118.0	0.0	667.7	183.2	8,342.7	17,810.1	18,679.3
1968	0.0	525.3	42.1	0.0	537.7	16.8	0.0	543.8	75.6	0.0	665.3	572.9	0.0	739.7	396.6	0.0	7,460.7	7,719.0
1969	767.0	830.3	116.4	742.3	776.0	62.1	0.0	804.8	184.3	0.0	659.2	195.2	115.3	910.4	1,090.2	12,586.6	22,033.4	22,985.8
1970	156.8	589.5	64.1	151.7	567.9	5.8	0.0	608.1	47.6	334.7	871.3	516.4	519.3	1,237.0	893.6	5,790.1	15,433.1	14,941.3
1971	336.4	905.1	55.9	325.5	688.6	9.0	0.0	736.2	52.7	56.2	552.0	200.4	97.7	688.4	494.9	2,775.8	12,420.1	11,952.2
1972	0.0	567.0	15.4	0.0	561.9	15.5	0.0	622.2	72.3	0.0	659.0	187.8	0.0	764.6	641.0	0.0	8,531.8	8,719.6
1973	385.7	575.2	25.7	373.2	576.9	0.2	0.0	643.3	105.3	1,044.6	911.3	1,421.1	626.0	1,261.2	1,225.1	5,311.0	13,939.7	15,194.5
1974	637.9	937.0	96.6	617.3	740.6	14.9	0.0	594.7	51.8	0.0	509.2	87.1	0.0	547.0	188.0	5,375.2	15,461.3	14,539.6
1975	715.1	925.4	123.4	692.0	878.5	48.4	0.0	760.0	363.6	52.0	690.6	380.7	0.0	647.6	199.2	3,581.4	13,338.5	13,527.3
1976	0.0	295.5	71.2	0.0	285.5	35.8	0.0	204.8	32.9	0.0	203.1	41.3	0.0	150.8	31.8	0.0	3,258.2	3,157.6
1977	0.0	273.0	22.7	0.0	291.1	22.5	0.0	18.4	13.7	0.0	48.5	57.2	0.0	393.1	489.7	0.0	2,513.4	2,692.5
1978	98.1	880.0	62.2	94.9	675.7	225.5	0.0	611.7	35.9	0.0	570.5	86.8	0.0	524.9	145.6	484.2	15,234.6	16,091.7
1979	323.2	599.4	52.1	312.7	531.6	3.0	0.0	578.5	149.5	0.0	646.0	300.0	0.0	804.0	330.5	1,949.3	11,735.8	12,093.9
1980	717.4	611.1	123.4	694.3	574.5	48.8	0.0	586.1	41.0	0.0	552.2	49.2	0.0	629.5	134.2	8,835.2	17,990.6	18,573.6
1981	0.0	475.2	8.5	0.0	499.6	8.8	0.0	581.7	92.6	0.0	747.0	1,297.8	1,200.1	1,385.0	2,201.5	1,200.1	7,870.5	9,625.0
1982	939.3	919.7	131.9	909.0	714.7	226.9	0.0	788.0	1,124.8	1,077.7	1,385.4	1,025.2	1,482.2	2,025.4	1,811.9	17,450.7	26,181.2	26,269.2
1983	1,571.3	1,162.5	514.4	1,520.6	956.9	279.6	0.0	931.6	173.3	2,005.8	1,928.6	2,658.5	2,487.9	2,980.2	3,126.9	23,554.0	31,966.7	32,711.3
1984	400.2	832.6	59.0	387.3	587.4	21.7	0.0	647.9	78.0	250.5	768.2	516.6	0.0	716.5	275.1	4,197.9	15,068.5	11,740.3
1985	0.0	573.4	24.5	0.0	565.3	44.4	0.0	616.3	31.9	0.0	657.5	195.6	0.0	659.9	419.1	0.0	7,524.0	7,281.3
1986	495.7	641.7	111.7	479.7	617.8	32.5	0.0	629.9	26.5	0.0	627.4	27.3	0.0	552.4	58.0	10,240.8	19,832.9	20,053.2
1987	0.0	536.2	11.7	0.0	475.1	11.2	0.0	250.8	29.9	0.0	229.1	33.8	0.0	302.4	58.0	0.0	4,524.5	4,286.3
1988	0.0	402.5	13.1	0.0	350.3	10.9	0.0	236.9	3.4	0.0	220.6	157.8	0.0	227.1	156.3	0.0	3,991.8	4,355.1

Table K-5: Presented as Table E-11: Unallocated, Regulated, and Natural Flow Comparison for August through December below Camanche (2040) (in TAF)*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	August			September			October			November			December			Total		
	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural	Unallocated	Regulated	Natural
1989	0.0	535.1	29.7	0.0	560.3	61.1	0.0	400.6	168.6	0.0	612.5	211.9	0.0	590.6	170.4	0.0	9,078.8	9,482.7
1990	0.0	492.9	16.4	0.0	479.7	6.8	0.0	538.4	6.1	0.0	154.3	15.7	0.0	204.2	52.2	0.0	5,442.7	5,115.8
1991	0.0	495.5	32.9	0.0	494.8	0.0	0.0	553.4	94.0	0.0	566.2	143.2	0.0	521.4	144.8	0.0	5,478.0	6,193.5
1992	0.0	500.9	19.7	0.0	337.7	36.0	0.0	332.6	36.8	0.0	255.0	89.3	0.0	408.3	310.9	0.0	4,962.7	5,260.4
1993	411.2	900.2	162.9	397.9	587.7	66.6	0.0	673.9	72.1	0.0	532.9	43.6	0.0	537.9	67.5	2,029.5	16,231.6	16,771.6
1994	0.0	440.7	21.8	0.0	553.5	18.7	0.0	555.0	48.2	0.0	240.2	251.9	0.0	546.6	340.8	0.0	4,815.8	5,211.9
1995	1,202.7	847.0	504.7	1,163.9	786.0	124.9	0.0	842.4	78.0	0.0	564.7	73.2	0.0	607.5	519.6	14,220.4	25,027.7	26,276.4
1996	380.3	741.6	100.7	368.1	577.9	39.1	0.0	553.1	0.0	275.4	884.2	670.3	2,122.5	2,349.0	2,685.3	8,078.3	18,315.2	18,558.1
1997	113.3	689.3	75.8	109.6	614.0	54.8	0.0	660.6	37.0	144.9	695.5	147.7	0.0	467.0	191.9	8,053.7	18,421.5	17,024.9
1998	1,028.3	976.6	264.3	995.1	832.0	134.0	0.0	709.9	125.0	0.0	696.0	293.4	0.0	819.8	422.3	11,050.1	20,921.8	22,034.5
1999	555.2	691.1	126.8	537.3	628.1	58.0	0.0	588.8	26.6	0.0	660.6	164.2	0.0	574.3	138.0	5,126.0	14,860.1	14,242.6
2000	203.3	722.1	27.3	196.7	552.1	68.9	0.0	575.8	86.8	0.0	604.9	103.8	0.0	578.0	93.1	2,133.4	12,322.1	11,870.0
2001	0.0	532.2	38.2	0.0	466.8	60.0	0.0	427.1	0.0	0.0	336.6	232.0	0.0	617.1	542.0	0.0	6,393.4	6,581.5
2002	0.0	523.6	28.6	0.0	497.9	0.0	0.0	531.0	19.8	0.0	567.6	332.1	0.0	677.6	376.5	0.0	8,997.2	9,265.2
2003	47.8	548.9	16.7	46.3	583.4	14.5	0.0	595.0	12.8	0.0	532.9	65.6	0.0	783.1	506.4	236.1	11,022.3	10,407.9
2004	0.0	568.5	5.7	0.0	514.4	0.0	0.0	292.6	160.8	0.0	547.5	195.7	0.0	751.7	408.4	148.8	8,267.9	8,325.3
2005	571.5	818.0	89.5	553.1	681.1	28.1	0.0	542.7	104.5	0.0	621.5	140.7	1,471.7	1,741.0	2,132.8	7,239.2	18,223.3	18,273.9
2006	446.6	887.2	118.7	432.2	529.9	75.9	0.0	571.8	104.8	19.4	615.3	238.5	32.5	758.5	333.0	11,880.1	23,227.2	21,838.6
2007	0.0	517.5	23.1	0.0	495.8	43.0	0.0	351.4	10.3	0.0	544.4	50.1	0.0	419.4	115.3	0.0	6,319.4	6,300.8
2008	0.0	478.3	42.5	0.0	342.8	53.0	0.0	515.1	3.9	0.0	536.1	226.0	0.0	478.3	127.1	0.0	6,272.9	6,815.2
2009	0.0	579.6	54.7	0.0	422.7	26.5	0.0	442.6	66.7	0.0	471.5	49.4	0.0	572.8	178.6	0.0	10,582.0	10,344.7
2010	377.3	476.1	36.6	365.1	346.3	23.7	0.0	700.5	527.4	391.8	667.1	417.8	1,210.3	1,991.9	2,047.7	3,464.0	12,945.8	13,955.8

* Unallocated water is simulated below Camanche and regulated and unimpaired flow is simulated at Mokelumne Hill.

Figure K-1: Presented as Figure F-1: Average Total Natural Flow at Mokelumne Hill Compared to Unallocated Flow below Camanche in 2010 and 2040 Baseline Conditions by Water Year Type (in TAF) Values shown provide flow in cubic feet per second (cfs) averaged over the water year type indicated

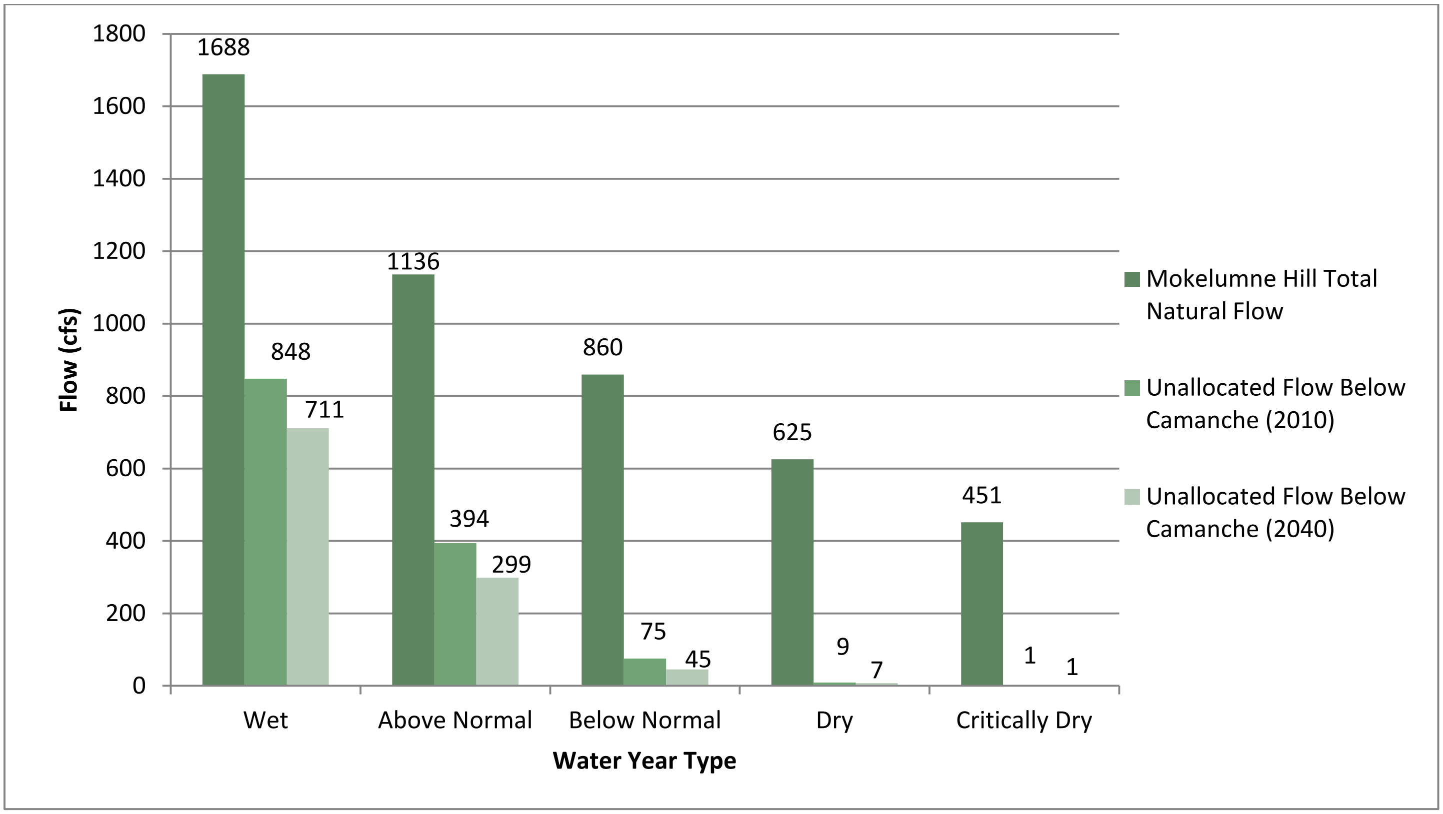


Figure K-2: Presented as Figure G-1: Required and Modeled Annual Flows for the 2010 Base Case from Camanche Reservoir
Values shown provide flow in cubic feet per second (cfs) averaged over the yearly period indicated

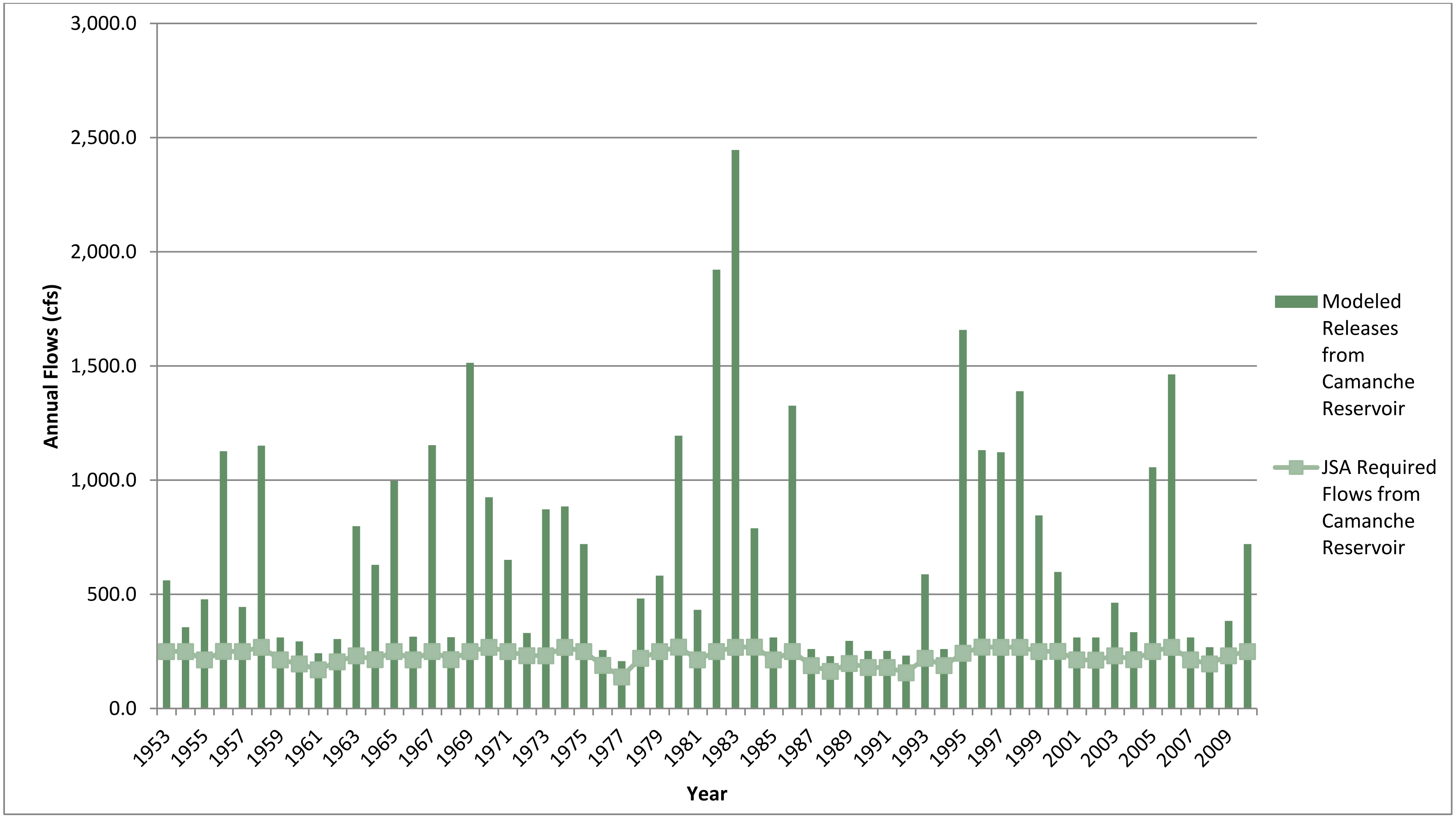


Figure K-3: Presented as Figure G-2: Required and Modeled Annual Flows for the 2040 Base Case from Camanche Reservoir
Values shown provide flow in cubic feet per second (cfs) averaged over the yearly period indicated

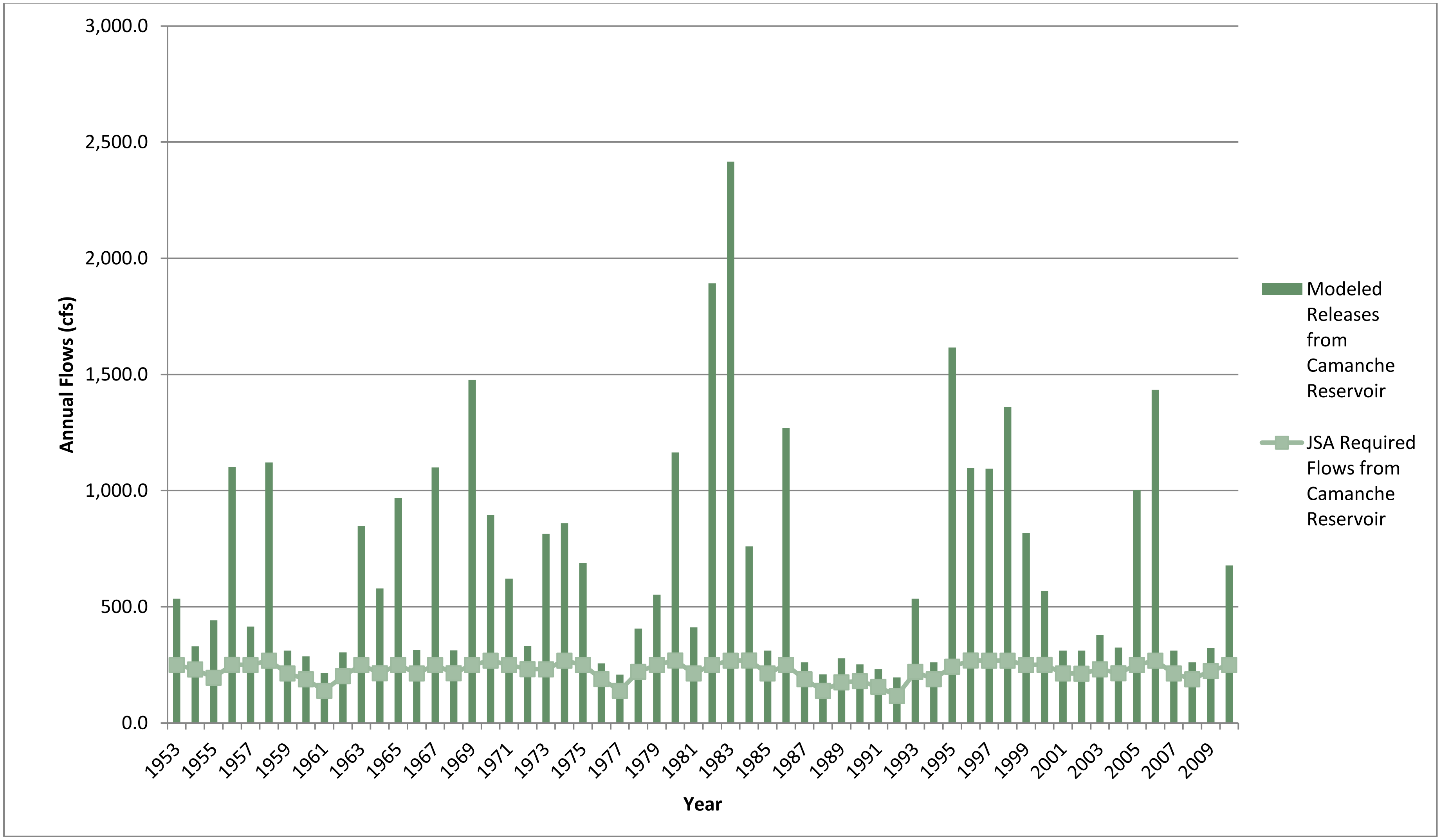


Figure K-4: Presented as Figure G-3: Required and Modeled Annual Flows for the 2010 Base Case from Woodbridge Dam
Values shown provide flow in cubic feet per second (cfs) averaged over the yearly period indicated

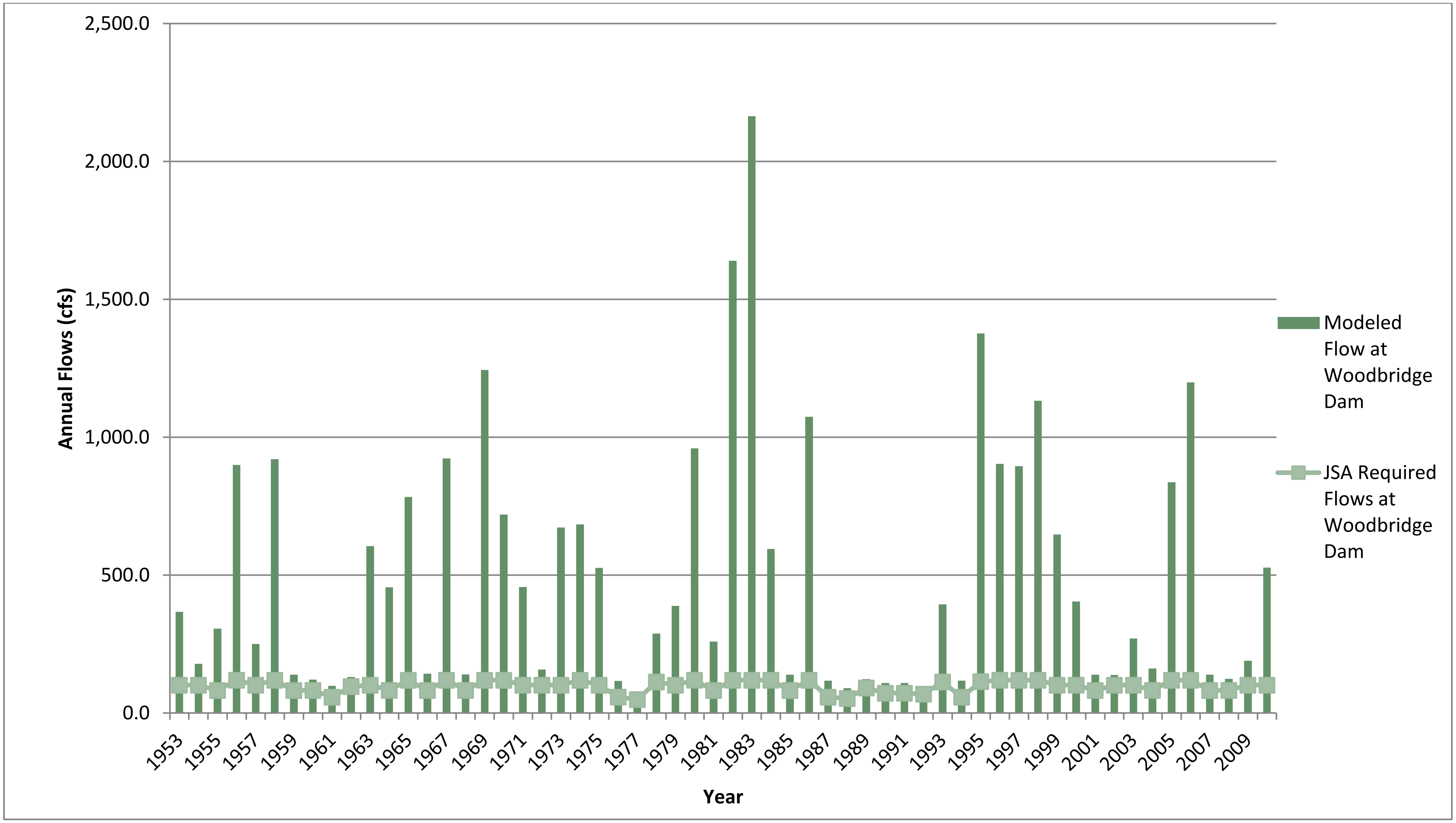


Figure K-5: Presented as Figure G-4: Required and Modeled Annual Flows for the 2040 Base Case from Woodbridge Dam
Values shown provide flow in cubic feet per second (cfs) averaged over the yearly period indicated

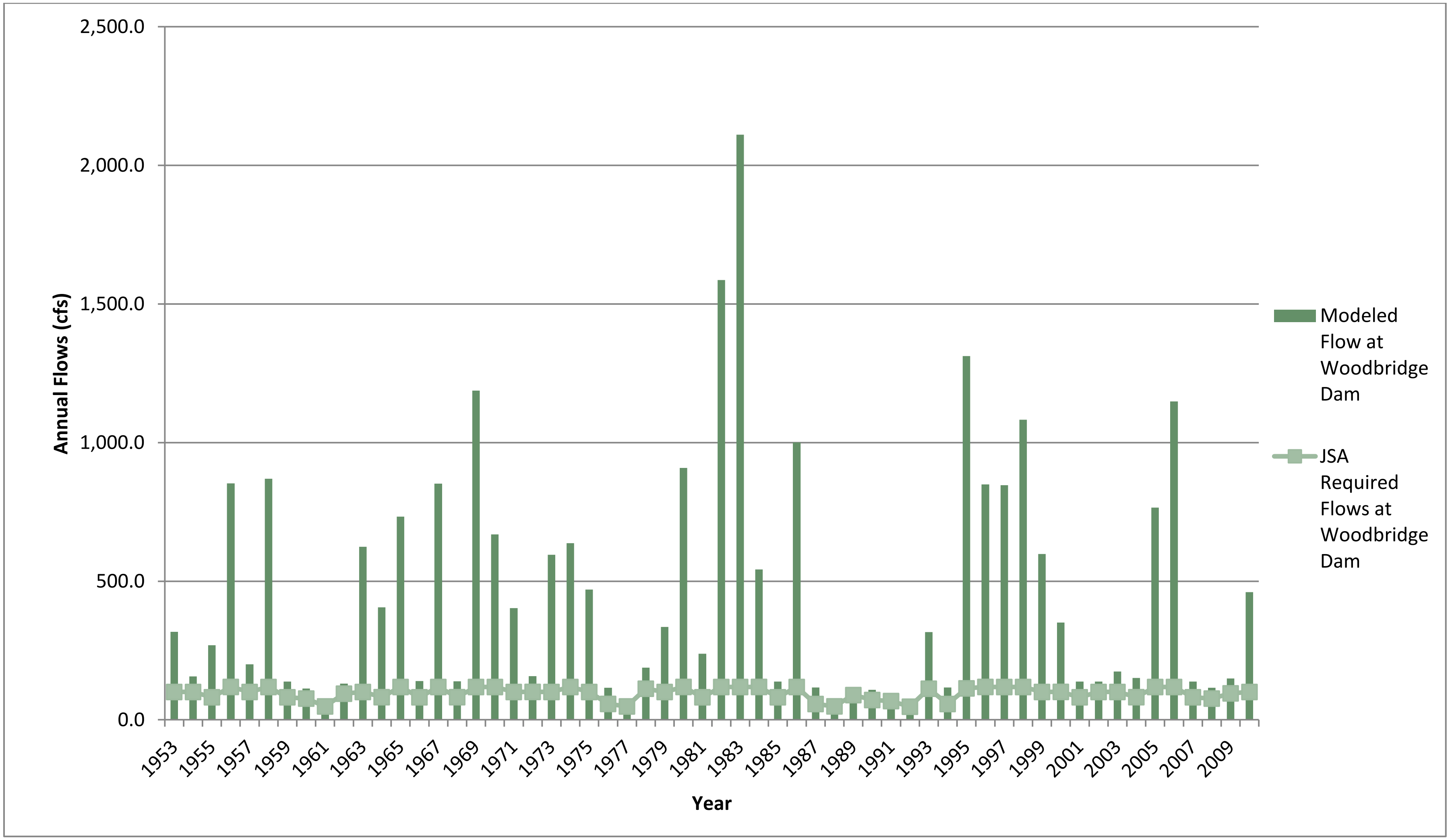


Table K-6: Presented as Table I-1: Riparian Diversions Above Highway 99*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1954	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1955	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1956	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1957	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1958	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1959	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1960	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1961	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1962	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1963	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1964	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1965	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1966	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1967	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1968	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1969	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1970	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1971	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1972	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1973	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1974	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1975	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1976	1.6	1.4	4.3	14.0	35.6	50.7	24.8	16.2	8.1	7.6	3.2	5.8	173.4
1977	1.6	1.4	4.3	14.0	35.6	50.7	24.8	16.2	8.1	7.6	3.2	5.8	173.3
1978	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1979	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1980	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1981	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1982	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1983	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5

Table K-6: Presented as Table I-1: Riparian Diversions Above Highway 99*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1984	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1985	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1986	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1987	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1988	1.6	1.4	4.3	14.0	35.6	50.7	24.8	16.2	8.1	7.6	3.2	5.8	173.3
1989	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1990	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1991	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1992	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1993	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1994	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1995	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1996	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1997	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1998	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
1999	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
2000	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
2001	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
2002	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
2003	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
2004	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
2005	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
2006	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
2007	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
2008	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
2009	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
2010	1.6	1.4	4.3	14.1	35.6	50.7	49.6	32.4	16.2	7.6	3.2	5.8	222.5
Ave	0.1	0.1	0.3	0.8	2.1	3.1	2.9	1.9	0.9	0.5	0.2	0.3	13.2
Max	0.1	0.1	0.3	0.8	2.1	3.1	3.0	2.0	1.0	0.5	0.2	0.4	13.4
Min	0.1	0.1	0.3	0.8	2.1	3.1	1.5	1.0	0.5	0.5	0.2	0.3	10.4

*Note: Riparian diversions are the same for both the 2010 and 2040 baseline cases.

Table K-7: Presented as Table I-2: Riparian Diversions Above Woodbridge Diversion Dam*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1954	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1955	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1956	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1957	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1958	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1959	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1960	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1961	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1962	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1963	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1964	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1965	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1966	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1967	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1968	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1969	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1970	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1971	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1972	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1973	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1974	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1975	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1976	0.1	0.1	0.3	1.1	2.7	3.9	1.9	1.2	0.6	0.6	0.2	0.4	13.3
1977	0.1	0.1	0.3	1.1	2.7	3.9	1.9	1.2	0.6	0.6	0.2	0.4	13.3
1978	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1979	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1980	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1981	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1982	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1983	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1

Table K-7: Presented as Table I-2: Riparian Diversions Above Woodbridge Diversion Dam*
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1984	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1985	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1986	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1987	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1988	0.1	0.1	0.3	1.1	2.7	3.9	1.9	1.2	0.6	0.6	0.2	0.4	13.3
1989	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1990	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1991	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1992	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1993	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1994	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1995	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1996	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1997	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1998	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
1999	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
2000	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
2001	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
2002	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
2003	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
2004	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
2005	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
2006	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
2007	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
2008	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
2009	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
2010	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
Ave	0.1	0.1	0.3	1.1	2.7	3.9	3.7	2.4	1.2	0.6	0.2	0.4	16.9
Max	0.1	0.1	0.3	1.1	2.7	3.9	3.8	2.5	1.2	0.6	0.2	0.4	17.1
Min	0.1	0.1	0.3	1.1	2.7	3.9	1.9	1.2	0.6	0.6	0.2	0.4	13.3

*Note: Riparian diversions are the same for both the 2010 and 2040 baseline cases.

Table K-8: Presented as Table I-3: Riparian Diversions Above Interstate 5 *
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1954	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1955	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1956	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1957	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1958	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1959	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1960	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1961	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1962	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1963	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1964	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1965	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1966	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1967	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1968	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1969	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1970	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1971	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1972	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1973	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1974	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1975	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1976	0.7	0.6	2.0	6.5	16.5	23.4	11.5	7.5	3.7	3.5	1.5	2.7	80.0
1977	0.7	0.6	2.0	6.5	16.5	23.4	11.5	7.5	3.7	3.5	1.5	2.7	80.0
1978	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1979	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1980	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1981	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1982	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1983	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1984	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7

Table K-8: Presented as Table I-3: Riparian Diversions Above Interstate 5 *
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1985	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1986	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1987	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1988	0.7	0.6	2.0	6.5	16.5	23.4	11.5	7.5	3.7	3.5	1.5	2.7	80.0
1989	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1990	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1991	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1992	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1993	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1994	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1995	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1996	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1997	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1998	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
1999	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
2000	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
2001	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
2002	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
2003	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
2004	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
2005	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
2006	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
2007	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
2008	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
2009	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
2010	0.7	0.6	2.0	6.5	16.4	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
Ave	0.7	0.6	2.0	6.5	16.4	23.4	22.3	14.6	7.3	3.5	1.5	2.7	101.5
Max	0.7	0.6	2.0	6.5	16.5	23.4	22.9	14.9	7.5	3.5	1.5	2.7	102.7
Min	0.7	0.6	2.0	6.5	16.4	23.4	11.5	7.5	3.7	3.5	1.5	2.7	80.0

*Note: Riparian diversions are the same for both the 2010 and 2040 baseline cases.

Table K-9: Presented as Table J-1: 2010 Unallocated Water below Camanche Dam
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	410.0	0.0	0.0	0.0	386.2	373.8	386.2	386.2	373.8	0.0	0.0	0.0	2,316.3
1954	0.0	0.0	0.0	0.0	8.0	7.8	8.0	8.0	7.8	0.0	0.0	0.0	39.7
1955	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2,008.1	2,008.1
1956	2,772.2	889.8	118.0	26.7	1,883.8	1,102.4	712.3	712.3	689.4	0.0	0.0	0.0	8,907.0
1957	0.0	0.0	0.0	0.0	186.0	180.0	186.0	186.0	180.0	0.0	0.0	0.0	917.8
1958	0.0	794.3	796.7	1,579.5	2,216.6	1,184.9	801.2	801.2	775.3	0.0	0.0	0.0	8,949.7
1959	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1960	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1961	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1962	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1963	0.0	1,034.1	0.0	0.0	1,283.0	837.2	629.0	629.0	608.7	0.0	381.9	0.0	5,403.0
1964	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,807.8	3,807.8
1965	2,129.0	582.9	0.0	202.3	841.9	814.7	841.9	841.9	814.7	0.0	318.4	46.3	7,434.1
1966	44.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.4
1967	427.3	271.0	809.5	912.8	2,740.9	995.4	1,028.5	1,028.5	995.4	0.0	0.0	0.0	9,209.4
1968	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1969	2,475.3	1,298.7	660.3	2,051.7	2,935.3	1,125.1	862.1	862.1	834.3	0.0	0.0	164.6	13,269.4
1970	3,249.9	709.0	272.4	0.0	255.5	247.3	255.5	255.5	247.3	0.0	359.8	543.5	6,395.5
1971	446.0	289.9	294.8	0.0	438.9	424.7	438.9	438.9	424.7	0.0	81.3	121.8	3,399.8
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	756.6	946.5	457.0	0.0	479.4	463.9	479.4	479.4	463.9	0.0	1,069.6	650.2	6,245.8
1974	1,133.4	0.0	640.1	426.9	838.4	712.0	735.7	735.7	712.0	0.0	0.0	0.0	5,934.2
1975	0.0	0.0	0.0	0.0	841.3	814.2	841.3	841.3	814.2	0.0	77.1	0.0	4,229.5
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	336.4	325.6	336.4	336.4	325.6	0.0	0.0	0.0	1,660.4
1979	0.0	93.8	379.2	1.6	425.3	411.6	425.3	425.3	411.6	0.0	0.0	0.0	2,573.9
1980	2,957.2	2,062.7	292.0	0.0	919.8	788.4	814.7	814.7	788.4	0.0	0.0	0.0	9,438.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,447.0	1,447.0
1982	1,312.9	2,572.2	1,649.8	3,296.5	2,540.3	1,006.8	1,040.3	1,040.3	1,006.8	0.0	1,102.7	1,506.3	18,074.9

Table K-9: Presented as Table J-1: 2010 Unallocated Water below Camanche Dam
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1983	1,172.5	1,888.2	3,300.6	1,549.2	3,946.7	2,819.1	1,671.0	1,671.0	1,617.1	0.0	2,030.8	2,512.1	24,178.5
1984	1,283.5	621.3	136.9	0.0	502.7	486.5	502.7	502.7	486.5	0.0	275.6	13.5	4,811.8
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	4,736.8	2,612.1	132.4	1,335.8	570.3	589.3	589.3	570.3	0.0	0.0	0.0	11,136.4
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	594.6	575.4	594.6	594.6	575.4	0.0	0.0	0.0	2,934.6
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	551.0	2,772.7	2,291.2	4,018.2	1,485.2	1,300.4	1,300.4	1,258.5	0.0	0.0	0.0	14,977.7
1996	0.0	1,844.7	877.5	152.7	1,527.8	461.7	477.1	477.1	461.7	0.0	300.4	2,146.7	8,727.3
1997	5,962.7	1,243.7	212.2	0.0	211.6	204.8	211.6	211.6	204.8	0.0	170.0	0.0	8,633.0
1998	390.1	1,760.9	1,118.0	1,462.2	2,317.9	1,242.1	1,124.4	1,124.4	1,088.2	0.0	13.3	0.0	11,641.6
1999	346.5	1,501.1	481.7	0.0	686.1	767.2	651.4	651.4	630.3	0.0	0.0	0.0	5,715.7
2000	0.0	802.9	446.4	0.0	305.8	295.9	305.8	305.8	295.9	0.0	0.0	0.0	2,758.5
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	1.5	0.0	0.0	277.4	268.4	277.4	277.4	268.4	0.0	0.0	0.0	1,370.5
2004	0.0	53.0	215.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	268.0
2005	0.0	529.7	1,121.7	490.6	1,581.5	900.9	664.2	664.2	642.8	0.0	0.0	1,521.0	8,116.7
2006	1,494.3	826.1	1,091.3	3,830.7	2,435.1	1,093.4	542.6	542.6	525.1	0.0	44.4	56.7	12,482.3
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.0	0.0	0.0	83.1	80.4	83.1	83.1	80.4	0.0	0.0	0.0	410.0
2010	0.0	0.0	0.0	0.0	524.3	507.4	524.3	524.3	507.4	0.0	416.8	1,234.4	4,238.8
Ave	495.9	481.1	357.9	317.4	688.0	406.5	350.7	350.7	339.4	0.0	114.5	306.6	4,208.7
Max	5,962.7	4,736.8	3,300.6	3,830.7	4,018.2	2,819.1	1,671.0	1,671.0	1,617.1	0.0	2,030.8	3,807.8	24,178.5
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table K-10: Presented as Table J-2: 2040 Unallocated Water below Camanche Dam
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	386.8	0.0	0.0	0.0	274.7	265.8	274.7	274.7	265.8	0.0	0.0	0.0	1,742.3
1954	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1955	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,794.7	1,794.7
1956	2,749.0	868.2	93.3	3.0	1,805.6	1,003.8	615.8	615.8	596.0	0.0	0.0	0.0	8,350.4
1957	0.0	0.0	0.0	0.0	66.3	64.1	66.3	66.3	64.1	0.0	0.0	0.0	327.2
1958	0.0	700.4	772.0	1,556.3	2,139.0	1,086.9	705.3	705.3	682.5	0.0	0.0	0.0	8,347.7
1959	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1960	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1961	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1962	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1963	0.0	1,758.6	0.0	0.0	1,062.9	729.4	523.8	523.8	506.9	0.0	356.9	0.0	5,462.2
1964	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,209.5	3,209.5
1965	2,105.8	561.8	0.0	150.9	754.3	723.0	747.1	747.1	723.0	0.0	293.3	22.1	6,828.3
1966	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2
1967	73.6	249.9	784.8	892.2	2,666.1	903.9	934.1	934.1	903.9	0.0	0.0	0.0	8,342.7
1968	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1969	2,361.9	1,277.6	639.8	2,029.2	2,858.6	1,028.0	767.0	767.0	742.3	0.0	0.0	115.3	12,586.6
1970	3,226.6	687.8	247.7	0.0	156.8	151.7	156.8	156.8	151.7	0.0	334.7	519.3	5,790.1
1971	422.7	268.8	270.1	0.0	336.4	325.5	336.4	336.4	325.5	0.0	56.2	97.7	2,775.8
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	379.1	925.4	432.3	0.0	385.7	373.2	385.7	385.7	373.2	0.0	1,044.6	626.0	5,311.0
1974	1,110.2	0.0	594.3	400.1	760.2	617.3	637.9	637.9	617.3	0.0	0.0	0.0	5,375.2
1975	0.0	0.0	0.0	0.0	715.1	692.0	715.1	715.1	692.0	0.0	52.0	0.0	3,581.4
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	98.1	94.9	98.1	98.1	94.9	0.0	0.0	0.0	484.2
1979	0.0	0.0	354.4	0.0	323.2	312.7	323.2	323.2	312.7	0.0	0.0	0.0	1,949.3
1980	2,884.6	2,041.0	267.3	0.0	818.9	694.3	717.4	717.4	694.3	0.0	0.0	0.0	8,835.2
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,200.1	1,200.1
1982	1,289.7	2,551.1	1,625.1	3,269.7	2,458.8	909.0	939.3	939.3	909.0	0.0	1,077.7	1,482.2	17,450.7
1983	1,149.3	1,867.1	3,276.0	1,522.5	3,865.3	2,717.2	1,571.3	1,571.3	1,520.6	0.0	2,005.8	2,487.9	23,554.0
1984	1,260.2	599.6	112.3	0.0	400.2	387.3	400.2	400.2	387.3	0.0	250.5	0.0	4,197.9

Table K-10: Presented as Table J-2: 2040 Unallocated Water below Camanche Dam
Values shown provide flow in cubic feet per second (cfs) averaged over the monthly period indicated

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	4,328.1	2,587.4	112.5	1,261.8	479.7	495.7	495.7	479.7	0.0	0.0	0.0	10,240.8
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	411.2	397.9	411.2	411.2	397.9	0.0	0.0	0.0	2,029.5
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	310.5	2,749.9	2,266.4	3,938.9	1,385.4	1,202.7	1,202.7	1,163.9	0.0	0.0	0.0	14,220.4
1996	0.0	1,750.2	852.8	130.0	1,450.7	368.1	380.3	380.3	368.1	0.0	275.4	2,122.5	8,078.3
1997	5,939.4	1,222.6	187.6	0.0	113.3	109.6	113.3	113.3	109.6	0.0	144.9	0.0	8,053.7
1998	342.6	1,739.7	1,093.3	1,438.9	2,240.2	1,143.9	1,028.3	1,028.3	995.1	0.0	0.0	0.0	11,050.1
1999	287.3	1,480.0	457.0	0.0	587.9	666.1	555.2	555.2	537.3	0.0	0.0	0.0	5,126.0
2000	0.0	708.2	421.8	0.0	203.3	196.7	203.3	203.3	196.7	0.0	0.0	0.0	2,133.4
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	47.8	46.3	47.8	47.8	46.3	0.0	0.0	0.0	236.1
2004	0.0	0.0	148.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	148.8
2005	0.0	197.1	1,097.0	463.9	1,507.2	806.1	571.5	571.5	553.1	0.0	0.0	1,471.7	7,239.2
2006	1,471.0	804.9	1,066.7	3,807.5	2,357.5	995.3	446.6	446.6	432.2	0.0	19.4	32.5	11,880.1
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.0	0.0	0.0	0.0	377.3	365.1	377.3	377.3	365.1	0.0	391.8	1,210.3	3,464.0
Ave	473.5	463.8	347.1	311.1	628.3	345.5	288.8	288.8	279.5	0.0	108.7	282.6	3,817.6
Max	5,939.4	4,328.1	3,276.0	3,807.5	3,938.9	2,717.2	1,571.3	1,571.3	1,520.6	0.0	2,005.8	3,209.5	23,554.0
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix H: Climate Change Memorandum

Appendix H provides the MCG-approved Climate Change Memorandum which summarizes climate change work performed within the watershed and identifies how MokeWISE projects may mitigate potential climate change effects.

MokeWISE Program:
Climate Change

Date: 3 April 2015

Table of Contents

Climate Change Overview

The State of California, along with scientific organizations, including the International Panel on Climate Change (IPCC), have documented changes in both global and local climate over the past 100 years and anticipate even more changes in air temperature, precipitation, and mean sea levels in the coming decades. In California, warming temperatures are expected to raise the snowfall elevation, causing more winter precipitation in the Sierra Nevada to occur as rainfall. This will lead to larger and earlier runoff events. As a result of these changes, several million acre-feet of natural snowpack storage could be lost annually, reducing available water supply. In addition, the increasing severity of storms and increased runoff could overwhelm existing reservoir flood protection capacity and increase flood risks downstream.

Water and environmental resources can be adversely affected in many ways, including by rising air and surface water temperatures, reduced snow pack, longer droughts, less frequent more intense storms, increased size and frequency of wildfires, and rising sea levels. These changes can affect all elements of water supply systems, from watersheds to reservoirs, conveyance systems, and treatment facilities.

Planning for these changes is necessary in order to ensure a reliable water supply, maintain water quality, protect against flooding and protect and restore ecosystems and habitat. As part of the MokeWISE program, a review of climate change information developed by the Mokelumne-Amador-Calaveras (MAC) and Eastern San Joaquin (ESJ) Integrated Regional Water Management (IRWM) Regions and related subsequent publications was conducted to determine how climate change may impact the upper and lower watersheds, what water resources are most vulnerable, and strategies for addressing these vulnerabilities. This section provides a summary of the climate change vulnerabilities identified in the MAC and ESJ Regions, with updates from the State publications "Our Changing Climate 2012" and the "California Water Plan 2013 (CWP)", which provide strategies included each of the regions' IRWM plans. The summary identifies how the strategies address the vulnerabilities, and summarizes how each of the MokeWISE projects aligns with these strategies for adaptation to climate change and to mitigate greenhouse gas emissions.

Consideration of climate change impacts to water resources is a required IRWM Plan Standard and the state recommends it in several planning efforts, including the Safeguarding California Plan, the California Water Plan (CWP), and the California Water Action Plan (CWAP). The potential for climate change impacts in the MokeWISE region is significant. Projects implemented through this program should consider climate change to ensure that objectives are met and maximum benefit is achieved for the region.

Climate Change Vulnerabilities

Assessments of climate change vulnerabilities were identified in the MAC and ESJ IRWM Regions for their respective IRWM Plan updates. These vulnerability assessments focused on determining how vulnerable each Region's water resources are to climate change impacts on water demand, water supply, water quality, flood management, hydropower, ecosystems and habitat, and sea level rise. The vulnerability to increased wildfires of the MAC region has been added based on subsequent published information. The vulnerabilities identified for each IRWM region are listed in **Table 1**.

The MAC Region's highest priority vulnerabilities are water supply, water quality, ecosystem and habitat, increased water demand to fight wildfires, and hydropower. The ESJ Region's highest priority vulnerabilities include water reserve storage and management, water demand uncertainty, water quality and saline intrusion, and flooding and water logging in agricultural areas.

Table 1: Climate Change Vulnerabilities by IRWM Region

Vulnerability		MAC Region	ESJ Region	Both Regions
Water Demand	Increased water demand to fight increase in wildfires			X
	Increased demand for process cooling water for food processing industries with increased surface water temperatures			X
	Increased domestic demands with increased evapotranspiration			X
	Increased agricultural demands due to longer growing season, increased temperatures and evapotranspiration, and more frequent/severe drought			X
	Vulnerability of agricultural products to continued high temperature and changes to chilling hours (e.g. grapes for wine production, cherries)		X	
	Harm to grapes vines and impacts to harvest due to excessive winter precipitation		X	
	Increased power demands due to increased cooling needs in buildings		X	

	Increased power demands at vineyards to use power operated cooling equipment		X	
Water Supply	Decreased water supply due to decreased snowpack in the Sierra Nevada Mountains and shift in timing of seasonal runoff			X
	Water table decline due to inadequate recharge		X	
Water Quality	Reduced water quality due to saline water intrusion from sea-level and from lowered water tables/reduced streamflow		X	
	Higher concentrations of surface and groundwater contaminants due to lower surface water flows and lower groundwater tables			X
	Increased pesticide contamination to surface waters due to increased pesticide use (higher temperatures are more conducive to pests)			X
	Reduced dissolved oxygen content due to increased surface water temperatures			X
	Increased nutrient load to surface waters due to increase in wildfires			X
	Increased nutrient loading due to increased urban and agricultural seasonal runoff		X	
	Degraded surface and groundwater quality due to reduction of meadow area that can provide contaminant reduction	X		
Flood Management	Increased flooding in low-lying areas due to sea level rise and sea water intrusion into Delta		X	
	Increased flood inundation due to increased runoff in the winter and potentially fall			X
	Increased seasonal flooding due to increases in seasonal precipitation during winter and fall			X

	Increased flooding due to reduction of meadow area which help reduce floods in winter	X		
Hydro-power	Reduced hydropower generation due to lower reservoir levels caused by increased customer demand and changes in timing of seasonal runoff/flasher storm systems			X
Ecosystem and Habitat	Impacts to vegetation due to increased temperatures and evapotranspiration, changes in precipitation patterns and distribution, and more frequent/severe droughts and wildfires			X
	Reduced quality of fish habitat due to reduced water quality, lower flows and warmer water temperatures			X
	Hindered upward migration of anadromous fish due to low spring flow			X
	Shift of freshwater-saltwater habitat due to lower summer stream flows		X	
Sea Level Rise	Impacts to agricultural land in the Delta's reclaimed regions due to sea level rise		X	
	Exacerbated saline intrusion to surface and groundwater		X	
	Greater risk of levee overtopping or failure due to sea level rise		X	

Strategies for Addressing Climate Change

Identifying strategies that address the climate change vulnerabilities described above is a key step in adapting to climate change as well as mitigating greenhouse gas emissions. The MAC Region and the ESJ Region each identified Resource Management Strategies (RMS) from the 2009 California Water Plan (CWP) Update that would help them to meet their water resource management objectives, including identifying RMS that could address the Regions' climate change vulnerabilities. In addition, the RMS were evaluated for their ability to potentially reduce GHG emissions and mitigate climate change impacts of the energy needed to treat and distribute water.

Since selection of these strategies, the 2013 CWP Update was published. The following 10 "Essential Actions" are from the California Water Action Plan (CWAP) released by the California Governor in 2014, which align with the CWP. These essential actions are considered priorities for the State of California.

- Make Conservation a California way of life
- Invest in integrated water management and increase regional self-reliance
- Achieve the coequal goals for the Delta
- Protect and restore important ecosystems
- Manage and prepare for dry periods
- Expand water storage capacity and improve groundwater management
- Provide safe drinking water and secure wastewater systems to all communities
- Increase flood protection
- Improve operational and regulatory efficiency
- Identify sustainable and integrated financing

Within these Essential Actions there are 17 objectives:

- Strengthen Integrated Regional Water Management Planning
- Use and Reuse Water More Efficiently
- Expand Conjunctive Management of Multiple Supplies (groundwater & surface storage)
- Protect and Restore Surface Water and Groundwater Quality
- Practice Environmental Stewardship
- Improve Flood Management Using an Integrated Water Management
- Manage the Delta to Achieve the Coequal Goals for California
- Prepare Prevention, Response, and Recovery Plans
- Reduce the Carbon Footprint of Water Systems and Water Uses
- Improve Data, Analysis, and Decision-Support Tools
- Invest in Water Technology and Science
- Strengthen Tribal/State Relations and Natural Resources Management
- Ensure Equitable Distribution of Benefits
- Public Access to Waterways, Lakes, and Beaches
- Strengthen Alignment of Land Use Planning and Integrated Water Management
- Strengthen Alignment of Government Process and Tools
- Improve Integrated Water Management Finance Strategy and Investments

There are more than 300 specific actions in Update 2013, Vol. 1, Ch. 8, "Roadmap for Action" and Vol. 3, "Resource Management Strategies (RMS)." The strategies in the 2013 CWP Update are largely the same as those listed in the 2009 CWP Update, but with some additional strategies added including sediment management, outreach and engagement, and water and culture. The 2013 CWP Update strategies will be considered in detail in the next update of each regions' IRWM Plans.

RMS selected for inclusion in the MAC and ESJ Regions' Plans, the climate change vulnerabilities they help to address, and their contribution to GHG emissions mitigation in the Regions are shown in **Table 2**. The categories identified in this table correspond to the major areas identified in the CWP Update. Note that these RMS, defined in the 2009 CWP Update, were identified as relevant in the respective IRWM Plans, and reference in the MokeWISE program does not reflect endorsement of the strategies by any or all MCG members.

Table 2: RMS that Address Climate Change Vulnerabilities

Resource Management Strategy	Vulnerability Adaptation							Mitigation		
	Water Demand	Water Supply	Water Quality	Flood Management	Hydropower	Ecosystem & Habitat	Sea Level Rise	Energy Efficiency	Emissions Reduction	Carbon Sequestration
Reduce Water Demand										
Agricultural Water Use Efficiency	✓	✓			✓	✓		✓	✓	
Urban Water Use Efficiency	✓	✓			✓	✓		✓	✓	
Improve Operational Efficiency and Transfers										
Conveyance – Regional/Local		✓	✓	✓		✓		✓	✓	
System Reoperation		✓		✓	✓			✓	✓	
Water Transfers		✓						*	*	
Increase Water Supply										
Conjunctive Management and Groundwater Storage		✓	✓	✓		✓		*	*	
Precipitation Enhancement		✓			✓	✓		✓		
Recycled Municipal Water		✓				✓		*	*	
Surface Storage – Regional/Local		✓	✓	✓	✓	✓		*	✓	
Improve Water Quality										

Resource Management Strategy	Vulnerability Adaptation							Mitigation		
	Water Demand	Water Supply	Water Quality	Flood Management	Hydropower	Ecosystem & Habitat	Sea Level Rise	Energy Efficiency	Emissions Reduction	Carbon Sequestration
Drinking Water Treatment and Distribution		✓	✓					✓	✓	
Groundwater Remediation/Aquifer Remediation		✓	✓					*	*	
Matching Quality to Use	✓	✓	✓			✓		*	*	
Pollution Prevention		✓	✓			✓			✓	
Salt and Salinity Management		✓	✓			✓			✓	
Urban Runoff Management			✓	✓		✓		✓	✓	
Practice Resource Stewardship										
Agricultural Lands Stewardship	✓		✓							✓
Economic Incentives	✓	✓	✓		✓		✓	✓	✓	✓
Ecosystem Restoration		✓	✓	✓	✓		✓			✓
Forest Management		✓	✓	✓	✓					✓

Resource Management Strategy	Vulnerability Adaptation							Mitigation		
	Water Demand	Water Supply	Water Quality	Flood Management	Hydropower	Ecosystem & Habitat	Sea Level Rise	Energy Efficiency	Emissions Reduction	Carbon Sequestration
Land Use Planning and Management	✓	✓	✓	✓	✓		✓	✓	✓	✓
Recharge Area Protection		✓	✓	✓						✓
Water-dependent Recreation			✓	✓						✓
Watershed Management		✓	✓	✓	✓		✓	✓	✓	✓
Improve Flood Management										
Flood Risk Management		✓	✓	✓	✓		✓			✓
Other Strategies										
Irrigated Land Retirement	✓	✓	✓		✓			*	*	
Rain-fed Agriculture	✓	✓	✓		✓			✓	✓	

Strategies identified in the 2009 California Water Plan Update (Bulletin 160-09)

Key:

✓ Indicates that, in general, this will provide a beneficial effect

X Indicates that, in general, this will provide an adverse effect

* Indicates that this may provide either beneficial or adverse effects

MokeWISE Projects' Ability to Address Climate Change Vulnerabilities

The projects selected for inclusion in the MokeWISE program align with a number of the strategies identified above, and therefore are expected to help the Upper and Lower Mokelumne River watersheds adapt to climate change as well as mitigate greenhouse gas emissions. **Table 3** provides the name of each MokeWISE program project, and indicates each related vulnerability, resource management strategies implemented, and greenhouse gas (GHG) mitigation effects expected by the project. These projects provide a balance of benefits that will help to respond to climate change vulnerabilities.

Table 3: Project Potential for Implementing Resource Management Strategies

Projects	Related Vulnerabilities	RMS Implemented	GHG Mitigation Effects
1a. Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir	• Impacted ecosystem and habitat	• Ecosystem Restoration • Water-Dependent Recreation • Flood Risk Management	• None
1b. High Country Meadow Restoration Program	• Degraded surface water and groundwater quality Impacted ecosystems and habitat	• Ecosystem Restoration • Recharge Area Protection • Watershed Management • Flood Risk Management	• Carbon Sequestration
1c. Mokelumne River Day Use Area Floodplain Habitat Restoration Project	• Increased flooding • Impacted ecosystem and habitat	• Ecosystem Restoration • Recharge Area Protection • Watershed Management • Flood Risk Management	• Carbon Sequestration
1d. Fish Screens for Riparian Diversions in the Lower Mokelumne River	• Impacted ecosystems and habitat	• Watershed Management	• None
1f. Riparian Restoration Program – Below Camanche River	• Degraded surface water and groundwater quality Increased flooding • Impacted ecosystems and habitat	• Ecosystem Restoration • Recharge Area Protection • Watershed Management • Flood Risk Management	• Carbon Sequestration
1g. Mokelumne Water Quality, Soil Erosion & Sedimentation Inventory/ Monitoring	• Decreased surface water quality	• Sediment Management • Watershed Management	• None

Projects	Related Vulnerabilities	RMS Implemented	GHG Mitigation Effects
2a. Municipal Recycled Wastewater Recharge Program	• Decreased water supply / Water table decline • Degraded surface water and groundwater quality	• Conjunctive Management and Groundwater Storage • Recycled Municipal Water • Matching Quality to Use • Pollution Prevention	• Energy Efficiency • Emissions Reduction
2b.Woodbridge Winery Wastewater Reuse	• Decreased water supply • Degraded surface water and groundwater quality	• Conjunctive Management and Groundwater Storage • Recycled Municipal Water • Matching Quality to Use • Pollution Prevention	• Energy Efficiency • Emissions Reduction
2c. Amador County Reuse	• Decreased water supply • Degraded surface water and groundwater quality	• Recycled Municipal Water • Matching Quality to Use • Pollution Prevention	• Energy Efficiency • Emissions Reduction
4a. Groundwater Banking within the Eastern San Joaquin Groundwater Basin	• Decreased water supply / Water table decline • Degraded surface water and groundwater quality	• Water Transfers • Conjunctive Management and Groundwater Storage	• Energy Efficiency • Emissions Reduction
4b. Amador and Calaveras Counties Hydrologic Assessment	• Decreased water supply / Water table decline • Degraded surface and groundwater quality	• Water Transfers • Conjunctive Management and Groundwater Storage • Flood Risk Management	• Energy Efficiency • Emissions Reduction

Projects	Related Vulnerabilities	RMS Implemented	GHG Mitigation Effects
4d. NSJWCD Infrastructure Improvements	• Decreased water supply / Decreased water supply / Water table decline	• Conveyance – Regional/Local	• Energy Efficiency • Emissions Reduction
5a. Regional Urban Water Conservation Program	• Increased domestic / urban and commercial, industrial and institutional (CII) demands • Degraded surface water and groundwater quality	• Urban Water Use Efficiency • Matching Quality to Use • Pollution Prevention • Urban Runoff Management • Economic Incentives	• Energy Efficiency • Emissions Reduction
5b. Regional Agriculture Conservation Program	• Increased agricultural demands • Degraded surface water and groundwater quality	• Agricultural Water Use Efficiency	• Energy Efficiency • Emissions Reduction • Carbon Sequestration
7b. Raise Lower Bear Feasibility Study	• Decreased water supply • Increased seasonal flooding	• System Reoperation • Water Transfers • Conjunctive Management and Groundwater Storage • Surface Storage – Regional/Local • Watershed Management • Flood Risk Management	• Energy Efficiency • Emissions Reduction • Carbon Sequestration
7c. Surface Storage Regional Assessment	• Decreased water supply • Increased seasonal flooding	• Surface Storage – Regional/Local	• Energy Efficiency • Emissions Reduction
7d. Re-operation of Existing Storage	• Increased seasonal flooding • Reduced hydropower generation	• System Reoperation • Surface Storage – Regional/Local • Flood Risk Management	• Energy Efficiency • Emissions Reduction
7f. Blue & Twin Lakes Dams Reliability & Replacement Assessment	• Decreased Water Supply • Increased Seasonal Floods	• Local/Regional Surface Storage	• Energy Efficiency • Emissions Reduction

Projects	Related Vulnerabilities	RMS Implemented	GHG Mitigation Effects
8a. Jeff Davis Water Treatment Plant Replacement	• Decreased water supply	• Urban Water Use Efficiency • Surface Storage – Regional/Local • Drinking Water Treatment and Distribution	• Energy Efficiency • Emissions Reduction
8b. Rehabilitation of Transmission Main	• Decreased water supply	• Urban Water Use Efficiency • Conveyance – Regional/Local	• Energy Efficiency • Emissions Reduction
8c. Barney Way Septic System Conversion	• Decreased water supply • Degraded surface water and groundwater quality	• Pollution Prevention • Recharge Area Protection	• None
8d. Camanche Village Recycled Water Project	• Decreased water supply • Degraded surface water and groundwater quality	• Recycled Municipal Water • Matching Quality to Use • Pollution Prevention	• Energy Efficiency • Emissions Reduction

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Appendix I: Project Concept List and Descriptions

Appendix I provides brief descriptions for each of the project concepts considered by the MCG.

#	Type	Concept Name	Description
1a	Ecosystem / Habitat Restoration	Upper Mokelumne Anadromous Fish Restoration Sponsor: Foothill Conservancy	Transport anadromous fish above Camanche and Pardee to expand their habitat, improve their resiliency in the face of climate change and enhance upper ecosystems and recreational opportunities.
1b	Ecosystem / Habitat Restoration	High Country Meadow Restoration Program Sponsor: Foothill Conservancy	Develop a three-phased program to restore high-elevation meadows to approximate natural function to provide water supply, storage, and ecosystem enhancement benefits. The initial phase of the program would involve mapping, identifying, and assessing potential meadows for restoration. The second phase would include setting goals and opportunities for both the program and for each of the identified meadows. The third and final phase would involve developing an implementation plan and budget for restoring the identified meadows. This implementation plan and budget could then be used to secure funding for implementation of the restorations.
1c	Ecosystem / Habitat Restoration	Mokelumne River Day Use Area Floodplain Habitat Restoration Project Sponsor: SJCRCD	This project is intended to restore a portion of the seasonal floodplain habitat located along the stretch of the Mokelumne River downstream of East Bay Municipal Utility District's (EBMUD or the District) Camanche Reservoir by working with willing participants consistent with the Lower Mokelumne River Watershed Stewardship Plan. Floodplain habitat has been lost as a result of mining and modification of geomorphic processes that has taken place since the advent of the gold rush days in the 1800s. Floodplain creation serves to enhance the habitat for juvenile salmonids and other native fish species within the lower Mokelumne. EBMUD owns land immediately downstream of the Camanche Dam that it uses to support the District's water supply operations (EBMUD's Mokelumne River Day Use Area (MRDUA)). Those lands include properties that have deteriorated riparian and aquatic habitat associated with the above-noted historic human modifications. There is an opportunity for the construction of restoration projects on those properties that when implemented would improve existing fisheries habitat and provide a degree of flood management.
1d	Ecosystem / Habitat Restoration	Fish Screens for Riparian Diversions in the Lower Mokelumne	Develop and implement a program to identify and prioritize riparian diversions on the Lower Mokelumne for fish screens. Working with willing landowners, the program would then secure and install fish screens on these riparian diversions to reduce

#	Type	Concept Name	Description
		Sponsor: *none*	entrainment of fish. Currently, the four largest pumps/diversions are screened, but according to a late 1990's assessment, approximately 60 remain unscreened. Additionally, the California Fish Passage Assessment Database by CalFish identifies over 400 diversions on the main stem of the Mokelumne.
1e	Ecosystem / Habitat Restoration	Riparian Restoration Program – Upstream of Pardee Reservoir Sponsor: Foothill Conservancy	Develop and implement a program that analyzes and addresses riparian restoration needs by identifying potential areas for restoration, identifying partnership opportunities with willing landowners, and developing a funding base for restoration projects that provide benefits to water users. May include removing invasive species and maximizing the habitat value of farm edges.
1f	Ecosystem / Habitat Restoration	Riparian Restoration Program – Below Camanche Reservoir Sponsor: SJCRCD Co-Sponsor: Foothill Conservancy	Support the implementation efforts of the Lower Mokelumne Watershed Stewardship Plan, which analyzes and addresses riparian restoration needs. May include developing a funding base for projects identified in the Plan.
2a	Recycled Water	Municipal Recycled Wastewater Recharge Program Sponsor: City of Lodi	Use treated, disinfected wastewater to recharge, either direct or in-lieu, Valley groundwater aquifers. The project should be further fleshed out after the Water Availability Analysis findings are released, which would help identify what municipal recycled water supplies are suitable for recharge, potential downstream impacts of diverting wastewater, and nearby areas potentially feasible for recharge. Uses including consumptive use and seawater intrusion barriers will be considered.
2b	Recycled Water	Constellation Winery Wastewater Reuse Sponsor: *Constellation Winery?* Co-Sponsor: GBA, NSJWCD	Use treated wastewater from the Constellation Winery facility for agricultural irrigation in lieu of groundwater pumping; provide in-lieu groundwater recharge/banking.

#	Type	Concept Name	Description
2c	Recycled Water	Amador County Regional Reuse Sponsor: AWA	Implement aspects of the Amador County Regional Approach for Reuse Study.
2d	Recycled Water	Mokelumne Hill Sanitary District Reclaimed Wastewater Sponsor: CPUD	Reclaim treated wastewater to offset use of Mokelumne surface water. Uses of this water may include ranching or other spray applications.
3a	Desalination	Solar-Powered Desalination Sponsor: *none*	Develop a solar-powered desalination project, which may include identifying partners for a cost-sharing program. This desalination facility would clean brackish water from the Delta using solar troughs. The solar panels would create enough heat to separate the salt and water through evaporation. The remaining salt solidifies and can be removed and used in other industries as building materials, metals, or fertilizers. Some systems have a 93% recovery rate and use about 1/5 of the energy used by traditional desalination plants. Cost per acre-foot is cited around $450, but may be greater depending on the location and scale of implementation.
4a	Groundwater Management	Groundwater Banking within the Eastern San Joaquin Groundwater Basin Sponsor: GBA, CCWD	Identify opportunities for direct and in-lieu banking with a variety of sources including Mokelumne River, stormwater, agricultural runoff, etc. Could include gravity infiltration and groundwater injection. Also consider land currently used for farming, with voluntary participation and fair compensation for owners. Geographic scope includes the Eastern San Joaquin Groundwater Basin, including portions of Calaveras County.
4b	Groundwater Management	Amador and Calaveras County Hydrologic Assessment Sponsor: AWA, CCWD Co-Sponsor: JVID	Assess potential for groundwater banking in Amador and Calaveras counties. This could include assessing structure of fractured rock aquifers and age of water, in addition to mapping of sandy soils as a means to inform potential project areas.

#	Type	Concept Name	Description
4c	Groundwater Management	San Joaquin County Groundwater Banking and Exchange Sponsor: GBA, EBMUD	This project is seen as a regional effort whereby one or more partner agencies would obtain a new water right and/or modify an existing water right to enable surface water to be diverted from the Mokelumne River and banked in the Eastern San Joaquin Groundwater Basin for later use by one or more of the partners (and further to improve overdrafted groundwater conditions in the Eastern San Joaquin Groundwater Basin). This project would build upon the recent Demonstration Project efforts between EBMUD and the GBA. Under one scenario, a portion of the Mokelumne River supply would be conveyed through existing and/or new facilities for storage and regional use in the Basin. Various in-lieu and direct recharge projects could be used to recharge water in wet years for extraction in dry years. Recharge could be via recharge basins or direct injection. While the first stage of a project would rely primarily on EBMUD's facilities for conveyance, some new facilities required such as an Intertie with EBMUD's Mokelumne Aqueduct, a new pipeline and pump station that directs water from the aqueducts to the recharge site, and any required facilities to provide treatment as needed prior to injection and or following extraction. Water stored in the Basin would be extracted for use via wells installed within project areas. The quantity extracted could be divided by the partner agencies (upcountry agencies would receive their share via an in-lieu exchange with EBMUD). Groundwater would be sent to the EBMUD service area via connection(s) to EBMUD's Mokelumne Aqueducts. A portion of the quantity stored would remain in the ground to meet SJC's share requirements.
4d	Groundwater Management	NSJWCD Infrastructure Improvements Sponsor: NSJWCD	Improve the infrastructure for reliable surface water delivery to the North San Joaquin Water Conservation District so the District can utilize existing water rights and its agricultural customers can reduce reliance on groundwater sources. The largest of these projects includes rebuilding the southern pump station and southern distribution system, and rebuilding the northern distribution system.

#	Type	Concept Name	Description
5a	Water Conservation	Regional Urban Water Conservation Program Sponsor: UMRWA, GBA, City of Lodi	Reduce demand through implementation of efficient urban water use practices. This program includes submitting a regional conservation plan for funding. The funding received would then be distributed among agencies to fund their individual plans. Plan elements may include initiating a pilot program with funding available to encourage residents to replace existing water reliant landscaping and utilize landscaping BMP's to reduce runoff and improve water quality; increasing irrigation efficiency; metering and billing based on water use; leak detection; rainwater capture; stormwater capture; education and outreach regarding lawn and landscape watering needs.
5b	Water Conservation	Amador Canal Conversion to Pipeline Sponsor: AWA	Placement of a pipeline in or along the 18 mile Amador Canal to conserve an estimated 1,500 AF of water annually.
5c	Water Conservation	Regional Agriculture Conservation Program Sponsor: SJCRCD	Increase irrigation efficiency; A program which would work with growers and agencies to test and evaluate agricultural management practices for irrigation water management efficiency.
6a	Stormwater Management and Flood Control	Cosgrove Creek Flood Management Project Sponsor: *none*	Solve flood control issues at Cosgrove Creek to allow flood waters to naturally recharge the aquifer. Project could potentially include recreational components and involve utilizing a 50-acre lot owned by CCWD for recharge purposes.
6b	Stormwater Management and Flood Control	Mokelumne Stormwater Capture and Reuse Sponsor: Calaveras County	Analyze stormwater runoff within the Mokelumne Hill area, including the ditches that ultimately flow into the Mokelumne River.

#	Type	Concept Name	Description
6c	Stormwater Management and Flood Control	Mokelumne Floodplain Management Plan - Camanche to Below Woodbridge Dam Sponsor: SJCRCD	In coordination with the Lower Mokelumne Watershed Stewardship Plan, work with willing landowners to create set back levees, re-configure side channels, and/or increase riparian buffer areas in the Mokelumne River from Camanche to Woodbridge Dam to maximize available habitat for salmonids and (in some cases) restore some floodplain function and promote groundwater storage.
7a	Surface Storage	PG&E Storage Recovery Sponsor: AWA, *CCWD?*	Evaluate the feasibility of removing silt and sediment from behind PG&E dams.
7b	Surface Storage	Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering Sponsor: AWA, JVID	Evaluate the feasibility of enlarging Lower Bear Reservoir by raising the existing dam (embankment) by 32 feet to increase surface water storage capacity within the upper Mokelumne River watershed. This feasibility study would be a continuation of previous studies and serve to address previously unanswered questions and unresolved issues. Previous studies performed on behalf of Amador Water Agency suggest that Lower Bear Reservoir would provide 18,300 Acre Feet of additional Yield (Willard, 2005). In addition to modifications to the dam itself, other facilities that would need to be constructed include an updated intake structure and spillway. Also note that the project would require the relocation of adjacent roads and existing recreation facilities. An operational scheme for an enlarged reservoir would need to be prepared to determine how much yield could be realized for the partners that elect to take part in the project.
7c	Surface Storage	Surface Storage Regional Assessment Sponsor: UMRWA	Conduct a regional assessment to evaluate the feasibility of the constructing additional surface storage in Amador and Calaveras Counties. The study would include discussions on location, technical feasibility, political feasibility, environmental feasibility, and legal feasibility.
7d	Surface Storage	Re-operation of Existing Storage	Feasibility study to assess capability to re-operate existing storage to store water for consumptive use in addition to hydropower. The study would include a discussion on

#	Type	Concept Name	Description
		Sponsor: UMRWA	legal, environmental, political, and technical feasibility, as well as address the issue of flood control capabilities.
8a	Local Infrastructure	Jeff Davis Water Treatment Plant Replacement Sponsor: CPUD	Evaluate the feasibility of replacing the existing Jeff Davis Water Treatment Plant (WTP), a sand filter water treatment plant, with a state of the art membrane filtration plant. The Jeff Davis WTP was designed in 1970 and is oversized for the current and projected District demands. The project would reduce backwash water requirements which would reduce Mokelumne water needs.
8b	Local Infrastructure	Rehab of Transmission Main Sponsor: CPUD	Conduct a study to determine the benefits of replacing all or a portion of the transmission main that conveys treated water from the Jeff Davis WTP to Mokelumne Hill, Paloma, and San Andreas. The study would include assessment of areas that are reaching life expectancy, areas of water loss, and recommendations for rehabilitation. Upon completion of the study, replace or line the recommended areas of the current transmission main. The transmission main was installed in the 1970's and has had one large repair since that time. Replacing or lining the transmission main will increase the life expectancy, and likely improve efficiencies and reduce water loss.
8c	Local Infrastructure	Barney Way Septic System Conversion Sponsor: CCWD	Hook existing residences along Barney Way either into the public sewer system or implement a community septic vault system to improve water quality of the Mokelumne River. This project would evaluate both options to determine and implement the most cost-effective conversion. Barney Way sits alongside the northern side of the Middle Fork of the Mokelumne off of Highway 26, downstream of Schaads Dam.
8d	Local Infrastructure	Lake Camanche Village Recycled Water Project Sponsor: AWA	A feasibility study for converting from existing wastewater treatment ponds to a recycled water plant in the Camanche Village area to allow for recycled water to be used locally.
9a	Policies and Initiatives	Land Use Coordination Sponsor: Calaveras Planning Coalition, MyValleySprings.com	Develop a program to improve coordination between willing water agencies and land use agencies.

#	Type	Concept Name	Description
9b	Policies and Initiatives	State Wild and Scenic River Designation Sponsor: *none*	Develop language for and draft a position statement that would encourage the designation of the reach between Salt Springs Dam and Pardee Reservoir under the State Wild and Scenic Rivers system. Each MCG member organization would sign, approve, or otherwise show support for this position statement.
9c	Policies and Initiatives	Sustainable Forest - Watershed Management Project Sponsor: *none*	Draft a resolution for MokeWISE members in support of scientifically proven forest practices that protect the Mokelumne Watershed by 1) thinning to reduce the risk and impacts of wildfires, 2) reducing erosion and sediment yield into stream courses, and 3) improving water management
9d	Policies and Initiatives	Watershed Coordinator Sponsor: SJCRCD	Support funding efforts for the establishment of local Watershed Coordinator positions.
9e	Policies and Initiatives	Groundwater Management Tools Sponsor: GBA	Identify additional options for the Eastern San Joaquin Groundwater Basin Authority to more effectively manage groundwater levels.
9f	Policies and Initiatives	Mixed-Use Project Concept for Calaveras County Mokelumne Reservation Sponsor: *CCWD?*	Evaluate the legal feasibility of and options for allowing CCWD/CPUD to assign all or a portion of Calaveras County's area of origin reservation on the Mokelumne. In addition to consumptive uses, evaluate other potential beneficial uses of the water, including fish, wildlife, and recreation. This may also include evaluating the feasibility of both new and previously proposed projects.
9g	Policies and Initiatives	MokeWISE Public Interest Profile Enhancement Project (PIPE) Sponsor: *none*	Support an informal, non-regulatory process among stakeholders that will help regional entities be better prepared to seek appropriations approval from the State Water Board. These processes may include developing a list of public interest criteria which can be used to evaluate proposed water uses.

Appendix J: Preliminary Project Assessment Memorandum

Appendix J provides the MCG-approved methodology for preliminarily assessing project concepts, which includes an assessment to determine if each project is feasible, beneficial, attainable, and compatible.

MokeWISE Program Draft Memorandum:
Project Assessment

Revision Date: 14 February 2014

Table of Contents

Introduction

The Mokelumne Watershed Inter-regional Sustainability Evaluation (MokeWISE) program has emerged following years of dialogue between a diverse set of stakeholders in the Upper and Lower Mokelumne River watersheds. MokeWISE, when concluded, is expected to yield a scientifically-based and broadly-supported water resources program that includes sustainable approaches to water resources management in the Mokelumne River watershed.

Members of the Mokelumne Collaborative Group (MCG), the stakeholder group driving development of the MokeWISE program, were asked to complete a table summarizing initial ideas related to desired potential benefits to be achieved and potential consequences to be avoided by the program, and potential ways of measuring these outcomes. Information provided through this exercise was compiled by the project team with the goal of identifying areas of common interest, which were used to develop joint program objectives and measures.

Based on the information provided by MCG members, MokeWISE Program Objectives were developed and submitted for acceptance by the MCG. The Program Objectives will serve as a guide to determine how well the MokeWISE program addresses the objectives of the MCG. In order to understand whether individually proposed project concepts will address some or all of the Program Objectives, the objectives were used as the basis for developing a process for assessing individual project concepts and portfolios. The following sections present the proposed approach to assessing project concepts and portfolios in the MokeWISE program.

Project Concept Assessment

A wide array of project concepts will be developed through the MokeWISE program. Project concepts will be qualitatively assessed based on four screening criteria: feasible, beneficial, attainable, and compatible. Each criterion is described below.

- **Feasible:** Each project concept will be assessed at a conceptual level for its technical feasibility. Concepts will be determined to pass the preliminary technical feasibility screen if the project concept, or similar projects / concepts, have been demonstrated to be technically feasible and no technical "fatal flaws" have been identified which would suggest the project may not be able to be implemented. If, however, the project concept is determined to have technical or other challenges that threaten its feasibility, the project concept will not pass this screen and will not be eligible for incorporation into a program or portfolio. It should be noted that the purpose of this screen is to remove concepts which are fatally flawed and not to remove concepts which may not have universal support.
- **Beneficial:** Each project concept will be assessed at a conceptual level to establish whether it is beneficial. A project will be determined to be beneficial if it achieves or helps to achieve one or more of the desired project outcomes established by the MCG. If a project or concept achieves one or more of the desired project outcomes and is therefore beneficial, it is considered to have passed this screen. If, however, the project concept will not achieve or help to achieve one or more of the desired project outcomes established by the MCG, the project concept will not pass this screen and will not be eligible for incorporation into a program or portfolio.
- **Attainable:** Each project concept will be assessed at a conceptual level to establish whether the benefits it seeks to provide are attainable. If it is determined that the project could be reasonably expected based on engineering judgment to provide the benefits it proposes to achieve, it will be preliminarily determined to be attainable and therefore pass this screen. If, however, the project concept is not reasonably expected based on engineering judgment to provide the benefits it proposes to achieve, the project concept will not pass this screen and will not be eligible for incorporation into a program or portfolio.
- **Compatible:** Each project concept will be assessed at a conceptual level to establish whether it is compatible with the desired outcomes and consequences to be avoided expressed by MCG member organizations. If a project concept has no benefits or impacts that are contrary to the objectives, desired outcomes, and impacts to be

avoided as set forth by MCG organizations, the project will be determined to be compatible and will pass this screen. If, however, the project concept would provide benefits or impacts that are not compatible with the objectives, desired outcomes, and impacts to be avoided by MCG organizations, the project concept will not pass this screen and will not be eligible for incorporation into a program or portfolio. In addition, a concept will not pass this screen if it is determined to be in violation of or not compatible with the perceived wishes, goals, or desired outcomes of community members.

It is envisioned that each concept passing all four screening criteria will be carried forward for potential incorporation in a portfolio or program. However, it is understood that the screening process is iterative. So while this document sets parameters for each of the screens, there is room for allowances. The overarching purpose of the screening process is to remove fatally flawed concepts, while retaining concepts which may not have universal support. This keeps some concepts in the process longer and allows time and space for creative discussion which may result in the concepts becoming more broadly supported.

Portfolio Assessment

Following assessment of individual project concepts, the MCG will develop portfolios or programs, which will consist of groupings of project concepts. Portfolios will be developed to achieve the suite of desired project outcomes established by the MCG. The attributing stakeholder(s) associated with each desired outcome will be tasked with determining which project concept(s) best address each outcome and which project concept(s) should be incorporated into programs or portfolios to achieve that outcome.

The process for developing and assessing portfolios will be developed by the MCG in future MCG discussions.

Assessment Criteria

Table 1 summarizes project outcomes and attributing stakeholders. As described above, the attributing stakeholder(s) associated with each desired outcome will be tasked with determining which project concept(s) best address each outcome and which project concept(s) should be incorporated into programs or portfolios to achieve that outcome.

Following assessment of individual project concepts, the MCG will develop portfolios or programs, which will consist of groupings of project concepts.

Table 1: Preliminary Project Concept and Portfolio Assessment Criteria

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
Water Supply	Promote demand-side management strategies	The program should promote projects and policies that support demand-side management strategies including conservation, water use efficiency, peak period rationing and leak detection.	Cost/benefit of conservation vs. new supply; amount of water saved per project implemented	AWA, Calaveras Planning Coalition, Foothill Conservancy, Calaveras County, JVID, Sierra Club
	Increase supply reliability	The program should result in increased water supply reliability for water purveyors.	Water accounting system for surface and groundwater; Acre-feet (AF) of supply in various hydrologic year types	EBMUD, AWA, Lodi, NSJWCD, GBA/SJ County, CCWD, CPUD, JVID, SJCRCD
	Increase amount of stored water	The program should result in an increase in the amount of water stored within the watershed and consider both ground and surface options.	Acre-feet per year (AFY) of supply diverted for recharge; groundwater level monitoring; AF of surface storage available	CCWD, Stockton East, JVID, GBA/SJ County, Stockton Municipal Utilities, Calaveras County, AWA, Calaveras PUD, JVID, Woodbridge Irrigation District, SJCRCD
	Promote smart, responsible development	The program should promote projects and policies that ensure that the water needs of new development are met while limiting negative externalities and end use harm.	Inclusion of land use coordination component(s) in recommended program	Calaveras County, MyValleySprings.com, Foothill Conservancy, SJCRCD
	Reduce reliance on groundwater for irrigation	The program should result in a reduced reliance on groundwater for irrigation and explore surface water alternatives.	AFY of groundwater used for irrigation	SJCRCD

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
	Promote a long-term groundwater balance	The program should promote projects and policies that seek to contribute to a positive long-term groundwater balance.	Groundwater level monitoring; flow diversion measurements	CA Sport Fishing, MyValleySprings.com, Stockton East, Stockton Municipal Utilities, SJFB, Woodbridge Irrigation District, SJCRCD
	Maximize water resource availability for all beneficial uses	The program should promote projects and policies that allocate water to the full spectrum of beneficial uses based on full analysis of all potential sources of supply.	Number of different types of uses supported by the recommended program; number of different supply sources studied	Calaveras County, CCWD, Calaveras Planning Coalition, Foothill Conservancy
	Decrease the need to import water	The program should seek to implement state legislative goals to improve self-sufficiency and reduce the need to import water	The amount of water imported	Calaveras Planning Coalition
Water Demands	Review and understand existing agency demand estimates	The MCG should review and come to a common understanding of water demand estimates described in existing planning documents	Number of MCG stakeholders who understand existing demand numbers.	Foothill Conservancy, Calaveras Planning Coalition, MyValleySprings.com, Trout Unlimited
	To identify water demand issues for timely consideration by the water agencies during their next UWMP update.	The program should identify issues and analyses for water agencies to consider as they prepare demand and population estimates.	Number of demand issues and analyses identified for water agency consideration as they prepare demand and population estimates for their UWMP Updates.	Calaveras Planning Coalition, Foothill Conservancy

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
Water Quality	Protect and improve surface and groundwater quality	The program should result in improved water quality within the watershed for both surface water and groundwater.	Groundwater and surface water quality monitoring.	Lodi, NSJWCD, EBMUD, SJCRCD, CCWD, JVID, Sierra Club
	Match delivered water quality to use	The program should try to avoid wasting high quality water on uses that do not need it.	The amount of high quality water saved by substitution with lower quality water; the amount of high quality water that is put to uses that do not need it.	Calaveras Planning Coalition
	Use water purification technology as a tool to maximize beneficial uses	The program should seek to implement the state's legislative goals to use water purification technology as a tool to increase the beneficial uses of water.	The amount of water that was put to additional beneficial uses through purification technology.	Calaveras Planning Coalition
Recreation	Increase access for water-based recreation	The program should result in increased access to the Mokelumne River from Highway 12 to the headwaters.	Number of new public access points	Delta Fly Fishers, SJCRCD
	Increase angling and other recreational opportunities	The program should result in increased spawning habitat, designating sections of the river for hatchery and wild species, and designating appropriate environmental flows.	Number of fish observed during annual fish counts; amount of spawning habitat created or enhanced; length of river designated for wild species; amount and timing of environmental flows	Delta Fly Fishers
	Increase angling and other	The program should result in the stocking of hatchery-raised trout, salmon, and steelhead in designated areas on the	Number of hatchery-raised trout, salmon, and steelhead	Delta Fly Fishers

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
	recreational opportunities	Upper Mokelumne and designating and managing wild trout, salmon, and steelhead sections.	observed during angling surveys	
	Increase angling and other recreational opportunities	The program should result in the reintroduction of trout, salmon, and steelhead in the Upper Mokelumne river.	Number of trout, salmon, and steelhead observed during fish counts	Delta Fly Fishers, MyValleySprings.com
	Increase angling and other recreational opportunities	The program should result in increased angling, harvesting, and other recreational opportunities.	Estimated monetized, or otherwise quantified, benefit of recreational enhancements included in recommended program(s)	EBMUD, JVID, Trout Unlimited, SJCRCD
Water Rights	Resolve existing water rights conflicts in the watershed	The program should seek to resolve existing water rights protests and to achieve a common understanding of the application of relevant water rights law in the watershed.	Number of water rights protests resolved	GBA/SJ County, EBMUD, JVID, Foothill Conservancy, CA Sport Fishing, Woodbridge Irrigation District, Sierra Club
Flood Management	Enhance flood protection and management	The program should result in multi-benefit projects which provide flood protection for residents and businesses within the watershed and enhance ecosystem function.	Annualized cost (probability and magnitude) of flood-related damages in the watershed	NSJWCD, SJCRCD
Data	Use sound, agreed-upon data to evaluate program alternatives	The program should produce an agreed-upon hydrology dataset and Water Availability Analysis	MCG approval of data used during program	CA Sport Fishing, Foothill Conservancy, Trout Unlimited, US Forest Service, Sierra Club

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
	Use sound, agreed-upon data to evaluate program alternatives	Program components should be described with sufficient detail to allow for evaluation.	Ability of program component to be evaluated	CA Sport Fishing, Calaveras Planning Coalition
	Promote the contribution of sound scientific data to current body of knowledge	The program should generate and promote projects with monitoring and reporting requirements to increase water resources data	Number of recommended project(s) including a data collection and reporting component	Calaveras County, Calaveras Planning Coalition, SJCRCD
Environment	Protect and enhance natural environment	The program should result in the protection and enhancement of the natural environment of the Mokelumne watershed.	Number and extent of protection and enhancement measures; monetization or other quantification of environmental benefits / enhancements	EBMUD, CA Sport Fishing, Foothill Conservancy, JVID, Trout Unlimited, Sierra Club, SJCRCD
	Protect and enhance natural environment	The program should include support for wild and scenic designation of the Mokelumne River down to the Pardee High Pool.	Degree of support for Wild and Scenic designation	Calaveras Public Utility District, Calaveras Planning Coalition, Sierra Club
	Protect and restore fisheries	The program should protect, restore, and enhance fisheries in the Mokelumne River downstream of Woodbridge Dam.	Number of fish counted during annual fish counts and surveys	Delta Fly Fishers, Trout Unlimited
Agricultural Benefits	Enhance or maintain the water supply for the beneficial use of	The project should increase the current agricultural water supply	Measured by amount of water available for agricultural use.	SJFB, SJCRCD

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
	agricultural practices			
Collaboration	Foster long-term regional relationships and avoid unnecessary conflict and litigation	The program should foster long-term regional relationships which will promote continued collaboration on water management issues and reduce unnecessary litigation.	Percentage of MCG stakeholders continuing commitment throughout project duration and number of issues resolved in the process Number of issues resolved through the MokeWISE program	USFS, Foothill Conservancy, Calaveras County, Calaveras Planning Coalition, EBMUD, NSJWCD, JVID, SJCRCD
	Promote broadly-supported outcomes that benefit a wide range of interests	The program should promote projects and policies that support outcomes benefiting a wide range of interests within the watershed.	Percentage of MCG member organizations that receive a tangible benefit from implementation of the preferred program	SJCRCD, GBA/SJ County, MyValleySprings.com, Foothill Conservancy
	Promote broadly-supported outcomes that benefit a wide range of interests	The program should promote the least controversial projects and policies.	Degree of consensus among MCG members on selected alternative	NSJWCD, Foothill Conservancy, SJCRCD
	Promote broadly-supported outcomes that benefit a wide range of interests	The program should result in agreements that reduce conflict.	Number of agreements that reduce conflict	Foothill Conservancy, SJCRCD
	Develop a program consistent with all	The program should facilitate a common understanding of the requirements contained in all existing licenses, permits,	Number of existing licenses, permits, and agreements violated by the	Trout Unlimited, Foothill Conservancy

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
	existing licenses, permits, and agreements affecting the River	and agreements affecting the Mokelumne River and ensure that MCG proposals will not interfere with their implementation.	recommended program(s) and severity of violation	
	Develop a program consistent with all existing licenses, permits, and agreements affecting the River	The program should adhere to all CEQA/NEPA regulations.	Completion of CEQA/NEPA documentation	Calaveras Planning Coalition
Other Human Values	Increase investment in forest management	The program should promote forest management that reduces the economic impact of wildfires and other natural disasters, particularly on water supply.	Flux of sediment discharged post-fire compared to historic events (e.g., Power Fire); monetization of costs avoided by pre-emptive management	Sierra Nevada Conservancy
	Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	The program should seek to design projects and policies to improve socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on DACs.	Acres of cultural resource areas preserved; acres of recreational area maintained; miles of stream enhanced for fisheries	Calaveras Planning Coalition

Category	*Objective*	*Summary*	*Potential Measurement*	*Attributing Stakeholders*
	Achieve equity	The program should be designed to achieve equity across regions, cultures, incomes, and time,	Amount of perceived equity across regions, cultures, incomes, and time.	Calaveras Planning Coalition, MyValleySprings.com

Appendix K: Preliminary Project Assessment

Appendix K provides the MCG-approved preliminary assessment of concepts. This assessment determined if project concepts were feasible, beneficial, attainable, and compatible.

#	Type	Concept Name	Description	Feasible	Beneficial	Attainable	Compatible	Notes
1a	Ecosystem / Habitat Restoration	Upper Mokelumne Anadromous Fish Restoration Sponsor: Foothill Conservancy	Transport anadromous fish above Camanche and Pardee to expand their habitat, improve their resiliency in the face of climate change and enhance upper ecosystems and recreational opportunities.	Yes	Yes	Yes	Yes	
1b	Ecosystem / Habitat Restoration	High Country Meadow Restoration Program Sponsor: Foothill Conservancy	Develop a three-phased program to restore high-elevation meadows to approximate natural function to provide water supply, storage, and ecosystem enhancement benefits. The initial phase of the program would involve mapping, identifying, and assessing potential meadows for restoration. The second phase would include setting goals and opportunities for both the program and for each of the identified meadows. The third and final phase would involve developing an implementation plan and budget for restoring the identified meadows. This implementation plan and budget could then be used to secure funding for implementation of the restorations.	Yes	Yes	Yes	Yes	
1c	Ecosystem / Habitat Restoration	Mokelumne River Day Use Area Floodplain Habitat Restoration Project Sponsor: SJCRCD	This project is intended to restore a portion of the seasonal floodplain habitat located along the stretch of the Mokelumne River downstream of East Bay Municipal Utility District's (EBMUD or the District) Camanche Reservoir by working with willing participants consistent with the Lower Mokelumne River Watershed Stewardship Plan. Floodplain habitat has been lost as a result of mining and modification of geomorphic processes that has taken place since the advent of the gold rush days in the 1800s. Floodplain creation serves to enhance the habitat for juvenile salmonids and other native fish species within the lower Mokelumne. EBMUD owns land immediately downstream of the Camanche Dam that it uses to support the District's water supply operations (EBMUD's Mokelumne River Day Use Area (MRDUA)). Those lands include properties that have deteriorated riparian and aquatic habitat associated with the above-noted historic human modifications. There is an opportunity for the construction of restoration projects on those properties that when implemented	Yes	Yes	Yes	Yes	

#	Type	Concept Name	Description	Feasible	Beneficial	Attainable	Compatible	Notes
			would improve existing fisheries habitat and provide a degree of flood management.					
1d	Ecosystem / Habitat Restoration	Fish Screens for Riparian Diversions in the Lower Mokelumne Sponsor: *none*	Develop and implement a program to identify and prioritize riparian diversions on the Lower Mokelumne for fish screens. Working with willing landowners, the program would then secure and install fish screens on these riparian diversions to reduce entrainment of fish. Currently, the four largest pumps/diversions are screened, but according to a late 1990's assessment, approximately 60 remain unscreened. Additionally, the California Fish Passage Assessment Database by CalFish identifies over 400 diversions on the main stem of the Mokelumne.	Yes	Yes	Yes	Yes	
1e	Ecosystem / Habitat Restoration	Riparian Restoration Program – Upstream of Pardee Sponsor: Foothill Conservancy	Develop and implement a program that analyzes and addresses riparian restoration needs by identifying potential areas for restoration, identifying partnership opportunities with willing landowners, and developing a funding base for restoration projects that provide benefits to water users. May include removing invasive species and maximizing the habitat value of farm edges.	Yes	Yes	Yes	Yes	
1f	Ecosystem / Habitat Restoration	Riparian Restoration Program – Below Camanche Sponsor: SJCRCD Co-Sponsor: Foothill Conservancy	Support the implementation efforts of the Lower Mokelumne Watershed Stewardship Plan, which analyzes and addresses riparian restoration needs. May include developing a funding base for projects identified in the Plan.	Yes	Yes	Yes	Yes	
2a	Recycled Water	Municipal Recycled Wastewater Recharge Program Sponsor: City of Lodi	Use treated, disinfected wastewater to recharge, either direct or in-lieu, Valley groundwater aquifers. The project should be further fleshed out after the Water Availability Analysis findings are released, which would help identify what municipal recycled water supplies are suitable for recharge, potential downstream impacts of diverting wastewater, and nearby areas potentially feasible for recharge. Uses including consumptive use and seawater intrusion barriers will be considered.	Yes	Yes	Yes	Yes	Challenges may include perception issues and downstream impacts relating to water rights.

#	Type	Concept Name	Description	Feasible	Beneficial	Attainable	Compatible	Notes
2b	Recycled Water	Constellation Winery Wastewater Reuse Sponsor: *Constellation Winery?* Co-Sponsor: GBA, NSJWCD	Use treated wastewater from the Constellation Winery facility for agricultural irrigation in lieu of groundwater pumping; provide in-lieu groundwater recharge/banking.	Yes	Yes	Yes	Yes	
2c	Recycled Water	Amador County Regional Reuse Sponsor: AWA	Implement aspects of the Amador County Regional Approach for Reuse Study.	Yes	Yes	Yes	Yes	Institutional challenges may be a fatal flaw, but if costs were lower/ offset, some institutional issues would be removed.
2d	Recycled Water	Mokelumne Hill Sanitary District Reclaimed Wastewater Sponsor: CPUD	Reclaim treated wastewater to offset use of Mokelumne surface water. Uses of this water may include ranching or other spray applications.	Yes	Yes	Yes	Yes	What is the amount of this water?
3a	Desalination	Solar-Powered Desalination Sponsor: *none*	Develop a solar-powered desalination project, which may include identifying partners for a cost-sharing program. This desalination facility would clean brackish water from the Delta using solar troughs. The solar panels would create enough heat to separate the salt and water through evaporation. The remaining salt solidifies and can be removed and used in other industries as building materials, metals, or fertilizers. Some systems have a 93% recovery rate and use about 1/5 of the energy used by traditional desalination plants. Cost per acre-foot is cited around $450, but may be greater depending on the location and scale of implementation.	Yes	Yes	Yes	Yes	Where would it be located and how large would it be? A brackish water source is needed; Water Availability Analysis will inform this May not be compatible with the Delta Plan; may be infeasible in the primary zone of Delta
4a	Groundwater Management	Groundwater Banking within the Eastern San Joaquin Groundwater Basin Sponsor: GBA, CCWD	Identify opportunities for direct and in-lieu banking with a variety of sources including Mokelumne River, stormwater, agricultural runoff, etc. Could include gravity infiltration and groundwater injection. Also consider land currently used for farming, with voluntary participation and fair compensation for owners. Geographic scope includes the Eastern San Joaquin Groundwater Basin, including portions of Calaveras County.	Yes	Yes	Yes	Yes	

#	Type	Concept Name	Description	Feasible	Beneficial	Attainable	Compatible	Notes
4b	Groundwater Management	Amador and Calaveras County Hydrologic Assessment Sponsor: AWA, CCWD Co-Sponsor: JVID	Assess potential for groundwater banking in Amador and Calaveras counties. This could include assessing structure of fractured rock aquifers and age of water, in addition to mapping of sandy soils as a means to inform potential project areas.	Yes	Yes	Yes	Yes	
4c	Groundwater Management	San Joaquin County Groundwater Banking and Exchange Sponsor: GBA, EBMUD	This project is seen as a regional effort whereby one or more partner agencies would obtain a new water right and/or modify an existing water right to enable surface water to be diverted from the Mokelumne River and banked in the Eastern San Joaquin Groundwater Basin for later use by one or more of the partners (and further to improve overdrafted groundwater conditions in the Eastern San Joaquin Groundwater Basin). This project would build upon the recent Demonstration Project efforts between EBMUD and the GBA. Under one scenario, a portion of the Mokelumne River supply would be conveyed through existing and/or new facilities for storage and regional use in the Basin. Various in-lieu and direct recharge projects could be used to recharge water in wet years for extraction in dry years. Recharge could be via recharge basins or direct injection. While the first stage of a project would rely primarily on EBMUD's facilities for conveyance, some new facilities required such as an Intertie with EBMUD's Mokelumne Aqueduct, a new pipeline and pump station that directs water from the aqueducts to the recharge site, and any required facilities to provide treatment as needed prior to injection and or following extraction. Water stored in the Basin would be extracted for use via wells installed within project areas. The quantity extracted could be divided by the partner agencies (upcountry agencies would receive their share via an in-lieu exchange with EBMUD). Groundwater would be sent to the EBMUD service area via connection(s) to EBMUD's Mokelumne Aqueducts. A portion of the quantity stored would remain in the ground to meet SJC's share requirements.	Yes	Yes	Yes	Yes	May be challenging to obtain water rights.

#	Type	Concept Name	Description	Feasible	Beneficial	Attainable	Compatible	Notes
4d	Groundwater Management	NSJWCD Infrastructure Improvements Sponsor: NSJWCD	Improve the infrastructure for reliable surface water delivery to the North San Joaquin Water Conservation District so the District can utilize existing water rights and its agricultural customers can reduce reliance on groundwater sources. The largest of these projects includes rebuilding the southern pump station and southern distribution system, and rebuilding the northern distribution system.	Yes	Yes	Yes	Yes	Groundwater management should be demonstrated
5a	Water Conservation	Regional Urban Water Conservation Program Sponsor: UMRWA, GBA, City of Lodi	Reduce demand through implementation of efficient urban water use practices. This program includes submitting a regional conservation plan for funding. The funding received would then be distributed among agencies to fund their individual plans. Plan elements may include initiating a pilot program with funding available to encourage residents to replace existing water reliant landscaping and utilize landscaping BMP's to reduce runoff and improve water quality; increasing irrigation efficiency; metering and billing based on water use; leak detection; rainwater capture; stormwater capture; education and outreach regarding lawn and landscape watering needs.	Yes	Yes	Yes	Yes	
5b	Water Conservation	Amador Canal Conversion to Pipeline Sponsor: AWA	Placement of a pipeline in or along the 18 mile Amador Canal to conserve an estimated 1,500 AF of water annually.	Yes	Yes	Yes	Yes	
5c	Water Conservation	Regional Agriculture Conservation Program Sponsor: SJCRCD	Increase irrigation efficiency; A program which would work with growers and agencies to test and evaluate agricultural management practices for irrigation water management efficiency.	Yes	Yes	Yes	Yes	Mobile Efficiency Labs have been implemented in the lower watershed with DWR; additional programs will be implemented. It may be difficult to quantify expected savings.

#	Type	Concept Name	Description	Feasible	Beneficial	Attainable	Compatible	Notes
6a	Stormwater Management and Flood Control	Cosgrove Creek Flood Management Project Sponsor: *none*	Solve flood control issues at Cosgrove Creek to allow flood waters to naturally recharge the aquifer. Project could potentially include recreational components and involve utilizing a 50-acre lot owned by CCWD for recharge purposes.	Yes	Yes	Yes	Yes	
6b	Stormwater Management and Flood Control	Mokelumne Stormwater Capture and Reuse Sponsor: Calaveras County	Analyze stormwater runoff within the Mokelumne Hill area, including the ditches that ultimately flow into the Mokelumne River.	Yes	Yes	Yes	Yes	Could be downstream impacts that need to be considered.
6c	Stormwater Management and Flood Control	Mokelumne Floodplain Management Plan - Camanche to Below Woodbridge Dam Sponsor: SJCRCD	In coordination with the Lower Mokelumne Watershed Stewardship Plan, work with willing landowners to create set back levees, re-configure side channels, and/or increase riparian buffer areas in the Mokelumne River from Camanche to Woodbridge Dam to maximize available habitat for salmonids and (in some cases) restore some floodplain function and promote groundwater storage.	Yes	Yes	Yes	Yes	Challenge may be not in constructing the new levees, but in taking down existing levees, thereby taking on liability for downstream flood damages.
7a	Surface Storage	PG&E Storage Recovery Sponsor: AWA, *CCWD?*	Evaluate the feasibility of removing silt and sediment from behind PG&E dams.	Yes	Yes	Yes	Yes	
7b	Surface Storage	Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering Sponsor: AWA, JVID	Evaluate the feasibility of enlarging Lower Bear Reservoir by raising the existing dam (embankment) by 32 feet to increase surface water storage capacity within the upper Mokelumne River watershed. This feasibility study would be a continuation of previous studies and serve to address previously unanswered questions and unresolved issues. Previous studies performed on behalf of Amador Water Agency suggest that Lower Bear Reservoir would provide 18,300 Acre Feet of additional Yield (Willard, 2005). In addition to modifications to the dam itself, other facilities that would need to be constructed include an updated intake structure and spillway. Also note that the project would require the relocation of adjacent roads and existing recreation facilities. An operational scheme for an enlarged reservoir would need to be prepared to determine how much yield could be realized for the partners that elect to take part in the project.	Yes	Yes	Yes	Yes	

#	Type	Concept Name	Description	Feasible	Beneficial	Attainable	Compatible	Notes
7c	Surface Storage	Surface Storage Regional Assessment Sponsor: UMRWA	Conduct a regional assessment to evaluate the feasibility of the constructing additional surface storage in Amador and Calaveras Counties. The study would include discussions on location, technical feasibility, political feasibility, environmental feasibility, and legal feasibility.	Yes	Yes	Yes	Yes	
7d	Surface Storage	Re-operation of Existing Storage Sponsor: UMRWA	Feasibility study to assess capability to re-operate existing storage to store water for consumptive use in addition to hydropower. The study would include a discussion on legal, environmental, political, and technical feasibility, as well as address the issue of flood control capabilities.	Yes	Yes	Yes	Yes	
8a	Local Infrastructure	Jeff Davis Water Treatment Plant Replacement Sponsor: CPUD	Evaluate the feasibility of replacing the existing Jeff Davis Water Treatment Plant (WTP), a sand filter water treatment plant, with a state of the art membrane filtration plant. The Jeff Davis WTP was designed in 1970 and is oversized for the current and projected District demands. The project would reduce backwash water requirements which would reduce Mokelumne water needs.	Yes	Yes	Yes	Yes	
8b	Local Infrastructure	Rehab of Transmission Main Sponsor: CPUD	Conduct a study to determine the benefits of replacing all or a portion of the transmission main that conveys treated water from the Jeff Davis WTP to Mokelumne Hill, Paloma, and San Andreas. The study would include assessment of areas that are reaching life expectancy, areas of water loss, and recommendations for rehabilitation. Upon completion of the study, replace or line the recommended areas of the current transmission main. The transmission main was installed in the 1970's and has had one large repair since that time. Replacing or lining the transmission main will increase the life expectancy, and likely improve efficiencies and reduce water loss.	Yes	Yes	Yes	Yes	
8c	Local Infrastructure	Barney Way Septic System Conversion Sponsor: CCWD	Hook existing residences along Barney Way either into the public sewer system or implement a community septic vault system to improve water quality of the Mokelumne River. This project would evaluate both options to	Yes	Yes	Yes	Yes	

#	Type	Concept Name	Description	Feasible	Beneficial	Attainable	Compatible	Notes
			determine and implement the most cost-effective conversion. Barney Way sits alongside the northern side of the Middle Fork of the Mokelumne off of Highway 26, downstream of Schaads Dam.					
8d	Local Infrastructure	Lake Camanche Village Recycled Water Project Sponsor: AWA	A feasibility study for converting from existing wastewater treatment ponds to a recycled water plant in the Camanche Village area to allow for recycled water to be used locally.	Yes	Yes	Yes	Yes	
9a	Policies and Initiatives	Land Use Coordination Sponsor: Calaveras Planning Coalition, MyValleySprings.com	Develop a program to improve coordination between willing water agencies and land use agencies.	Yes	Yes	Yes	Yes	
9b	Policies and Initiatives	State Wild and Scenic River Designation Sponsor: *none*	Develop language for and draft a position statement that would encourage the designation of the reach between Salt Springs Dam and Pardee Reservoir under the State Wild and Scenic Rivers system. Each MCG member organization would sign, approve, or otherwise show support for this position statement.	Pending	Pending	Pending	Pending	Depending on the outcome of the Wild and Scenic legislation currently being considered, the MCG will revisit this.
9c	Policies and Initiatives	Sustainable Forest - Watershed Management Project Sponsor: *none*	Draft a resolution for MokeWISE members in support of scientifically proven forest practices that protect the Mokelumne Watershed by 1) thinning to reduce the risk and impacts of wildfires, 2) reducing erosion and sediment yield into stream courses, and 3) improving water management	Yes	Yes	Yes	Yes	
9d	Policies and Initiatives	Watershed Coordinator Sponsor: SJCRCD	Support funding efforts for the establishment of local Watershed Coordinator positions.	Yes	Yes	Yes	Yes	

#	Type	Concept Name	Description	Feasible	Beneficial	Attainable	Compatible	Notes
9e	Policies and Initiatives	Groundwater Management Tools Sponsor: GBA	Identify additional options for the Eastern San Joaquin Groundwater Basin Authority to more effectively manage groundwater levels.	Yes	Yes	Yes	Yes	
9f	Policies and Initiatives	Mixed-Use Project Concept for Calaveras County Mokelumne Reservation Sponsor: *CCWD?*	Evaluate the legal feasibility of and options for allowing CCWD/CPUD to assign all or a portion of Calaveras County's area of origin reservation on the Mokelumne. In addition to consumptive uses, evaluate other potential beneficial uses of the water, including fish, wildlife, and recreation. This may also include evaluating the feasibility of both new and previously proposed projects.	Yes	Yes	Yes	Yes	
9g	Policies and Initiatives	MokeWISE Public Interest Profile Enhancement Project (PIPE) Sponsor: *none*	Support an informal, non-regulatory process among stakeholders that will help regional entities be better prepared to seek appropriations approval from the State Water Board. These processes may include developing a list of public interest criteria which can be used to evaluate proposed water uses.	Yes	Yes	Yes	Yes	

Appendix L: Environmental Assessment of Concepts

Appendix L provides the MCG-approved environmental assessment of project concepts. Concepts were assessed based on their potential feasibility, geomorphic benefit, and fisheries benefit.

MokeWISE Draft Concept Assessment Information

Version: 9 January 2015

#	Concept Name	Feasibility (scale 1-5, 1 less, 5 more) Benefit score explanation	Geomorphic benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Fisheries benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Environmental considerations	General Comments	Potential Direction for Concept Development including Additional Benefits
1a	Upper Mokelumne Anadromous Fish Restoration	4 Logistics in transporting salmonids into and out of upper watershed would carry costs. How much suitable habitat remains upstream? How much of the upper watershed has compromised habitat from hydroelectric operations? There is a high degree of interest in implementing this type of program, though none that have yet come to fruition.	5 If increased resiliency becomes a real outcome, it would be of immense benefit to stressed salmonid populations in central, interior CA. Additionally, presence of anadromous fish would result in many measures which would enhance habitat in the upper watershed. For instance, successful implementation could create positive biogeomorphic benefits through substrate rejuvenation during spawning, and in providing a reintroduction of marine nutrients into the upper watershed ecosystem when spawners die.	2 Relocating adult anadromous salmonids from the lower Mokelumne River to the upper Mokelumne River offers the opportunity to bring marine nutrients into the upper watershed and, if accomplished using steelhead, would provide advantages of increasing genetic diversity of the resident rainbow trout population in the upper watershed. Relocating adult fall-run Chinook salmon to the upper watershed, however, is not expected to produce substantial benefits in terms of increasing fall-run Chinook salmon population abundance in the absence of an effective method for trap and haul to return juvenile salmon to the lower river where they can complete their migration to coastal marine waters. Passage of juvenile Chinook salmon from the upper watershed downstream volitionally is not expected to be feasible as a result of both existing passage barriers to downstream migration as well as predation mortality occurring within the reservoirs.	Hydropower peaking flows could be disruptive to habitat requirements in the upper watershed.	Positive effects to fish populations would be anticipated to be larger than biogeomorphic effects. Studies would need to be in place to assess outcomes and to ensure that goals are met. // The concept of relocating adult salmonids to the upper parts of the watershed has merit and is a restoration activity compatible with both salmonid recovery actions, as well as establishing diversified life history strategies within the watershed. Technical issues with regard to migration feasibility, particularly for juveniles that would be migrating downstream through the watershed, would need to be addressed.	Develop implementation plan including all logistics, benefits and costs. Develop monitoring plan to track project trajectory following implementation. Identify which reaches might warrant managing for temperature, if any. // Including downstream collection facilities and transport for juvenile salmonids produced in the upper watershed (e.g., trap and haul) would substantially enhance fishery benefits but has proven to be difficult, in many cases has low trap efficiency (e.g., rotary screw traps), and has relatively high cost and ongoing annual labor needs. Variable flows and high debris loading have posed problems for downstream migrant traps. A more detailed plan of the trap and haul program for both upstream adults and downstream juvenile migrants could improve this concept.
1b	High Country Meadow Restoration Program	5 Meadow restoration projects have been successfully implemented in the Mokelumne River watershed as well as other Sierra Nevada watersheds. There appears to be a high degree of institutional interest, knowledge and support for such projects.	5 Meadow restoration would improve geomorphic functions in the upper watershed, which have been shown to result in a cascade of positive effects locally and downstream. Locally, GW retention of flows in a healthy the meadow aquifer may result in continuous flows through a dry summer. A cascade effect may occur downstream, which could include an increase in baseflows leading to better water quality and geomorphic functionality, which may improve fish habitat and riparian corridor health.	4 Protecting existing high elevation meadows, in combination with implementing the meadow restoration program, provides environmental benefit through the protection and preservation of sensitive habitat as well as promoting habitat diversity within the watershed. High elevation meadows serve a variety of environmental functions that can be easily lost if adequate protections and restoration mechanisms are not implemented.	Restoration of meadow functions would likely increase groundwater supplies and baseflows at least in the upper watershed via greater infiltration rates as waters slow from draining hillslopes to crossing meadows prior to entering streams. Peak flow and sediment transport rates should decrease during episodic flood events. Meadow morphology may be returned to approximate natural capabilities, which should allow provide increased levels of geomorphic and ecologic processes in restored meadows, including a possible shift from xeric plant species such as sage back to mesic meadow species such as grasses and sedges that have the added benefit of greater bank stability properties.	Rehabilitation actions would likely restore geomorphic functions in the meadow and downstream from it. Such projects have been shown to result in a cascade of positive effects to hydrologic elements within the greater watershed, including downstream flows and groundwater storage. Ecological elements of the meadow community such as vegetation and animal communities would also benefit from restoration. Upper watershed meadows may soon, if not quite yet, be considered a keystone environmental element much as protection and enhance of salmonids and their habitats are now, so perceived positive benefits of meadow restoration would likely be lower than those for salmonids, but may be as important geomorphically and ecologically. // The concept of restoration of diverse natural habitat, such as high elevation meadows, should be strongly supported and encouraged.	Utilize available governmental documents and grants along with existing professional expertise and literature sources to develop the proposed three-phase program. Gather baseline data pre-restoration and conduct post-restoration monitoring to quantify restoration outcomes.

#	Concept Name	Feasibility (scale 1-5, 1 less, 5 more) Benefit score explanation	Geomorphic benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Fisheries benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Environmental considerations	General Comments	Potential Direction for Concept Development including Additional Benefits
1c	Mokelumne River Day Use Area Floodplain Habitat Restoration Project	4 Floodplain connectivity was achieved when slope creation directly downstream of Camanche Dam flooded killed existing riparian trees on left bank of the river (when looking downstream). This and other floodplain restoration projects could provide a template within which to develop a program for the lower Moke.	5 Floodplain restoration would help to restore fundamental geomorphic functions, positively influencing hydrologic and ecologic functions.	4 A number of studies are currently emerging from the Yolo Bypass, Cosumnes River, and many other watersheds that have demonstrated the benefit of seasonally inundated floodplain habitat as juvenile rearing areas for Chinook salmon and steelhead. Floodplain habitat has been shown to be productive and results in increased growth rates of juvenile salmonids that has been identified as a factor increasing the probability of survival during their downstream migration through the Delta and ocean. Floodplain habitat needs to be carefully developed to provide connectivity with the mainstem river, avoid areas of stranding and dewatering as flows recede, and provide cover and substrate to promote both production of prey resources, but also to provide cover habitat to reduce the risk of predation.	The ability of flows greater than the natural "bankfull" (i.e. unimpaired, average 2-yr flow) to spread out across additional floodplain space would increase potential sediment deposition. Flood flow attenuation may decrease flood effects on downstream structures and communities. Reconnection would promote increased channel morphodynamics, as the river and the floodplain adjust to locally refreshed hydraulics.	Floodplain restoration projects are more likely to be implemented on public lands. Because the Mokelumne flows east-west, shading benefits are greater on the south bank than on the north. Different restoration techniques may be needed on the two banks to protect the existing shading values. // There is growing broad support within the scientific community for reconnecting mainstem rivers with seasonally inundated floodplain to benefit juvenile salmonid growth and survival. Floodplain restoration offers a variety of environmental benefits that can be relatively expensive to accomplish and requires a stable and sufficient funding source for implementation.	Perhaps specific individual landowners would be willing to implement additional floodplain restoration programs over and above that achieved on public lands. Any increase in connectivity between the river channel and the floodplain would be beneficial to geomorphic, hydrologic and ecologic functions. A continuous stretch of reconnected floodplain along at both sides of the river corridor would provide the most positive benefit, though any increase would be beneficial. If bankline trees are lost during a project, there could be localized temperature effects, but in the long-term replanting and natural recruitment would provide new shading.
1d	Fish Screens for Riparian Diversions in the Lower Mokelumne	4 From a technical point of view, screening diversions is a matter of installation of the necessary materials.	4 The more fish and supporting food web organisms killed because of diversions, the fewer that can contribute to river bed and bank bioturbation processes such as salmonids revitalizing the channel bed during spawning activities. Diversions alter hydraulic gradients and shear stresses, dependent on a given river discharge and the diversion rate and volume. Any reduction in kill rate would be very beneficial to the river ecosystem.	3 There are a number of riparian diversions that occur from the lower Mokelumne River, primarily for agricultural irrigation, that are currently unscreened. The largest of the diversions, such as that at the Woodbridge Irrigation District dam, have been screened to provide protection for downstream migrating juvenile salmonids. Although installation of positive barrier fish screens is identified as an environmental benefit through reducing the risk of juvenile salmonid entrainment, the incremental benefit of screening only a small percentage of the existing unscreened diversions diminishes the overall effectiveness of screening program. In addition, no information is available on the specific unscreened diversions and their operations that would contribute to the greatest level of entrainment risk and hence it is difficult, given the current state of information, to prioritize among the existing unscreened diversions, and determine which should receive the highest priority. The magnitude of biological benefit varies in response to a number of factors such as the magnitude and seasonal timing of diversion as well as the location of the diversion. Relatively large unscreened diversions located in areas where juvenile salmonid rearing occurs typically pose the greatest risk of entrainment. Funding priorities focused on providing intake screening of the largest diversions (by volume) located in sensitive habitat are expected to offer the greatest biological benefit. Installation of positive barrier fish screens on the lower Mokelumne River should be encouraged and will result in direct benefits to improving juvenile survival. The greater the volume of unscreened diversions that can be equipped with intake screens the greater the potential biological benefit.	It is unknown how many aquatic organisms are directly and negatively affected by the stresses of diversions, but diversions contribute to an overall decrease in abundance and diversity of organisms in the river ecosystem, first simply due to decreased volume of water in the river, and also due to deaths directly related to the diversion intake. A decrease in diversions would allow flows to perform more geomorphic work. An increase in diversion screens would decrease the number of organisms killed during the diversion process. Providing positive barrier intake screens on currently unscreened water diversions will contribute directly to a reduction in entrainment risk and mortality. The concept plan would be improved by providing additional detailed information on the locations, size, volume of diversion, availability of funding for intake screen installation, location relative to sensitive habitat such as juvenile rearing areas, and willingness of local landowners to participate in a screening program will be beneficial in better describing the potential biological benefits, educating local landowners regarding the benefits of screening, and for use as a technical basis for developing grant applications and securing funding.	It would be useful to determine accurate values for numbers of diversions and of those, how many are not screened. Either way, it appears to be many in number. // In general reducing sources of direct mortality, such as entrainment into unscreened diversions, provides a positive incremental benefit to increasing survival and abundance of juvenile salmonids produced in the lower Mokelumne River. The relatively large number of diversions within the lower Mokelumne River and Delta, however, make the incremental contribution of installing positive barrier fish screens on each individual diversion relatively low.	Develop a plan to quantify diversion fish fills, prioritize diversions to be screened, calculate costs associated with screening. A potential key to successful screening compliance may be in developing a compelling, consistent message that resonates with water rights owners along with making the cost of compliance via grant funding or other monies attractive/tractable, or perhaps in developing regulations or legislation that would mandate compliance. // The program would benefit from developing a plan or vision of how intake screening would be accomplished, the schedule for screening, the anticipated cost and availability of grant and other funds, identification of highest priority diversions from the river based on their size and locations, seasonal diversion patterns relative to the occurrence of sensitive fish species in the area, and proximity of the diversion to sensitive fish habitat such as juvenile salmonid rearing areas. Survival studies have been done that show relatively low survival in the Mokelumne River for juvenile Chinook salmon. Qualitative analyses of the potential contribution to juvenile survival as a result of various levels of fish screening would be helpful to provide a basis for assessing "costs and benefits" for funding proposals. Development and installation of even a small number of intake screens on a pilot scale would be beneficial to demonstrating the operational reliability and benefits to gain local landowner support for expanding the program in the future.

#	Concept Name	Feasibility (scale 1-5, 1 less, 5 more) Benefit score explanation	Geomorphic benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Fisheries benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Environmental considerations	General Comments	Potential Direction for Concept Development including Additional Benefits
1e	Riparian Restoration Program – Upstream of Pardee	5 Meadow and riparian resportation projects have been accomplished in the Mokelumne River watershed and elswhere and are demonstrated to be feasible. Challenges such as establishing and maintaining a reliable water supply for irrigation during the re-establishment phase of restoration has been a challenge for some projects. A key element to restoration success is to identify reaches where riparian restoration can be accomplished. Develop criteria in which short term goals and long term goals are equally weighted. Riparian corridor restoration that contains fully mature trees may take up to 3-4 decades. Most upstream riparian corridor lands are publically -or agency-owned, so feasibility of project implementation is likely very high. The feasiblity score is dependent on the specific locations and attributes of individual restoration sites but there is great potential benefit to the integrity of the watershed and its functions.	5 In upper watersheds, undisturbed riparian corridors provide the natural interface between the channel environment and local hillslopes, meadows and floodways. Removal of invasive plant species and an increase in native species should improve riparian/forest health and strengthen its connectivity to the river. An increase in the amount of wood available to fall into the channel (i.e. streamwood) would improve habitat diversity through structural additions to flow fields, refugia during high flows and from predation, and provide additional nutrients to aquatic organisms. Should help improve water quality, and may attenuate flood flows.	3 Protecting and improving riparian vegetation is an important watershed management activity that contributes directly towards increased habitat diversity, habitat complexity, and habitat function not only for terrestrial species, but also for those aquatic species inhabiting the Mokelumne River. Insect production from riparian areas provides a valuable foraging resource for juvenile salmonid and other fish species inhabiting the river. Much of the upper Mokelumne River watershed is under the ownership of organizations such as BLM, PG&E and the U.S. Forest Service which is expected to help facilitate planning and implementation of successful protection of existing resources and restoration of degraded resources with substantial areas of riparian vegetation that would provide significant benefit to the ecosystem. A number of small restoration projects that are fragmented within the watershed provide less environmental benefit than providing greater contiguous areas that have connectivity among riparian corridors. The benefit score for fishery habitat reflects the high potential benefits to the watershed and ecosystem. There is some uncertainty in the planning, scope and magnitude of the restoration effort, and in some projects the lack of a reliable long-term water supply for irrigation during the re-establishment process has diminished restoration success and benefits.	Riparian restoration takes time, particularly for trees to mature and become large enough to function as structural components when they enter the river network. Hydropower peaking flows could be disruptive to riparian restoration.	It is important to allow streamwood and other organic materials to remain undisturbed in the river in the patterns in which they fall or come to rest, if at all possible. Streamwood breaks down stochastically via decay and disintegration. This process is meant to contribute to carbon storage and carbon transport from upper watershed to the ocean in a range from entire trees to dissolved organic carbon. // Protecting and restoring riparian habitat within the Mokelumne River watershed is an important element in developing a more comprehensive and integrated watershed management program. The program should receive broad support from the scientific community, various agencies, and landowners as it proceeds forward.	Develop a framework and public outreach program in which streamwood is shown to be a necessary, vital component to river health. One project goal could be to educate the public that removal/cutting of streamwood when found in the river, even if it is blocking passage, is not of ecological/geomorphic benefit. Another project could be to pass through or transport streamwood around existing dams so that the structural and carbon contributions of streamwood are not lost to the downstream reaches.
1f	Riparian Restoration Program – Below Camanche	3 Identify reaches where riparian restoration can be accomplished. Develop criteria in which short term goals and long term goals are equally weighted. Riparian corridor restoration that contains fully mature trees may take up to 3-4 decades. Most downstream riparian corridor lands are privately-owned, so feasibility of project implementation is probably not as high as for concept 1e.	5 In lowland environs, riparian corridors connect river corridors and floodplains. In many cases, floodplains develop natural levees that serve to capture high flows that then spread out on the adjacent floodplain, thus providing a natural sink for particulate organics and minerals along with a percolation basin into which still waters can recharge the local aquifer while contributing to flood attenuation downstream.	3 The implementation of efforts identified in the Mokelumne River stewardship plan are valuable to provide an opportunity for coordination, communication, integrated management planning, in securing additional funding for implementation of various restoration and enhancement projects. The environmental benefits are difficult to assess at this time since the magnitude of benefit is linked to the types of projects that would be implemented, the magnitude and duration that those projects would provide benefit, and the level of funding for restoration and long-term maintenance are largely unknown.	Riparian restoration takes time, particularly for trees to mature and become large enough to function as structural components when they enter the river network.	Same comments as 1e, with an additional comment that lowland river corridors are more heavily populated than in the upper watershed. More people generally means more river interaction, and in some cases may result in more manipulation (i.e. cutting or removal) of streamwood perceived as dangerous or to be clogging the river. It's important to work to change perceptions so that residents, visitors and stakeholders understand that streamwood is "good" in rivers. // Support for the stewardship program should be broad-based within the watershed and should be used as the political and scientific foundation for identifying specific high priority projects for implementation in combination with specific estimates of the schedule for implementation and the corresponding budget. A 5 to 10 year description of the vision of the stewardship program implementation would be helpful to convey the long-term vision for the watershed.	Develop a framework and public outreach program in which streamwood is shown to be a necessary, vital component to river health. One project goal could be to educate the public that removal/cutting of streamwood when found in the river, even if it is blocking passage, is not of ecological/geomorphic benefit. Further, riparian corridors are vital components of a healthy river corridor, serving many important functions. Linking riparian corridors and adjacent floodplains provides the best possible use of near-channel space by recreating natural conditions.

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1g	Mokelumne Water Quality, Soil Erosion & Sedimentation Restoration	4 Technically feasible to inventory upper watershed roads, trails, and other areas that have been disturbed by human development and that are visibly eroded and gullied. Project may take 3-5 years to coordinate between land owners. USFS, BLM and PG&E are likely to support project goals. Similar projects have been successfully implemented in other California watersheds.	3 Water quality would improve with a decrease in artificially increased sediment supply from roads, trails, and other development. Project would likely decrease the need for mechanical removal of sediment from reservoirs (i.e. Tiger Creek Afterbay sedimentation).	3 Management of soil erosion and sediment deposition within aquatic habitats is an important element in defining the quality and suitability of aquatic habitat, particularly for salmonid spawning and juvenile rearing, but also for other aquatic resources, including macroinvertebrate and insect production within various parts of the watershed. Soil erosion as a result of road crossings, local land use, fire, and other factors has been identified as an important factor affecting habitat quality and suitability within a watershed. Development of a strategic management and restoration program to address soil erosion issues within the watershed provides a variety of environmental benefits. A key element in assessing the magnitude of potential environmental benefit of such a program, however, is dependent upon the location and the magnitude of restoration, the degree of suspended sediment and deposited sediment reduction, and the ability for long-term maintenance are key elements underscoring the magnitude of benefits such a program would have to Mokelumne River watershed aquatic resources.	A decrease in sedimentation and turbidity would increase water quality and potentially improve substrate habitat for spawning fish and invertebrates that utilize interstitial spaces in the channel bed, as well as improve spring and summer fish growth rates. Reduce fine-grained sedimentation reduces redd (fish nest) scour, with the associated loss of incubating eggs.	Large influxes of sediment from roads and trails are known to have an adverse effect on the river channel ecosystems. On the other hand, steady influxes of sediment during typical flows and runoff events should be expected. Large influxes of sediment following fire, or during episodically large runoff and flood events should also be expected. Furthermore, sedimentation build-up in reservoirs should not be unexpected given these natural processes. These examples bring home the point that it is important to identify the baseline sedimentation rates along with where increased sedimentation rates are originating from. // Sediment deposition and soil erosion has been identified as a significant factor affecting habitat conditions for salmonids and other aquatic resources throughout the Central Valley. A number of innovative programs are being developed in other watersheds, such as the Napa River watershed, that can serve, in part, as case studies and models for the development of a strategic plan for sediment erosion control, public landowner outreach and education, identification of funding mechanisms, and identification of the environmental benefits that would be derived from such a program. ~~It is encouraged that~~ Other similar programs ~~that~~ have been developed and are being implemented in other watersheds in California and can ~~elsewhere~~ be reviewed and considered when developing a similar program for the Mokelumne River system.	Use of similar watershed improvement projects and the knowledge and data developed from those studies to help in the planning and design of this project. Develop a public outreach program to achieve landowner support as needed.

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2a	Municipal Recycled Wastewater Recharge Program	3 Description focuses mainly on GW recharge, while spreadsheet focuses more on recycled water used for irrigation. Both concepts are valid and complementary.	3 The less water diverted from the river channel, the better for the geomorphic and ecological health of the ecosystem.	2 The use of treated water supplies for groundwater storage augmentation has a number of benefits associated with increasing water storage, water supply reliability, drought water contingency, and other water demand related benefits. The benefits of groundwater storage for enhancing fishery conditions, however, are considered to be relatively low given the cost of groundwater storage and the relatively small amount of water that could be used beneficially for enhancing instream flows.	Programs where reclaimed water is used to recharge aquifers exist, so frameworks and guidelines are likely readily available.	Water rights issues could "muddy" this effort. Improvements in irrigation practices, fallowing fields, or replacing water intensive crops with drought tolerate crops could create a potentially large source of water that was perhaps once needed but after changes could be used to recharge local aquifers or remain as fresh water in the channel (major benefit to the river ecosystem). California regulations for groundwater replenishment via either surface or subsurface using recycled water went into effect on June 18, 2014: http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Lawbook.shtml A potential key component of measuring successful project implementation would be that conserved water does not become supply for new demand. // There is limited experience on how groundwater storage opportunities could be used to enhance fishery habitat, however, opportunities for conjunctive benefit either directly or indirectly through groundwater storage should be explored and identified. In several systems, the use of riparian wells has been identified as a method for seasonally increasing critically low instream flows or reducing water temperatures to benefit Chinook salmon, steelhead, and other aquatic species. Benefits and these types of conjunctive operations should be further explored.	Develop framework to identify treatment plants ready and able to begin program versus those that will need upgrades. Identify GW aquifers in greatest need of recharge. Prioritize where initial implementation might be most feasible and expand program as funding and opportunities present themselves. // Additional benefits of wastewater recharge programs in reducing demands on surface water supplies may also provide instream flow benefits but they are difficult to quantify given the level of information available at this time. Reducing demand on surface water supplies offers biological benefits to Mokelumne River fishery resources. The magnitude of benefits depends, in large part, on the magnitude, seasonal timing, and water year types when surface water demands can be reduced and instream flows increased and made more reliable.
2b	Constellation Winery Wastewater Reuse	3 If private interest is high and funds are available, then project could be moved to a higher feasibility score. A simplified permit process may be helpful here, as the efforts appear to be voluntary (though not explicitly stated).	3 The less water diverted from the river channel, the better for the geomorphic and ecological health of the ecosystem.	1 There appears to be very little potential benefit to fishery habitat or resources that would be gained by the use of treated wastewater for agricultural irrigation in lieu of groundwater pumping. There may be opportunities where a reduction in groundwater demand could provide direct and/or indirect benefits to increased instream flows and enhance fishery habitat, however, those opportunities have not been identified in the concept proposal.	Monitoring requirements per CA groundwater replenishment or other pertinent regulations should be followed to provide for useful assessment of effects to GW quality and water table levels.	Individuals who voluntarily chose to participate in important changes to water use are to be highly commended. On September 30, 2014, Assembly Bill 2193 was signed into law by Governor Brown, which aims to streamline permitting processes for voluntary restoration projects. Other ways to reduce water needs may be achieved through improvements in irrigation methods and potentially development of grape strains that can tolerate less water yet produce quality grapes. A potential key component of measuring successful project implementation would be that conserved water does not become supply for new demand. // Although there is general support for the use of treated wastewater as an agricultural irrigation source that would serve beneficially to reduce demands on local groundwater storage for municipal and other water supplies, the linkage to enhancing fishery habitat through conjunctive operations has not been developed for the proposed project.	Establish a pre- and post-implementation monitoring plan that would help in the development of a region- and winery-specific framework that could be adopted by others.

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2c	Amador County Regional Reuse	4 Study proposes three alternatives and provides costs involved with implementation to use tertiary treated wastewater for city irrigation purposes initially, in Sutter Creek and Jackson, CA, Amador County. Agricultural uses may follow. Recycled water facilities would have to be funded and constructed in order to implement any of the alternatives. Technical feasibility should be high, particularly if funding is available.	3 The less water diverted from the river channel, the better for the geomorphic and ecological health of the ecosystem. The less groundwater pumped from aquifers, the better the GW water quality. Concept spreadsheet lists 400 AF/yr of recycled water use, providing conserved surface (diverted from Jackson Creek) or groundwater supplies as available for potable water uses. It is unclear whether diversions would actually decrease.	2 As described above for to be the potential benefits of water reuse programs for purposes of improving or augmenting instream flows or fishery habitat are largely unknown. Opportunities exist for conjunctive operations that would have the potential to benefit fishery habitat, however, those opportunities have not been explicitly identified or characterized.	Monitoring requirements per CA groundwater replenishment or other pertinent regulations should be followed to provide for proper assessment and follow-up that water quality standards are continually met.	It is unlikely if any water rights holders could achieve a profound reduction in volumetric water take from the system, as continuing development creates new needs even as efficiencies increase. On the other hand, a potential key component of measuring successful project implementation could be that conserved water does not become supply for new demand.	Concept development has been completed, and a refinement study presumably underway. Adoption of tertiary water for municipal and potentially even irrigation uses will likely become "second nature" in the years to come. Being near the forefront of these types of water conservation strategies reflects high degrees of civic responsibility.
3a	Solar-Powered Desalination	3 Adoption of new solar-powered desalinization technologies such as Water FX (still in pilot phases as of Fall, 2014) have a higher likelihood of failure, so while initial results are promising, feasibility is not assured at this early date. Capital costs appear to be relatively reasonable. Successful technological implementation has not yet been fully proven, so feasibility is deemed low. Nevertheless, if successful this concept could prove very valuable.	2 New technology is focused on using brackish GW supplies, so fresh water flows in the Mokelumne River might benefit incrementally, if at all.	2 Although desalinization provides the opportunity for increased water supplies for municipal and industrial application, desalinization is not a cost-effective method for increasing instream flows for fishery habitat enhancement. There are potential indirect opportunities where conjunctive operations with a desalinization facility could reduce demands on surface water supplies that could then subsequently be used for fishery habitat purposes. The magnitude and feasibility of such conjunctive use programs and their cost-effectiveness has not yet been presented.	Solar-powered desalinization plants would need to be carefully constructed and placed to prevent destruction of natural land use, and to minimize harm to wildlife.	Desalinization projects are forward looking; care must be given to planning and studies so that the benefits of additional fresh water supplies are not outweighed by unforeseen costs, such as distribution and disposal of salts or endangerment to land or wildlife. // In general, the application of desalinization appears to have positive water supply benefits, although at a potentially higher cost than many other sources. Desalinization to the extent that it is cost effective and feasible for a specific project application offers increased water supply reliability, particularly in critically low flow years, that would benefit municipal demand bur may have very little, if any, fishery benefit.	Adoption of solar-powered desalination would be very cutting-edge and if successful (both locally and if the technology itself is deemed truly successful at the demonstrated 93% recovery level), could be used to access 'new' GW sources for fresh water as well as produce derivative mineral resources for potential sale.
4a	Groundwater Banking within the Eastern San Joaquin Groundwater Basin	4 Groundwater banking projects in Southern California could be used as frameworks for similar projects in the Mokelumne River watershed. Recharge potential is generally greater in San Joaquin County than Amador or Calaveras Counties.	2 In coupled groundwater-surface water systems, improvement in the overall health of one of the systems would contribute to improved health in the other. Fewer river diversions would allow unallocated waters to stay in the river and perform geomorphic functions, though the benefit would likely be small and incremental at best.	2 As discussed above, the application of groundwater banking, although having a number of water supply benefits, does not appear to be a cost effective method for improving instream flows and fishery habitat. Opportunities may be identified where additional groundwater banking could provide direct and/or indirect benefits by reducing surface water supply demand that could have fishery benefit, however, those do not appear to have been identified to date.	New studies and results showing potential recharge areas should be used to supplement existing studies.	GW banking projects in each groundwater region could provide for equivalent benefits for each GW basin. Groundwater banking projects have the potential to reduce reliance on surface water diversions that could then be used to increase a reliable supply of instream flows that would benefit fish and other aquatic resources. The magnitude of surface water benefits has not been quantified for the proposed project and therefore potential fishery benefits, although potential, remain uncertain. Additional development of the banking concept in terms of seasonal timing of diversions, volumes diverted, changes both positive and negative in surface water flows and other details are needed to further asses the proposed project benefits.	Coupling groundwater recharge basins with floodplains adjacent to the river corridor could potentially serve multiple purposes: GW recharge, sediment deposition, increased connectivity between river and floodplain. Use of gates similar to those used at the Sutter Bypass to open and close floodplain areas to promote GW recharge could be explored for feasibility.

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4b	Amador and Calaveras Counties Hydrologic Assessment	4 A regional GW assessment is technically feasible; implementation of GW storage programs after assessment is completed should be feasible also. Recharge potential is generally greater in San Joaquin County than Amador or Calaveras Counties.	2 In coupled groundwater-surface water systems, improvement in the overall health of one of the systems would contribute to improved health in the other. Fewer river diversions would allow unallocated waters to stay in the river and perform geomorphic functions, though the benefit would likely be small and incremental at best.	2 As discussed above, the application of groundwater banking, although having a number of water supply benefits, does not appear to be a cost effective method for improving instream flows and fishery habitat. Opportunities may be identified where additional groundwater banking could provide direct and/or indirect benefits by reducing surface water supply demand that could have fishery benefit, however, those do not appear to have been identified to date.	New studies and results showing potential recharge areas should be used to supplement existing studies.	GW banking projects in each groundwater region could provide for equivalent benefits for each GW basin.	Coupling groundwater recharge basins with floodplains adjacent to the river corridor could potentially serve multiple purposes: GW recharge, sediment deposition, increased connectivity between river and floodplain. Use of gates similar to those used at the Sutter Bypass to open and close floodplain areas to promote GW recharge could be explored for feasibility.
4c	San Joaquin County Groundwater Banking and Exchange	5 Groundwater banking projects in Southern California could be used as frameworks for similar projects in the Mokelumne River watershed. Recharge potential is generally greater in San Joaquin County than Amador or Calaveras Counties.	2 In coupled groundwater-surface water systems, improvement in the overall health of one of the systems would contribute to improved health in the other. Fewer river diversions would allow unallocated waters to stay in the river and perform geomorphic functions, though the benefit would likely be small and incremental at best.	1 Increasing water diversions from the Mokelumne River for the purpose of groundwater bank augmentation provides a number of benefits for municipal and industrial water supply, but does not appear to provide any benefit to instream flows or habitat conditions occurring within the Mokelumne River for fisheries or other aquatic resources.	New studies and results showing potential recharge areas should be used to supplement existing studies.	GW banking projects in each groundwater region could provide for equivalent benefits for each GW basin. // Although surface water diversions from the Mokelumne River for increased groundwater banking provides water supply reliability and water storage benefits for municipal and industrial uses, as well as other beneficial uses, there appears to be little or no benefit to fisheries or other aquatic resources within the watershed.	Coupling groundwater recharge basins with floodplains adjacent to the river corridor could potentially serve multiple purposes: GW recharge, sediment deposition, increased connectivity between river and floodplain. Use of gates similar to those used at the Sutter Bypass to open and close floodplain areas to promote GW recharge could be explored for feasibility.
4d	NSJWCD Infrastructure Improvements	5 Concept is sound, in that existing infrastructure is upgraded. Funds for the costs of improvements would be needed.	1 Higher efficiency in pumping stations will likely not affect geomorphic conditions in the river corridor. If pipelines are constructed in place of aqueducts, then evaporation, leakage and seepage rates would diminish, thereby potentially requiring fewer AF of diversions for the same volumetric delivery.	1 Improving infrastructure to allow Increasing water diversions from the Mokelumne River for the purpose of groundwater bank augmentation provides a number of benefits for municipal and industrial water supply, but does not appear to provide any benefit to instream flows or habitat conditions occurring within the Mokelumne River for fisheries or other aquatic resources.	A decrease in GW pumping would be beneficial for GW reserves.	Investments in capital improvements will pay off in the long term, even if it appears costly in the short-term. As a society, we must consistently strive to balance environmental and human needs.	Identify the best long-term solution, regardless of short-term costs. Upgrading infrastructure prior to equipment failure or emergency repairs shows fiscal responsibility.

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5a	Regional Urban Water Conservation Program	5 Most Californians understand this goal due to current (and recurrent) drought conditions, and support the need for conservation, especially right now.	1 As flows are already thoroughly regulated throughout the watershed, any conservation gains would likely be offset by other water rights entities using non-allocated waters for other purposes, such as groundwater banking. Likely little to no geomorphic benefit.	3 The water that is available within the watershed to meet competing beneficial uses is a function of water supply and water demand. To the extent that urban water management and other conservation practices can be used to effectively reduce water demand there would be benefit to increasing available surface water supplies for other beneficial uses, including instream flow augmentation and fishery habitat enhancement. The magnitude of the incremental benefit of increased conservation on water supplies, coldwater pool management within Camanche and Pardee reservoirs, and associated instream flows in the lower Mokelumne River are difficult to quantify. Efforts within the EBMUD service area have already been implemented to enhance conservation and reduce water supply demand. The incremental additional opportunities to further enhance conservation and the magnitude of the associated water supply benefit requires further analysis and consideration.	Reduction in urban water use is a worthy and necessary goal, but does little to address needed improvements in efficiencies in agricultural irrigation, which uses ~70 to 80% of the available water supply.	The spreadsheet comment "If 20% by 2020 is already met, the additional conservation benefit is difficult to squeeze out of a new program" is not understood without additional information. It could be conjectured to refer to a current goal of a 20% reduction in municipal water use, but that is not explicitly stated. In addition to increasing efforts towards improving water conservation, further effort should also be devoted towards beneficial reuse of existing water supplies, including, but not limited to, treatment and wastewater reuse for agricultural irrigation, residential irrigation, and other water demands.	There are many avenues to pursue to reduce municipal demand. Develop a framework to guide process, potentially with incrementally bigger goals as current goals are met. Reductions should be embraced as permanent, with citizen mindsets fully embracing water conservation principles no matter what type of water year, i.e. conserve just as much during wet years as dry years.
5c	Regional Agriculture Conservation Program	5 Voluntary efficiencies would be very useful, and may lead to permanent reductions in water usage as new technologies are adopted. Challenges exist in the management and potential benefits of additional water conservation actions. For example, additional conservation has the potential to increase surface water flows that would benefit fish and other aquatic resources if left in the stream. In contrast, conservation is viewed by some as a method for increasing water supplies that would serve to meet additional agricultural, residential, commercial, and industrial demand growth and therefore would not provide additional environmental benefits . Conservation management plans would help provide guidance on the potential magnitude of additional water supplies developed through conservation programs, how those potential water supplies may vary seasonally and in response to variation in hydrology (water year type) as well as firm projections of how water supplies developed through conservation would be allocated among various beneficial uses. In the absence of better information on conservation planning and use there remains a relatively high degree of uncertainty in the magnitude and types of benefits that would be derived from such a program.	5 Since agricultural irrigation uses the vast majority of available water supply, significant increases in efficiencies have the potential to truly reduce surface water diversions and GW pumping throughout the watershed.	2 As described above for urban water conservation, agricultural water conservation and beneficial reuse offers an opportunity to reduce demand and thereby increase surface water supply availability and reliability. The magnitude of benefit to fishery habitat and instream flows that would be generated through increased irrigation conservation within the Mokelumne River watershed appears to be lower than that for urban conservation. In many of the areas within the watershed agricultural conservation measures have already been implemented in an effort to reduce water supply demand and associated cost. The incremental benefit of further agricultural irrigation conservation in benefiting instream flows, coldwater pool storage, and other aspects of fishery habitat within the watershed, however, appear to be moderately low. The incremental additional opportunities to further enhance conservation and the magnitude of the associated water supply benefit requires further analysis and consideration. New technologies are continuing to be developed to enhance agricultural water conservations such as new drip delivery systems, soil moisture monitoring, improved monitoring and modeling to predict soil moisture levels and irrigation demand, reduced over irrigation, etc. In addition, as conservation ethics increase cultural shifts are expected that will further enhance conservation. It is difficult to predict these changes with current information or to develop reliable long-term projections of the magnitude of conservation or how that additional water supply developed through conservation will be allocated among competing beneficial uses and across variously hydrologic conditions. In the absence of improved projections and detailed plans for implementation and monitoring the potential biological benefits for improved instream flows remains highly uncertain.	If diversions and GW pumping could be reduced enough to provide additional flows to the river channel, positive benefits to geomorphic and ecological processes would follow. Increased efficiencies could reduce pressures to use unallocated waters of the Mokelumne River. Benefits are also achieved by using groundwater storage as a method for reducing the demands on surface water supplies and contributing to increased instream flows that benefit fisheries and other aquatic resources. There are a number of benefits to maintaining existing instream flows in the streams for fishery benefits and meeting agricultural and other demands through alternative means including conservation.	As increased efficiencies are embraced by vanguard agricultural entities, quantification of conservation and savings may spur the embrace of such actions by other agricultural entities, resulting in further and potentially widespread adoption of the most efficient conservation methods. A potential key component of measuring successful agricultural conservation would be that conserved water does not become supply for new demand, whether agricultural or municipal.	Develop a framework that would monitor conservation projects, what worked and what did not, costs and savings (water-use and monetary), permanent changes in practices, whether conservation measures become more widespread, and other measures of how well conservation measures worked.

#	Concept Name	Feasibility (scale 1-5, 1 less, 5 more) Benefit score explanation	Geomorphic benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Fisheries benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Environmental considerations	General Comments	Potential Direction for Concept Development including Additional Benefits
6a	Mokelumne Floodplain Management Plan - Camanche to Below Woodbridge Dam	4 Successful restoration work in the EBMUD day use area directly below Camanche Dam provides a number of scientifically sound restoration techniques that have been developed, tested, and monitored, with many methods and results academically published. Other Sierra Nevada watersheds have performed similar work, so frameworks for a range of specific projects are likely readily available.	5 Restoration that involves connectivity to floodplains, side channels, and an increase in riparian corridor width and length would provide multiple biogeomorphic beneficial uses to the aquatic ecosystem. Benefits include: sediment deposition on floodplains, increased connectivity during high flows would provide for increased refugia, increased productivity on the floodplains which can yield larger juvenile fish, shading which improves water temperature, additional opportunities for streamwood to enter the active channel and provide structure, food and dissolved organic carbon to the system.	3 As discussed with regard to concept 1C, available scientific information is demonstrating biological benefits for juvenile rearing salmonids and other aquatic resources associated with levee setbacks, seasonally inundated floodplain, and improved riparian vegetation. Although the broad program outlined in concept 6a has the potential to substantially benefit large areas of aquatic habitat within the lower Mokelumne River that would be expected to improve juvenile rearing habitat, juvenile growth rates, juvenile survival, and contribute to overall increases in salmonid abundance the timing of implementation, the locations where restoration activities would occur, and the aerial extent of restoration activities have not been identified. Therefore the opportunities to enhance habitat and the magnitude of potential biological benefits remain somewhat uncertain. The opportunity certainly exists to provide major habitat benefit through such restoration activities if they were implemented over a large landscape of the lower river.	Improvements in the lower watershed are key to healthy ecosystem function within the regulated flow environment that currently exists.	Public and private support seems relatively high on the lower Mokelumne River for projects of this nature. // Types of potential restoration activities that have been identified in the concept proposal are beneficial in creating high quality habitat for juvenile salmonid rearing, increasing habitat diversity and complexity along the river for a variety of fish and other wildlife resources, and can be made compatible with the geomorphic processes, instream flows, and other factors that influence the interaction between shoreline topography and hydrologic conditions occurring within the river.	Restoration concepts are well developed and contractors have proven capable of implementing plan sets with geomorphic and engineering guidance.
7a	PG&E Storage Recovery	5 Technically feasible to remove sediment from reservoirs. Local conditions, and possibly trace-metal contamination (such as mercury), may constrain sediment removal at individual reservoirs.	4 Dams and reservoirs capture sediments that would otherwise transport downstream, resulting in sedimentation in and upstream of the reservoirs and causing erosion of the stream bed below the dam due to lack of sediments below-dam. At Tiger Creek Afterbay, sedimentation has aggraded the Mokelumne River channel at the upstream end, and only 25% of its original capacity remains (2013 survey by Sierra Nevada Conservancy). Moving appropriately-sized sediments from the reservoir to downstream locations may increase the sediment supply that could perform geomorphic work in the short-term, which could result in a significant positive geomorphic benefit.	1 Although removal of silt and accumulated sediment from upstream PG&E's reservoirs would be beneficial from the standpoint of improving water supply storage as well as hydroelectric facility operations. Sediment removal would have very little direct benefit to aquatic habitat resources within the watershed. Sediment removal from existing impoundments would reduce the risk of sediment resuspension during high flow periods, reduce suspended sediment loading and sediment deposition in habitats downstream of the reservoirs, thereby improving the quality and availability of habitat for salmonids and other aquatic resources. Increasing the reservoir storage volume by sediment removal would also create additional opportunities to further trap suspended sediments and bedload transport in the upper part of the watershed. Given the size of the PG&E facilities, and sediment trapping that would occur downstream in Pardee and Camanche reservoirs, the proposed concept proposal is expected to provide relatively little benefit for habitat enhancement within the lower Mokelumne River downstream of Camanche dam.	Sediment removal from reservoirs could be beneficial, especially if the larger size fractions of these sediments could be repurposed to provide augmentation to locations within the river corridor. Benefits may need to be assessed based on presence/absence of mercury, and the relative risks of removal/disposal or methylation if left in place. Mercury and other trace metal risks are thought to be generally lower in the Upper Moke than in other Sierran watersheds.	The project would enhance water supply by restoring reservoir capacity and retaining more cold water. This could be beneficial for aquatic species as well as humans, particularly during periods of extended drought as climate change introduces additional uncertainties to the water supply. Restoring lost water storage capacity in existing reservoirs would be more cost effective and create less impact than constructing new reservoirs // An evaluation of the feasibility of sediment removal in and of itself provides no biological benefit to the watershed. Benefit from such an action occurs only as a result of the actual implementation of sediment removal and the associated increase in water storage.	Evaluate the cost-benefit ratio of restoring existing reservoirs versus construction of new reservoirs. Evaluate feasibility and benefits of screening reservoir sediments and using those that fall within a prescribed range for gravel augmentation projects in other areas of the river corridor.

#	Concept Name	Feasibility (scale 1-5, 1 less, 5 more) Benefit score explanation	Geomorphic benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Fisheries benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Environmental considerations	General Comments	Potential Direction for Concept Development including Additional Benefits
7b	Raise Lower Bear Reservoir Feasibility Study and Update of Preliminary Engineering	5 Technically feasible to study raising dam height.	1 Raising Lower Bear Reservoir would capture waters that are currently unallocated, especially high flows during the wet season November-April, including those from atmospheric river events. High flows are needed in the upper Mokelumne to provide rejuvenating flows for aquatic species and riparian corridor ecosystem services. High flows are also needed in the lower Mokelumne to supply and move spawning gravels and to provide forces needed to re-shape and renew the enhanced and natural spawning beds in the overcoarsened sediments below Camanche Dam, which are needed to provide critical habitat for anadromous fish. Such flows are important as episodic events that may render significant changes to the river not achieved through smaller flood events. Benefits and impacts depend on operational parameters.	2 Raising the elevation of Little Bear Reservoir would provide a small increase in water storage capability and opportunities for releases downstream that could benefit the cold water pool in Camanche and Pardee reservoirs as well as enhance instream flows for salmonids within the watershed immediately downstream of Little Bear Reservoir as well as further downstream in the lower Mokelumne River. The overall benefits of increasing reservoir storage, however, on fishery habitat are considered to be moderately low. Benefits and impacts depend on operational parameters.	Capture of additional winter flood flows could reduce the ability of peak flood hydrographs from doing "natural" geomorphic work more so than under current regulated conditions. Processes that need peak flows include sediment transport, rejuvenation of channel bed and bank substrates and floodplain inundation. Benefits and impacts depend on operational parameters.	Careful consideration would need to be given to development of this concept, as the balance between supporting human needs and river ecosystem needs is fragile. Raising reservoir dam heights is likely a better solution than building new dams. Studies to understand potential effects of a raised reservoir on morphologic and aquatic resources are important to consider. Additional stored water could potentially be used to recharge GW basins in the watershed. Benefits and impacts depend on operational parameters.	Develop river hydrographs, models and criteria that could be used to evaluate and minimize adverse effects caused by loss of occasional episodic peak flows. Strive to develop hydrologic rules such that there would be small or no losses to hydrographic durations and peaks when compared to current conditions, and that potentially seek to improve upon the current hydrographic conditions. Benefits and impacts depend on operational parameters.
7c	Surface Storage Regional Assessment	5 Technically feasible to assess regional surface storage concepts.	3 Removal of additional flows from the watershed and any local river reaches may generally result in a negative geomorphic effect to the channel and the aquatic ecosystem, as lower flows become less able to perform the geomorphic work and maintenance needed in the channel. Mitigation elements that provide benefits, perhaps below Camanche Dam to enhance anadromous fish habitat, could result in a significant positive geomorphic benefit.	2 A study of the regional feasibility of increasing additional on-stream and off-stream storage within the watershed is expected to have only moderately low benefit for fishery habitat. The degree of fishery benefit would depend on specific information regarding the location of additional storage, the magnitude of additional storage, operational strategies, including instream flow releases, the effects of increased storage on geomorphic processes that affect fishery habitat, and other factors.	On-stream dam and reservoir construction would create a discontinuity in the river channel network. Such discontinuities are seldom a positive benefit for the river ecosystem, as sediment, water, aquatic and riparian processes are fundamentally disrupted. The significance of such discontinuities should be evaluated, and mitigation measures identified and weighed for their effectiveness in producing no negative effects to river ecosystem values. Off-stream storage avoids the discontinuity aspect.	Coequal goals of water supply and environmental protection were set by the legislature for the Delta. The same goals could be utilized to guide assessments in the Mokelumne River watershed. There may be a range of projects and locations in the watershed that meet a set of criteria for this concept. Care should be taken to evaluate potential environmental effects on a regional scale to provide a comprehensive evaluation of regional surface storage projects and how they might achieve the coequal goals.	Hydrographic information, geomorphic field mapping plus channel geometry analysis, and models of projects should be used to evaluate the effects of removing varying amounts of water from the river and the potential effects on the Mokelumne River channel and ecosystem.

#	Concept Name	Feasibility (scale 1-5, 1 less, 5 more) Benefit score explanation	Geomorphic benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Fisheries benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Environmental considerations	General Comments	Potential Direction for Concept Development including Additional Benefits
7d	Re-operation of Existing Storage	3 Agreement by all parties as to the scope, objectives and purposes of any re-operation could lead to gains in the ability to meet current and future human and environmental needs.	3 Depending on the objectives of re-operation, geomorphic benefits may or may not accrue with this project. There would seem to be a high potential for geomorphic benefits to be realized.	1 A feasibility study to identify the potential opportunities for increasing water supplies for consumptive use and hydroelectric generation are anticipated to have very low potential benefit for enhancing fishery habitat. A feasibility study, in and of itself, provides no benefit for fishery habitat, however, the identification of potential opportunities to implement alternative operational strategies could have a small incremental benefit on resident and migratory fish.	Reoperation of upper watershed storage could help optimize existing water supply and reduce needs for GW pumping or importing water.	This concept provides an opportunity for an element including improvement to ecosystem health, in large part through continuing to embrace new understandings of the importance of environmental stewardship, and in seeking to improve existing river conditions.	Goals and objectives should consider environmental needs to be as important as any other considerations.
7e	Optimization of Calaveras County Reservation	3 The use of full water rights would necessarily affect entities that currently use any surplus supply. Hence, this concept would probably result in less water in the river.	2 It is unlikely that additional removal of water from the river corridor will provide any geomorphic benefits.	2 The evaluation of the legal feasibility of modifying the area of origin under the State Water Resources Control Board water right permitting process appears to have relatively low potential benefit for improving fishery habitat conditions. Specific information regarding the potential changes in operations, seasonal timing, and magnitude of changes that would occur as a result of implementation of the proposed project have not been developed and therefore there is high a level of uncertainty regarding the potential magnitude of fishery benefits associated with the concept proposal.	Less water in the river corridor generally translates to increased stressors for aquatic organisms that depend on a healthy ecosystem. Problems caused by less water generally include increased water temperatures; higher concentrations of chemicals (i.e. fertilizers) in the water columns which can disrupt aquatic life cycle; fewer to no episodic high flow events, which leads to riparian encroachment, and fewer instances of channel substrate renewal associated with robust sediment transport events.	This concept faces the same challenges that so many other water use entities face, which are two-fold and in opposition. First, that of having more water rights than are used, so others may currently use water that by law belongs to a particular water rights holder. Second, the unfortunate but real problem that water rights are over-allocated, such that in no case will all rights holders receive their entire allocation, let alone those who need water but have no rights to it, and thus are subject to market rates for water supply. This dichotomy presents a problem that has not yet been solved, and which will likely continue to be in place for some years to come. In the meantime, all parties struggle to achieve a workable balance. // The concept proposal is difficult to assess from of fishery benefit perspective in the absence of additional information and detail.	Include a water use efficiency component to the evaluation, which could potentially result in a reduction in water needs that does not involve taking the full allotment of water as currently allowed under the law.
8a	Jeff Davis Water Treatment Plant Replacement	4 Replacing outdated water treatment technologies is a great idea, and could lead the way and provide a template for other entities to consider similar actions.	3 Projects that permit additional flow in the river network are beneficial to geomorphic processes, relative to increases in flow rates and hydrographic peaks, so there is some potential that this concept could result in increased flows.	1 Modifying the existing wastewater treatment plant backwashing process appears to have very little potential to benefit fishery resources. Although the proposed project would provide greater efficiency of wastewater treatment plant operations and incrementally reduce water required for filter backwashing, the magnitude of the potential change in water supply is anticipated to be minimal in terms of fishery habitat enhancement.	Would gains in efficiencies lead to increased flows in the river, or would additional flows be re-allocated to consumptive or other human needs?	Upgraded wastewater treatment plants could provide a template and lead the way for other entities to consider similar actions.	Project goals could include using reclaimed wastewaters for GW infiltration and appropriate municipal uses if possible, and to designate the accrued "water saved" to river flows.
8b	Rehab of Transmission Main	4 This project would extend the positive benefits of water conservation and treatment efficiencies by replacing or rehabilitating outdated facilities with newer equipment.	2 This project would likely not provide much in the way of geomorphic benefits to the river corridor, but could potentially be an additional factor in increased water efficiencies, which overall may provide additional waters to the river.	1 Improvements in the efficiency of water conveyance from the existing water treatment plant to local landowners, although reducing loss during transmission is expected to have very little direct or indirect fishery benefit. Presumably, increasing water conveyance efficiency would incrementally reduce the demand on surface waters. However, the incremental magnitude of such a reduction on the ability to provide instream flows or cold water pool management for fishery habitat is expected to be minimal.	Replacement/rehabilitation of existing structures would likely have minimal effects to the river corridor environment.	Good to see engagement in upgrading structural components of the water network. // There is general support for improving water conveyance and water use efficiency as a method for reducing demand. Although there is broad support for increasing conveyance efficiency the incremental benefits of individual projects are likely to be relatively low in terms of providing additional supplies that would benefit fishery resources and other aquatic species.	Explore multiple end uses for treated waters, including GW infiltration (not mentioned in the description).

#	Concept Name	Feasibility (scale 1-5, 1 less, 5 more) Benefit score explanation	Geomorphic benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Fisheries benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Environmental considerations	General Comments	Potential Direction for Concept Development including Additional Benefits
8c	Barney Way Septic System Conversion	4 Improvements to septic/sewer systems are common and would likely provide a series of health benefits to the local community.	2 The concept would provide relatively little geomorphic benefit to the river corridor, but would likely improve water quality, perhaps to the Middle Fork Mokelumne as well as to Camanche Lake.	2 Reducing the use of local septic systems through interconnection with a main wastewater treatment facility is thought to provide some moderately low incremental benefit towards improving water quality conditions within the local watersheds. Wastewater leakage from septic systems into the local water supply, including adjacent streams and rivers, reduces the potential for contaminant and bacterial growth that improve habitat quality as well as water quality. The incremental benefit of such improvement on fishery habitat associated with individual proposal, however, is expected to be moderately low.	There are environmental and human health components to this project that are compelling even though the concept has little to no geomorphic component.	Improvements in water quality, particularly those associated with sewage, are good for river ecosystem and human health environments. // Although there is general support for reducing reliance on septic systems for wastewater treatment and disposal, the incremental benefit of individual projects in improving water quality conditions that would benefit fishery habitat have not been documented.	Explore use of excess treated water for GW infiltration.
8d	Lake Camanche Village Recycled Water Project	4 Improvements in waste water treatment options are well-documented and relatively easily implemented, and would likely provide additional water supplies for non-potable use.	1 Little to no geomorphic benefit to the river corridor.	1 Converting an existing wastewater treatment plant process from one mode to another is expected to have virtually no benefit for fishery habitat. Although there is the potential for a small incremental improvement in overall wastewater treatment plant efficiency the benefit to fishery habitat through increased water supply availability, instream flows or cold water pool management is anticipated to be minimal.	An increase in waste water usage for local purposes could be beneficial by lessening the pressures on using surface and GW for non-potable needs.	Good to see engagement in upgrading structural components of the water network.	Identify beneficial uses for additional supplies of treated waste water.

Notes:

1. Three semi-quantitative scales and accompanying narratives are meant to convey a general sense of how the reviewers regarded each concept from various perspectives: overall concept feasibility, geomorphic benefit, and fisheries benefit. The scale designations do not provide a "score", nor are the scale values additive or cumulative in terms of overall concept feasibility.

2. Feasibility scale explanation: The word 'feasibility' is meant to convey the thoughts of the reviewers as to how easily a concept might be brought to fruition, generally in terms of (a) whether similar projects have been successful in the past, (b) how receptive stakeholders might be toward the project, and/or (c) technical viability.

3. Geomorphic benefit scale explanation: Geomorphic benefits are generally realized when hydrologic processes perform naturally. Such processes allow stream corridors, of any size, to evolve naturally over time, either through incremental or episodic events, which when combined, provide high quality habitat for aquatic and riparian species.

For instance, a geomorphic benefit of "5", and the accompanying narrative, would suggest that relatively substantial increases in either hydrologic or sediment transport processes would yield important benefits.

A geomorphic benefit of "3", coupled with the explanatory narrative, would suggest either (a) that some increases in hydrologic or sediment transport processes may occur or (b) that even if the project itself yielded important benefits, the geomorphic benefits would likely be moderate.

A geomorphic benefit of "1", and the accompanying narrative, would suggest that the particular concept would convey little benefit to geomorphic processes, even if the project itself would convey important benefits to the community at large.

4. Fishery benefit scores were based on qualitative professional judgment. Scores were generally ranked based on the potential certainty of implementation and the anticipated magnitude of benefit over time and in space. A proposed study, for example, would provide no immediate fishery benefit by itself (low score) but has the potential to develop into a beneficial project would have substantial benefit if implemented. For example, a project to screen diversions has great potential benefit but would rank 1 if there is no funding, plans, and the likelihood of only one diversion being screened. A project that has funding, permits, willing partners, that would screen a substantial water volume at multiple sites would rank a 5. A project that is in development but a good chance of funding and implementation that would benefit fish over a period of years but still has uncertainty regarding implementation would rank a 3. Suggestions for improving ranking scores are provided above for many of the proposed project ideas. The ranking scores are not intended to be added for a composite ranking but rather should accompany the text for discussion and context.

Appendix M: Objectives Assessment Project Concept Briefs

Appendix M provides the MCG-approved assessment of project concepts against each of the program objectives and consequences to be avoided.

1a: Upper Mokelumne Anadromous Fish Restoration

Foothill Conservancy; CSPA

Overview

Sponsor(s): Foothill Conservancy; California Sportfishing Protection Alliance (CSPA)

Concept type: Planning and implementation

Estimated Costs: unknown

Funding Source(s): unknown

Concept location: Immediately downstream and upstream of Camanche and Pardee dams.

Conduct a study to determine the feasibility of transporting anadromous fish above and below Camanche and Pardee dams. Based on the results, implement the project. Expected results of transportation include expanding fish habitat, improving resiliency in the face of climate change, and enhancing upper ecosystems and recreational opportunities. Project proponents do not anticipate negative impacts to water agencies as a result of implementing this concept.

This concept is well suited with concept 1e: Pardee Riparian Restoration; these two concepts could be integrated and pursued in tandem.

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not have elements that include promoting demand-side management strategies.
WS-2: Increase supply reliability	○	The concept would not address and/or increase supply reliability.
WS-3: Increase amount of stored water	○	The concept would not increase the amount of stored water.
WS-4: Promote smart, responsible development	○	While the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.

Objective	● ◗ ○	*Justification*
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation.
WS-6: Promote a long-term groundwater balance	○	The concept would not help to promote a long-term groundwater balance.
WS-7: Maximize water resource availability for all beneficial uses	○	The concept does not involve maximizing water resource availability.
WS-8: Decrease the need to import water	○	The concept would not decrease the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	○	The concept would not protect or improve surface and/or groundwater quality.
WQ-12: Match delivered water quality use	○	The concept does not involve treating water, nor does it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	The concept does not include water purification elements.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.

Objective	● ◗ ○	*Justification*
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	●	Presence of anadromous fish would result in many measures which would enhance habitat in the upper watershed. For instance, successful implementation could create positive biogeomorphic benefits through substrate rejuvenation during spawning, and in providing a reintroduction of marine nutrients into the upper watershed ecosystem when spawners die. Relocating adult anadromous salmonids from the lower Mokelumne River to the upper Mokelumne River offers the opportunity to bring marine nutrients into the upper watershed and, if accomplished using steelhead, would provide advantages of increasing genetic diversity of the resident rainbow trout population in the upper watershed.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	●	The concept involves transporting fish (potentially hatchery-raised trout) above Camanche and Pardee dams, which would result in stocking hatchery-raised trout in the upper Mokelumne. The description for the concept does not explicitly state that wild trout sections would be designated and managed on the upper Mokelumne.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	●	The purpose of the concept is to transport anadromous fish (salmon, etc.) into the upper Mokelumne above Camanche and Pardee dams. If implemented, the concept would increase angling and other recreational opportunities by reintroducing salmon to the upper reaches of the River.
R-18: Increase angling and other recreational opportunities (increase opportunities)	●	The purpose of the concept is to transport anadromous fish (salmon, trout, etc.) into the upper Mokelumne above Camanche and Pardee dams. If implemented, the concept would increase angling and other recreational opportunities by reintroducing these anadromous fish to the upper reaches of the River.

Objective	● ◗ ○	*Justification*
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	○	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including number of fish transported upstream, number of fish transported downstream, and other information that would help determine the success of the program.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.

Objective	● ◗ ○	***Justification***
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	The concept would maximize benefits for DACs, as a number of the surrounding towns, including the City of Jackson, are designated as DACs
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, concept benefits would be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	●	The concept would protect and enhance the natural environment by relocating adult salmonids to the upper parts of the watershed.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	●	Relocating adult anadromous salmonids from the lower Mokelumne River to the upper Mokelumne River offers the opportunity to bring marine nutrients into the upper watershed and, if accomplished using steelhead, would provide advantages of increasing genetic diversity of the resident rainbow trout population in the upper and lower watershed.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	○	The concept does not include elements that would increase agricultural water supply.

Objective	● ◗ ○	***Justification***
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would likely require coordination between a number of entities (including non-governmental organizations and water agencies) that would contribute to fostering long-term regional relationships and help to avoid unnecessary conflict and litigation. Additionally, the feasibility study would help to identify and resolve issues prior to implementation.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	Implementation of the concept would increase recreational opportunities within Camanche reservoir and upstream, while also enhancing ecosystems in the upper watershed. These outcomes are supported by a wide range of interests within the watershed.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	●	The concept would likely result in agreements between federal and/or state agencies and water agencies that would reduce conflict, particularly related to dams, and other barriers limiting fish migration.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River.

Objective	● ◗ ○	*Justification*
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	While predation mortality occurring within the reservoirs could be high, the benefits of transporting fish to fisheries and other wildlife is high.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.

Objective	● ◗ ○	*Justification*
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	The concept does not include elements that would create adverse socio-economic and public health and safety impacts.
CA-46: Avoid end use harm	●	The concept does not include elements that would allocate water in ways that create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	The concept involves the transportation of anadromous fish above and below Camanche and Pardee dams. These benefits would be experienced by both regions, with the potential to provide benefit to the state.

1b: High Country Meadow Restoration Program

Foothill Conservancy

Overview

Sponsor(s): Foothill Conservancy

Concept type: Planning

Estimated Costs: unknown

Funding Source(s): unknown

Concept location: High country meadows

Develop a program to restore high-elevation meadows to approximate natural function to provide water supply, storage, and ecosystem enhancement benefits. The program would involve mapping, identifying, and assessing potential meadows for restoration as well as seek funding for the planning phases of identified meadow restoration opportunities in the Mokelumne River Watershed. The project would require coordination with local groups such as the Amador Calaveras Consensus Group, which is currently involved in meadow restoration projects in the watershed.

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	As an implementation plan, the concept does not have elements that promote demand-side management strategies. Implementation of the project described in the concept would also not have elements that would promote demand-side management strategies.

Objective	● ◗ ○	***Justification***
WS-2: Increase supply reliability	◗	As an implementation plan, the concept itself would not increase supply reliability. If implemented, restoration of meadow functions would likely decrease peak flow and sediment transport rates during episodic flood events. This could contribute to increased supply reliability if less flood water was spilled and agencies were able to capture more flood event water. Decreasing peak flows would shift the flow duration curve, potentially releasing water more slowly over a longer period throughout the summer months.
WS-3: Increase amount of stored water	◗	The concept does not include elements that would store water, nor would it increase the amount of stored water. If implemented, restoration of meadow functions would likely increase groundwater supplies and baseflows at least in the upper watershed via greater infiltration rates as waters slow from draining hillslopes to crossing meadows prior to entering streams. However, the amount of water stored would likely be negligible.
WS-4: Promote smart, responsible development	○	As an implementation plan, the concept itself would not promote smart, responsible development. And if implemented, while the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.
WS-5: Reduce reliance on groundwater for irrigation	○	As an implementation plan, the concept itself would not reduce reliance on groundwater. Implementation of the plan would also not reduce reliance on groundwater for irrigation.

Objective	● ◗ ○	*Justification*
WS-6: Promote a long-term groundwater balance	◗	As an implementation plan, the concept itself would not promote a long-term groundwater balance. If implemented, while restoring meadow function would likely increase groundwater supplies via greater infiltration rates as waters slow, the amount of water infiltrated into the groundwater basin would likely be small.
WS-7: Maximize water resource availability for all beneficial uses	◗	As an implementation plan, the concept itself would not maximize water resource availability for all beneficial uses. However, implementing the implementation plan would maximize water resource availability for multiple beneficial uses by increasing base flows in the summer, which is beneficial for fish and other wildlife, and decreasing peak flood flows, which is beneficial for water agencies and downstream communities that experience flooding.
WS-8: Decrease the need to import water	○	As an implementation plan, the concept itself would not decrease the need to import water. If implemented, while the restoration could help to increase supply reliability for users on the Mokelumne, this would likely not result in a substantial decrease in the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates. Restoration would also not review existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update. Restoration would also not identify water demand issues.

Objective	● ◗ ○	*Justification*
WQ-11: Protect and improve surface and groundwater quality	◗	As an implementation plan, the concept itself would not protect or improve surface and/or groundwater quality. However, restoration would improve geomorphic functions in the upper watershed, which could result in an increase in baseflows leading to better water quality.
WQ-12: Match delivered water quality use	○	As an implementation plan, the concept itself would not involve treating water, nor does it involve delivering treated water. Restoration would also not involve treating water, nor would it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	As an implementation plan, the concept itself would not use water purification technology as a tool to maximize beneficial uses. Restoration would also not include water purification elements.
R-14: Increase access for water-based recreation	○	As an implementation plan, the concept itself does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters. Restoration would also not include these elements.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	◗	The concept would not contribute to increasing spawning habitat. If the implementation plan were implemented, protecting existing high elevation meadows, in combination with implementing the meadow restoration program, provides environmental benefit through the protection and preservation of sensitive habitat as well as promoting habitat diversity within the watershed. High elevation meadows serve a variety of environmental functions that can be easily lost if adequate protections and restoration mechanisms are not implemented.

Objective	● ◗ ○	***Justification***
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections. Restoration would also not meet this objective.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne. Restoration would also not meet this objective.
R-18: Increase angling and other recreational opportunities (increase opportunities)	◗	As an implementation study, the concept itself would not increase angling, harvesting, or other recreational opportunities. However, meadow restoration would improve geomorphic functions in the upper watershed, which have been shown to result in a cascade of positive effects locally and downstream. Locally, groundwater retention of flows in a healthy meadow aquifer may result in continuous flows through a dry summer. A cascade effect may occur downstream, which could include an increase in baseflows leading to better water quality and geomorphic functionality, which may improve fish habitat and riparian corridor health. These outcomes would increase angling and other recreational opportunities.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed. This objective would also not be achieved if restoration were implemented.

Objective	● ◗ ○	***Justification***
F-20: Enhance flood protection and management	◗	The concept does not include elements that would enhance flood protection and/or flood management, nor (depending on the scale of the project) would the concept enhance ecosystem function in a way that would provide flood protection. Restoration would contribute to decreased peak flow and sediment transport rates during episodic flood events. Thus, the concept would enhance flood protection and management by helping to slow and attenuate floodwaters.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program. Restoration would also not meet this objective.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	○	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including information on groundwater recharge, delayed release/flow regime, surface water temperature, and water quality.

Objective	● ◗ ○	***Justification***
O-24: Increase investment in forest management	◗	As an implementation plan, the concept would not meet this objective. However, if restoration were implemented, meadow morphology may be returned to approximate natural capabilities, which should provide increased levels of geomorphic and ecologic processes in restored meadows, including a possible shift from xeric plant species such as sage back to mesic meadow species such as grasses and sedges that have the added benefit of greater bank stability properties.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	As an implementation plan, the concept would not meet this objective. However, if restoration implementation were located in or near a DAC, restoration could contribute to socio-economic, cultural, recreational, public health, and public safety benefits of a DAC.
O-26: Achieve equity	◗	As an implementation plan, the concept would not directly achieve equity. However, the benefits realized from restoration activities would not be limited to a narrow group; rather, project benefits would be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	◗	The concept itself would not enhance the natural environment. However, if restoration were implemented, protecting existing high elevation meadows, in combination with implementing the meadow restoration program, provides environmental benefit through the protection and preservation of sensitive habitat as well as promoting habitat diversity within the watershed.

Objective	● ◗ ○	***Justification***
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation. Restoration activities would also not meet this objective.
E-29: Protect and restore fisheries	◗	As an implementation plan, the concept itself would not protect and restore fisheries. However, restoration would result in increased baseflows, which benefit fish and other wildlife. However, if the meadows restored are above Camanche and Pardee, lower Mokelumne fish would not experience these benefits.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	○	The concept does not include elements that would increase agricultural water supply. Implementation of restoration activities would also not meet this objective.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would likely require coordination between a number of entities, including non-governmental organizations and state/federal agencies, that would contribute to fostering long-term regional relationships and help to avoid unnecessary conflict and litigation.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	The concept would promote broadly-supported outcomes by identifying areas for restoration. Restoration activities would restore high country meadows and help attenuate flood flows. These outcomes are supported by a wide range of interests within the watershed.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.

Objective	● ◗ ○	***Justification***
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	◗	The concept would not directly address any current watershed conflicts. Restoration activities could reduce conflict as there have been long-standing disagreements between ranchers and land-managers regarding restoration. Implementation of restoration could result in agreements that reduce these conflicts.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. As such, the concept would not interfere with any entity exercising a water right.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	The purpose of this concept is to develop an implementation plan which will help avoid basing decisions on incomplete or inaccurate information.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept will not result in construction of a new or larger on-stream dam. Restoration activities would not seek new or larger on-stream dams.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife. Restoration would also not create any harmful impacts.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses. Restoration activities would also not include these elements.

Objective	● ◗ ○	***Justification***
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another. Restoration activities would also not include these elements.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows. Restoration activities would also not diminish existing flow benefits.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate. This also applies to any restoration activities.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. This also applies to any restoration activities.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	The concept does not include elements that would create adverse socio-economic and public health and safety impacts. This also applies to any restoration activities.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm. This also applies to any restoration activities.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation. This also applies to any restoration activities.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs. This also applies to any restoration activities.

1c: Mokelumne River Day Use Area Floodplain Habitat Restoration Project

San Joaquin County Resource Conservation District; CSPA

Overview

Sponsor(s): San Joaquin County Resource Conservation District (SJCRCD); California Sportfishing Protection Alliance (CSPA)

Concept type: Implementation

Estimated Costs: $111,110 (capital)

Funding Source(s): USFWS Partners for Fish and Wildlife Program, Anadramous Fish Restoration Program, USDA NRCS, NOAA FIsheries, DWR (Floodplain Corridor Protection Program), CA Fish and Wildlife, Dept. of Conservation, Riparian Habitat Joint Venture, San Joaquin Council of Governments, Lower Mokelumne River Partnership (EBMUD, USFWS, CAFW). Private landowners could also provide funding in the form of irrigation lines, water for new plants, some weed control and invasives removal.

Concept location: Approximately 38.225 -121.025; a roughly 0.8 mile reach of the lower Mokelumne River below Camanche Dam and McIntire Road.

This concept intends to restore a portion of the seasonal floodplain habitat located along the stretch of the Mokelumne River downstream of East Bay Municipal Utility District's (EBMUD or the District) Camanche Reservoir by working with willing participants consistent with the Lower Mokelumne River Watershed Stewardship Plan. Floodplain habitat has been lost as a result of mining and modification of geomorphic processes that has taken place since the advent of the gold rush days in the 1800s.

EBMUD owns land immediately downstream of the Camanche Dam that it uses to support the District's water supply operations (EBMUD's Mokelumne River Day Use Area (MRDUA)). Those lands include properties that have deteriorated riparian and aquatic habitat associated with the above-noted historic human modifications. Lands included in EBMUD's MRDUA would be reconfigured to create a seasonal floodplain. Reclaiming dredger pools with dredger tailings would serve as a source of construction material for habitat creation.

Dredged material would be excavated, screened and washed to remove the fines; placed in the dredger pool and graded to allow seasonal flows >500 cubic feet per second (cfs) in the lower Mokelumne River to inundate an area approximately 1 acre area in size. The source of gravel for the seasonal floodplain restoration project would be from within the project boundaries. The area created / restored would provide habitat for juvenile salmonids. Fines would be deposited in low-lying upland areas and revegetated.

Assessment

Objective	● ◗ ○	*Justification*
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not have elements that promote demand-side management strategies.
WS-2: Increase supply reliability	○	While the concept could provide some degree of supply reliability by creating floodplain that would facilitate groundwater recharge, this amount is likely negligible and would not increase supply reliability.
WS-3: Increase amount of stored water	○	While the concept could increase the amount of stored water by creating floodplain that would facilitate groundwater recharge, this amount is likely negligible and would not significantly increase the amount of stored water.
WS-4: Promote smart, responsible development	◗	The concept would restore and enhance floodplain, which would reduce the impact of development on the watershed.
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation.
WS-6: Promote a long-term groundwater balance	○	The concept would not help to promote a long-term groundwater balance.
WS-7: Maximize water resource availability for all beneficial uses	◗	The concept would create habitat and provide flood control, which maximizes water resource availability for beneficial uses.
WS-8: Decrease the need to import water	○	The concept would not decrease the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.

Objective	● ◗ ○	*Justification*
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	●	The concept would reduce sedimentation/erosion by reducing and attenuating flood flows. Additionally, creating riparian buffers can filter sediments and pollutants.
WQ-12: Match delivered water quality use	○	The concept does not involve treating water, nor does it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	The concept does not include water purification elements.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	●	A number of studies are currently emerging from the Yolo Bypass, Cosumnes River, and many other watersheds that have demonstrated the benefit of seasonally inundated floodplain habitat as juvenile rearing areas for Chinook salmon and steelhead. The concept would revitalize floodplain habitat, which has been shown to be productive and results in increased growth rates of juvenile salmonids. Increased growth rates have been identified as a factor increasing the probability of survival during downstream migration through the Delta and ocean.

Objective	● ◗ ○	*Justification*
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	◗	The concept would result in increased angling opportunities by providing habitat for fish. As noted above, floodplain habitat can increase growth rates, which contribute to migration survival.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	●	The concept revitalizes floodplains, which helps to reduce and attenuate flood flows, thereby enhancing flood protection and management.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	●	The concept is well-defined enough to complete a quantitative assessment.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including flood flow attenuation, effects on spawning and juvenile fish, and potential geomorphic effects.

Objective	● ◗ ○	*Justification*
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	While the concept is not located within a DAC, it does provide health and safety benefits to DACs by attenuating flood flows which can flood DACs downstream.
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, concept benefits would be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	●	The concept would protect and enhance the natural environment. The ability of flows greater than the natural "bankfull" (i.e. unimpaired, average 2-yr flow) to spread out across additional floodplain space would increase potential sediment deposition. Flood flow attenuation may decrease flood effects on downstream structures and communities. Reconnection would promote increased channel morphodynamics, as the river and the floodplain adjust to locally refreshed hydraulics.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.

Objective	● ◗ ○	*Justification*
E-29: Protect and restore fisheries	●	The concept would protect and restore fisheries by providing spawning and rearing habitat for fish. As noted above, floodplain habitat has been shown to be productive and results in increased growth rates of juvenile salmonids. Increased growth rates have been identified as a factor increasing the probability of survival during downstream migration through the Delta and ocean.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	○	The concept does not include elements that would increase agricultural water supply.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would likely require coordination between a number of entities (including EBMUD, non-governmental organizations, state/federal government agencies, and private landowners) that would contribute to fostering long-term regional relationships and help to avoid unnecessary conflict and litigation.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	The concept would attenuate flood flows, provide valuable habitat for fish and other wildlife, and recharge the groundwater basin. These outcomes are supported by a wide range of interests within the watershed.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would not directly address any current watershed conflicts.

Objective	●	◗	○	*Justification*
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River		●		As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)		●		As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information		●		Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams		●		The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife		●		The concept would not result in harmful impacts to fisheries and other wildlife. On the contrary, floodplain habitat would be created that would benefit fisheries and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses		●		The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another		●		The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow		●		The concept does not include elements that would alter existing in-stream flows.

Objective	● ◗ ○	*Justification*
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	The concept does not include elements that would create adverse socio-economic and public health and safety impacts.
CA-46: Avoid end use harm	●	The concept does not include elements that would allocate water in ways that create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

1d: Fish Screens for Riparian Diversions in the Lower Mokelumne

Trout Unlimited

Overview

Develop and implement a program to identify and prioritize riparian diversions for fish screens on the Lower Mokelumne River, working with willing landowners. The program would secure and install fish screens on prioritized riparian diversions to reduce entrainment of fish. Currently, the four largest pumps/diversions are screened, but according to a late 1990's assessment, approximately 60 remain unscreened. Additionally, the California Fish Passage Assessment Database by CalFish identifies over 400 diversions on the main stem of the Mokelumne.

Sponsor(s): Trout Unlimited

Concept type: Planning and implementation

Estimated Costs: $9,700 per cfs of the diversion that is screened (Capital and O&M)

Funding Source(s): EBMUD

Concept location: Lower Mokelumne River

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not have elements that promote demand-side management strategies.
WS-2: Increase supply reliability	◗	The concept could potentially increase supply reliability by assuring diverters that use of their diversion would not be restricted due to potential impacts to fish.
WS-3: Increase amount of stored water	○	The concept would not increase the amount of stored water.

Objective	● ◗ ○	***Justification***
WS-4: Promote smart, responsible development	○	While the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation.
WS-6: Promote a long-term groundwater balance	○	The concept would not help to promote a long-term groundwater balance.
WS-7: Maximize water resource availability for all beneficial uses	○	The concept does not involve maximizing water resource availability.
WS-8: Decrease the need to import water	○	The concept would not decrease the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	○	The concept would not protect or improve surface and/or groundwater quality.
WQ-12: Match delivered water quality use	○	The concept does not involve treating water, nor does it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	The concept does not include water purification elements.

Objective	● ◗ ○	***Justification***
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	●	The more fish and supporting food web organisms killed because of diversions, the fewer that can contribute to river bed and bank bioturbation processes such as salmonids revitalizing the channel bed during spawning activities. Diversions alter hydraulic gradients and shear stresses, dependent on a given river discharge and the diversion rate and volume. Any reduction in kill rate would be very beneficial to the river ecosystem.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	◗	The concept would reduce the number of fish entrained as a result of unscreened diversions in the lower Mokelumne. Consequently, more fish would be left in the river, which would increase angling and other recreational opportunities. However, these opportunities are incremental based on the numbers and size of installed screens.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.

Objective	● ◗ ○	***Justification***
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	○	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including number of screens installed, cost of each screen, and reduction in number of fish entrained.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	○	The concept is not located within a DAC. As such, it would not directly contribute to socio-economic, cultural, recreational, public health, and public safety benefits of a DAC.
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, concept benefits would be spread across regions, cultures, incomes, and time.

Objective	● ◗ ○	*Justification*
E-27: Protect and enhance natural environment (enhance natural envt)	●	In general, reducing sources of direct mortality, such as entrainment into unscreened diversions, provides a positive incremental benefit to the natural environment by increasing survival and abundance of juvenile salmonids produced in the lower Mokelumne River.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	●	Installation of positive barrier fish screens is identified as an environmental benefit through reducing the risk of juvenile salmonid entrainment. The greater the volume of unscreened diversions that can be equipped with intake screens, the greater the potential biological benefit. However, the magnitude of biological benefit varies in response to a number of factors such as the magnitude and seasonal timing of diversion as well as the location of the diversion. Relatively large unscreened diversions located in areas where juvenile salmonid rearing occurs typically pose the greatest risk of entrainment. Providing intake screening of the largest diversions (by volume) located in sensitive habitat are expected to offer the greatest biological benefit. Installation of positive barrier fish screens on the lower Mokelumne River will result in direct benefits to improving juvenile survival.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	◗	The concept could potentially enhance and maintain agricultural water supply by assuring diverters that use of their diversion would not be restricted due to potential impacts to fish.

Objective	● ◗ ○	*Justification*
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would likely require coordination between a number of entities (including non-governmental organizations, state/federal government agencies, water agencies, and private diverters) that would contribute to fostering long-term regional relationships and help to avoid unnecessary conflict and litigation.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	Implementation of the concept would reduce fish entrainment and help build relationships between diverters, NGO's, and state/federal agencies. These outcomes are supported by a wide range of interests within the watershed.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	●	The concept would likely result in agreements between federal and/or state agencies, water agencies, private diverters, and non-governmental organizations that would reduce conflict, particularly related to fish entrainment, and other barriers limiting fish migration.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA documentation, etc.

Objective	●	◗	○	*Justification*
CA-37: Avoid basing decisions on incomplete or inaccurate information		●		Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams		●		The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife		●		The concept would not result in harmful impacts to fisheries and other wildlife. On the contrary, installing fish screens would result in fishery benefits.
CA-40: Avoid conversion of agricultural lands to developed uses		●		The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another		●		The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow		●		The concept does not include elements that would alter existing in-stream flows.
CA-43: Avoid closing the process to the public		●		As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply		●		The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply.
CA-45: Minimize adverse socio-economic and public health and safety impacts		●		The concept does not include elements that would create adverse socio-economic and public health and safety impacts.

Objective	● ◗ ○	***Justification***
CA-46: Avoid end use harm	●	The concept does not include elements that would allocate water in ways that create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	◗	While benefits would be realized by the entire region, costs would likely be accrued by those diverting entities seeking to screen diversions. To avoid interregional inequity, any cost sharing would need to be carefully considered.

1e: Riparian Restoration Program – Upstream of Pardee

Foothill Conservancy

Overview

This concept will develop and implement a program to analyze and address riparian restoration needs by identifying potential areas for restoration, identifying partnership opportunities with willing landowners, and developing a funding base for restoration projects that provides benefits to water users. The project may include removing invasive species, restoring native species, and restoring identified habitat.

Sponsor(s): Foothill Conservancy

Concept type: Planning and implementation

Estimated Costs: unknown

Funding Source(s): unknown

Concept location: Upstream of Pardee Reservoir

This concept is well suited with concept 1a: Anadromous Fish Restoration; these two concepts could be integrated and pursued in tandem.

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not have elements that promote demand-side management strategies.
WS-2: Increase supply reliability	○	The concept would not address and/or increase supply reliability.
WS-3: Increase amount of stored water	○	The concept would not increase the amount of stored water.
WS-4: Promote smart, responsible development	◗	The concept will restore and enhance riparian conditions on existing developed parcels in coordination with willing landowners, reducing the impact of development on the watershed.

Objective	● ◗ ○	***Justification***
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation.
WS-6: Promote a long-term groundwater balance	○	The concept would not help to promote a long-term groundwater balance.
WS-7: Maximize water resource availability for all beneficial uses	●	The concept would provide habitat and increase water quality for fish and other wildlife, which contributes to maximizing water resource availability for all beneficial uses.
WS-8: Decrease the need to import water	○	The concept would not result in a substantial decrease in the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	◗	The concept would likely protect and improve surface water quality in the Mokelumne, as healthy riparian corridors can filter pollutants and provide carbon storage and transport resulting from the decay of streamwood and other organic material. However, the magnitude of these benefits is unknown.
WQ-12: Match delivered water quality use	○	The concept does not involve treating water, nor does it involve delivering treated water.

Objective	● ◗ ○	***Justification***
WQ-13: Use water purification technology as a tool to maximize beneficial uses	◗	Depending upon the restoration approach(es) implemented, the project may achieve an increased level of water purification through natural treatment systems.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	●	Protecting and improving riparian vegetation is an important watershed management activity that contributes directly towards increased habitat diversity, habitat complexity, and habitat function not only for terrestrial species, but also for those aquatic species inhabiting the Mokelumne River. Restoring greater continuous areas versus smaller fragmented areas would maximize these benefits.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	◗	The concept could include stocking hatchery-raised trout in designated areas on the upper Mokelumne and designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	◗	The concept could include reintroducing salmon in the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	●	Restoring riparian habitat maximizes beneficial conditions for aquatic species, including juvenile salmonids. The concept increases angling and other recreational opportunities by maximizing these conditions.

Objective	● ◗ ○	***Justification***
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	◗	While the concept is not directly designed to enhance flood protection and management, restoring riparian habitat could provide flood attenuation.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	○	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including number of acres restored and the resulting number of species restored.
O-24: Increase investment in forest management	◗	The concept could increase investment in forest management by restoring riparian habitat, which could improve riparian/forest health and strength forest connectivity to the river.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	There are a number of DACs upstream of Pardee. The concept could potentially maximize benefits for a DAC, depending on the location of restoration activities.

Objective	● ◗ ○	*Justification*
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, project benefits would be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	●	The concept would protect and enhance the natural environment by allowing streamwood and other organic materials to remain undisturbed in the river in the patterns in which they fall or come to rest. Streamwood breaks down stochastically via decay and disintegration. This process is meant to contribute to carbon storage and carbon transport from upper watershed to the ocean in a range from entire trees to dissolved organic carbon. Additionally, an increase in the amount of wood available to fall into the channel (i.e. streamwood) would improve habitat diversity through structural additions to flow fields, refugia during high flows and from predation, and provide additional nutrients to aquatic organisms. Restoring greater continuous areas versus smaller fragmented areas would maximize these benefits.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	●	The concept would protect and improve riparian vegetation, which contributes directly towards increased habitat diversity, habitat complexity, and habitat function for fish and other aquatic species. Insect production from riparian areas provides a valuable foraging resource for juvenile salmonid and other fish species inhabiting the river. These benefits are limited to the upper Mokelumne.

Objective	● ◗ ○	*Justification*
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	○	The concept does not include elements that would increase agricultural water supply.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would require coordination between a number of entities, which could include non-governmental organizations, PG&E, and state/federal agencies. This coordination would contribute to fostering long-term regional relationships and help to avoid unnecessary conflict and litigation.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	The concept would restore riparian habitat and increase recreational and angling opportunities. These outcomes are supported by a wide range of interests within the watershed.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would not directly address any current watershed conflicts.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. As such, the concept would not interfere with any entity exercising a water right.

Objective	● ◗ ○	*Justification*
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.

Objective	● ◗ ○	***Justification***
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	The concept does not include elements that would create adverse socio-economic and public health and safety impacts.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

1f: Riparian Restoration Program – Below Camanche

San Joaquin County Resource Conservation District; Foothill Conservancy

Overview

Support the implementation efforts of the Lower Mokelumne Watershed Stewardship Plan, which analyzes and addresses riparian restoration needs. The project may include developing a funding base for projects identified in the Plan.

Sponsor(s): San Jaquin County Resource Conservation District (SJCRD), Foothill Conservancy

Concept type: Implementation

Estimated Costs: dependent on resoration contractor--average is ~$8,000/acre for invasive/non-invasive species removal (Capital)

Funding Source(s): USFWS Partners for Fish and Wildlife Program, Anadramous Fish Restoration Program, USDA NRCS, NOAA Fisheries, DWR (Floodplain Corridor Protection Program), CA Fish and Wildlife, Department of Conservation

Concept location: Approximate midpoint between Camanche Dam and confluence with Cosumnes River (38.149, -121.273)

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not have elements that promote demand-side management strategies.
WS-2: Increase supply reliability	○	The concept would not address and/or increase supply reliability.
WS-3: Increase amount of stored water	◗	The concept could increase the amount of stored water as floodplains develop natural levees that serve to capture

Objective	● ◗ ○	***Justification***
		high flows that then spread out on the adjacent floodplain, thus providing a natural sink for particulate organics and minerals along with a percolation basin into which still waters can recharge the local aquifer while contributing to flood attenuation downstream. However, the amount of recharge could be minimal depending on the size of floodplains in the more populated areas in the lower Mokelumne.
WS-4: Promote smart, responsible development	◗	The concept will restore and enhance riparian conditions on existing developed parcels in coordination with willing landowners, reducing the impact of development on the watershed.
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation.
WS-6: Promote a long-term groundwater balance	◗	The concept could help to promote a long-term groundwater balance by providing opportunities for groundwater recharge.
WS-7: Maximize water resource availability for all beneficial uses	●	The concept would provide habitat and increase water quality for fish and other wildlife, which contributes to maximizing water resource availability for all beneficial uses.
WS-8: Decrease the need to import water	○	The concept would not result in a substantial decrease in the need to import water.
WS-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.

Objective	● ◗ ○	***Justification***
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	◗	The concept would likely protect and improve surface water quality in the Mokelumne, as healthy riparian corridors can filter pollutants and provide carbon storage and transport resulting from the decay of streamwood and other organic material. However, the magnitude of these benefits is unknown.
WQ-12: Match delivered water quality use	○	The concept does not involve treating water, nor does it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	◗	Depending upon the restoration approach(es) implemented, the project may achieve an increased level of water purification through natural treatment systems.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	●	Protecting and improving riparian vegetation is an important watershed management activity that contributes directly towards increased habitat diversity, habitat complexity, and habitat function not only for terrestrial species, but also for those aquatic species inhabiting the Mokelumne River. Restoring greater continuous

Objective	● ◗ ○	*Justification*
		areas versus smaller fragmented areas would maximize these benefits.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	◗	Because restoration work would be conducted below Camanche, the concept does not include elements that would stock hatchery-raised fish in the upper Mokelumne. However, the concept could designate and manage wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	Because restoration work would be conducted below Camanche, the concept does not include reintroducing salmon in the upper Mokelumne
R-18: Increase angling and other recreational opportunities (increase opportunities)	●	Restoring riparian habitat maximizes beneficial conditions for aquatic species, including juvenile salmonids. The concept increases angling and other recreational opportunities by maximizing these conditions.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	●	In lowland environs, riparian corridors connect river corridors and floodplains. In many cases, floodplains develop natural levees that serve to capture high flows that then spread out on the adjacent floodplain, thus providing a natural sink for particulate organics and minerals along with a percolation basin into which still waters can recharge the local aquifer while contributing to flood attenuation downstream.

Objective	● ◗ ○	***Justification***
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	○	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including number of acres restored and the resulting number of species restored.
O-24: Increase investment in forest management	◗	The concept could increase investment in forest management by restoring riparian habitat, which could improve riparian/forest health and strength forest connectivity to the river.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	Restoration activities would benefit DACs in Lodi and Stockton by reducing attenuating flood flows that would otherwise cause flooding in these DACs.
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, project benefits would be spread across regions, cultures, incomes, and time.

Objective	● ◗ ○	*Justification*
E-27: Protect and enhance natural environment (enhance natural envt)	●	The concept would protect and enhance the natural environment by allowing streamwood and other organic materials to remain undisturbed in the river in the patterns in which they fall or come to rest. Streamwood breaks down stochastically via decay and disintegration. This process is meant to contribute to carbon storage and carbon transport from upper watershed to the ocean in a range from entire trees to dissolved organic carbon. Additionally, an increase in the amount of wood available to fall into the channel (i.e. streamwood) would improve habitat diversity through structural additions to flow fields, refugia during high flows and from predation, and provide additional nutrients to aquatic organisms. Restoring greater continuous areas versus smaller fragmented areas would maximize these benefits.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	●	The concept would protect and improve riparian vegetation, which contributes directly towards increased habitat diversity, habitat complexity, and habitat function for fish and other aquatic species. Insect production from riparian areas provides a valuable foraging resource for juvenile salmonid and other fish species inhabiting the river.

Objective	● ◗ ○	*Justification*
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	○	The concept does not include elements that would increase agricultural water supply.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would require coordination between a number of entities, which could include non-governmental organizations, private landowners, and water agencies. This coordination would contribute to fostering long-term regional relationships and help to avoid unnecessary conflict and litigation.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	The concept would restore riparian habitat and increase recreational and angling opportunities. These outcomes are supported by a wide range of interests within the watershed.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would not directly address any current watershed conflicts.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. As such, the concept would not

Objective	● ◗ ○	***Justification***
		interfere with any entity exercising a water right.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	The concept involves supporting restoration activities noted in the Lower Mokelumne Watershed Stewardship Plan. Implementation of any aspects of the plan would require a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows.

Objective	● ◗ ○	*Justification*
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	The concept does not include elements that would create adverse socio-economic and public health and safety impacts.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

1g: Mokelumne Water Quality, Soil Erosion, and Sedimentation Restoration

Amador Water Agency

Overview

Sponsor(s): Amador Water Agency (AWA)

Concept type: Planning

Estimated Costs: $400,000 (capital)

Funding Source(s): Watershed Restoration Grant, USFS rehabilitation funds for Power Fire, funds from Benefiting Users of Mokelumne Water

Concept location: Upstream of Pardee Reservoir

The purpose of this concept is to eliminate man-caused water pollution and adverse impacts on aquatic resources from sediment by eliminating point sources of gully erosion. The concept would develop a three-phase program in the Mokelumne Watershed upstream of Pardee Reservoir. Gullies from road and trail drainage (open & closed for use) and any other "unnatural" eroding surfaces that deliver significant amounts of sediment to streams will be the primary targets for this program because they can be the biggest contributors to water quality degradation and adverse impacts on river aquatic resources. The program would consist of three phases: 1) inventory areas of soil erosion in coordination with land owners, 2) set priorities, and develop an action plan, and 3) seek partners and funding for projects. The USFS Amador District Ranger is currently developing a study and restoration projects in the 2004 Power Fire burn area, which affected 17,000 acres within the upper Mokelumne watershed. This concept would be coordinated with that, as well as with the Amador Calaveras Consensus Group which is currently engaged in this work with the USFS.

Assessment

Objective	● ◗ ○	*Justification*
● *Fully addressed* ◗ *Partially addressed* ○ *Not addressed*		

Objective	● ◗ ○	***Justification***
WS-1: Promote demand-side management strategies	○	As an implementation plan, the concept does not have elements that promote demand-side management strategies. Implementation of the project described in the concept would also not have elements that would promote demand-side management strategies.
WS-2: Increase supply reliability	○	As an implementation plan, the concept would not increase supply reliability. Implementation of the project described in the concept would also not increase supply reliability.
WS-3: Increase amount of stored water	◗	The concept itself does not include elements that would increase the amount of stored water. However, if implemented, less erosion, sedimentation and surface run-off could decrease the amount of sedimentation occurring in reservoirs. Storage in Tiger Creek Afterbay has been reduced by 76% since it was built in 1931; remaining capacity is anticipated ot be lost in the next 25 years (Moke Watershed Avoided Cost Analysis: Why Sierra Fuel Treatments Make Economic Sense).
WS-4: Promote smart, responsible development	○	Neither the concept nor its implementation would promote smart, responsible development.
WS-5: Reduce reliance on groundwater for irrigation	○	Neither the concept nor its implementation would reduce reliance on groundwater for irrigation

Objective	● ◗ ○	*Justification*
WS-6: Promote a long-term groundwater balance	◗	The concept itself does not promote a long-term groundwater balance. However, if implemented, groundwater supplies would likely increase due to greater infiltration rates as erosion slows.
WS-7: Maximize water resource availability for all beneficial uses	◗	As an implementation plan, the concept itself does not address maximizing water resource availability for all beneficial uses. However, restoration and control of erosion and sedimentation would provide optimum use of storage facilities. If implemented, peak flood flows would decrease and run-off would be less turbid, which is beneficial for water agencies and downstream communities that experience flooding.
WS-8: Decrease the need to import water	◗	The concept itself would not decrease the need to import water. However, if implemented, the concept could increase storage on the Mokelumne, which could decrease the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates. Implementation of the project described in the concept would also not review existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update. Implementation of the project described in the concept would also not identify water demand issues.

Objective	● ◗ ○	*Justification*
WQ-11: Protect and improve surface and groundwater quality	◗	As an implementation plan, the concept would not protect and improve surface and groundwater quality. However, if implemented, the project would likely improve surface and groundwater quality by reducing pollutants and turbidity sourced by roads, trails and other development that enter the system via erosion.
WQ-12: Match delivered water quality use	○	As an implementation plan, the concept itself would not involve treating water, nor does it involve delivering treated water. If implemented, the concept would also not match delivered water quality to use.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	As an implementation plan, the concept does not use water purification technology as a tool to maximize beneficial uses. Implementation of the project as described in the concept would also not use purification technology as a tool to maximize beneficial uses.
R-14: Increase access for water-based recreation	○	As an implementation plan, the concept itself does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters. Implementation of the project as described in the concept would also not increase access.

Objective	● ◗ ○	*Justification*
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	◗	As an implementation plan, the concept itself would not increase spawning habitat. However, if the project as described in the concept were implemented, habitat would likely benefit. Management of soil erosion and sediment deposition within aquatic habitats is an important element in defining the quality and suitability of aquatic habitat, particularly for salmonid spawning and juvenile rearing, but also for other aquatic resources, including macroinvertebrate and insect production within various parts of the watershed. Soil erosion as a result of road crossings, local land use, fire, and other factors has been identified as an important factor affecting habitat quality and suitability within a watershed.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	As an implementation plan, the concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections. Implementation of the project described in the concept would also not stock hatchery-raised trout.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	As an implementation plan, the concept itself does not include reintroducing salmon into the upper Mokelumne. Implementation of the project described in the concept would also not reintroduce salmon into the upper Mokelumne.

Objective	● ◗ ○	*Justification*
R-18: Increase angling and other recreational opportunities (increase opportunities)	◗	The concept itself does not address increasing recreational or angling opportunities. However, if implemented, the project would likely reduce sedimentation, which could improve fish counts and lead to more angling opportunities. Less erosion would improve geomorphic functions which could include an increase in baseflows leading to better water quality and geomorphic functionality, which may improve fish habitat and riparian corridor health. These outcomes would increase angling and other recreational opportunities.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed. Implementation of the project described in the concept would also not resolve existing water rights conflicts.
F-20: Enhance flood protection and management	◗	The concept itself does not address flood protection or management. However, as a result of reduced sedimentation and sheet flow runoff and higher infiltration rates, peak flood flows and sedimentation transport rates during flood events would decrease. Implementing the project described in the concept would enhance flood protection for residents and businesses within the watershed by helping to slow and attenuate floodwaters.

Objective	● ◗ ○	***Justification***
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	As an implementation plan, the concept itself does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program. Implementation of the project described in the concept would also not produce a hydrology dataset or Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	◗	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed. However, the purpose of this concept is to assess feasibility and collect sound, agreed-upon data prior to implementation of the concept.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including how and where erosion and sedimentation is occurring, restoration methods, erosion and sedimentation control and prevention, and the relationship between storage and erosion.
O-24: Increase investment in forest management	◗	The concept does not directly address increasing investment in forest management. However, if implemented, the concept could lead to additional investments in forest management as a result to improvements to riparian and fluvial health.

Objective	● ◗ ○	*Justification*
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	As an implementation plan, the concept would not directly contribute to socio-economic, cultural, recreational, public health and public safety benefits of a DAC. If implemented, the project described in the concept could maximize these benefits, particularly if the areas identified in the implementation plan are located within a DAC.
O-26: Achieve equity	◗	As an implementation plan, the concept would not directly achieve equity. However, the benefits realized from restoration activities would not be limited to a narrow group; rather, project benefits would be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	◗	As an implementation plan, the concept itself would not protect and enhance the natural environment. Implementation of the project as described in the concept would protect and enhance the natural environment by restoring eroded lands, leading to a healthier watershed for aquatic wildlife such as fish and frogs and promoting increased stability in more sensitive habitats. In addition, increased bank stability would promote vegetation diversity and flood events would have a less dramatic disruption in the area.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation. If implemented, the project as described in the concept would also not incorporate or seek a wild and scenic designation.

Objective	● ◗ ○	***Justification***
E-29: Protect and restore fisheries	◗	The concept itself does not directly address fisheries. However, a reduction in sedimentation and turbidity could potentially improve substrate habitat for spawning fish and invertebrates that utilize interstitial spaces in the channel bed, as well as improve spring and summer fish growth rates. Reduce fine-grained sedimentation reduces redd (fish nest) scour, with the associated loss of incubating eggs.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	○	The concept does not include elements that would increase agricultural water supply. Implementation of the concept would also not enhance or maintain agricultural water supply.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	One purpose of the concept is to seek partners for the project (which may include private landowners and the USFS Amador District Ranger), which would foster long-term regional relationships. The implementation plan helps avoid unnecessary conflict and litigation by identifying and attempting to resolve these issues early on.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	Implementation of the concept would lead to improved water quality, greater ecological diversity and reduced flooding hazards. These outcomes are supported by a wide range of stakeholders.

Objective	● ◗ ○	*Justification*
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	◗	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens. The project described in the concept would also need to undergo these screenings to determine if it was the least controversial project.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would not directly address any current watershed conflicts. Soil restoration activities would also not address this objective.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. This would also be required of the project described in the concept if it were to be implemented.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc. This would also be required of the project described in the concept if it were to be implemented.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.

Objective	● ◗ ○	***Justification***
CA-38: Avoid demand for new or larger on-stream dams	●	The concept will not result in construction of a new or larger on-stream dam. If the project as described in the concept is implemented, there would also not be demand for new or larger on-stream dams.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife. On the contrary, the implementation of the project described in the concept would likely increase water quality, which would benefit fish and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept would not convert agricultural lands to developed uses. Implementation of the project described in the concept would also not convert agricultural lands.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept would not shift environmental impacts from one area to another. Implementation of the project described in the concept would also not shift environmental impacts.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows. Implementation of the project described in the concept would also not diminish the benefits of existing in-stream flow.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate. This also applies to any restoration activities.

Objective	● ◗ ○	*Justification*
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. This also applies to implementation of the project described in the concept.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	The concept does not include elements that would create adverse socio-economic and public health and safety impacts. Implementation of the project described in the concept would provide public health and safety benefits by upgrading the treatment process from a sand filter to a membrane filtration process.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm. This also applies to implementation of the project described in the concept.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation. This also applies to any restoration activities.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs. This also applies to any restoration activities.

2a: Municipal Recycled Wastewater Recharge Program

City of Lodi

Overview

Sponsor(s): City of Lodi

Concept type: Planning and implementation

Estimated Costs: unknown

Funding Source(s): State grants, City of Lodi Utility Rates, Regional Groundwater Extraction Fee

Concept location: San Joaquin County, west of Davis Road, south of SR 12 and north of Eight Mile Road

The concept involves using treated, disinfected wastewater to recharge, either direct or in-lieu, Valley groundwater aquifers. Based on findings from the MokeWISE Water Availability Analysis, the City currently treats 7,095 AFY of wastewater. Of this, 1,642 AFY is used as recycled water. Assuming the 3,700 AFY agricultural reuse project is implemented, the City of Lodi could currently treat and reuse roughly 1,700 AFY of wastewater. This number will grow to 3,050 AFY in the future, accounting for population growth. The concept includes developing a feasibility study to identify nearby areas potentially feasible for recharge and document potential downstream impacts of diverting wastewater. Uses including consumptive use and seawater intrusion barriers will be considered. After the feasibility study is published, study recommendations will be implemented.

Assessment

Objective	● ◗ ○	*Justification*
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not have elements that promote demand-side management strategies.

Objective	● ◗ ○	***Justification***
WS-2: Increase supply reliability	●	The concept would increase supply reliability by reusing treated wastewater, which would likely offset Mokelumne River water and groundwater that is currently used by the City of Lodi. As a supply, recycled water is more reliable than Mokelumne River water and groundwater. Because of this, the City of Lodi and its customers could become more resilient against changes in the Mokelumne River system and changes in groundwater levels.
WS-3: Increase amount of stored water	●	The purpose of the concept is to use treated recycled water to recharge the groundwater basin, which would increase the amount of stored water.
WS-4: Promote smart, responsible development	○	While the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation, as the purpose of the concept is to recharge the groundwater basin and does not offset groundwater use for irrigation.
WS-6: Promote a long-term groundwater balance	●	The purpose of the concept is to recharge the groundwater basin, which would help promote a long-term groundwater balance.
WS-7: Maximize water resource availability for all beneficial uses	●	The concept would maximize water resource availability for all beneficial uses by reusing treated wastewater for either consumptive uses or as a seawater intrusion barrier (use as a seawater intrusion barrier would help protect current supplies).

Objective	● ◗ ○	*Justification*
WS-8: Decrease the need to import water	○	The City does not currently import water, as its supply portfolio is groundwater and Mokelumne River water. As such, the concept would not decrease the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	●	The concept would protect and improve groundwater quality by increasing the amount of stored water, which would help dilute pollutants in the groundwater. If the recycled water is used as a seawater intrusion barrier, it would protect groundwater quality.
WQ-12: Match delivered water quality use	○	While the concept involves treating water, it does not involve increasing the level of treatment for use in groundwater recharge. Additionally, the concept does not involve delivering treated water, aside from continuing to pump groundwater.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	●	The concept would treat wastewater to be used for recharge, which maximizes beneficial use of the wastewater.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.

Objective	● ◗ ○	***Justification***
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	The concept would not contribute to increasing spawning habitat, designating sections of the river for hatchery and wild species, or designating environmental flows.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	While the concept would decrease the likelihood of fish entrainment by removing an unscreened diversion, the extent to which this would increase angling opportunities is likely negligible.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.

Objective	● ◗ ○	*Justification*
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	◗	The concept has some quantitative information available, including an estimated amount of water available for groundwater recharge.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including information on groundwater recharge and recovery and water quality.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	The concept would be located in the San Joaquin Valley and would serve the City of Lodi. Portions of the City and a number of areas within the Valley are DACs and would benefit from this concept.
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, project benefits would be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	○	The concept does not incorporate elements that would protect and enhance the natural environment.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.

Objective	● ◗ ○	*Justification*
E-29: Protect and restore fisheries	○	While the concept could reduce the use of Mokelumne River water, this amount would be negligible and likely not help to protect and restore fisheries.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	●	The concept maintains and provides a more reliable water supply for agricultural uses by using recycled water instead of Mokelumne River water and groundwater.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would help foster regional relationships by requiring long-term coordination between the City and other entities participating in groundwater recharge within the Valley.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	The concept would protect supplies for agricultural users and contribute to groundwater recharge. These outcomes are supported by a wide range of interests within the watershed, including farmers, water agencies, and non-governmental organizations.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would serve recycled water for irrigation and groundwater recharge; its implementation would not directly address any current watershed conflicts.

Objective	● ◗ ○	*Justification*
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. As such, the concept would not interfere with any entity exercising a water right.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows.

Objective	● ◗ ○	***Justification***
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. On the contrary, the concept increases the reliability of a supply.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	Use of recycled water mandates protections of public health and safety. As a condition of implementation, the concept would be required to follow regulations mandating health and safety impacts. Additionally, the concept does not include elements that would create adverse socio-economic impacts.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

2b: Constellation Winery Wastewater Reuse

Constellation Winery; GBA, NSJWCD

Overview

Sponsor(s): Constellation Winery; Groundwater Basin Authority, North San Joaquin Water Conservation District

Concept type: Planning and implementation

Estimated Costs: unknown

Funding Source(s): unknown

Concept location: NSJWCD's fourth diversion point on the Mokelumne River

Currently, Constellation Winery has an unscreened diversion point on the Mokelumne River and riparian rights. This concept involves moving their diversion point to North San Joaquin Water Conservation District's (NSJWCD's) fourth diversion point, which is a state-of-the-art facility with a fish screen. The project would divert surface water from the combined diversion and blend it with wastewater from Constellation Winery (treated wastewater is currently being used to irrigate forage crops, but is high in potassium). This blended water would be used for irrigation and recharge (percolation ponds), depending on the year type. In wet years, between 2,000 and 4,000 acre-feet per year (AFY) will be available for the project. In these wet years, 50% (likely 1,000 to 2,000 AFY) would be used for irrigation, and the remaining 50% would be used for recharge. In dry years, 1,000 to 2,000 AFY would be available for the project. In these dry years, all water would be used for irrigation.

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not have elements that promote demand-side management strategies.

Objective	● ◗ ○	***Justification***
WS-2: Increase supply reliability	●	The concept would extend the use of Mokelumne River water by blending it with recycled water. This blending would increase the number of irrigated acres and recharge potential of the Mokelumne River water. The concept would increase supply reliability for NSJWCD by increasing the use of recycled water. In wet years, use of NSJWCD's Mokelumne water would be extended by blending it with recycled water. In dry years, NSJWCD would have access to Mokelumne River water through Constellation's water right; the District would be able to use the blended water for irrigation, when previously, groundwater would have been used. As a supply, recycled water is more reliable and available to NSJWCD in more hydrologic year types than Mokelumne River water. Because of this, NSJWCD and its customers could become more resilient in dry years when Mokelumne River under NSJWCD's water right is likely unavailable.
WS-3: Increase amount of stored water	○	The concept would not increase the amount of stored water.
WS-4: Promote smart, responsible development	○	While the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.
WS-5: Reduce reliance on groundwater for irrigation	●	Because NSJWCD's surface water rights are junior and are often unavailable in dry years, groundwater is a large portion of their supply portfolio. The concept would help reduce reliance on groundwater by 1,000 to 2,000 AFY by irrigating with recycled water instead of groundwater.
WS-6: Promote a long-term groundwater balance	●	The concept would help promote a long-term groundwater balance by offsetting groundwater use by using recycled water for irrigation instead of groundwater. Between 1,000 and 2,000 AFY of groundwater would be offset.

Objective	● ◗ ○	*Justification*
WS-7: Maximize water resource availability for all beneficial uses	●	The concept will allocate water to both agricultural users and to groundwater recharge by blending Mokelumne River supply with treated wastewater, maximizing water availability for multiple beneficial uses.
WS-8: Decrease the need to import water	○	The concept would offset use of groundwater supplies, not the use of imported water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	◗	The concept would protect and improve groundwater quality because more groundwater would be left in the basin, which dilutes the concentrations of constituents. However, because the amount of groundwater that would be offset is small (1,000 to 2,000 AFY), this benefit would be minimal.
WQ-12: Match delivered water quality use	●	Currently, Mokelumne River water and groundwater are used for irrigation in the concept area (treated wastewater is used to irrigate forage crops). The concept would match delivered water quality to use by blending treated wastewater with Mokelumne River water to use for grape and other crop irrigation.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	●	The purpose of the concept is to reuse treated wastewater created by Constellation Winery, which uses water treatment technology to maximize beneficial uses, including irrigation and groundwater recharge.

Objective	● ◗ ○	***Justification***
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	The concept would not contribute to increasing spawning habitat, designating sections of the river for hatchery and wild species, or designating environmental flows.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	While the concept would decrease the likelihood of fish entrainment by removing an unscreened diversion, the extent to which this would increase angling opportunities is likely negligible.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.

Objective	● ◗ ○	***Justification***
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	◗	The concept has some quantitative information available, including an estimated amount of water available for groundwater recharge and irrigation.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including information on groundwater recharge and recovery, crop yield, and water quality.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	○	The concept is not located within a DAC and would not directly contribute to socio-economic, cultural, recreational, public health, and public safety benefits of a DAC.
O-26: Achieve equity	●	The benefits realized from implementing the concept, including removing of an unscreened diversion and increasing supply reliability for NSJWCD, would not be limited to a narrow group; rather, project benefits would be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	●	One outcome of the concept is the removal of an unscreened diversion from the Mokelumne River. This would protect and enhance the natural environment by decreasing the likelihood that fish would become entrained by the unscreened diversion.

Objective	● ◗ ○	*Justification*
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	●	NSJWCD's fourth diversion is a state of the art diversion facility with a fish screen. The diversion used by Constellation Winery does not have a fish screen. The concept would move Constellation Winery's diversion point to NSJWCD's fourth diversion point and abandon their current diversion. Because of this, an unscreened diversion would be removed from the River, which reduces the likelihood of fish becoming entrained in unscreened diversions.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	●	The concept maintains and provides water supply for agricultural uses by blending recycled water with Mokelumne River water, which allows NSJWCD access to Mokelumne River water even in dry years when Mokelumen River water under the District's water right may not be available to the District. Additionally, using blended recycled water during dry years offsets groundwater use, as NSJWCD relies on groundwater for irrigation in dry years.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would help foster regional relationships by requiring long-term coordination between NSJWCD, agricultural water users, and Constellation Winery.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	The concept would provide resiliency for agricultural water users, contribute to groundwater recharge, and remove an unscreened diversion from the Mokelumne River. These outcomes are supported by a wide range of interests within the watershed, including farmers, water agencies, and non-governmental organizations.

Objective	● ◗ ○	*Justification*
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would serve recycled water for irrigation and recharge groundwater; its implementation would not directly address any current watershed conflicts.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. As such, the concept would not interfere with any entity exercising a water right.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.

Objective	● ◗ ○	*Justification*
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife. On the contrary, an outcome of the concept is an abandoned unscreened diversion point on the Mokelumne River, which would reduce the likelihood of fish entrainment and benefit fish and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow	◗	Changing a point of diversion could alter in-stream flows. However, due to the small amount of diverted water that would be moved to the new diversion point, diminishment of current in-stream benefits would likely be low.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. On the contrary, the concept increases the reliability of a supply.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	Use of recycled water mandates protections of public health and safety. As a condition of implementation, the concept would be required to follow regulations mandating health and safety impacts. Additionally, the concept does not include elements that would create adverse socio-economic impacts.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that would create end use harm.

Objective	● ◗ ○	***Justification***
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

2c: Amador County Regional Reuse

Amador Water Agency; JVID

Overview

Sponsor(s): Amador Water Agency; Jackson Valley Irrigation District (JVID)

Concept type: Implementation

Estimated Costs: $118,612 per year , two sites (O&M)

Funding Source(s): WRCB Revolving Fund, Water Recycling Grant Programs, USDA Rural Utilities, US Bureau of Reclamation, IRWM

Concept location: Near the cities of Jackson and Sutter Creek

The concept involves implementing aspects of the Amador County Regional Approach for Reuse Study. There are three alternatives identified in the Reuse Study: (1) a regional recycled water tertiary plant located in the City of Sutter Creek, (2) a regional recycled water tertiary plant located in the City of Jackson, and (3) upgrade the recycled water treatment plant located in the City of Jackson to serve local users and construct a recycled water treatment plant located in the City of Sutter Creek to serve users located in Sutter Creek, Amador City, Martell, and the Gold Rush Ranch Development. The Study recommends implementation of Alternative 3, the decentralized system. The Amador County Regional Reuse project would involve developing a refinement study that would further define pipeline alignments, storage sites, pump station layouts, and required upgrades to existing WWTPs. The project would also provide engineering cost estimates, enough information for preparation of an environmental review, and refined information for continued public meetings.

Assessment

Objective	● ◗ ○	*Justification*
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not have elements that promote demand-side management strategies.

Objective	● ◗ ○	***Justification***
WS-2: Increase supply reliability	●	The concept would increase supply reliability by 400 AFY by reusing treated wastewater, which would offset Mokelumne River water use. As a supply, recycled water is more reliable than Mokelumne River water, as it is not tied to hydrologic year type, but rather population. Because of this, AWA could become more resilient against changes in the Mokelumne River system.
WS-3: Increase amount of stored water	○	The concept would not increase the amount of stored water.
WS-4: Promote smart, responsible development	●	AWA policy requires that all new development, where feasible, will be required to utilize recycled water. This concept promotes this objective by providing a recycled water supply source.
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation, as AWA does not use groundwater.
WS-6: Promote a long-term groundwater balance	○	The concept would not promote a long-term groundwater balance.
WS-7: Maximize water resource availability for all beneficial uses	●	The concept would maximize water resource availability for all beneficial uses by reusing treated wastewater and likely offsetting Mokelumne River water use.
WS-8: Decrease the need to import water	○	AWA does not currently import water. As such, the concept would not decrease the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.

Objective	● ◗ ○	*Justification*
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	○	The concept would not protect or improve surface and/or groundwater quality.
WQ-12: Match delivered water quality use	●	The concept would match delivered water quality to use by treating wastewater and reusing it for non-potable needs. This maximizes Mokelumne River water for those who need potable water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	●	The concept would provide disinfected tertiary treated water, which maximizes its beneficial use.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	The concept would not contribute to increasing spawning habitat, designating sections of the river for hatchery and wild species, or designating environmental flows.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.

Objective	● ◗ ○	*Justification*
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	The concept would not increase angling and other recreational opportunities.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	◗	The concept has some quantitative information available, including an estimated amount of water that would be available for treatment and reuse.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including information on treatment, water quality, and end uses.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.

Objective	● ◗ ○	***Justification***
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	The concept would maximize socio-economic and public health and safety benefits by serving recycled water to AWA customers in Sutter Creek, which is a DAC.
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, project benefits would be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	●	The concept would provide recycled water for 158 acres of oak mitigation preserve, 1 acre of viewpoint, and 6 acres for the historic tailing wheels park. Supplying water to these end uses help protect the natural environment.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	○	While the concept could reduce the use of Mokelumne River water by up to 400 AFY. The less water diverted from the river channel, the better for the geomorphic and ecological health of the ecosystem. However, this amount is negligible and won't have a significant benefit on fisheries.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	◗	The concept is focused on municipal sites initially; however, future expansion for agricultural sites (primarily vineyards) is being considered.

Objective	● ◗ ○	***Justification***
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would help foster regional relationships by requiring long-term coordination between varying entities within Amador County, including AWA, state government, and non-governmental agencies.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	The concept would provide resiliency for AWA customers and likely offset Mokelumne River use. These outcomes are supported by a wide range of interests within the watershed, including water agencies and non-governmental organizations.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would serve recycled water to AWA customers; its implementation would not directly address any current watershed conflicts.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. As such, the concept would not interfere with any entity exercising a water right.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.

Objective	● ◗ ○	*Justification*
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. On the contrary, the concept increases the reliability of a supply.

Objective	● ◗ ○	***Justification***
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	Use of recycled water mandates protections of public health and safety. As a condition of implementation, the concept would be required to follow regulations mandating health and safety impacts. Additionally, the concept does not include elements that would create adverse socio-economic impacts.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that would create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

3a: Solar-Powered Desalination Study

No identified sponsor

Overview

Sponsor(s): none

Concept type: Planning and implementation

Estimated Costs: uknown

Funding Source(s): uknown

Concept location: near the Delta

The concept would assess the feasibility of a solar-powered desalination facility. Based on the results of the study, the concept would also involve developing a solar-powered desalination project, which may include identifying partners for a cost-sharing program. This desalination facility would clean brackish water from the Delta, agricultural drainage water, or from groundwater using solar troughs. The solar panels would create enough heat to separate the salt and water through evaporation. The remaining salt solidifies and can be removed and used in other industries as building materials, metals, or fertilizers. Some systems have a 93% recovery rate and use about 1/5 of the energy used by traditional desalination plants. Cost per acre-foot is cited around $450, but may be greater depending on the location and scale of implementation.

Assessment

Objective	● ◗ ○	***Justification***
WS-1: Promote demand-side management strategies	○	The concept does not have elements that promote demand-side management strategies.
WS-2: Increase supply reliability	●	The concept would increase supply reliability by diversifying supply portfolios and treating water which is currently of too poor a quality to be beneficially used.
WS-3: Increase amount of stored water	○	The concept would not increase the amount of stored water.
WS-4: Promote smart, responsible development	○	While the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.

Objective	● ◗ ○	***Justification***
WS-5: Reduce reliance on groundwater for irrigation	◗	The concept could potentially reduce reliance on groundwater for irrigation, assuming the desalinated water was delivered to and used by agricultural users that currently use groundwater.
WS-6: Promote a long-term groundwater balance	◗	If the source water is Delta water, the concept would not promote a long-term groundwater balance. If the source water is brackish groundwater, the concept could promote a long-term groundwater balance if the desalinated water was used for recharge or salt water intrusion barriers. However, if the desalinated groundwater was used for consumptive use, the concept would not promote a long-term groundwater balance, as it would likely encourage additional groundwater pumping.
WS-7: Maximize water resource availability for all beneficial uses	●	The concept would maximize water resource availability for all beneficial uses by diversifying supply portfolios and by treating and using water that is currently unavailable for use due to quality issues.
WS-8: Decrease the need to import water	○	The concept would not decrease the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.

Objective	● ◗ ○	*Justification*
WQ-11: Protect and improve surface and groundwater quality	◗	The concept could potentially protect and improve surface and groundwater quality if the project used agricultural drainage water for its source. Agricultural drainage water can affect groundwater and surface water quality. Additionally, if the concept used groundwater and either recharged the groundwater basin or used the desalinated water as a saltwater intrusion barrier, the concept could also protect and improve groundwater quality.
WQ-12: Match delivered water quality use	●	The concept would match delivered water quality to use by treating water which is currently too brackish to be put to beneficial use.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	●	The concept uses water purification technology to maximize beneficial uses by desalinating brackish water for use.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	Desalinization is not a cost-effective method for increasing instream flows for fishery habitat enhancement.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.

Objective	● ◗ ○	*Justification*
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	The concept would not increase angling and other recreational opportunities.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	●	The concept would require the use of an agreed-upon hydrology dataset and/or Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	○	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including water quality information, cost, yield, and other information that would help determine the success of the program.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.

Objective	● ◗ ○	***Justification***
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	The project location is not yet well-defined. However, if the desalinated water is delivered to disadvantaged communities, the concept would maximize water supply benefits for that DAC.
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, concept benefits would likely be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	◗	There are potential indirect opportunities where conjunctive operations with a desalinization facility could reduce demands on surface water supplies that could then subsequently be used for fishery habitat purposes. However, the magnitude and feasibility of such conjunctive use programs and their cost-effectiveness is not known at this time.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	○	The concept does not include elements that would protect and restore fisheries.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	●	The concept would enhance or maintain water supply for agricultural uses. Desalinated water could be used for agricultural water supply, or for recharge and/or saltwater intrusion. All of these end uses would enhance or maintain agricultural water supply.

Objective	● ◗ ○	*Justification*
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would likely require coordination between a number of entities (including non-governmental organizations, water agencies, and state government) that would contribute to fostering long-term regional relationships and help to avoid unnecessary conflict and litigation.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	Implementation of the concept could reduce Mokelumne River use, diversify supply portfolios, and/or recharge groundwater and provide a saltwater intrusion barrier. These outcomes are supported by a wide range of interests within the watershed.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	◗	Treating agricultural runoff water could reduce conflict by improving surface and groundwater quality. Additionally, conflict could be reduced if the desalinated water is used for groundwater recharge and/or as a saltwater intrusion barrier.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. As such, the concept would not interfere with any entity exercising a water right.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.

Objective	● ◗ ○	***Justification***
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	◗	The concept could result in harmful impacts to fisheries and wildlife, particularly in the Delta. The desalinization plant would need to be carefully constructed and placed to prevent destruction of natural land use, and to minimize harm to wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	◗	The concept would require the construction of a desalination plant. To meet this objective, construction of the plant would need to avoid converting agricultural lands (this is particularly the case in the Delta where agriculture is concentrated and where source water could be agricultural drainage water).
CA-41: Avoid shifting environmental impacts from one area to another	◗	The concept would likely reduce the use of Mokelumne River water but, if the source water were Delta supply, the concept could increase diversions from the Delta. This could shift environmental impacts from the Mokelumne River to the Delta. If the source water were agricultural drainage water, there would be no shift in environmental impacts.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing Mokelumne River in-stream flows.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.

Objective	● ◗ ○	***Justification***
CA-44: Avoid dependency on potentially unreliable supply	◗	Agricultural drainage water and Delta supply can be unreliable. Agricultural drainage water is assumed to be decreasing due to agricultural efficiencies and Delta supply can be unavailable in certain year types and in certain times of the year. Depending on the end use and the size of the desalination plant, there may be a risk of creating dependency on a potentially unreliable supply.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	Use of desalinated water mandates protections of public health and safety. As a condition of implementation, the concept would be required to follow regulations mandating health and safety impacts. Cost distribution would need to be considered to minimize adverse socio-economic impacts.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

4a: Groundwater Banking within the Eastern San Joaquin Groundwater Basin

Groundwater Basin Authority, Calaveras County Water District, North San Joaquin Water Conservation District; CPUD

Overview

Sponsor(s): Groundwater Basin Authority (GBA), Calaveras County Water District (CCWD), North San Joaquin Water Conservation District (NSJWCD); Calaveras Public Utilities District (CPUD)

Concept type: Planning

Estimated Costs: unknown

Funding Source(s): unknown

Concept location: Eastern San Joaquin Groundwater Basin, including portions of Calaveras County

The concept would identify opportunities for direct and in-lieu banking with a variety of sources including Mokelumne River, stormwater, agricultural runoff, etc. Recharge methods could include gravity infiltration and groundwater injection. Land that is currently used for farming may be considered for the sole and express purpose of groundwater banking and recharge subject to SJC Development Title 9-1080 (as applicable) with voluntary participation and fair compensation of the landowners for either seasonal or long-term projects. Geographic scope includes the Eastern San Joaquin Groundwater Basin, including portions of Calaveras County. The study would include evaluation of the proposed beneficial uses of the project and clarifying operational parameters. It would also identify impacts, and constraints in the following areas: river flows, domestic water supply, technical, political, environmental (including both species-related and geomorphic), economic, legal, and recreation – recognizing that a more detailed Environmental Impact Report would be required prior to implementing a project. The study will include consultation with members of the MokeWISE MCG.

Assessment

Objective	●	◗	○	*Justification*
● *Fully addressed*		◗ *Partially addressed*		○ *Not addressed*

Objective	● ◗ ○	*Justification*
WS-1: Promote demand-side management strategies	○	As a feasibility study, the concept does not have elements that promote demand-side management strategies. Implementation of the project described in the concept would also not have elements that would promote demand-side management strategies.
WS-2: Increase supply reliability	◗	As a feasibility study, the concept itself would not increase supply reliability. However, if groundwater banking projects were implemented, supply reliability would be increased by storing water for use in drier years when other supplies may become unavailable.
WS-3: Increase amount of stored water	◗	As a feasibility study, the concept itself would not increase stored water. However, if groundwater banking projects were implemented, the amount of water stored in the groundwater basin would increase.
WS-4: Promote smart, responsible development	◗	As a feasibility study, the concept itself would not increase supply reliability. However, groundwater banking projects would promote smart, responsible development by increasing the amount of stored water that would be available for use during drier years.
WS-5: Reduce reliance on groundwater for irrigation	○	As a feasibility study, the concept itself would not reduce reliance on groundwater. Implementation of groundwater banking projects would also not reduce reliance on groundwater for irrigation; their implementation would increase groundwater supply that could be used for irrigation.

Objective	● ◗ ○	*Justification*
WS-6: Promote a long-term groundwater balance	◗	As a feasibility study, the concept itself would not promote a long-term groundwater balance. However, groundwater banking projects would promote a long-term groundwater balance by banking water in wetter years to increase groundwater levels; this water would then be used during drier years when other supplies are unavailable.
WS-7: Maximize water resource availability for all beneficial uses	◗	As a feasibility study, the concept itself would not maximize water resource availability for all beneficial uses. However, groundwater banking projects would maximize water resource availability for all beneficial uses by increasing the amount of stored water that could be used for beneficial uses in drier years.
WS-8: Decrease the need to import water	◗	As a feasibility study, the concept itself would not decrease the need to import water. However, groundwater banking projects could decrease the need to import water in drier years, as banked water would be used in lieu of imported water during drier years.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates. Groundwater banking projects would also not review existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update. Implementing groundwater banking projects would also not identify water demand issues.

Objective	● ◗ ○	***Justification***
WQ-11: Protect and improve surface and groundwater quality	◗	As a feasibility study, the concept itself would not protect or improve surface and/or groundwater quality. Groundwater banking projects would protect and improve groundwater quality by increasing the amount of stored groundwater, which would help dilute pollutants. However, depending on the location and timing of diversions from the Mokelumne, surface water quality may suffer.
WQ-12: Match delivered water quality use	○	As a feasibility study, the concept itself would not involve treating water, nor does it involve delivering treated water. The objective would also not be met if groundwater banking projects were implemented.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	As a feasibility study, the concept itself would not use water purification technology as a tool to maximize beneficial uses. The objective would also not be met if groundwater banking projects were implemented.
R-14: Increase access for water-based recreation	○	As a feasibility study, the concept itself does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters. Implementation of groundwater banking projects would also not increase access.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	The concept would not contribute to increasing spawning habitat, designating sections of the river for hatchery and wild species, or designating environmental flows. Implementation of t groundwater banking projects would also not meet this objective.

Objective	● ◗ ○	*Justification*
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	As a feasibility study, the concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections. Implementation of groundwater banking projects would also not stock hatchery-raised trout.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	As a feasibility study, the concept itself does not include reintroducing salmon into the upper Mokelumne. Implementation of groundwater banking projects would also not reintroduce salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	As a feasibility study, the concept itself would not increase angling, harvesting, or other recreational opportunities. Implementation of groundwater banking projects would also not increase opportunities.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed. Implementation of groundwater banking projects would also not resolve existing water rights conflicts.
F-20: Enhance flood protection and management	◗	As a feasibility study, the concept would not enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection. However, implementation of groundwater banking projects could enhance flood protection by banking flows which could cause flooding.

Objective	● ◗ ○	***Justification***
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	●	As a feasibility study, the concept would require the use of an agreed-upon hydrology dataset and Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	◗	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed. However, the purpose of this concept is to assess feasibility and collect sound, agreed-upon data prior to implementation of the concept.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute scientific data to the current body of knowledge by completing a feasibility study and developing information about potential locations and recharge methods for groundwater banking in the Eastern San Joaquin Groundwater Basin.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters. Groundwater banking would also not increase investment in forest management.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	As a feasibility study, the concept would not maximize socio-economic, cultural, recreational, public health, and public safety benefits. If implemented, groundwater banking projects would maximize these benefits because DACs overlay the basin.

Objective	● ◗ ○	***Justification***
O-26: Achieve equity	◗	As a feasibility study, the concept would not directly achieve equity. However, if groundwater banking projects were implemented, the benefits realized would not be limited to a narrow group; rather, project benefits would be spread across all of the ESJ Groundwater Basin, spanning regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	○	The concept itself would not enhance the natural environment. In coupled groundwater-surface water systems, improvement in the overall health of one of the systems would contribute to improved health in the other. Fewer river diversions would allow unallocated waters to stay in the river and perform geomorphic functions, though the benefit would likely be small and incremental at best.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation. If implemented, groundwater banking projects would also not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	○	As a feasibility study, the concept will not protect and restore fisheries. There would also be no benefit to fisheries if implemented groundwater banking projects diverted water from the Mokelumne River.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	◗	As a feasibility study, the concept would not enhance or maintain water supply for beneficial use in agricultural practices. Implementing groundwater banking projects would enhance water supply for agricultural practices as there is significant agriculture overlying the Eastern San Joaquin Groundwater Basin.

Objective	● ◗ ○	*Justification*
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The purpose of the concept is to assess the feasibility of groundwater banking projects in the Eastern San Joaquin Groundwater Basin. This helps avoid unnecessary conflict and litigation by identifying and attempting to resolve issues early on.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	◗	As a feasibility study, the concept would not directly promote broadly-supported outcomes that benefit a wide range of interests. However, implementing groundwater banking projects would increase the amount of stored water during wetter years, which could then be used in lieu of Mokelumne River water during drier years. This outcome is broadly supported by a wide range of interests.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	◗	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens. The project described in the concept would also need to undergo these screenings to determine if it was the least controversial project.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	As a feasibility study, the concept would not result in agreements that reduce conflicts. Implementation of the project described in the concept would also not reduce conflict in the watershed.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. This would also be required of the project described in the concept if it were to be implemented.

Objective	● ◗ ○	*Justification*
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc. This would also be required of the project described in the concept if it were to be implemented.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	The purpose of this concept is to study the feasibility of implementing groundwater banking projects in the Eastern San Joaquin Groundwater Basin; as such, the nature of the concept will help avoid basing decisions on incomplete or inaccurate information.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept will not result in construction of a new or larger on-stream dam. There would also not be demand for new or larger on-stream dams if groundwater banking projects were implemented.
CA-39: Avoid harmful impacts to fisheries and other wildlife	◗	The concept would not create harmful impacts to fisheries and other wildlife. Groundwater banking projects, if diverting Mokelumne River water for banking, could potentially harm fisheries and other wildlife by reducing in-stream flows; mitigation measures could be included to limit these impacts.
CA-40: Avoid conversion of agricultural lands to developed uses	◗	The concept would not convert agricultural lands to developed uses. Implementing groundwater banking projects could potentially convert agricultural lands; this could be mitigated through compensation and coordination with willing agricultural landowners.

Objective	● ◗ ○	*Justification*
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept would not shift environmental impacts from one area to another. Implementation of groundwater banking projects would also not shift environmental impacts.
CA-42: No diminishment of the benefits of existing in-stream flow	◗	The concept does not include elements that would alter existing in-stream flows. Groundwater banking projects could potentially reduce in-stream flows by diverting Mokelumne River water for banking; mitigation measures could be included to limit the impacts of reduced flows.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate. This also applies to implementation of groundwater banking projects.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. Groundwater banking projects would bolster supply reliability by storing water for use in drier years.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	As a feasibility study, this concept does not have adverse socio-economic and public health and safety impacts. Groundwater banking projects would minimize these impacts by increasing water quality through more stored water and reducing the likelihood of water shortages in drier years.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm. This also applies to implementation of groundwater banking projects.

Objective	● ◗ ○	*Justification*
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation. This would also be required if the project described in the concept were implemented.
CA-48: Avoid interregional inequity	◗	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs. Depending on the location of diversions on the Mokelumne River, groundwater banking projects could potentially have interregional inequity.

4b: Amador and Calaveras Counties Hydrologic Assessment

Amador Water Agency, Calaveras County Water District; JVID

Overview

Assess the potential for groundwater banking in Amador and Calaveras counties. This could include assessing structure of fractured rock aquifers and age of water, in addition to mapping of sandy soils as a means to inform potential project areas. The study would include evaluation of the proposed beneficial uses of the project and clarifying operational parameters. It would also identify impacts, and constraints in the following areas: river flows, domestic water supply, technical, political, environmental (including both species-related and geomorphic), economic, legal, and recreation – recognizing that a more detailed Environmental Impact Report would be required prior to implementing a project. The study will include consultation with members of the MokeWISE MCG.

Sponsor(s): Amador Water Agency (AWA), Calaveras County Water District (CCWD); Jackson Valley Irrigation District (JVID)

Concept type: Planning

Estimated Costs: unknown

Funding Source(s): IRWM Program

Concept location: Amador and Calaveras counties

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	As a feasibility study, the concept does not have elements that promote demand-side management strategies. Implementation of the project described in the concept would also not have elements that would promote demand-side management strategies.

Objective	● ◗ ○	***Justification***
WS-2: Increase supply reliability	◗	As a feasibility study, the concept would not increase supply reliability. However, implementation of the project described in the concept would increase supply reliability by diversifying supply options and, depending on use patterns, potentially providing a dry year supply.
WS-3: Increase amount of stored water	◗	As a feasibility study, the concept would not increase the amount of stored water. However, implementation of the project described in the concept would increase the amount of stored water by banking water in the ground.
WS-4: Promote smart, responsible development	○	While the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation. Implementation of the project as described in the concept would also not reduce reliance on groundwater.
WS-6: Promote a long-term groundwater balance	◗	As a feasibility study, the concept itself would not promote a long-term groundwater balance. However, implementation of the project described in the concept could promote a long-term groundwater balance by recharging the groundwater.
WS-7: Maximize water resource availability for all beneficial uses	◗	As a feasibility study, the concept itself would not maximize water resource availability for all beneficial uses. However, implementation of the project as described in the concept would likely maximize water resource availability for all beneficial uses by recharging the groundwater basin and maximizing storage.

Objective	● ◗ ○	*Justification*
WS-8: Decrease the need to import water	○	As a feasibility study, the concept itself would not decrease the need to import water. If implemented, the project described in the concept would offset use of Mokelumne River supplies, not the use of imported water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates. Implementation of the project described in the concept would also not review existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update. Implementation of the project described in the concept would also not identify water demand issues.
WQ-11: Protect and improve surface and groundwater quality	◗	As a feasibility study, the concept itself would not protect and improve surface and/or groundwater quality. Implementation of the project described in the concept could protect and improve groundwater quality by recharging the groundwater basin and diluting constituents.
WQ-12: Match delivered water quality use	○	As a feasibility study, the concept itself would not involve treating water, nor does it involve delivering treated water. Implementation of the project described in the concept would also not meet this objective.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	As a feasibility study, the concept itself would not use water purification technology as a tool to maximize beneficial uses. Implementation of the project described in the concept would also not meet this objective.

Objective	● ◗ ○	*Justification*
R-14: Increase access for water-based recreation	○	As a feasibility study, the concept itself does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters. Implementation of the project as described in the concept would also not increase access.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	The concept itself does not include elements that would increase spawning habitat. Additionally, the application of groundwater banking does not appear to be a cost effective method for improving fishery habitat.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	As a feasibility study, the concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections. Implementation of the project described in the concept would also not stock hatchery-raised trout.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	As a feasibility study, the concept itself does not include reintroducing salmon into the upper Mokelumne. Implementation of the project described in the concept would also not reintroduce salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	As a feasibility study, the concept itself would not increase angling, harvesting, or other recreational opportunities. Implementation of the project described in the concept would also not increase opportunities.

Objective	● ◗ ○	***Justification***
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed. Implementation of the project described in the concept would also not resolve existing water rights conflicts.
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection. Implementation of the project described in the concept would also not provide flood protection or management.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	●	As a feasibility study, the concept would require the use of an agreed-upon hydrology dataset and/or Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	○	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by completing a feasibility study and developing information about the groundwater in the upper watershed.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters. Implementation of the project described in the concept would also not increase investment in forest management.

Objective	● ◗ ○	***Justification***
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	As a feasibility study, the concept would not maximize socio-economic, cultural, recreational, public health, and public safety benefits. If implemented, the project as described in the concept would maximize these benefits because CCWD, AWA, and JVID serve DACs.
O-26: Achieve equity	◗	As a feasibility study, the concept would not directly achieve equity. However, if the project described in the concept were implemented, the benefits realized from the project would not be limited to a narrow group; rather, project benefits would be spread across all of AWA's, CCWD's, and JVID's service area, spanning regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	○	The concept itself would not enhance the natural environment. In coupled groundwater-surface water systems, improvement in the overall health of one of the systems would contribute to improved health in the other. Fewer river diversions would allow unallocated waters to stay in the river and perform geomorphic functions, though the benefit would likely be small and incremental at best.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation. If implemented, the project as described in the concept would also not incorporate or seek a wild and scenic designation.

Objective	● ◗ ○	*Justification*
E-29: Protect and restore fisheries	○	As a feasibility study, the concept will not protect and restore fisheries. While implementation of the project described in the concept would likely reduce Mokelumne River use, the benefit to fisheries would likely be small and incremental.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	◗	As a feasibility study, the concept would not enhance or maintain water supply for beneficial use in agricultural practices. Implementing the project described in the concept would enhance water supply for agricultural practices because AWA, CCWD, and JVID serves agricultural users within its service area.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The purpose of the concept is to assess the feasibility of groundwater banking in the upper watershed. This helps avoid unnecessary conflict and litigation by identifying and attempting to resolve these issues early on.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	As a feasibility study, the concept would not directly promote broadly-supported outcomes that benefit a wide range of interests. However, the project described in the concept would likely promote broadly-supported outcomes. Implementation of the project described in the concept would diversify supplies, serve DACs, and leave more water in the Mokelumne. These outcomes are broadly supported by a wide range of interests.

Objective	● ◗ ○	*Justification*
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	◗	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens. The project described in the concept would also need to undergo these screenings to determine if it was the least controversial project.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	As a feasibility study, the concept would not result in agreements that reduce conflicts. Implementation of the project described in the concept would also not reduce conflict in the watershed.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. This would also be required of the project described in the concept if it were to be implemented.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc. This would also be required of the project described in the concept if it were to be implemented.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	The purpose of this concept is to study the feasibility of groundwater banking in the upper watershed; as such, the nature of the concept will help avoid basing decisions on incomplete or inaccurate information.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept will not result in construction of a new or larger on-stream dam. If the project as described in the concept is implemented, there would also not be demand for new or larger on-stream dams.

Objective	● ◗ ○	***Justification***
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife. Implementation of the project described in the concept would also not harm fisheries and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept would not convert agricultural lands to developed uses. Implementation of the project described in the concept would also not convert agricultural lands.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept would not shift environmental impacts from one area to another. Implementation of the project described in the concept would also not shift environmental impacts.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows. Implementation of the project described in the concept would also not diminish the benefits of existing in-stream flow.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate. This also applies to implementation of the project described in the concept.
CA-44: Avoid dependency on potentially unreliable supply	◗	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. Groundwater banking and use could potentially create dependence on a potentially unreliable supply; sustainable extraction rates would need to be identified to avoid this.

Objective	● ◗ ○	***Justification***
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	As a feasibility study, this concept does not have adverse socio-economic and public health and safety impacts. Implementation of the project described in the concept would also not create adverse socio-economic and public health and safety impacts.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm. This also applies to implementation of the project described in the concept.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation. This would also be required if the project described in the concept were implemented.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs. This also holds if the project described in the concept were to be implemented.

4c: San Joaquin County Groundwater Banking and Exchange

Groundwater Basin Authority, East Bay Municipal Utility District; WID

Overview

Sponsor(s): Groundwater Basin Authority (GBA), East Bay Municipal Utility District (EBMUD); Woodbridge Irrigation District (WID)

Concept type: Implementation

Estimated Costs: $40,000,000 - $100,000,000

Funding Source(s): Water agency capital investments, state/federal grants, loans

Concept location: Eastern San Joaquin Groundwater Basin, including portions of Calaveras County

This concept is seen as a regional effort whereby one or more partner agencies could obtain a new water right and/or modify an existing water right to enable surface water to be diverted from the Mokelumne River and banked in the Eastern San Joaquin Groundwater Basin for later use by one or more of the partners (and further to improve overdrafted groundwater conditions in the Eastern San Joaquin Groundwater Basin). This concept builds upon the recent Demonstration Project efforts between San Joaquin County (SJC), a GBA member agency, and EBMUD.

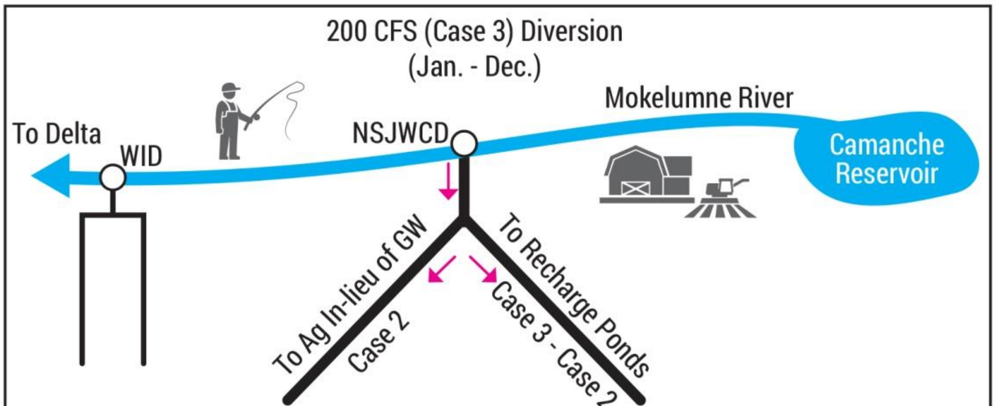
Under one scenario, a portion of the Mokelumne River supply would be conveyed through existing and/or new facilities for storage and regional use in the Basin. Various in-lieu and direct recharge projects could be used to recharge water in wet years for extraction in dry years. Recharge could be via recharge basins or direct injection.

While the first stage of a project would rely primarily on EBMUD's facilities for conveyance, some new facilities are possibly required such as an Intertie with EBMUD's Mokelumne Aqueduct, a new pipeline and pump station that directs water from the aqueducts to the recharge site, and any required facilities to provide treatment as needed prior to injection and or following extraction. Other means and measures could also be used to deliver water to a proposed banking site, such as use of existing NSJWCD Mokelumne River intakes and upgraded distribution systems.

Water stored in the Basin would be extracted for use via wells installed within project areas. The quantity extracted could be divided by the partner agencies (upcountry agencies could receive their share via an in-lieu exchange with EBMUD). Groundwater could be sent to the EBMUD service area via connection(s) to EBMUD's Mokelumne Aqueducts. A portion of the quantity stored would remain in the ground to meet SJC's share requirements.

Modeling conducted assumed two cases, as outlined below in Figure 1. The first case assumed diversions from March through October and the second case assumed diversions in all months except July. Both cases assumed a maximum diversion of 200 cfs. The assessment below includes results from Case 2 and Case 4 (Case 3 minus Case 2). Both cases would temporarily store water in Camanche that is available during the diversion window when EBMUDs demands are fully met. This water would be carried over on a seasonal basis, but could be released within the diversion window for use. It is assumed that this water would count towards EBMUDs storage requirements per the Camanche permit.

Figure 1: Two Modeled Scenarios for Concept 4c*



Month	CFS In-Lieu	Month	CFS Recharge
January	0	Jan	200
February	0	Feb	200
March	50	March	150
April	100	April	100
May	120	May	80
June	180	June	20
July	200	July	0
August	180	August	20
September	120	September	80
October	50	October	150
November	0	November	200
December	0	December	200

* Initially, three cases were proposed and modeled. After viewing results, the Modeling Workgroup decided to drop the first case. The third case assumed a 200 cfs diversion in all months. The Workgroup decided to reconfigure the third case so that it reflected the difference in diversion between the second case and the third case (200 cfs in all months). These two cases are reflected in the above graphic.

Assessment

Objective	● ◗ ○	*Justification*
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept would not have elements that would promote demand-side management strategies.
WS-2: Increase supply reliability	●	The concept would increase supply reliability by storing water for use in drier years when other supplies may become unavailable. The concept would divert water from March through October with a peak diversion of 200 cubic feet per second (cfs) in July. All or a portion of this diverted water could be stored for use in drier years. Unallocated water below Camanche is unchanged between the 2040 baseline case and the case that includes concept implementation.
WS-3: Increase amount of stored water	●	The purpose of the concept is to increase the amount of stored water by banking water in the groundwater basin. The concept would divert water from March through October with a peak diversion of 200 cfs in July. All or a portion of this diverted water could be stored for use in drier years. Unallocated water below Camanche is unchanged between the 2040 baseline case and the case that includes concept implementation.
WS-4: Promote smart, responsible development	●	The concept would promote smart, responsible development by implementing a program that would encourage more responsible use of the groundwater basin and result in increased groundwater levels.

Objective	● ◗ ○	*Justification*
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation; implementation of the concept would increase the groundwater supply that could be used for irrigation.
WS-6: Promote a long-term groundwater balance	●	The concept would promote a long-term groundwater balance by banking water. The concept would divert water from March through October with a peak diversion of 200 cfs in July. All or a portion of this diverted water could be used to recharge the groundwater basin.
WS-7: Maximize water resource availability for all beneficial uses	●	The concept would maximize water resource availability for all beneficial uses by increasing the amount of stored water that could be beneficially used in drier years. The concept would divert water from March through October with a peak diversion of 200 cfs in July. All or a portion of this diverted water could be stored for use in drier years. Unallocated water below Camanche is unchanged between the 2040 baseline case and the case that includes concept implementation.
WS-8: Decrease the need to import water	●	The concept would decrease the need to import water in drier years, as banked water would be used in lieu of imported water during drier years. It is unknown at this time the reduction in imported water, but it is assumed that some portion of the stored water used during dry years would be in lieu of importing water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.

Objective	● ◗ ○	*Justification*
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	◗	The concept would increase stored water. Leaving some of the diverted water in the groundwater basin protects and improves groundwater quality by helping dilute pollutants in the groundwater. However, surface water quality may suffer, as modeling indicates that under the 2040 baseline condition, in-stream flows to the Delta average 323.1 TAFY. Implementing the concept as configured in Case 2 would decrease this average flow by 23.1 TAFY to 300 TAFY (Table 1). Implementing the concept as configured in Case 4 (Case 3 – Case 2) would decrease this average flow by 23.3 TAFY to 299.7 TAFY (Table 2). Having decreased flow could harm water quality.
WQ-12: Match delivered water quality use	○	The concept does not involve treating water, nor does it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	The concept does not include water purification elements.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.

Objective	● ◗ ○	***Justification***
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	The concept would not contribute to increasing spawning habitat, designating sections of the river for hatchery and wild species, nor designating environmental flows.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	The concept would not increase angling, harvesting, or other recreational opportunities.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	◗	The concept could enhance flood protection by banking flows which could cause flooding. The concept would divert water from March through October with a peak diversion of 200 cfs in July. While flooding is uncommon during this period, there may be some flood flows in March or October that could be diverted. However, unallocated water below Camanche is unchanged between the 2040 baseline case and the case that includes concept implementation.

Objective	● ◗ ○	*Justification*
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	●	The concept would require the use of an agreed-upon hydrology dataset and/or Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	●	The concept is well-defined enough to complete a quantitative assessment.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute scientific data to the current body of knowledge by being an example of an inter-regional groundwater banking program that would help provide water in dry years to a number of users and recharge the groundwater basin. Information collected could include amount of groundwater banked and changes in groundwater levels.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	The concept would maximize socio-economic and public health and safety impacts by providing water in dry years to DACs served by the partner agencies. It is assumed that some portion of the water extracted during dry years would be delivered to DACs. Additionally, any DACs with private wells would benefit from the increased groundwater quality in all years due to the increased groundwater levels and pollutant dilution.

Objective	● ◗ ○	***Justification***
O-26: Achieve equity	●	The benefits realized by this concept would not be limited to a narrow group; rather, project benefits would be spread across all partner agencies, spanning regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	○	In coupled groundwater-surface water systems, improvement in the overall health of one of the systems would contribute to improved health in the other. Fewer river diversions would allow unallocated waters to stay in the river and perform geomorphic functions, though the benefit would likely be small and incremental at best.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	○	The concept would not benefit fisheries, as water diverted from the Mokelumne River would not provide any benefit to instream flow for fisheries or other aquatic resources.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	●	The concept would enhance and maintain water supply for agricultural uses by increasing groundwater levels and storing water for use in dry years. The concept would divert water from March through October with a peak diversion of 200 cfs in July. All or a portion of this water would be used for agricultural purposes, including irrigation and groundwater recharge.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would help foster regional relationships by requiring long-term coordination between the GBA, EBMUD, and other partner agencies.

Objective	● ◗ ○	*Justification*
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	The concept would provide dry year resiliency for water users and contribute to groundwater recharge. These outcomes are supported by a wide range of interests within the watershed, including farmers, water agencies, non-governmental organizations, and state/federal agencies.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	●	The concept would result in an agreement that would help recharge the groundwater basin, while also providing dry year supplies. This agreement would reduce conflict surrounding allocation of supply in dry years.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.

Objective	● ◗ ○	***Justification***
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	○	The concept would likely harm fisheries and other wildlife by reducing in-stream flows in the Mokelumne River. Based on modeling, under the 2040 baseline condition, in-stream flows to the Delta average 323.1 TAFY. Implementing the concept as configured in Case 2 would decrease this average flow by 23.1 TAFY to 300 TAFY (Table 1). Implementing the concept as configured in Case 4 (Case 3 – Case 2) would decrease this average flow by 23.3 TAFY to 299.7 TAFY (Table 2). Mitigation measures could be included to limit impacts associated with decreased river flow.
CA-40: Avoid conversion of agricultural lands to developed uses	◗	The concept could potentially convert agricultural lands depending on the location of the recharge areas; this could be mitigated through compensation and coordination with willing agricultural landowners.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.

Objective	● ◗ ○	***Justification***
CA-42: No diminishment of the benefits of existing in-stream flow	○	The concept would reduce in-stream flows by diverting Mokelumne River water for banking. Based on modeling, under the 2040 baseline condition, in-stream flows to the Delta average 323.1 TAFY. Implementing the concept as configured in Case 2 would decrease this average flow by 23.1 TAFY to 300 TAFY (Table 1). Implementing the concept as configured in Case 4 (Case 3 – Case 2) would decrease this average flow by 23.3 TAFY to 299.7 TAFY (Table 2). However, operational parameters could be included that could create more reliable flows at times that are key for lifestages of aquatic species.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept would bolster supply reliability by storing water for use in drier years.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	The concept would minimize these impacts by increasing water quality through more stored water and providing a reliable supply in drier years.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that would create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.

Objective	● ◗ ○	*Justification*
CA-48: Avoid interregional inequity	●	The proposed diversion location is in the lower watershed near NSJWCD. Benefits of the concept are also largely realized in the lower watershed. As such, there would be no interregional inequity.

Table 1: Difference in Mokelumne Flow to Delta between 2040 Baseline Case and Case Implementing Case 2 of SJC Groundwater Banking (in TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	0.00	0.00	0.00	0.00	-14.76	-21.42	-16.55	-16.55	-14.28	57.21	0.00	0.00	-26.34
1954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1955	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1956	0.01	0.00	-3.07	-0.17	-7.37	-10.70	-24.60	-22.14	-14.28	30.12	0.00	0.01	-52.19
1957	0.00	0.00	0.00	0.00	-7.99	-7.73	-3.99	-3.99	-4.19	19.31	0.00	0.00	-8.59
1958	0.01	0.00	-3.07	-5.94	-7.37	-10.70	-24.60	-22.14	-14.28	30.11	0.00	0.01	-57.97
1959	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1961	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1963	0.01	0.00	0.01	0.00	-7.37	-10.70	-24.60	-22.14	-14.28	30.13	0.00	0.01	-48.93
1964	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1965	0.01	0.01	0.01	-5.94	-7.37	-15.09	-24.60	-22.14	-14.28	34.32	0.01	0.01	-55.05
1966	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1967	0.01	0.00	-3.07	-5.94	-7.37	-12.21	-24.60	-22.14	-14.28	31.71	0.00	0.01	-57.88
1968	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1969	0.01	0.00	-3.07	-5.94	-7.37	-10.70	-24.60	-22.14	-14.28	30.12	0.00	0.01	-57.96
1970	0.01	0.01	-3.06	0.01	-14.76	-18.28	-9.45	-9.66	-9.77	43.78	0.01	0.01	-21.13
1971	0.00	0.00	-3.07	0.00	-14.76	-21.42	-20.26	-20.26	-14.28	64.50	0.00	0.00	-29.56
1972	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1973	0.01	0.01	-3.07	0.00	-14.61	-7.30	-23.23	-22.14	-14.28	44.56	0.01	0.01	-40.04
1974	0.01	0.01	-3.07	-5.94	-7.37	-14.17	-24.60	-22.14	-14.28	33.48	0.01	0.01	-58.05
1975	0.00	0.00	0.00	0.00	-14.76	-20.06	-24.60	-22.14	-14.28	46.39	0.00	0.00	-49.44
1976	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1977	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1978	0.00	0.00	0.00	0.00	-11.82	-11.44	-5.91	-6.12	-6.35	28.53	0.00	0.00	-13.11
1979	0.00	0.00	-3.07	0.00	-14.76	-20.12	-19.47	-19.47	-14.28	61.81	0.00	0.00	-29.36

1980	0.01	0.01	-3.06	0.00	-7.36	-17.78	-24.60	-22.14	-14.28	36.98	0.01	0.01	-52.20
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1982	0.00	0.00	-3.07	-5.95	-7.38	-18.42	-24.60	-22.14	-14.28	37.62	0.00	0.00	-58.21
1983	0.00	0.00	-3.07	-5.95	-7.38	-10.71	-24.60	-22.14	-14.28	30.21	0.00	0.00	-57.91
1984	0.00	0.00	-3.07	0.00	-14.76	-21.42	-24.11	-22.14	-14.28	59.26	0.00	0.00	-40.52
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1986	0.01	0.01	-3.07	-5.94	-7.37	-13.01	-24.60	-22.14	-14.28	32.40	0.01	0.01	-57.99
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	0.00	0.00	0.00	0.00	-14.76	-21.42	-24.60	-22.14	-14.28	47.69	0.00	0.00	-49.50
1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.01	-3.07	-5.94	-7.37	-10.70	-22.51	-22.14	-14.28	28.00	0.00	0.01	-57.99
1996	0.01	0.01	-3.07	-5.94	-7.37	-13.44	-22.91	-22.14	-14.28	43.21	0.01	0.01	-45.89
1997	0.01	0.01	-3.06	0.00	-13.65	-13.21	-6.82	-7.04	-7.23	33.11	0.01	0.01	-17.87
1998	0.00	0.00	-3.07	-5.95	-7.37	-10.71	-24.60	-22.14	-14.28	30.24	0.00	0.00	-57.85
1999	0.00	0.00	-3.07	0.00	-14.76	-3.37	-24.60	-22.14	-14.28	30.10	0.00	0.00	-52.09
2000	0.00	0.00	-3.07	0.00	-14.76	-21.42	-12.25	-12.25	-12.18	53.69	0.00	0.00	-22.24
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	0.00	-5.76	-5.58	-2.88	-2.88	-3.12	13.92	0.00	0.00	-6.30
2004	0.00	0.00	-3.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-3.07
2005	0.01	0.00	-3.07	-5.94	-7.37	-10.70	-24.60	-22.14	-14.28	30.16	0.00	0.01	-57.92
2006	0.01	0.00	-3.07	-5.94	-7.37	-10.70	-24.60	-22.14	-14.28	30.17	0.00	0.00	-57.91
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2010	0.00	0.00	0.00	0.00	-14.76	-21.42	-22.73	-22.14	-14.28	57.91	0.00	0.00	-37.41
Ave	0.00	0.00	-1.22	-1.34	-5.51	-7.52	-10.88	-10.09	-6.89	20.36	0.00	0.00	-23.08
Max	0.01	0.01	-3.07	-5.94	-7.37	-10.71	-24.60	-22.14	-14.28	62.58	0.00	0.00	-57.91
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.03	0.00	0.00	0.00	0.00

Table 2: Difference in Mokelumne Flow to Delta between 2040 Baseline Case and Case Implementing Case 4 (Case 3 - Case 2) of SJC Groundwater Banking (in TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	-12.3	0.0	0.0	0.0	-9.8	-2.4	0.0	-2.5	-9.5	11.9	0.0	0.0	-24.6
1954	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1955	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12.3	-12.3
1956	-12.3	-11.5	-5.6	-0.2	-4.9	-1.2	0.0	-2.5	-9.5	6.0	0.0	0.0	-41.7
1957	0.0	0.0	0.0	0.0	-8.0	-2.4	0.0	-2.5	-4.2	10.1	0.0	0.0	-6.9
1958	0.0	-11.1	-9.2	-5.9	-4.9	-1.2	0.0	-2.5	-9.5	6.0	0.0	0.0	-38.4
1959	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1960	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1961	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1962	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1963	0.0	-11.1	0.0	0.0	-4.9	-1.2	0.0	-2.5	-9.5	6.0	-11.9	0.0	-35.1
1964	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12.3	-12.3
1965	-12.3	-11.1	0.0	-5.9	-4.9	-2.4	0.0	-2.5	-9.5	7.1	-11.9	-1.3	-54.7
1966	-1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.3
1967	-4.4	-11.1	-9.2	-5.9	-4.9	-2.4	0.0	-2.5	-9.5	7.1	0.0	0.0	-42.8
1968	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1969	-12.3	-11.1	-9.2	-5.9	-4.9	-1.2	0.0	-2.5	-9.5	6.0	0.0	-6.9	-57.6
1970	-12.3	-11.1	-9.2	0.0	-9.8	-2.4	0.0	-2.5	-9.5	11.9	-11.9	-12.3	-69.1
1971	-12.3	-11.1	-9.2	0.0	-9.8	-2.4	0.0	-2.5	-9.5	11.9	-3.4	-5.9	-54.2
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	-12.3	-11.1	-9.2	0.0	-9.8	-0.1	0.0	-2.5	-9.5	9.6	-11.9	-12.3	-69.1
1974	-12.3	0.0	-9.2	-5.9	-4.9	-2.4	0.0	-2.5	-9.5	7.1	0.0	0.0	-39.6
1975	0.0	0.0	0.0	0.0	-9.8	-2.4	0.0	-2.5	-9.5	11.9	-3.1	0.0	-15.4
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	-9.8	-2.4	0.0	-2.5	-6.3	12.8	0.0	0.0	-8.3
1979	0.0	0.0	-9.2	0.0	-9.8	-2.4	0.0	-2.5	-9.5	12.0	0.0	0.0	-21.4

1980	-12.3	-11.5	-9.2	0.0	-4.9	-2.4	0.0	-2.5	-9.5	7.1	0.0	0.0	-45.2
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12.3	-12.3
1982	-12.3	-11.1	-9.2	-6.0	-4.9	-2.4	0.0	-2.5	-9.5	7.1	-11.9	-12.3	-74.9
1983	-12.3	-11.1	-9.2	-6.0	-4.9	-1.2	0.0	-2.5	-9.5	6.0	-11.9	-12.3	-74.9
1984	-12.3	-11.5	-6.8	0.0	-9.8	-2.4	0.0	-2.5	-9.5	11.9	-11.9	0.0	-54.8
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	-11.1	-9.2	-5.9	-4.9	-2.4	0.0	-2.5	-9.5	7.1	0.0	0.0	-38.4
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	-9.8	-2.4	0.0	-2.5	-9.5	11.9	0.0	0.0	-12.3
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	-11.1	-9.2	-5.9	-4.9	-1.2	0.0	-2.5	-9.5	6.0	0.0	0.0	-38.4
1996	0.0	-11.5	-9.2	-5.9	-4.9	-2.4	0.0	-2.5	-9.5	7.1	-11.9	-12.3	-63.0
1997	-12.3	-11.1	-9.2	0.0	-9.8	-2.4	0.0	-2.5	-7.2	13.7	-8.7	0.0	-49.5
1998	-12.3	-11.1	-9.2	-5.9	-4.9	-1.2	0.0	-2.5	-9.5	6.0	0.0	0.0	-50.7
1999	-12.3	-11.1	-9.2	0.0	-9.8	3.7	0.0	-2.5	-9.5	6.0	0.0	0.0	-44.8
2000	0.0	-11.5	-9.2	0.0	-9.8	-2.4	0.0	-2.5	-9.5	11.9	0.0	0.0	-33.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	-5.8	-2.4	0.0	-2.5	-3.1	7.9	0.0	0.0	-5.8
2004	0.0	0.0	-9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-9.0
2005	0.0	-11.1	-9.2	-5.9	-4.9	-1.2	0.0	-2.5	-9.5	6.0	0.0	-12.3	-50.7
2006	-12.3	-11.1	-9.2	-5.9	-4.9	-1.2	0.0	-2.5	-9.5	6.0	-1.2	-2.0	-53.8
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

2010	0.0	0.0	0.0	0.0	-9.8	-2.4	0.0	-2.5	-9.5	11.9	-11.9	-12.3	-36.5
Ave	-3.5	-4.2	-3.5	-1.3	-3.8	-0.9	0.0	-1.3	-4.8	4.7	-2.1	-2.4	-23.3
Max	-12.3	-11.1	-9.2	-5.9	-4.9	-1.2	0.0	-2.5	-9.5	10.8	-11.9	-12.3	-74.9
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

4d: NSJWCD Infrastructure Improvements

North San Joaquin Water Conservation District

Overview

The concept would improve the infrastructure to increase reliable surface water delivery to the North San Joaquin Water Conservation District so the District can utilize existing water rights and its agricultural customers can reduce reliance on groundwater sources. The largest of these projects includes rebuilding the southern pump station and southern distribution system, and rebuilding the northern distribution system.

Sponsor(s): North San Joaquin Water Conservation District (NSJWCD)

Concept type: Implementation

Estimated Costs: unknown

Funding Source(s): unknown

Concept location: NSJWCD service area

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not have elements that promote demand-side management strategies.
WS-2: Increase supply reliability	●	The concept would increase supply reliability for NSJWCD by approximately 17,000 AFY by sizing infrastructure that allows NSJWCD to divert Mokelumne River water, pursuant to its current water rights. This water would help the District deliver water to its customers during years when it is available.
WS-3: Increase amount of stored water	○	The concept does not include elements that would increase the amount of stored water.

Objective	● ◗ ○	***Justification***
WS-4: Promote smart, responsible development	●	The concept promotes smart, responsible development by using Mokelumne River water in wetter years, thereby recharging the groundwater basin, which can be used in lieu of Mokelumne River water in drier years.
WS-5: Reduce reliance on groundwater for irrigation	●	The concept would reduce reliance on groundwater for irrigation by approximately 17,000 AFY in years when NSJWCD has access to Mokelumne River water, as many users within the NSJWCD service area currently use groundwater to meet irrigation needs. Increasing surface water use would offset groundwater use.
WS-6: Promote a long-term groundwater balance	●	The concept would promote a long-term groundwater balance by reducing the use of groundwater by approximately 17,000 AFY in years when NSJWCD has access to Mokelumne River water, thereby leaving this water in the basin and allowing the basin to recharge.
WS-7: Maximize water resource availability for all beneficial uses	●	The concept would maximize water resource availability for all beneficial uses by approximately 17,000 AFY by using Mokelumne River water in lieu of groundwater during years when Mokelumne River water is available to the District.
WS-8: Decrease the need to import water	○	NSJWCD does not import water from outside of the watershed. Implementation of the concept would not decrease the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.

Objective	● ◗ ○	*Justification*
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	◗	The concept would protect groundwater quality by leaving approximately 17,000 AFY of water in the basin that would dilute pollutants (in years when Mokelumne River water is available to NSJWCD). However, Mokelumne River diversions would increase by roughly 17,000 AFY in wetter years when Mokelumne River water is available to NSJWCD. Because these diversions would occur in high flow years, it is likely that Mokelumne River quality would not be significantly impacted. However, the magnitude of this impact is not currently known.
WQ-12: Match delivered water quality use	○	The concept does not involve treating water, nor does it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	The concept does not include water purification elements.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	The concept would not contribute to increasing spawning habitat, designating sections of the river for hatchery and wild species, nor designating environmental flows.

Objective	● ◗ ○	***Justification***
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	The concept would not increase angling, harvesting, or other recreational opportunities.
WR-19: Resolve existing water rights conflicts in the watershed	●	By developing infrastructure that allows NSJWCD to utilize its existing water rights, the concept would resolve existing water rights conflicts surrounding NSJWCDs rights.
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	●	The concept is well-defined enough to complete a quantitative assessment.

Objective	● ◗ ○	*Justification*
D-23: Promote the contribution of sound scientific data to current body of knowledge	○	The concept involves increasing diversions from the Mokelumne River and would not contribute scientific data to the current body of knowledge.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters. Raising Lower Bear would also not increase investment in forest management.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	The concept would maximize benefits for DACs, as NSJWCD serves areas of Lodi that are classified as DACs. The concept would provide increased supply reliability for these DACs.
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, concept benefits would likely be spread across cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	○	The concept would decrease groundwater pumping by 17,000 AFY in wetter years, which would enhance groundwater reserves that could be used in drier years when Mokelumne River water is unavailable to NSJWCD. However, higher efficiency in pumping stations will likely not affect geomorphic conditions in the river corridor. If pipelines are constructed in place of aqueducts, then evaporation, leakage and seepage rates would diminish, thereby potentially requiring fewer AF of diversions for the same volumetric delivery.

Objective	● ◗ ○	***Justification***
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	○	The concept does not include elements that would protect and restore fisheries and would not provide benefit to instream flows.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	●	By increasing supply reliability for agricultural users, the concept would enhance and maintain the water supply for beneficial use in agricultural practices.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	○	While the concept does not prohibit or preclude fostering long-term regional relationships and avoiding unnecessary conflict and litigation, it does not directly address it. Implementation of the concept would not require coordination between a number of different agencies; NSJWCD is the only agency that would be involved in the implementation of the concept.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	◗	The concept would reduce groundwater pumping by 17,000 AFY during wetter years, which would help the groundwater basin recharge and stabilize. However, diversions from the Mokelumne River would increase by 17,000 AFY. These outcomes would benefit NSJWCD and other groundwater users, while potentially creating negative environmental impacts.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.

Objective	● ◗ ○	*Justification*
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	Implementation of the concept would not directly address any current watershed conflicts.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. As such, the concept would not interfere with any entity exercising a water right.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	○	The concept would increase diversions from the Mokelumne by 17,000 AFY in wetter years, which could harm fisheries and other wildlife. Mitigation measures could be added to reduce this impact.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses.

Objective	● ◗ ○	*Justification*
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow	○	The concept would increase Mokelumne diversions by 17,000 AFY in wetter years when Mokelumne River water is available to NSJWCD. This reduction in flows would reduce the benefits of existing in-stream flows. Mitigation measures could be included to reduce this impact.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply	◗	The concept would increase the use of Mokelumne River water by 17,000 AFY in lieu of groundwater during wetter years. This would help balance the groundwater basin, allowing it to recharge in wetter years; this source could then be used in drier years when Mokelumne River water is unavailable to NSJWCD. While increasing the use of Mokelumne River water would increase dependency on a potentially unreliable supply, the recharge resulting from forgoing groundwater would be available to NSJWCD when Mokelumne River water is unavailable.
CA-45: Minimize adverse socio-economic and public health and safety impacts	◗	The concept would likely increase water quality delivered to NSJWCD by using Mokelumne River water in wetter years and recharged groundwater in drier years. This would increase public health and safety benefits. However, costs would need to be considered to minimize adverse socio-economic impacts to ratepayers associated with constructing the infrastructure.

Objective	● ◗ ○	*Justification*
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that would create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

5a: Regional Urban Water Conservation Program

Upper Mokelumne River Watershed Authority, Groundwater Basin Authority, City of Lodi

Overview

Sponsor(s): Upper Mokelumne River Watershed Authority (UMRWA), Groundwater Basin Authority (GBA), City of Lodi

Concept type: Implementation

Estimated Costs: $80,000

Funding Source(s): unspecified grants and local jurisdiction operating funds

Concept location: Amador County, Calaveras County and San Joaquin Groundwater Banking Authority. (There will be spill over outside the MokeWISE area.)

The concept would reduce demand by 109 AFY through implementation of efficient urban water use practices. This program includes submitting a regional conservation plan for funding. The funding received would then be distributed among agencies to fund their individual plans. Plan elements may include initiating a pilot program with funding available to encourage residents to replace existing water reliant landscaping and utilize landscaping BMP's to reduce runoff and improve water quality; increasing irrigation efficiency; metering and billing based on water use; leak detection; rainwater capture; stormwater capture; education and outreach regarding lawn and landscape watering needs.

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	●	The concept would promote demand-side management strategies by implementing conservation measures that would reduce urban demand for water by 109 AFY.

Objective	● ◗ ○	*Justification*
WS-2: Increase supply reliability	●	The concept would increase supply reliability by decreasing the urban demand for water by 109 AFY. This increases reliability by decreasing the amount of time that urban (and other) Mokelumne River and groundwater users would experience water shortages. Based on modeling, this concept would increase the average amount of unallocated water below Camanche. Under baseline 2040 conditions, average unallocated flow is projected to be 230.0 thousand acre-feet per year (TAFY). The concept would increase that amount to 230.1 TAFY, an increase of 0.1 TAFY or 100 AFY (Table 1).
WS-3: Increase amount of stored water	◗	The concept could increase the amount of stored water by conserving groundwater or water that would otherwise be left in surface storage. This assumes that the conserved water would remain in these places of storage and not be re-allocated for another use.
WS-4: Promote smart, responsible development	●	The concept promotes smart, responsible development by encouraging water users to decrease use, thereby decreasing gallons per capita per day. This would help accommodate a growing population.
WS-5: Reduce reliance on groundwater for irrigation	●	The concept would reduce reliance on groundwater for irrigation by reducing the amount of water used for irrigation.
WS-6: Promote a long-term groundwater balance	◗	The concept could promote a long-term groundwater balance by reducing the amount of water that would be otherwise be pumped for use. This assumes that the groundwater that would otherwise be pumped would remain in the groundwater basin and not be used by another entity.

Objective	● ◗ ○	***Justification***
WS-7: Maximize water resource availability for all beneficial uses	●	The concept would maximize water resource availability for all beneficial uses by conserving 109 AFY of water, which could be made available for other beneficial uses, including groundwater recharge, environmental flows, or consumptive use. Based on modeling, this concept would increase the average amount of unallocated water below Camanche. Under baseline 2040 conditions, average unallocated flow is projected to be 230 TAFY. The concept would increase that amount to 230.1 TAFY, an increase of 0.1 TAFY or 100 AFY (Table 1).
WS-8: Decrease the need to import water	◗	The concept conserves water which could potentially decrease the need to import water if the water being conserved would otherwise have been imported.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	◗	The concept could potentially increase surface and groundwater quality, assuming that the 109 AFY of conserved water would remain in the basin or Mokelumne River. If the conserved water were re-allocated, there would be no benefit.
WQ-12: Match delivered water quality use	○	The concept does not involve treating water, nor does it involve delivering treated water.

Objective	● ◗ ○	*Justification*
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	The concept does not include water purification elements.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	Based on modeling, the concept does not significantly alter the average in-stream flow in such a way as to increase the spawning habitat benefit. Under baseline 2040 conditions, average inflow to the Delta is projected to be 323.1 TAFY, while the concept would marginally increase that inflow to 323.2 TAFY; an increase of 0.1 TAFY or 100 AFY (Table 2).
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	The concept would not increase angling, harvesting, or other recreational opportunities.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.

Objective	● ◗ ○	*Justification*
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	●	The concept is well-defined enough to complete a quantitative assessment. Modeling with MOCASIM has been performed.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute scientific data to the current body of knowledge by collecting and reporting program information, including BMPs implemented and level of conservation achieved.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	The concept would maximize benefits for DACs by encouraging conservation, which would lower water bills for customers in DACs. These benefits would be realized within urban DAC's in Amador, Calaveras, and San Joaquin counties.

Objective	● ◗ ○	*Justification*
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, project benefits would be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	○	Based on modeling, the concept does not significantly alter the average in-stream flow in such a way as to enhance the natural environment. Under baseline 2040 conditions, average inflow to the Delta is projected to be 323.1 TAFY, while the concept would marginally increase that inflow to 323.2 TAFY This slight increase of 0.1 TAFY or 100 AF in flow would not likely provide a significant geomorphic or habitat benefit (Table 2).
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	◗	Based on modeling, the concept does not significantly alter the average in-stream flow in such a way as to restore fisheries. Under baseline 2040 conditions, average inflow to the Delta is projected to be 323.1 TAFY, while the concept would marginally increase that inflow to 323.2 TAFY; an increase of 0.1 TAFY or 100 AFY (Table 2). However, this concept could protect fisheries by conserving water which would otherwise be diverted for use. Assuming this forgone water was left in the river and not allocated elsewhere, this water could provide instream flow augmentation and/or fishery habitat protection.

Objective	● ◗ ○	***Justification***
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	○	The concept would not enhance or maintain water supply for agricultural uses.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would help foster regional relationships by requiring long-term coordination between water agencies, state/federal agencies, private water users, and non-governmental organizations.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	The concept would reduce demands and conserve water. These outcomes are supported by a wide range of interests within the watershed, including water agencies and non-governmental organizations.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would conserve water; its implementation would not directly address any current watershed conflicts.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. As such, the concept would not interfere with any entity exercising a water right.

Objective	● ◗ ○	***Justification***
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would decrease existing in-stream flows. On the contrary, the concept could potentially increase flows by leaving more water in the River.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.

Objective	● ◗ ○	***Justification***
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. On the contrary, the concept decreases dependency on water supplies which could be potentially unreliable.
CA-45: Minimize adverse socio-economic and public health and safety impacts	◗	Conserving water would not create any adverse public health and safety impacts. Depending on the levels of conservation, socio-economic impacts could be seen among water agencies whose revenue can heavily rely on supplied water. If water use decreases, revenues will also decrease, thereby causing adverse socio-economic impacts. Mitigation measures can be implemented to safeguard against these impacts.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that would create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

Table 1: Difference in Unallocated Flow between 2040 Baseline Case and Case Implementing Urban Conservation (TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	0.01	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.09
1954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1955	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.22
1956	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.09
1957	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.04
1958	0.00	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.10
1959	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1961	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1963	0.00	4.73	0.00	0.00	4.71	0.05	0.05	0.05	0.05	0.00	0.01	0.00	9.66
1964	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-9.41	-9.41
1965	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.10
1966	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
1967	0.11	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.18
1968	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1969	0.13	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.21
1970	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.10
1971	0.01	0.01	0.01	0.00	0.02	0.01	0.02	0.02	0.01	0.00	0.01	0.01	0.11
1972	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1973	0.11	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.20
1974	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.09
1975	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.00	0.01	0.00	0.12
1976	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1977	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1978	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.28
1979	0.00	0.02	0.02	0.00	0.02	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.11

1980	0.02	0.01	0.01	0.00	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.10
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12
1982	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.11
1983	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.11
1984	0.01	0.01	0.01	0.00	0.02	0.01	0.02	0.02	0.01	0.00	0.01	0.00	0.10
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1986	0.00	0.13	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.20
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	0.00	0.00	0.00	0.00	0.11	0.10	0.11	0.11	0.10	0.00	0.00	0.00	0.52
1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.12	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.19
1996	0.00	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.12
1997	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.10
1998	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.10
1999	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.10
2000	0.00	0.03	0.01	0.00	0.02	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.11
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.13
2004	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
2005	0.00	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.19
2006	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.10
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2010	0.00	0.00	0.00	0.00	0.08	0.07	0.08	0.08	0.07	0.00	0.01	0.01	0.39
Ave	0.01	0.09	0.00	0.00	0.09	0.01	0.01	0.01	0.01	0.00	0.00	-0.15	0.09
Max	0.01	0.13	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	-9.41	0.11
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2: Difference in Mokelumne Flow to Delta between 2040 Baseline Case and Case Implementing Urban Conservation (TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	0.01	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.09
1954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1955	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.22
1956	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.08
1957	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.04
1958	0.00	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.10
1959	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1961	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.71	5.17	4.51	15.39
1962	4.78	4.72	3.83	0.00	0.00	0.00	0.00	0.00	0.00	-4.61	-4.46	-4.61	-0.35
1963	-4.58	0.59	-4.58	0.00	4.71	0.05	0.05	0.05	0.05	0.03	0.03	0.03	-3.55
1964	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-9.41	-9.41
1965	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.10
1966	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
1967	0.11	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.17
1968	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1969	0.13	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.21
1970	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.10
1971	0.01	0.01	0.01	0.00	0.02	0.01	0.02	0.02	0.01	0.00	0.01	0.01	0.11
1972	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1973	0.11	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.19
1974	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.08
1975	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.00	0.01	0.00	0.12
1976	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1977	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1978	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.28
1979	0.00	0.02	0.02	0.00	0.02	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.11

1980	0.02	0.01	0.01	0.00	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.10
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12
1982	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.11
1983	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.11
1984	0.01	0.01	0.01	0.00	0.02	0.01	0.02	0.02	0.01	0.00	0.01	0.00	0.10
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1986	0.00	0.13	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.18
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	0.00	0.00	0.00	0.00	0.11	0.10	0.11	0.11	0.10	0.00	0.00	0.00	0.52
1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.12	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.18
1996	0.00	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.11
1997	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.09
1998	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.09
1999	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.10
2000	0.00	0.03	0.01	0.00	0.02	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.11
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	-0.01	0.00	0.00	0.12
2004	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
2005	0.00	0.10	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.18
2006	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.10
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2010	0.00	0.00	0.00	0.00	0.08	0.07	0.08	0.08	0.07	0.00	0.01	0.01	0.39
Ave	0.01	0.10	-0.01	0.00	0.09	0.01	0.01	0.01	0.01	0.02	0.01	-0.16	0.12
Max	0.01	0.13	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	-9.41	0.11
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

5b: Regional Agriculture Conservation Program

San Joaquin County Resource Conservation District; JVID

Overview

The concept will develop a program to increase agricultural irrigation efficiency. This program would work with growers and agencies to test and evaluate agricultural management practices for irrigation water management efficiency. Due to implementation of these practices, 2,262 AFY of water would be conserved.

Sponsor(s): San Joaquin County Resource Conservation District (SJCRCD); Jackson Valley Irrigation District (JVID)

Concept type: Implementation

Estimated Costs: $100,00

Funding Source(s): USDA NRCS CIG Grants, DWR Ag Water Use Efficiency grants, Department of Conservation, the water boards (state and regional),Water Agencies, Irrigation Districts.

Concept location: Amador, Calaveras, and San Joaquin counties. 38.173 -121.167 (USDA NRCS Plant Materials Center as study/demonstration site)

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	●	The concept would promote demand-side management strategies by evaluating conservation measures that would reduce the demand for agricultural irrigation and conserving 2,262 AFY of water.

Objective	● ◗ ○	*Justification*
WS-2: Increase supply reliability	●	The concept would increase supply reliability by decreasing the agricultural demand for water by 2,262 AFY. This increases reliability by decreasing the amount of time that agricultural (and other) Mokelumne River and groundwater users would experience water shortages. Based on modeling, this concept would increase the average amount of unallocated water below Camanche. Under baseline 2040 conditions, average unallocated flow below Camanche is projected to be 230.0 thousand acre-feet per year (TAFY). The concept would increase that amount to 231 TAFY, an increase of 1 TAFY (Table 1). This assumes that the water conserved would have been diverted from the Mokelumne River; if groundwater is conserved, the change in unallocated flows would be less than 1 TAFY.
WS-3: Increase amount of stored water	◗	The concept could increase the amount of stored water by conserving groundwater or water that would otherwise be left in surface storage. This assumes that the conserved water would remain in these places of storage and not be re-allocated for another use.
WS-4: Promote smart, responsible development	●	The concept promotes smart, responsible development by encouraging water users to decrease use, thereby decreasing water used per acre. This would help accommodate a growing population and increase agricultural land use efficiency.

Objective	● ◗ ○	***Justification***
WS-5: Reduce reliance on groundwater for irrigation	●	Many agricultural users in the upper and lower watershed rely on groundwater for irrigation. The concept would reduce reliance on groundwater for irrigation by reducing the amount of water used for agricultural irrigation by roughly 2,262 AFY.
WS-6: Promote a long-term groundwater balance	◗	The concept could promote a long-term groundwater balance by reducing the amount of water that would be otherwise be pumped for use (roughly 2,262 AFY). This assumes that the groundwater that would otherwise be pumped would remain in the groundwater basin and not be reallocated.
WS-7: Maximize water resource availability for all beneficial uses	●	The concept would maximize water resource availability for all beneficial uses by conserving 2,262 AFY of water, which could be made available for other beneficial uses, including groundwater recharge, environmental flows, or consumptive use. Based on modeling, this concept would increase the average amount of unallocated water below Camanche. Under baseline 2040 conditions, average unallocated flow below Camanche is projected to be 230.0 TAFY. The concept would increase that amount to 231 TAFY, an increase of 1 TAFY (Table 1). This assumes that the water conserved would have been diverted from the Mokelumne River; if groundwater is conserved, the change in unallocated flows would be less than 1 TAFY.
WS-8: Decrease the need to import water	◗	The concept conserves water which could potentially decrease the need to import water if the water being conserved would otherwise have been imported.

Objective	● ◗ ○	***Justification***
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	◗	The concept could potentially increase surface and groundwater quality, assuming that the 2,262 AFY of conserved water would remain in the basin or Mokelumne River. If the conserved water were re-allocated, there would be no benefit.
WQ-12: Match delivered water quality use	○	The concept does not involve treating water, nor does it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	The concept does not include water purification elements.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.

Objective	● ◗ ○	*Justification*
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	The concept could increase available surface water supplies for other beneficial uses, which could be used for instream flow augmentation and fishery habitat enhancement. Based on modeling, under baseline 2040 conditions, average inflow to the Delta is projected to be 323.1 TAFY. The concept would increase this flow to 324.5 TAFY, an increase of 1.4 TAFY (Table 2). However, this assumes that the water conserved would have been diverted from the Mokelumne River; if groundwater is conserved, the change in flow would be less than 1.4 TAFY. Because many agricultural users rely on groundwater for irrigation, agricultural conservation would likely lead to more groundwater recharge than it would biogeomorphic benefits that would increase spawning habitat.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	The concept would not increase angling, harvesting, or other recreational opportunities.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.

Objective	● ◗ ○	*Justification*
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	●	The concept is well-defined enough to complete a quantitative assessment. Modeling with MOCASIM has been performed.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute scientific data to the current body of knowledge by collecting and reporting program information, including BMPs implemented and level of conservation achieved.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	The concept would maximize benefits for agricultural users, some of which are in DACs. Encouraging conservation by these users would maximize socio-economic benefits for these users by helping lower water bills.

Objective	● ◗ ○	*Justification*
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, project benefits would be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	●	Since agricultural irrigation uses a big portion of available water supply, significant increases in efficiencies could reduce surface water diversions and GW pumping throughout the watershed. Based on modeling, the concept would increase in-stream flows. Under baseline 2040 conditions, average inflow to the Delta is projected to be 323.1 TAFY. The concept would increase this flow to 324.5 TAFY, an increase of 1.4 TAFY (Table 2). However, this assumes that the water conserved would have been diverted from the Mokelumne River; if groundwater is conserved, the change in flow would be less than 1.4 TAFY.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.

Objective	● ◗ ○	*Justification*
E-29: Protect and restore fisheries	◗	Many agricultural users in the upper and lower watershed rely on groundwater for irrigation. Based on modeling, under baseline 2040 conditions, average inflow to the Delta is projected to be 323.1 TAFY. The concept would increase this flow to 324.5 TAFY, an increase of 1.4 TAFY (Table 2). However, this assumes that the water conserved would have been diverted from the Mokelumne River; if groundwater is conserved, the change in flow would be less than 1.4 TAFY. While the concept would reduce reliance on both groundwater and surface water, it is likely that more groundwater would be conserved than would surface water. Based on the supply conserved, this could concept potentially protect and restore fisheries by conserving Mokelumne River water.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	●	By increasing supply reliability for agricultural users, the concept would enhance and maintain the water supply for beneficial use in agricultural practices.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would help foster regional relationships by requiring long-term coordination between water agencies, state/federal agencies, farmers, and non-governmental organizations.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	The concept would reduce demands and conserve water. These outcomes are supported by a wide range of interests within the watershed, including water agencies and non-governmental organizations.

Objective	● ◗ ○	***Justification***
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would conserve water; its implementation would not directly address any current watershed conflicts.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. As such, the concept would not interfere with any entity exercising a water right.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife.

Objective	● ◗ ○	*Justification*
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would decrease existing in-stream flows. On the contrary, the concept could potentially increase flows by leaving more water in the River.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. On the contrary, the concept decreases dependency on water supplies which could be potentially unreliable.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	Conserving water would not create any adverse public health and safety impacts. Depending on the amount of water agency delivered conserved, socio-economic impacts could be seen among water agencies whose revenue can heavily rely on supplied water. However, due to the large amount of groundwater and privately diverted Mokelumne River water used for agriculture, these impacts are likely low.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that would create end use harm.

Objective	●	◗	○	*Justification*
CA-47: Avoid violating procedural or substantive laws		●		As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity		●		Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

Table 1: Difference in Unallocated Flow between 2040 Baseline Case and Case Implementing Agricultural Conservation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	-0.01	0.00	0.00	0.00	-0.39	-0.38	-0.39	-0.39	-0.38	0.00	0.00	0.00	-1.93
1954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1955	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-3.18	-3.18
1956	-0.01	-0.01	-0.01	-0.09	-0.27	-0.38	-0.38	-0.38	-0.37	0.00	0.00	0.00	-1.92
1957	0.00	0.00	0.00	0.00	-0.14	-0.13	-0.14	-0.14	-0.13	0.00	0.00	0.00	-0.68
1958	0.00	-0.05	-0.01	-0.09	-0.27	-0.38	-0.38	-0.38	-0.37	0.00	0.00	0.00	-1.95
1959	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1961	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1963	0.00	11.10	0.00	0.00	-0.62	-0.51	-0.51	-0.51	-0.49	0.00	-0.02	0.00	8.45
1964	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.62	-1.62
1965	-0.01	-0.01	0.00	-0.03	-0.27	-0.37	-0.39	-0.39	-0.37	0.00	-0.02	-0.01	-1.87
1966	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
1967	-1.61	-0.01	-0.01	-0.08	-0.26	-0.36	-0.37	-0.37	-0.36	0.00	0.00	0.00	-3.43
1968	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1969	-1.66	-0.01	-0.01	-0.08	-0.26	-0.36	-0.37	-0.37	-0.35	0.00	0.00	-0.03	-3.49
1970	-0.01	-0.01	-0.01	0.00	-0.37	-0.35	-0.37	-0.37	-0.35	0.00	-0.02	-0.01	-1.87
1971	-0.01	-0.01	-0.01	0.00	-0.38	-0.37	-0.38	-0.38	-0.37	0.00	-0.02	-0.01	-1.96
1972	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1973	-1.63	-0.01	-0.01	0.00	-0.36	-0.35	-0.36	-0.36	-0.35	0.00	-0.02	-0.01	-3.47
1974	-0.01	0.00	-0.02	-0.01	-0.27	-0.37	-0.39	-0.39	-0.37	0.00	0.00	0.00	-1.84
1975	0.00	0.00	0.00	0.00	-0.40	-0.38	-0.40	-0.40	-0.38	0.00	-0.02	0.00	-1.98
1976	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1977	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1978	0.00	0.00	0.00	0.00	-0.80	-0.77	-0.80	-0.80	-0.77	0.00	0.00	0.00	-3.93
1979	0.00	-0.04	-0.02	0.00	-0.38	-0.37	-0.38	-0.38	-0.37	0.00	0.00	0.00	-1.96

1980	-0.04	-0.01	-0.01	0.00	-0.37	-0.37	-0.39	-0.39	-0.37	0.00	0.00	0.00	-1.95
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.64	-1.64
1982	-0.01	-0.01	-0.02	-0.10	-0.28	-0.38	-0.39	-0.39	-0.38	0.00	-0.02	-0.01	-1.97
1983	-0.01	-0.01	-0.01	-0.10	-0.28	-0.38	-0.38	-0.38	-0.37	0.00	-0.02	-0.01	-1.96
1984	-0.01	-0.01	-0.01	0.00	-0.37	-0.36	-0.37	-0.37	-0.36	0.00	-0.02	0.00	-1.87
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1986	0.00	-1.65	-0.01	-0.08	-0.25	-0.36	-0.37	-0.37	-0.36	0.00	0.00	0.00	-3.44
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	0.00	0.00	0.00	0.00	1.01	0.98	1.01	1.01	0.98	0.00	0.00	0.00	4.98
1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	-1.06	-0.01	-0.08	-0.26	-0.37	-0.37	-0.37	-0.36	0.00	0.00	0.00	-2.88
1996	0.00	-0.05	-0.01	-0.09	-0.27	-0.37	-0.38	-0.38	-0.37	0.00	-0.02	-0.01	-1.98
1997	-0.01	-0.01	-0.01	0.00	-0.38	-0.37	-0.38	-0.38	-0.37	0.00	-0.02	0.00	-1.94
1998	-0.03	-0.01	-0.01	-0.09	-0.27	-0.38	-0.38	-0.38	-0.37	0.00	0.00	0.00	-1.94
1999	-0.04	-0.01	-0.01	0.00	-0.38	-0.37	-0.38	-0.38	-0.37	0.00	0.00	0.00	-1.95
2000	0.00	-0.05	-0.01	0.00	-0.38	-0.37	-0.38	-0.38	-0.37	0.00	0.00	0.00	-1.96
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	0.00	-0.39	-0.38	-0.39	-0.39	-0.38	0.00	0.00	0.00	-1.95
2004	0.00	0.00	-0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.07
2005	0.00	-1.61	-0.01	-0.01	-0.26	-0.36	-0.36	-0.36	-0.35	0.00	0.00	-0.03	-3.37
2006	-0.01	-0.01	-0.01	-0.09	-0.27	-0.38	-0.38	-0.38	-0.37	0.00	-0.02	-0.01	-1.95
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2010	0.00	0.00	0.00	0.00	-1.16	-1.13	-1.16	-1.16	-1.13	0.00	-0.02	-0.01	-5.77
Ave	-0.09	0.11	-0.01	-0.02	-0.17	-0.19	-0.20	-0.20	-0.19	0.00	0.00	-0.11	-1.07
Max	-0.01	-1.65	-0.01	-0.09	-0.26	-0.38	-0.38	-0.38	-0.37	0.00	-0.02	-1.62	-1.96
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2: Difference in Mokelumne Flow to Delta between 2040 Baseline Case and Case Implementing Agricultural Conservation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	-0.01	0.00	-0.01	0.00	-0.39	-0.38	-0.39	-0.39	-0.38	-0.12	0.00	0.00	-2.06
1954	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.11
1955	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	-3.18	-3.29
1956	-0.01	-0.01	-0.02	-0.09	-0.27	-0.38	-0.38	-0.38	-0.37	-0.12	0.00	0.00	-2.04
1957	0.00	0.00	-0.01	0.00	-0.14	-0.13	-0.14	-0.14	-0.13	-0.03	0.00	0.00	-0.72
1958	0.00	-0.05	-0.02	-0.09	-0.27	-0.38	-0.38	-0.38	-0.37	-0.12	0.00	0.00	-2.07
1959	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.11
1960	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.11
1961	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
1962	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.10
1963	-0.10	11.02	-0.12	0.00	-0.62	-0.51	-0.51	-0.51	-0.49	-0.20	-0.10	-0.10	7.76
1964	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	-1.62	-1.73
1965	-0.01	-0.01	-0.01	-0.11	-0.27	-0.37	-0.39	-0.39	-0.37	-0.12	-0.01	-0.01	-2.07
1966	-0.01	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.12
1967	-1.60	0.00	-0.01	-0.08	-0.26	-0.36	-0.37	-0.37	-0.36	-0.10	0.01	0.02	-3.47
1968	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.11
1969	-1.64	0.00	-0.01	-0.08	-0.26	-0.36	-0.37	-0.37	-0.35	-0.10	0.01	-0.01	-3.54
1970	-0.01	-0.01	-0.02	-0.08	-0.37	-0.35	-0.37	-0.37	-0.35	-0.12	-0.01	-0.01	-2.07
1971	-0.01	-0.01	-0.02	0.00	-0.38	-0.37	-0.38	-0.38	-0.37	-0.12	-0.02	-0.01	-2.09
1972	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.11
1973	-1.61	0.00	-0.01	0.00	-0.36	-0.35	-0.36	-0.36	-0.35	-0.10	0.00	0.00	-3.51
1974	-0.01	0.00	-0.03	-0.09	-0.27	-0.37	-0.39	-0.39	-0.37	-0.12	0.00	0.00	-2.04
1975	0.00	0.00	-0.01	0.00	-0.40	-0.38	-0.40	-0.40	-0.38	-0.12	-0.02	0.00	-2.10
1976	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	0.00	0.00	-0.05
1977	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
1978	0.00	0.00	0.00	-0.08	-0.80	-0.77	-0.80	-0.80	-0.77	-0.12	0.00	0.00	-4.13
1979	0.00	-0.04	-0.04	0.00	-0.38	-0.37	-0.38	-0.38	-0.37	-0.12	0.00	0.00	-2.09

1980	-0.04	-0.01	-0.02	0.00	-0.37	-0.37	-0.39	-0.39	-0.37	-0.12	0.00	0.00	-2.07
1981	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	-1.64	-1.74
1982	-0.01	-0.01	-0.02	-0.10	-0.28	-0.38	-0.39	-0.39	-0.38	-0.12	-0.02	-0.01	-2.09
1983	-0.01	-0.01	-0.02	-0.10	-0.28	-0.38	-0.38	-0.38	-0.37	-0.12	-0.02	-0.01	-2.09
1984	-0.01	-0.01	-0.02	-0.08	-0.37	-0.36	-0.37	-0.37	-0.36	-0.12	-0.02	0.00	-2.08
1985	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.11
1986	0.02	-1.64	-0.01	-0.08	-0.25	-0.36	-0.37	-0.37	-0.36	-0.10	0.01	0.02	-3.48
1987	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	0.00	0.00	-0.05
1988	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.10
1990	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	0.00	0.00	-0.05
1991	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
1992	0.00	0.00	0.00	-4.46	-7.81	0.00	0.00	0.00	-0.30	0.00	0.00	0.00	-12.57
1993	0.00	0.00	0.00	-0.08	1.01	0.98	1.01	1.01	0.98	-0.12	0.00	0.00	4.78
1994	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	0.00	0.00	-0.05
1995	0.00	-1.05	-0.01	-0.08	-0.26	-0.37	-0.37	-0.37	-0.36	-0.11	0.01	0.01	-2.96
1996	0.00	-0.05	-0.02	-0.09	-0.27	-0.37	-0.38	-0.38	-0.37	-0.11	-0.01	-0.01	-2.09
1997	-0.01	-0.01	-0.02	0.00	-0.38	-0.37	-0.38	-0.38	-0.37	-0.12	-0.01	0.00	-2.05
1998	-0.02	-0.01	-0.02	-0.09	-0.27	-0.38	-0.38	-0.38	-0.37	-0.12	0.00	0.00	-2.05
1999	-0.04	-0.01	-0.02	0.00	-0.38	-0.37	-0.38	-0.38	-0.37	-0.12	0.00	0.00	-2.07
2000	0.00	-0.05	-0.02	0.00	-0.38	-0.37	-0.38	-0.38	-0.37	-0.12	0.00	0.00	-2.09
2001	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.11
2002	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.11
2003	0.00	0.00	-0.01	0.00	-0.39	-0.38	-0.39	-0.39	-0.38	0.08	0.00	0.00	-1.88
2004	0.00	0.00	-0.08	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.17
2005	0.02	-1.60	-0.01	-0.08	-0.26	-0.36	-0.36	-0.36	-0.35	-0.10	0.01	-0.01	-3.46
2006	-0.01	-0.01	-0.02	-0.09	-0.27	-0.38	-0.38	-0.38	-0.37	-0.12	-0.01	-0.01	-2.07
2007	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.11
2008	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	0.00	0.00	-0.05
2009	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	-0.11

2010	0.00	0.00	-0.01	0.00	-1.16	-1.13	-1.16	-1.16	-1.13	-0.12	-0.02	-0.01	-5.90
Ave	-0.09	0.11	-0.02	-0.10	-0.31	-0.19	-0.20	-0.20	-0.20	-0.09	0.00	-0.11	-1.40
Max	-0.01	-1.64	-0.02	-0.09	-0.26	-0.38	-0.38	-0.38	-0.37	-0.10	-0.02	-1.62	-2.09
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-12.57

6a: Mokelumne Floodplain Management Plan – Camanche to Below Woodbridge Dam

San Joaquin County Resource Conservation District

Overview

In coordination with the Lower Mokelumne Watershed Stewardship Plan, work with willing landowners to create set back levees, re-configure side channels, and/or increase riparian buffer areas in the Mokelumne River from Camanche to Woodbridge Dam to maximize available habitat for salmonids and (in some cases) restore some floodplain function and promote groundwater storage.

Sponsor(s): San Joaquin County Resource Conservation District (SJCRCD)

Concept type: Implementation

Estimated Costs: Dependent on restoration contractor. Average is ~$8,000/acre for invasive/non-invasive species removal (Capital)

Funding Source(s): USFWS Partners for Fish and Wildlife Program, Anadramous Fish Restoration Program, USDA NRCS, NOAA Fisheries, DWR (Floodplain Corridor Protection Program), CA Fish and Wildlife, Department of Conservation

Concept location: Lower Mokelumne Watershed (from Camanche to Woodbride Dam)

Assessment

Objective	● ◗ ○	*Justification*
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not have elements that promote demand-side management strategies.
WS-2: Increase supply reliability	○	The concept would not address and/or increase supply reliability.
WS-3: Increase amount of stored water	●	The concept would increase the amount of stored water by restoring floodplain function, which promotes groundwater storage.

Objective	● ◗ ○	*Justification*
WS-4: Promote smart, responsible development	●	The concept promotes smart, responsible development by encouraging set-back levees, reconfiguring side channels, and increasing riparian buffer areas, all of which help attenuate flood flows and can help mitigate flooding in developed areas.
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation.
WS-6: Promote a long-term groundwater balance	●	The concept would promote a long-term groundwater balance by restoring floodplain function, which promotes groundwater storage.
WS-7: Maximize water resource availability for all beneficial uses	●	The concept would maximize water resource availability for all beneficial uses by mobilizing flood flows in such a way as to provide geomorphic, habitat, flood management, and groundwater recharge benefits.
WS-8: Decrease the need to import water	○	The concept would not result in a substantial decrease in the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.

Objective	● ◗ ○	*Justification*
WQ-11: Protect and improve surface and groundwater quality	◗	The concept could protect or improve groundwater quality by recharging the groundwater basin and diluting groundwater constituents; however the extent and magnitude of this benefit is unknown at this time.
WQ-12: Match delivered water quality use	○	The concept does not involve treating water, nor does it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	The concept does not include water purification elements.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	◗	Available scientific information is demonstrating biological benefits for juvenile rearing salmonids and other aquatic resources associated with levee setbacks, seasonally inundated floodplain, and improved riparian vegetation. However, the locations where restoration activities would occur and the aerial extent of restoration activities will determine the overall success of the program. The opportunity certainly exists to provide major habitat benefit through such restoration activities if they were implemented over a large landscape of the lower river.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.

Objective	● ◗ ○	*Justification*
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	◗	The concept could increase angling and other recreational opportunities by providing habitat that promotes juvenile salmonid growth rates and survival, both of which contribute to increased recreational opportunities. However, the locations where restoration activities would occur and the aerial extent of restoration activities will determine the overall success of the program.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	●	The concept enhances flood management and protection by attenuating flows through set-back levees, re-configured side channels, and increased riparian buffer zones. These outcomes provide enhanced flood protection to developed areas in the Lower Mokelumne.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis separate from that which was produced as part of the MokeWISE program.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	○	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed.

Objective	● ◗ ○	***Justification***
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge by collecting and reporting program information, including information on groundwater recharge, flood attenuation, and riparian habitat.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	The concept is located along the river, and flood benefits would be seen in Lodi and Stockton, both of which have areas that the classified as DACs.
O-26: Achieve equity	●	The benefits realized from implementing the concept would not be limited to a narrow group; rather, project benefits would be spread across the lower Mokelumne region, spanning cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	●	Restoration that involves connectivity to floodplains, side channels, and an increase in riparian corridor width and length would provide multiple biogeomorphic beneficial uses to the aquatic ecosystem. Benefits include: sediment deposition on floodplains, increased connectivity during high flows would provide for increased refugia, increased productivity on the floodplains which can yield larger juvenile fish, shading which improves water temperature, additional opportunities for streamwood to enter the active channel and provide structure, food and dissolved organic carbon to the system.

Objective	● ◗ ○	***Justification***
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	●	The concept would likely protect and restore fisheries by providing juvenile salmonid habitat and shading which can improve water temperature. The locations where restoration activities would occur and the aerial extent of restoration activities will determine the overall success of the program.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	○	The concept does not include elements that would increase agricultural water supply.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The concept would require coordination between a number of entities, which could include non-governmental organizations, state/federal agencies, and private landowners. This coordination would contribute to fostering long-term regional relationships and help to avoid unnecessary conflict and litigation.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	The concept would restore riparian habitat, re-engage floodplains, and reduce flooding in developed areas. These outcomes are supported by a wide range of interests within the watershed.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.

Objective	● ◗ ○	*Justification*
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would not directly address any current watershed conflicts.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. As such, the concept would not interfere with any entity exercising a water right.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be the most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses.

Objective	● ◗ ○	***Justification***
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	The concept does not include elements that would create adverse socio-economic and public health and safety impacts.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

7a: PG&E Storage Recovery

Amador Water Agency, Calaveras County Water District

Overview

Sponsor(s): Amador Water Agency (AWA), Calaveras County Water District (CCWD)

Concept type: Planning

Estimated Costs: unknown

Funding Source(s): unknown

Concept location: PG&E reservoirs in the Mokelumne system

Evaluate the feasibility of removing silt and sediment from behind PG&E dams. The study would include evaluation of the proposed beneficial uses of the project and clarifying operational parameters. It would also identify impacts, and constraints in the following areas: river flows, domestic water supply, technical, political, environmental (including both species-related and geomorphic), economic, legal, and recreation – recognizing that a more detailed Environmental Impact Report would be required prior to implementing a project. The study will include consultation with members of the MokeWISE MCG.

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	As a feasibility study, the concept would not promote demand-side management strategies. Implementation of the project described in the concept would also not meet this objective.
WS-2: Increase supply reliability	◗	As a feasibility study, the concept would not increase supply reliability. However, if the project described in the concept were implemented, supply reliability would be increased by the amount of additional storage gained by desilting.
WS-3: Increase amount of stored water	◗	As a feasibility study, the concept would not increase the amount of stored water. However, stored water would be increased if sediment and silt were removed from behind PG&E dams.

Objective	● ◗ ○	*Justification*
WS-4: Promote smart, responsible development	○	As a feasibility study, the concept itself would not promote smart, responsible development. And if implemented, while the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.
WS-5: Reduce reliance on groundwater for irrigation	◗	As a feasibility study, the concept itself would not reduce reliance on groundwater. Implementation of the plan could potentially reduce groundwater for irrigation, assuming that the additional stored water is used for irrigation.
WS-6: Promote a long-term groundwater balance	◗	As a feasibility study, the concept itself would not promote a long-term groundwater balance. Implementation of the plan could potentially reduce groundwater for irrigation, assuming that the additional stored water is used for irrigation.
WS-7: Maximize water resource availability for all beneficial uses	◗	The concept itself would not maximize water resource availability for all beneficial uses. Removal of silt and sedimentation from behind dams would maximize water resource availability by capturing additional water during wet periods and increasing storage.
WS-8: Decrease the need to import water	◗	The concept itself would not decrease the need to import water. However, the need for imported water could be decreased with the use of added storage to capture additional water during wet periods.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates. Implementation of the project described in the concept would also not review existing agency demand estimates.

Objective	● ◗ ○	*Justification*
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update. Implementation of the project described in the concept would also not identify water demand issues.
WQ-11: Protect and improve surface and groundwater quality	○	As a feasibility study, the concept itself would not protect or improve surface and/or groundwater quality. Implementation of the project described in the concept would also not meet this objective. Dredging of toxic elements could present a fatal flaw to the concept's implementation and should be addressed in the feasibility study.
WQ-12: Match delivered water quality use	○	The concept itself would not involve treating water, nor does it involve delivering treated water. Desilting would also not involve treating water, nor would it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	As a feasibility study, the concept itself would not use water purification technology as a tool to maximize beneficial uses. Desilting would also not include water purification elements.
R-14: Increase access for water-based recreation	○	As a feasibility study, the concept itself does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters. Desilting would also not include these elements.

Objective	● ◗ ○	*Justification*
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	As a feasibility study, the concept itself would not increase spawning habitat. Sediment removal would have very little direct benefit to aquatic habitat resources within the watershed. Sediment removal from existing impoundments would reduce the risk of sediment resuspension during high flow periods, reduce suspended sediment loading and sediment deposition in habitats downstream of the reservoirs, thereby improving the quality and availability of habitat for salmonids and other aquatic resources. Increasing the reservoir storage volume by sediment removal would also create additional opportunities to further trap suspended sediments and bedload transport in the upper part of the watershed. Given the size of the PG&E facilities, and sediment trapping that would occur downstream in Pardee and Camanche reservoirs, desilting PG&E reservoirs is expected to provide relatively little benefit for habitat enhancement within the lower Mokelumne River downstream of Camanche dam.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections. Desilting would also not meet this objective.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne. Desilting would also not meet this objective.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	As a feasibility study, the concept would not increase angling and other recreational opportunities. Desilting would also not meet this objective.

Objective	● ◗ ○	*Justification*
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed. This objective would also not be achieved if restoration were implemented.
F-20: Enhance flood protection and management	◗	As a feasibility study, the concept would not enhance flood protection and management. If implemented, desilting could enhance flood protection by increasing the amount of storage available for catching flood flows.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	●	As a feasibility study, the concept would require the use of an agreed-upon hydrology dataset and/or Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	◗	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed. However, the purpose of this concept is to assess feasibility and collect sound, agreed-upon data prior to implementation of the concept.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute scientific data to the current body of knowledge by completing a feasibility study and developing information about the cost of desilting dams and the potential environmental and water supply benefits.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters. Implementation of the project described in the concept would also not increase investment in forest management.

Objective	● ◗ ○	*Justification*
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	○	As a feasibility study, the concept would not meet this objective. Additionally, desilting activities would not be located within a DAC and would not directly contribute to socio-economic, cultural, recreational, public health, and public safety benefits of a DAC.
O-26: Achieve equity	◗	As a feasibility study, the concept would not directly achieve equity. However, the benefits realized from desilting activities would not be limited to a narrow group; rather, project benefits would be spread across water agency customers, spanning regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	◗	As a feasibility study, the concept would not enhance the natural environment. However, sediment removal from reservoirs could be beneficial, especially if the larger size fractions of these sediments could be repurposed to provide augmentation to locations within the river corridor. Benefits may need to be assessed based on presence/absence of mercury, and the relative risks of removal/disposal or methylation if left in place. Mercury and other trace metal risks are thought to be generally lower in the Upper Moke than in other Sierran watersheds.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation. Restoration activities would also not meet this objective.
E-29: Protect and restore fisheries	○	As a feasibility study, the concept itself would not protect and restore fisheries. Desilting reservoirs would also not protect and restore fisheries downstream of Camanche.

Objective	● ◗ ○	*Justification*
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	◗	As a feasibility study, the concept would not enhance or maintain water supply for beneficial use in agricultural practices. Implementing the project described in the concept could enhance water supply for agricultural practices by potentially providing water to AWAs, CCWDs, JVIDs, and CPUDs agricultural customers.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The purpose of the concept is to assess the feasibility of desilting PG&E reservoirs. This helps avoid unnecessary conflict and litigation by identifying and attempting to resolve issues early on. Coordination between water agencies, PG&E, non-governmental organizations, and state/federal agencies would be required.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	◗	As a feasibility study, the concept would not directly promote broadly-supported outcomes that benefit a wide range of interests. However, the project described in the concept would likely promote broadly-supported outcomes. Desilting would increase the amount of stored water, reduce the need for additional on-stream storage, and increase recreation. These outcomes are broadly supported by a wide range of interests.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	◗	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens. The project described in the concept would also need to undergo these screenings to determine if it was the least controversial project.

Objective	● ◗ ○	*Justification*
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	◗	As a feasibility study, the concept would not result in agreements that reduce conflicts. Desilting PG&E reservoirs could reduce conflicts if the implementation reduced the need for new on-stream storage.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. This would also be required of the project described in the concept if it were to be implemented.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc. This would also be required of the project described in the concept if it were to be implemented.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	The purpose of this concept is to study the feasibility of desilting PG&E reservoirs; as such, the nature of the concept will help avoid basing decisions on incomplete or inaccurate information.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept will not result in construction of a new or larger on-stream dam. If the project as described in the concept is implemented, there would also not be demand for new or larger on-stream dams. On the contrary, implementation of the project could potentially reduce the demand for new or larger on-stream dams.

Objective	● ◗ ○	*Justification*
CA-39: Avoid harmful impacts to fisheries and other wildlife	◗	The concept would not create harmful impacts to fisheries and other wildlife. Implementation of the project described in the concept could create harmful impacts to fisheries and other wildlife by capturing more water and reducing downstream flows; mitigation measures could be implemented to maintain these current benefits.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept would not convert agricultural lands to developed uses. Implementation of the project described in the concept would also not convert agricultural lands.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept would not shift environmental impacts from one area to another. Implementation of the project described in the concept would also not shift environmental impacts.
CA-42: No diminishment of the benefits of existing in-stream flow	◗	The concept does not include elements that would alter existing in-stream flows. Implementation of the project described in the concept would reduce existing in-stream flows by capturing more water. It is unclear at this time if the benefits of current in-stream flow would be diminished; mitigation measures could be implemented to maintain these current benefits.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate. This also applies to implementation of the project described in the concept.

Objective	● ◗ ○	*Justification*
CA-44: Avoid dependency on potentially unreliable supply	◗	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. Making additional storage available by desilting could create dependency on this supply, which is more unreliable than other forms of supply, as it is susceptible to re-silting and hydrologic year type.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	As a feasibility study, this concept does not have adverse socio-economic and public health and safety impacts. Implementation of the project described in the concept would provide public health and safety benefits by upgrading the treatment process from a sand filter to a membrane filtration process.
CA-46: Avoid end use harm	◗	The concept does not allocate water in ways that create end use harm. It is not known at this time how the additional stored water would be allocated.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation. This would also be required if the project described in the concept were implemented.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs. This also holds if the project described in the concept were to be implemented.

7b: Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering

Amador Water Agency, Jackson Valley Irrigation District, Calaveras County Water District, Calaveras Public Utilities District

Overview

Sponsor(s): Amador Water Agency (AWA), Calaveras County Water District (CCWD), Jackson Valley Irrigation District (JVID), Calaveras Public Utility District (CPUD)

Concept type: Planning

Estimated Costs: $500,000

Funding Source(s): unknown

Concept location: Lower Bear Reservoir, Amador County

Evaluate the feasibility of enlarging Lower Bear Reservoir by raising the existing dam (embankment) by up to 32 feet to increase surface water storage capacity within the upper Mokelumne River watershed. This feasibility study would be a continuation of previous studies and serve to address previously unanswered questions and unresolved issues. The study would include evaluation of the proposed beneficial uses of the project and clarifying operational parameters. It would also identify benefits, impacts, and constraints in the following areas: technical, political, environmental (including both species-related and geomorphic), economic, legal, and recreation – recognizing that a more detailed Environmental Impact Report would be required prior to implementing a project. The study will include consultation with members of the MokeWISE MCG. Previous studies performed on behalf of Amador Water Agency suggest that Lower Bear Reservoir would provide 18,300 acre-feet of additional yield (Willard, 2005). In addition to modifications to the dam itself, other facilities that would need to be constructed include an updated intake structure and spillway. Also note that the project would require the relocation of adjacent roads and existing recreation facilities.

Modeling work performed in MOCASIM assumed five demand structures for Amador Water Agency, including an additional 5,000; 6,000; 7,000; 8,000; 9,000; and 10,000 AFY of demand. This additional demand was added onto AWA's projected 2040 demand. These additional demands were distributed over the year based on AWA's current yearly demand distribution. Modeling assumed a 2015 water right priority.

Assessment

Objective	● ◗ ○	*Justification*
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	As a feasibility study, the concept does not have elements that promote demand-side management strategies. Implementation of the project described in the concept would also not have elements that would promote demand-side management strategies.
WS-2: Increase supply reliability	◗	As a feasibility study, the concept would not increase supply reliability. If Lower Bear was raised by 32 feet, modeling shows that the firm yield would be between 2,000 AFY and 3,000 AFY (Table 1). While this concept would increase supply reliability for AWA and other partner agencies, this concept would decrease the average amount of unallocated water below Camanche. Under baseline 2040 conditions, average unallocated flow is projected to be 230.0 thousand acre-feet per year (TAFY). The concept would decrease that amount by between 5.7 TAFY and 8.2 TAFY, depending on the demand scenario. Under a 5,000 AFY demand, this would result in average unallocated flow of 224.3 TAFY; in a 10,000 AFY demand scenario, average unallocated flow would be 221.7 TAFY (Table 1).
WS-3: Increase amount of stored water	◗	As a feasibility study, the concept itself would not increase the amount of stored water. If Lower Bear was raised by 32 feet, the amount of stored water would be increased by up to 30 TAF of surface storage. A portion of the additional demand placed on the reservoir storage (5,000 – 10,000 AFY) could be moved to groundwater storage.

Objective	● ◗ ○	***Justification***
WS-4: Promote smart, responsible development	◗	As a feasibility study, the concept itself would promote smart, responsible development by studying the dam raise prior to implementing the project. If implemented, the project could meet this objective by implementing operational parameters that promote smart responsible development.
WS-5: Reduce reliance on groundwater for irrigation	◗	The concept itself would not reduce reliance on groundwater for irrigation. However, if Lower Bear were raised up to 32 feet for an additional 30 thousand acre-feet (TAF) of storage, a portion of the demand on that stored water (5,000 – 10,000 AFY) could be used in lieu of groundwater. This concept would decrease the average amount of unallocated water below Camanche. Under baseline 2040 conditions, average unallocated flow is projected to be 230.0 thousand acre-feet per year (TAFY). The concept would decrease that amount by between 5.7 TAFY and 8.2 TAFY, depending on the demand scenario. Under a 5,000 AFY demand, this would result in average unallocated flow of 224.3 TAFY; in a 10,000 AFY demand scenario, average unallocated flow would be 221.7 TAFY (Table 1). Thus, reliance on groundwater could be reduced between 5.7 TAFY and 8.2 TAFY.

Objective	● ◗ ○	*Justification*
WS-6: Promote a long-term groundwater balance	◗	The concept itself would not promote a long-term groundwater balance. However, if Lower Bear were raised 32 feet for an additional 30 TAF of storage, a portion of the demand on that stored water (5,000 – 10,000 AFY) could be used in lieu of groundwater. Under baseline 2040 conditions, average unallocated flow is projected to be 230.0 thousand acre-feet per year (TAFY). The concept would decrease that amount by between 5.7 TAFY and 8.2 TAFY, depending on the demand scenario. Thus, between 5.7 TAFY and 8.2 TAFY could be left in the groundwater basin, which would promote a long-term groundwater balance.
WS-7: Maximize water resource availability for all beneficial uses	◗	As a feasibility study, the concept would not maximize water resource availability. However, if the project were implemented, the raised reservoir would store an additional 30 TAF. The demand on this additional stored water (5,000 – 10,000 AFY) could be put to a variety of beneficial uses, including consumptive, groundwater recharge, and environmental.
WS-8: Decrease the need to import water	◗	The concept itself would not decrease the need to import water. However, the need for imported water in San Joaquin County could be decreased with the use of added storage to capture additional water during wet periods, assuming the concept included County partners (or was combined into a groundwater banking project).
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates. Implementation of the project described in the concept would also not review existing agency demand estimates.

Objective	● ◗ ○	***Justification***
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update. Implementation of the project described in the concept would also not identify water demand issues.
WQ-11: Protect and improve surface and groundwater quality	◗	As a feasibility study, the concept itself would not protect or improve surface and/or groundwater quality. However, the feasibility study will include analysis on the improvements associated with encapsulating exposed rocks on the dam face, which could be a source of elevated copper levels noted during spring snowmelt. Based on the feasibility study results, raising Lower Bear could include a component that reduces copper levels. The amount of copper reduction potentially feasible will be determined during the feasibility study and is unknown at this time.
WQ-12: Match delivered water quality use	○	The concept itself would not involve treating water, nor does it involve delivering treated water. Raising Lower Bear would also not involve treating water, nor would it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	As a feasibility study, the concept itself would not use water purification technology as a tool to maximize beneficial uses. Raising Lower Bear would also not include water purification elements.
R-14: Increase access for water-based recreation	○	As a feasibility study, the concept itself does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters. Raising Lower Bear would also not include these elements.

Objective	● ◗ ○	*Justification*
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	As a feasibility study, the concept itself would not increase spawning habitat. Raising the elevation of Lower Bear Reservoir could provide opportunities for releases downstream that could benefit the cold water pool in Camanche and Pardee reservoirs as well as enhance instream flows for salmonids within the watershed immediately downstream of Lower Bear Reservoir as well as further downstream in the lower Mokelumne River. The overall benefits of increasing reservoir storage, however, on fishery habitat are considered to be moderately low.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections. Raising Lower Bear would also not meet this objective.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne. Implementing the project described in the concept would also not meet this objective.
R-18: Increase angling and other recreational opportunities (increase opportunities)	◗	As a feasibility study, the concept would not increase angling and other recreational opportunities. If implemented, raising Lower Bear could potentially increase angling and recreational opportunities by increasing the surface area of the reservoir. However, the increase in these benefits is likely small.
WR-19: Resolve existing water rights conflicts in the watershed	◗	The concept could help address/clarify AWA's and CCWD's water rights. Additionally, raising Lower Bear could potentially be integrated with other projects (like a groundwater banking project) if it is structured that way.

Objective	● ◗ ○	***Justification***
F-20: Enhance flood protection and management	◗	As a feasibility study, the concept would not enhance flood protection and management. If implemented, the 30 TAF of additional storage would enhance flood protection by capturing flood flows. This concept would decrease the average amount of unallocated water below Camanche. Under baseline 2040 conditions, average unallocated flow is projected to be 230.0 thousand acre-feet per year (TAFY). The concept would decrease that amount by between 5.7 TAFY and 8.2 TAFY, depending on the demand scenario. Under a 5,000 AFY demand, this would result in average unallocated flow of 224.3 TAFY; in a 10,000 AFY demand scenario, average unallocated flow would be 221.7 TAFY (Table 1).
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	●	As a feasibility study, the concept would require the use of an agreed-upon hydrology dataset and/or Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	●	The concept is well-defined enough to complete a quantitative assessment. Modeling with MOCASIM has been performed. Additionally, the purpose of this concept is to assess feasibility and collect sound, agreed-upon data prior to implementation of the concept.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute scientific data to the current body of knowledge by completing a feasibility study and addressing questions that have been unanswered by previous Lower Bear studies.

Objective	● ◗ ○	***Justification***
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters. Raising Lower Bear would also not increase investment in forest management.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	As a feasibility study, the concept would not meet this objective. Raising Lower Bear would maximize these benefits for a DAC, as AWA, CCWD, JVID, and CPUD all serve DACs. Additional storage for these agencies would benefit the DACs that these agencies serve.
O-26: Achieve equity	◗	As a feasibility study, the concept would not directly achieve equity. However, the benefits realized from additional storage would not be limited to a narrow group; rather, project benefits would be spread across water agency customers, spanning regions, cultures, incomes, and time.

Objective	● ◗ ○	*Justification*
E-27: Protect and enhance natural environment (enhance natural envt)	○	The concept itself would not enhance the natural environment. Raising Lower Bear would capture additional peak flows, which would reduce the ability of flood hydrographs from doing "natural" geomorphic work even more so than current regulated conditions. Processes that need peak flows include sediment transport, rejuvenation of channel bed and bank substrates, and floodplain inundation. This concept would decrease the average amount of Mokelumne flow to the Delta. Under baseline 2040 conditions, average unallocated flow is projected to be 323.1 thousand acre-feet per year (TAFY). The concept would decrease that amount by between 4.6 TAFY and 7.1 TAFY, depending on the demand scenario. Under a 5,000 AFY demand, this would result in average unallocated flow of 318.5 TAFY; in a 10,000 AFY demand scenario, average flow to the Delta would be 315.9 TAFY (Table 2).
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation. Raising Lower Bear would also not meet this objective.

Objective	● ◗ ○	*Justification*
E-29: Protect and restore fisheries	◗	As a feasibility study, the concept would not protect and restore fisheries. Raising Lower Bear Reservoir could potentially provide opportunities for releases downstream that could benefit the coldwater pool in Camanche and Pardee reservoirs as well as enhance instream flows for salmonids within the watershed immediately downstream of Lower Bear Reservoir as well as further downstream in the lower Mokelumne River. The overall benefits of increasing reservoir storage, however, on fishery habitat are considered to be moderately low. This concept would decrease the average amount of Mokelumne flow to the Delta. Under baseline 2040 conditions, average unallocated flow is projected to be 323.1 thousand acre-feet per year (TAFY). The concept would decrease that amount by between 4.6 TAFY and 7.1 TAFY, depending on the demand scenario. Under a 5,000 AFY demand, this would result in average unallocated flow of 318.5 TAFY; in a 10,000 AFY demand scenario, average flow to the Delta would be 315.9 TAFY (Table 2).
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	◗	As a feasibility study, the concept would not enhance or maintain water supply for beneficial use in agricultural practices. However, the additional water stored by a raised Lower Bear (30 TAF) would likely enhance water supply for agricultural uses, as AWA, JVID, CPUD, and CCWD all serve agricultural customers. Demand placed on the additional storage (5,000 – 10,000 AFY) could serve agricultural uses. Additionally, if a lower watershed water agency partnered on this project, water supply for agricultural customers in the lower watershed would also be enhanced by this additional storage.

Objective	● ◗ ○	*Justification*
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The purpose of the concept is to assess the feasibility of raising Lower Bear. This helps avoid unnecessary conflict and litigation by identifying and attempting to resolve issues early on. Coordination between water agencies, non-governmental organizations, and state/federal agencies would be required.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	◗	As a feasibility study, the concept would directly promote broadly-supported outcomes that benefit a wide range of interests by studying aspects of raising Lower Bear that has yet been previously studied. However, raising Lower Bear would not likely promote broadly-supported outcomes, as there are a number of watershed stakeholders who fundamentally disagree with expanded on-stream storage.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	◗	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens. The project described in the concept would also need to undergo these screenings to determine if it was the least controversial project.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	As a feasibility study, the concept would not result in agreements that reduce conflicts. Raising Lower Bear would also not likely result in agreements that reduce conflict, as there are a number of watershed stakeholders who fundamentally disagree with expanded on-stream storage.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. This would also be required of the project described in the concept if it were to be implemented.

Objective	● ◗ ○	***Justification***
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc. This would also be required of the project if Lower Bear were raised.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	The purpose of this concept is to study the feasibility of raising Lower Bear Reservoir; as such, the nature of the concept will help avoid basing decisions on incomplete or inaccurate information.
CA-38: Avoid demand for new or larger on-stream dams	◗	The concept itself would not result in the construction of a new or larger on-stream dam. However, raising Lower Bear would result in a larger on-stream dam; as such, this objective would not be met.
CA-39: Avoid harmful impacts to fisheries and other wildlife	◗	The concept would not create harmful impacts to fisheries and other wildlife. Raising Lower Bear would provide a small increase in water storage capability and opportunities for releases downstream that could benefit the coldwater pool in Camanche and Pardee reservoirs as well as enhance instream flows for salmonids within the watershed immediately downstream of Lower Bear Reservoir as well as further downstream in the lower Mokelumne River. The overall benefits of increasing reservoir storage, however, on fishery habitat are considered to be moderately low. Mitigation measures could be implemented to minimize these impacts.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept would not convert agricultural lands to developed uses. Implementation of the project described in the concept would also not convert agricultural lands.

Objective	● ◗ ○	*Justification*
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept would not shift environmental impacts from one area to another. Implementation of the project described in the concept would also not shift environmental impacts.
CA-42: No diminishment of the benefits of existing in-stream flow	◗	The concept does not include elements that would alter existing in-stream flows. Raising Lower Bear would reduce existing in-stream flows by capturing more water. It is unclear at this time if the benefits of current in-stream flow would be diminished; mitigation measures could be implemented to maintain these current benefits.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate. This also applies to implementation of the project described in the concept.
CA-44: Avoid dependency on potentially unreliable supply	◗	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. Raising Lower Bear could create additional dependency on the Mokelumne River, which is susceptible to hydrologic year types can be unreliable in drier years.
CA-45: Minimize adverse socio-economic and public health and safety impacts	◗	As a feasibility study, this concept does not have adverse socio-economic and public health and safety impacts. Raising Lower Bear would not have adverse health and safety impacts. However, raising the reservoir could potentially have some adverse socio-economic impacts; more information on potential cost and yield is needed to determine the magnitude of these impacts.

Objective	● ◗ ○	***Justification***
CA-46: Avoid end use harm	◗	The concept does not allocate water in ways that create end use harm. It is not known at this time how the additional stored water would be allocated.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation. This would also be required if the project described in the concept were implemented.
CA-48: Avoid interregional inequity	◗	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs. Raising Lower Bear could potentially have interregional inequity, particularly in environmental costs.

Table 1: Concept 7b: Enlarged Lower Bear
Percent of the Year Demand is Met or Exceeded

	Annual Demand in TAF					
% Exc	**5**	**6**	**7**	**8**	**9**	**10**
100%	2.1	0.0	0.0	0.0	0.0	0.0
98%	3.1	2.7	0.4	0.2	0.0	0.0
96%	3.4	3.6	3.5	1.6	0.0	0.0
94%	3.8	3.8	4.5	2.3	0.5	0.0
92%	4.6	4.1	4.7	3.1	1.5	0.1
90%	5.0	4.7	4.8	4.5	2.0	1.2
88%	5.0	5.8	5.0	5.2	5.0	3.8
86%	5.0	6.0	5.0	5.3	5.6	4.5
84%	5.0	6.0	5.2	5.4	5.7	4.7
82%	5.0	6.0	5.9	5.6	5.9	5.2
80%	5.0	6.0	7.0	5.8	6.0	5.9
78%	5.0	6.0	7.0	6.4	6.1	6.2
76%	5.0	6.0	7.0	7.6	6.2	6.3
74%	5.0	6.0	7.0	8.0	6.5	6.4
72%	5.0	6.0	7.0	8.0	6.8	6.5
70%	5.0	6.0	7.0	8.0	7.3	6.6
68%	5.0	6.0	7.0	8.0	7.6	6.7
66%	5.0	6.0	7.0	8.0	8.0	6.8
64%	5.0	6.0	7.0	8.0	8.3	6.8
62%	5.0	6.0	7.0	8.0	8.8	7.2
60%	5.0	6.0	7.0	8.0	9.0	7.8
58%	5.0	6.0	7.0	8.0	9.0	8.6
56%	5.0	6.0	7.0	8.0	9.0	9.0
54%	5.0	6.0	7.0	8.0	9.0	9.3
52%	5.0	6.0	7.0	8.0	9.0	9.6

50%	5.0	6.0	7.0	8.0	9.0	10.0
48%	5.0	6.0	7.0	8.0	9.0	10.0
46%	5.0	6.0	7.0	8.0	9.0	10.0
44%	5.0	6.0	7.0	8.0	9.0	10.0
42%	5.0	6.0	7.0	8.0	9.0	10.0
40%	5.0	6.0	7.0	8.0	9.0	10.0
38%	5.0	6.0	7.0	8.0	9.0	10.0
36%	5.0	6.0	7.0	8.0	9.0	10.0
34%	5.0	6.0	7.0	8.0	9.0	10.0
32%	5.0	6.0	7.0	8.0	9.0	10.0
30%	5.0	6.0	7.0	8.0	9.0	10.0
28%	5.0	6.0	7.0	8.0	9.0	10.0
26%	5.0	6.0	7.0	8.0	9.0	10.0
24%	5.0	6.0	7.0	8.0	9.0	10.0
22%	5.0	6.0	7.0	8.0	9.0	10.0
20%	5.0	6.0	7.0	8.0	9.0	10.0
18%	5.0	6.0	7.0	8.0	9.0	10.0
16%	5.0	6.0	7.0	8.0	9.0	10.0
14%	5.0	6.0	7.0	8.0	9.0	10.0
12%	5.0	6.0	7.0	8.0	9.0	10.0
10%	5.0	6.0	7.0	8.0	9.0	10.0
8%	5.0	6.0	7.0	8.0	9.0	10.0
6%	5.0	6.0	7.0	8.0	9.0	10.0
4%	5.0	6.0	7.0	8.0	9.0	10.0
2%	5.0	6.0	7.0	8.0	9.0	10.0

Table 2: Difference in Unallocated Flow below Camanche between 2040 Baseline Case and Raising Lower Bear under 5,000 AF Demand (TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	-0.92	0.00	0.00	0.00	0.02	-16.01	-0.21	0.02	0.02	0.00	0.00	0.00	-17.08
1954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1955	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	59.58	59.58
1956	-31.81	-6.62	-2.28	7.92	5.66	-1.97	1.20	1.29	1.25	0.00	0.00	0.00	-25.36
1957	0.00	0.00	0.00	0.00	-2.87	1.00	1.55	1.55	1.50	0.00	0.00	0.00	2.72
1958	0.00	-12.48	2.23	2.77	-16.00	2.20	2.29	2.50	2.42	0.00	0.00	0.00	-14.06
1959	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1961	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1963	0.00	5.78	0.00	0.00	-21.06	0.60	1.10	1.10	1.07	0.00	0.19	0.00	-11.22
1964	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-21.49	-21.49
1965	-23.29	-0.46	0.00	17.82	14.76	-3.22	1.06	1.22	1.18	0.00	-2.69	2.17	8.54
1966	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60
1967	-4.43	3.30	-7.51	-0.82	19.56	-10.08	-5.20	-2.49	-2.41	0.00	0.00	0.00	-10.07
1968	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1969	-10.47	-1.23	2.08	-3.78	-14.72	12.34	-0.35	-0.03	-0.03	0.00	0.00	0.27	-15.92
1970	-8.79	-2.72	-5.76	0.00	3.99	0.19	4.45	4.45	4.31	0.00	-2.69	1.22	-1.35
1971	-0.11	0.13	-0.27	0.00	0.34	-4.80	0.28	0.34	0.33	0.00	1.85	0.09	-1.83
1972	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1973	-5.49	-0.15	2.16	0.00	-3.79	-4.76	0.20	0.20	0.20	0.00	-2.00	-2.70	-16.13
1974	-1.83	0.00	-1.06	4.46	-7.90	1.93	1.67	1.69	1.63	0.00	0.00	0.00	0.58
1975	0.00	0.00	0.00	0.00	-1.70	-6.81	-1.91	-1.70	-1.64	0.00	1.09	0.00	-12.66
1976	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1977	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1978	0.00	0.00	0.00	0.00	1.60	-5.72	1.37	1.60	1.54	0.00	0.00	0.00	0.39
1979	0.00	0.00	-3.67	0.00	-5.26	-3.78	1.08	1.08	1.05	0.00	0.00	0.00	-9.50

1980	-11.17	-9.17	-5.83	14.12	11.75	-1.77	1.72	2.37	2.29	0.00	0.00	0.00	4.32
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-11.40	-11.40
1982	-6.57	-12.23	-19.83	29.39	4.50	0.60	0.79	1.14	1.10	0.00	-5.01	-13.20	-19.33
1983	-5.72	-14.20	-21.41	3.13	30.49	17.40	0.77	1.35	1.37	0.00	-14.93	-16.69	-18.42
1984	-10.86	-4.42	-2.18	0.00	8.31	9.16	9.99	9.99	9.66	0.00	-3.42	0.57	26.81
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1986	0.00	-12.91	-17.49	12.43	1.65	5.66	1.71	1.71	1.65	0.00	0.00	0.00	-5.60
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	0.00	0.00	0.00	0.00	-7.38	-7.28	-3.95	-3.76	-3.64	0.00	0.00	0.00	-25.99
1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	-8.61	-16.41	-5.07	7.00	-16.98	0.04	2.55	2.50	0.00	0.00	0.00	-34.98
1996	0.00	-6.08	-14.80	-1.21	13.61	5.14	3.10	3.10	3.00	0.00	-8.32	-9.92	-12.40
1997	-3.86	-13.40	-5.93	0.00	6.30	7.23	7.56	7.56	7.32	0.00	-1.31	0.00	11.47
1998	0.24	-1.10	-3.88	3.95	9.66	-14.48	-0.67	-0.02	-0.02	0.00	0.00	0.00	-6.33
1999	-0.23	-7.67	-10.14	0.00	-0.29	13.01	-0.24	0.40	0.39	0.00	0.00	0.00	-4.77
2000	0.00	-4.88	-4.16	0.00	-2.21	1.67	2.25	2.25	2.17	0.00	0.00	0.00	-2.91
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	0.00	-2.88	-2.79	-0.46	-0.46	-0.45	0.00	0.00	0.00	-7.05
2004	0.00	0.00	-8.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-8.96
2005	0.00	-11.72	-9.87	-4.00	-22.82	18.17	2.64	2.99	2.90	0.00	0.00	-13.40	-35.11
2006	-4.77	-9.08	-28.07	-24.06	50.38	10.07	3.12	3.20	3.10	0.00	-0.53	-1.96	1.40
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2010	0.00	0.00	0.00	0.00	-9.70	-21.99	-9.76	-9.70	-9.39	0.00	-7.56	-27.54	-95.64
Ave	-2.23	-2.24	-3.16	0.98	1.22	-0.28	0.47	0.65	0.63	0.00	-0.78	-0.94	-5.67
Max	-3.86	-12.91	-21.41	-3.00	26.06	17.40	0.77	1.35	1.37	0.00	-14.93	-21.49	-18.42
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2: Difference in in Unallocated Flow below Camanche between 2040 Baseline Case and Raising Lower Bear under 10,000 AF Demand (TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	-0.92	0.00	0.00	0.00	0.02	-16.01	-0.39	0.02	0.02	0.00	0.00	0.00	-17.27
1954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1955	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	59.58	59.58
1956	-31.81	-6.62	-2.28	7.92	5.50	-4.60	1.13	1.29	1.25	0.00	0.00	0.00	-28.22
1957	0.00	0.00	0.00	0.00	-3.99	-2.68	1.55	1.55	1.50	0.00	0.00	0.00	-2.08
1958	0.00	-12.48	2.23	2.77	-20.06	1.23	2.09	2.50	2.42	0.00	0.00	0.00	-19.29
1959	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1961	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1963	0.00	5.78	0.00	0.00	-21.27	-5.65	1.10	1.10	1.07	0.00	0.19	0.00	-17.67
1964	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-21.49	-21.49
1965	-23.29	-0.46	0.00	17.82	14.73	-5.84	0.92	1.22	1.18	0.00	-2.69	2.17	5.75
1966	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60
1967	-4.43	3.30	-7.51	-0.82	19.56	-10.40	-9.77	-2.49	-2.41	0.00	0.00	0.00	-14.95
1968	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1969	-10.47	-1.23	2.08	-3.78	-16.65	3.93	-0.65	-0.03	-0.03	0.00	0.00	0.27	-26.57
1970	-8.79	-2.72	-5.76	0.00	3.90	-0.25	4.45	4.45	4.31	0.00	-2.69	1.22	-1.88
1971	-0.11	0.13	-0.27	0.00	0.34	-6.49	0.22	0.34	0.33	0.00	1.85	0.09	-3.58
1972	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1973	-5.49	-0.15	2.16	0.00	-3.85	-5.01	0.20	0.20	0.20	0.00	-2.00	-2.70	-16.45
1974	-1.83	0.00	-1.06	4.46	-7.96	-1.03	1.65	1.69	1.63	0.00	0.00	0.00	-2.46
1975	0.00	0.00	0.00	0.00	-1.70	-23.91	-2.11	-1.70	-1.64	0.00	1.09	0.00	-29.97
1976	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1977	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1978	0.00	0.00	0.00	0.00	1.60	-5.72	1.14	1.60	1.54	0.00	0.00	0.00	0.16
1979	0.00	0.00	-3.67	0.00	-5.31	-4.03	1.08	1.08	1.05	0.00	0.00	0.00	-9.80

1980	-11.17	-9.17	-5.83	14.12	11.69	-2.87	0.03	2.37	2.29	0.00	0.00	0.00	1.47
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-11.40	-11.40
1982	-6.57	-12.23	-23.22	9.99	4.01	0.10	0.49	1.14	1.10	0.00	-5.01	-13.20	-43.41
1983	-5.72	-14.20	-21.41	3.13	26.29	16.90	0.13	1.29	1.37	0.00	-14.93	-18.69	-25.82
1984	-11.18	-4.42	-2.18	0.00	6.63	8.66	9.99	9.99	9.66	0.00	-3.42	0.57	24.32
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1986	0.00	-12.91	-25.87	11.49	1.16	5.16	1.71	1.71	1.65	0.00	0.00	0.00	-15.90
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	0.00	0.00	0.00	0.00	-7.52	-7.78	-4.13	-3.76	-3.64	0.00	0.00	0.00	-26.82
1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	-8.61	-16.41	-5.07	6.84	-17.48	-0.60	2.53	2.50	0.00	0.00	0.00	-36.30
1996	0.00	-6.08	-14.80	-1.21	9.74	4.89	3.10	3.10	3.00	0.00	-8.32	-9.92	-16.52
1997	-7.13	-13.69	-5.93	0.00	5.04	7.15	7.56	7.56	7.32	0.00	-1.31	0.00	6.56
1998	0.24	-1.10	-3.88	3.95	9.66	-19.98	-1.31	-0.02	-0.02	0.00	0.00	0.00	-12.47
1999	-0.23	-7.67	-10.14	0.00	-0.79	8.99	-0.35	0.40	0.39	0.00	0.00	0.00	-9.40
2000	0.00	-4.88	-4.16	0.00	-4.18	1.30	2.25	2.25	2.17	0.00	0.00	0.00	-5.26
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	0.00	-2.88	-2.79	-0.46	-0.46	-0.45	0.00	0.00	0.00	-7.05
2004	0.00	0.00	-8.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-8.96
2005	0.00	-11.72	-9.87	-4.00	-22.84	12.15	2.44	2.99	2.90	0.00	0.00	-13.40	-41.34
2006	-4.77	-9.08	-30.86	-29.58	49.89	9.57	3.03	3.20	3.10	0.00	-0.53	-1.96	-7.99
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2010	0.00	0.00	0.00	0.00	-9.70	-21.99	-9.82	-9.70	-9.39	0.00	-7.56	-27.54	-95.70
Ave	-2.29	-2.25	-3.41	0.54	0.83	-1.46	0.29	0.64	0.63	0.00	-0.78	-0.97	-8.23
Max	-7.13	-12.91	-21.41	-22.41	21.85	16.90	0.13	1.29	1.37	0.00	-14.93	-21.49	-25.82
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3: Difference in Mokelumne Flow to Delta between 2040 Baseline Case and Raising Lower Bear under 5,000 AF Demand (TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	-0.94	0.00	0.00	0.00	0.02	-16.01	-0.21	0.02	0.02	7.50	0.00	0.00	-9.60
1954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.61	4.46	4.61	13.69
1955	4.61	4.17	4.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	59.23	72.62
1956	-34.66	-6.50	-2.12	8.14	2.89	-3.03	1.20	1.29	1.25	15.17	0.12	0.15	-16.10
1957	0.00	0.00	0.00	0.00	-2.87	1.00	1.55	1.55	1.50	2.62	0.00	0.00	5.34
1958	0.22	-22.38	-0.33	4.91	-22.03	2.31	2.29	2.50	2.42	8.58	0.18	0.22	-21.10
1959	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	1.79	1.84	5.47
1961	1.84	1.67	1.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.36
1962	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-4.61	-4.46	-4.61	-13.69
1963	-4.43	-2.58	-4.41	0.00	-19.53	-3.65	1.10	1.10	1.07	12.63	-0.82	0.19	-19.31
1964	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-26.66	-26.66
1965	-21.54	-0.50	-0.04	20.35	9.94	-3.22	1.06	1.22	1.18	1.94	-6.16	-0.40	3.84
1966	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32
1967	-2.87	2.41	-8.11	-1.39	22.07	-10.08	-5.20	-2.49	-2.41	2.39	0.04	0.05	-5.59
1968	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.55	0.00	10.55
1969	-12.09	-9.16	-2.11	-4.00	-15.37	12.63	-0.35	-0.03	-0.03	3.06	0.22	-1.29	-28.52
1970	-8.90	-2.75	-5.76	-0.01	3.99	0.19	4.45	4.45	4.31	16.78	-14.12	-1.41	1.21
1971	-0.76	0.98	-2.85	0.00	0.34	-4.80	0.28	0.34	0.33	5.77	2.78	1.60	4.01
1972	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1973	-12.64	-1.76	2.29	0.00	-3.79	-2.87	0.20	0.20	0.20	14.24	-10.72	-5.86	-20.50
1974	-3.50	-0.01	-3.06	3.86	-3.83	2.24	1.67	1.69	1.63	-0.01	-0.01	-0.01	0.67
1975	0.00	0.00	0.00	0.00	-1.70	-6.81	-1.91	-1.70	-1.64	0.00	-3.13	0.00	-16.89
1976	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1977	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1978	0.00	0.00	0.00	0.00	1.60	-5.72	1.37	1.60	1.54	4.07	0.00	0.00	4.46
1979	0.00	3.21	-10.03	0.00	-5.26	-3.78	1.08	1.08	1.05	13.75	0.00	0.00	1.09

1980	-22.65	-9.13	-5.78	14.28	12.15	-1.77	1.72	2.37	2.29	2.08	0.03	0.04	-4.35
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.56	6.56
1982	-17.42	-13.88	-23.22	21.84	4.50	0.60	0.79	1.14	1.10	10.72	-6.92	-13.20	-33.96
1983	-5.72	-14.20	-21.41	3.13	21.55	17.40	0.77	1.35	1.37	0.79	-15.08	-17.33	-27.36
1984	-10.68	-4.42	-2.18	0.00	8.31	9.16	9.99	9.99	9.66	5.40	-5.00	0.00	30.24
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1986	-0.01	-10.91	-22.59	11.91	1.68	12.09	1.71	1.71	1.65	4.51	-0.01	-0.01	1.71
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	4.46	7.81	0.00	0.00	0.00	0.30	0.00	0.00	0.00	12.57
1993	0.00	0.00	0.00	0.00	-7.38	-7.28	-3.95	-3.76	-3.64	0.00	0.00	0.00	-25.99
1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	-16.70	-16.09	-4.75	7.35	-16.62	0.04	2.55	2.50	8.58	0.27	0.33	-32.53
1996	0.10	-7.26	-14.69	-1.19	8.28	14.18	3.10	3.10	3.00	10.38	-12.72	-16.63	-10.36
1997	-12.69	-13.30	-5.98	0.00	6.75	7.23	7.56	7.56	7.32	7.88	-6.04	-0.05	6.25
1998	-0.65	-2.57	0.53	8.71	10.72	-14.48	-0.67	-0.02	-0.02	-0.01	-0.01	-0.01	1.51
1999	-8.24	-0.94	6.92	6.72	-0.29	-2.73	-0.24	0.40	0.39	-0.01	-0.02	-0.02	1.92
2000	0.00	-18.38	-6.11	0.00	-2.21	1.67	2.25	2.25	2.17	9.85	0.00	0.00	-8.50
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	0.00	-2.88	-2.79	-0.46	-0.46	-0.45	0.21	0.00	0.00	-6.84
2004	0.00	0.00	-8.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-8.96
2005	0.35	-3.74	-11.98	-3.60	-21.99	3.24	2.64	2.99	2.90	4.40	0.28	-12.09	-36.60
2006	-6.28	-9.93	-30.93	-24.24	50.43	10.13	3.12	3.20	3.10	6.00	-0.42	-1.97	2.21
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	1.79	1.84	5.47
2009	1.84	1.67	1.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.36

2010	0.00	0.00	0.00	0.00	-9.70	-21.99	-9.76	-9.70	-9.39	0.00	-7.93	-26.03	-94.51
Ave	-3.06	-2.71	-3.29	1.19	1.06	-0.58	0.47	0.65	0.63	3.15	-1.23	-0.88	-4.58
Max	-12.69	-10.91	-21.41	-10.55	17.11	17.40	0.77	1.35	1.37	14.46	-15.08	-26.00	-27.36
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.57

Table 4: Difference in Mokelumne Flow to Delta between 2040 Baseline Case and Raising Lower Bear under 10,000 AF Demand (TAF)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1953	-0.94	0.00	0.00	0.00	0.02	-16.01	-0.39	0.02	0.02	7.47	0.00	0.00	-9.81
1954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.61	4.46	4.61	13.69
1955	4.61	4.17	4.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.30	65.69
1956	-31.65	-6.53	-2.16	8.10	5.69	-4.39	1.13	1.29	1.25	15.00	0.09	0.12	-12.07
1957	0.00	0.00	0.00	0.00	-3.99	-2.68	1.55	1.55	1.50	3.70	0.00	0.00	1.62
1958	0.28	-23.52	-0.27	4.98	-22.06	-2.57	2.09	2.50	2.42	8.82	0.22	0.28	-26.83
1959	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	1.79	1.84	5.47
1961	1.84	1.67	1.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.36
1962	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-4.61	-4.46	-4.61	-13.69
1963	-4.38	-4.94	-4.36	0.00	-20.70	-5.35	1.10	1.10	1.07	12.84	-0.79	0.24	-24.16
1964	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-27.67	-27.67
1965	-21.52	-0.48	-0.03	20.37	10.62	-5.84	0.92	1.22	1.18	2.64	-6.34	-0.50	2.24
1966	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28
1967	-2.61	2.44	-8.08	-1.36	22.11	-10.40	-9.77	-2.49	-2.41	3.55	0.07	0.09	-8.86
1968	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1969	-13.26	-1.01	0.00	-3.72	-16.57	4.16	-0.65	-0.03	-0.03	2.97	0.22	-1.32	-29.24
1970	-8.90	-2.75	-5.76	0.00	3.90	-0.25	4.45	4.45	4.31	15.35	-13.35	-0.84	0.61
1971	-0.63	0.99	-2.85	0.00	0.34	-6.49	0.22	0.34	0.33	5.13	3.12	1.72	2.23
1972	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1973	-13.98	-0.13	2.21	0.00	-3.85	-5.01	0.20	0.20	0.20	3.82	-3.19	-3.70	-23.24
1974	-2.39	0.00	-1.75	4.25	-8.03	2.74	1.65	1.69	1.63	0.00	0.00	0.00	-0.21
1975	0.00	0.00	0.00	0.00	-1.70	-23.91	-2.11	-1.70	-1.64	0.00	-2.35	0.00	-33.40
1976	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1977	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1978	0.00	0.00	0.00	0.00	1.60	-5.72	1.14	1.60	1.54	2.35	0.00	0.00	2.50
1979	0.00	0.00	-6.11	0.00	-5.31	-4.03	1.08	1.08	1.05	7.74	0.00	0.00	-4.50

1980	-16.40	-9.16	-5.83	14.24	11.60	-2.87	0.03	2.37	2.29	3.68	0.00	0.00	-0.05
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-16.93	-16.93
1982	-6.57	-12.23	-23.22	9.99	4.01	0.10	0.49	1.14	1.10	10.73	-6.93	-13.20	-34.60
1983	-5.72	-14.20	-21.41	3.13	17.34	16.90	0.13	1.29	1.37	0.79	-15.08	-19.33	-34.77
1984	-10.82	-4.42	-2.18	0.00	6.63	8.66	9.99	9.99	9.66	5.69	-5.00	0.00	28.21
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1986	0.07	-11.00	-25.79	6.19	1.30	11.89	1.71	1.71	1.65	4.88	0.06	0.07	-7.27
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	4.46	7.81	0.00	0.00	0.00	0.30	0.00	0.00	0.00	12.57
1993	0.00	0.00	0.00	0.00	-7.52	-7.78	-4.13	-3.76	-3.64	0.00	0.00	0.00	-26.82
1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	-15.19	-16.09	-4.75	7.20	-17.12	-0.60	2.53	2.50	8.58	0.26	0.33	-32.35
1996	0.14	-7.24	-14.65	-1.15	4.45	13.97	3.10	3.10	3.00	10.53	-12.69	-16.59	-14.04
1997	-15.91	-13.41	-5.94	0.00	5.57	7.15	7.56	7.56	7.32	8.11	-6.00	-0.01	2.00
1998	-0.60	-2.53	0.59	8.77	10.79	-19.98	-1.31	-0.02	-0.02	0.04	0.04	0.05	-4.20
1999	-7.81	-0.91	6.96	6.69	-0.79	-6.76	-0.35	0.40	0.39	0.02	0.02	0.02	-2.13
2000	0.00	-18.01	-6.11	0.00	-4.18	1.30	2.25	2.25	2.17	9.98	0.00	0.00	-10.36
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	0.00	-2.88	-2.79	-0.46	-0.46	-0.45	0.21	0.00	0.00	-6.84
2004	0.00	0.00	-8.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-8.96
2005	0.40	-11.55	-19.53	-3.54	-22.52	13.11	2.44	2.99	2.90	5.02	0.33	-11.95	-41.90
2006	-6.20	-9.87	-30.86	-32.44	50.04	9.75	3.03	3.20	3.10	6.35	-0.35	-1.88	-6.13
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2010	0.00	0.00	0.00	0.00	-9.70	-21.99	-9.82	-9.70	-9.39	1.10	-8.13	-27.40	-95.04
Ave	-2.80	-2.76	-3.37	0.76	0.71	-1.42	0.29	0.64	0.63	2.91	-1.28	-1.45	-7.13
Max	-15.91	-11.00	-21.41	-22.41	12.91	16.90	0.13	1.29	1.37	13.04	-15.08	-27.67	-34.77
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.57

7c: Surface Storage Regional Assessment

Upper Mokelumne River Watershed Authority

Overview

Sponsor(s): Upper Mokelumne River Watershed Authority (UMRWA)

Concept type: Planning

Estimated Costs: $200,000 (capital)

Funding Source(s): unspecified grant

Concept location: Amador and Calaveras counties

Conduct a regional assessment to evaluate the feasibility of the constructing additional surface storage – including both on-stream and off-stream storage opportunities – in Amador and Calaveras Counties. The study would include discussions on location, technical feasibility, political feasibility, environmental feasibility, economic feasibility, and legal feasibility. The study would include evaluation of the proposed beneficial uses of the project and clarifying operational parameters. It would also identify impacts, and constraints in the following areas: river flows, domestic water supply, technical, political, environmental (including both species-related and geomorphic), economic, legal, and recreation – recognizing that a more detailed Environmental Impact Report would be required prior to implementing a project. The study will include consultation with members of the MokeWISE MCG.

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	As a feasibility study, the concept does not have elements that promote demand-side management strategies. Implementation of the project described in the concept would also not have elements that would promote demand-side management strategies.
WS-2: Increase supply reliability	◗	As a feasibility study, the concept itself would not increase supply reliability. However, if the project as described in the concept were implemented, supply reliability would be increased by increasing the amount of stored water.

Objective	● ◗ ○	*Justification*
WS-3: Increase amount of stored water	◗	As a feasibility study, the concept itself would not increase the amount of stored water. However, the purpose of the project as described in the concept is to increase the amount of stored water. As such, implementation of the project would result in an increased amount of stored water.
WS-4: Promote smart, responsible development	○	As a feasibility study, the concept itself would not promote smart, responsible development. And if implemented, while the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.
WS-5: Reduce reliance on groundwater for irrigation	◗	The concept itself would not reduce reliance on groundwater for irrigation. However, if the project were implemented, more surface water would be stored which could be used to offset the use of groundwater for irrigation.
WS-6: Promote a long-term groundwater balance	◗	The concept itself would not promote a long-term groundwater balance. However, if the project were implemented, it could potentially promote a long-term groundwater balance by using surface water for irrigation instead of groundwater, thereby leaving more groundwater in the basin.
WS-7: Maximize water resource availability for all beneficial uses	◗	As a feasibility study, the concept would not maximize water resource availability. However, if the project were implemented, additional surface storage would capture additional water, which could be put to a variety of beneficial uses, including consumptive, groundwater recharge, and environmental.
WS-8: Decrease the need to import water	◗	The concept itself would not decrease the need to import water. However, the need for imported water could be decreased with the use of added storage to capture additional water during wet periods.

Objective	● ◗ ○	*Justification*
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates. Implementation of the project described in the concept would also not review existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update. Implementation of the project described in the concept would also not identify water demand issues.
WQ-11: Protect and improve surface and groundwater quality	○	As a feasibility study, the concept itself would not protect or improve surface and/or groundwater quality. Implementation of the project described in the concept would also not meet this objective.
WQ-12: Match delivered water quality use	○	The concept itself would not involve treating water, nor does it involve delivering treated water. Additional surface storage would also not involve treating water, nor would it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	As a feasibility study, the concept itself would not use water purification technology as a tool to maximize beneficial uses. Implementing the project described in the concept would also not include water purification elements.
R-14: Increase access for water-based recreation	◗	As a feasibility study, the concept itself does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters. Access to the Mokelumne River could be increased if additional on-river storage were built from Highway 12 to the headwaters.

Objective	● ◗ ○	*Justification*
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	As a feasibility study, the concept itself would not increase spawning habitat. On-stream dam and reservoir construction would create a discontinuity in the river channel network. Such discontinuities are seldom a positive benefit for the river ecosystem, as sediment, water, aquatic, and riparian processes are fundamentally disrupted. Off-stream storage avoids the discontinuity aspect.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections. Increased storage would also not meet this objective.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne. Implementing the project described in the concept would also not meet this objective.
R-18: Increase angling and other recreational opportunities (increase opportunities)	◗	As a feasibility study, the concept would not increase angling and other recreational opportunities. If implemented, additional storage could potentially increase angling and recreational opportunities by providing access to the additional storage, which could be used for angling and other recreating. However, the increase in these benefits is likely small.
WR-19: Resolve existing water rights conflicts in the watershed	◗	The purpose of the concept is to assess, among other things, legal feasibility. This could include discussion on water rights, including how they could apply to the project.

Objective	● ◗ ○	***Justification***
F-20: Enhance flood protection and management	◗	As a feasibility study, the concept would not enhance flood protection and management. If implemented, additional storage would enhance flood protection by capturing flood flows. The magnitude of these benefits will differ depending on the size and location of the storage.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	●	As a feasibility study, the concept would require the use of an agreed-upon hydrology dataset and/or Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	◗	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed. However, the purpose of this concept is to assess feasibility and collect sound, agreed-upon data prior to implementation of the concept.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute scientific data to the current body of knowledge by completing a feasibility study and developing information about potential locations and costs associated with implementing additional storage in Amador and Calaveras counties.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters. Implementation of the project described in the concept would also not increase investment in forest management.

Objective	● ◗ ○	*Justification*
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	As a feasibility study, the concept would not meet this objective. Additional storage would maximize these benefits for a DAC, as AWA, CCWD, JVID, and CPUD all serve DACs. Additional storage for these agencies would benefit the DACs that these agencies serve.
O-26: Achieve equity	◗	As a feasibility study, the concept would not directly achieve equity. However, the benefits realized from additional storage would not be limited to a narrow group; rather, project benefits would be spread across water agency customers, spanning regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	○	The concept itself would not enhance the natural environment. Removal of additional flows from the watershed and any local river reaches may generally result in a negative geomorphic effect to the channel and the aquatic ecosystem, as lower flows become less able to perform the geomorphic work and maintenance needed in the channel. Mitigation elements that provide benefits, perhaps below Camanche Dam to enhance anadromous fish habitat, could offset potential geomorphic impacts.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation. Additional storage would also not meet this objective.

Objective	● ◗ ○	***Justification***
E-29: Protect and restore fisheries	○	As a feasibility study, the concept itself would not protect and restore fisheries. If additional storage is implemented, the degree of fishery benefit would depend on specific information regarding the location of additional storage, the magnitude of additional storage, operational strategies, including instream flow releases, the effects of increased storage on geomorphic processes that affect fishery habitat, and other factors.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	◗	As a feasibility study, the concept would not enhance or maintain water supply for beneficial use in agricultural practices. Implementing the project described in the concept could enhance water supply for agricultural practices by potentially providing water to AWAs, CCWDs, JVIDs, and CPUDs agricultural customers.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The purpose of the concept is to assess the feasibility of implementing additional storage in Amador and Calaveras counties. This helps avoid unnecessary conflict and litigation by identifying and attempting to resolve issues early on. Coordination between water agencies, PG&E, non-governmental organizations, and state/federal agencies would be required.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	◗	As a feasibility study, the concept would directly promote broadly-supported outcomes that benefit a wide range of interests by providing information to the region about potential storage opportunities. If additional surface storage were implemented, this objective could be met depending on the type of storage. If the storage were on-stream, this objective would not be met, as there are a number of watershed stakeholders that oppose additional on-stream storage.

Objective	● ◗ ○	*Justification*
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	◗	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens. The project described in the concept would also need to undergo these screenings to determine if it was the least controversial project.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	◗	As a feasibility study, the concept would not result in agreements that reduce conflicts. Additional on-stream storage in the upper watershed would also not likely result in agreements that reduce conflict, as there are a number of watershed stakeholders who fundamentally disagree with additional on-stream storage. However, any resulting off-stream storage or optimization of current storage could result in agreements that reduce conflict.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. This would also be required of the project described in the concept if it were to be implemented.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc. This would also be required of the project described in the concept if it were to be implemented.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	The purpose of this concept is to study the feasibility of additional storage in the upper watershed; as such, the nature of the concept will help avoid basing decisions on incomplete or inaccurate information.

Objective	● ◗ ○	*Justification*
CA-38: Avoid demand for new or larger on-stream dams	◗	The concept itself would not result in the construction of a new or larger on-stream dam. However, if additional on-stream storage is implemented as a result of the concept, this objective would not be met.
CA-39: Avoid harmful impacts to fisheries and other wildlife	◗	The concept would not create harmful impacts to fisheries and other wildlife. Implementation of additional storage could potentially create harmful impacts to fisheries and other wildlife. Mitigation measures could be implemented to minimize these impacts.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept would not convert agricultural lands to developed uses. Implementation of the project described in the concept would also not convert agricultural lands.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept would not shift environmental impacts from one area to another. Implementation of the project described in the concept would also not shift environmental impacts.
CA-42: No diminishment of the benefits of existing in-stream flow	◗	The concept does not include elements that would alter existing in-stream flows. Implementation of the project described in the concept would reduce existing in-stream flows by capturing more water. It is unclear at this time if the benefits of current in-stream flow would be diminished; mitigation measures could be implemented to maintain these current benefits.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate. This also applies to implementation of the project described in the concept.

Objective	● ◗ ○	*Justification*
CA-44: Avoid dependency on potentially unreliable supply	◗	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. Making additional storage available by desilting could create dependency on this supply, which is more unreliable than other forms of supply, as it is susceptible to re-silting and hydrologic year type.
CA-45: Minimize adverse socio-economic and public health and safety impacts	◗	As a feasibility study, this concept does not have adverse socio-economic and public health and safety impacts. Implementation of the project described in the concept could minimize health and safety impacts by providing some flood management. Cost sharing would need to be carefully considered to minimize socio-economic impacts.
CA-46: Avoid end use harm	◗	The concept does not allocate water in ways that create end use harm. It is not known at this time how the additional stored water would be allocated.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation. This would also be required if the project described in the concept were implemented.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs. This also holds if the project described in the concept were to be implemented.

7d: Re-operation of Existing Storage

Upper Mokelumne River Watershed Authority; CSPA

Overview

Sponsor(s): Upper Mokelumne River Watershed Authority (UMRWA); California Sportfishing Protection Alliance (CSPA)

Concept type: Planning

Estimated Costs: $300,000 (capital)

Funding Source(s): unspecified grant and agency in-kind

Concept location: PG&E reservoirs on the upper Mokelumne

Conduct a study to assess the feasibility of re-operating existing storage to store water for consumptive use in addition to hydropower. The study would include a discussion on legal, environmental, political, economic, and technical feasibility, as well as address the issue of flood control capabilities. The study would include evaluation of the proposed beneficial uses of the project and clarifying operational parameters. It would also identify impacts, and constraints in the following areas: river flows, domestic water supply, technical, political, environmental (including both species-related and geomorphic), economic, legal, and recreation – recognizing that a more detailed Environmental Impact Report would be required prior to implementing a project. The study will include consultation with members of the MokeWISE MCG.

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	As a feasibility study, the concept does not have elements that promote demand-side management strategies. Implementation of the project described in the concept would also not have elements that would promote demand-side management strategies.

Objective	● ◗ ○	***Justification***
WS-2: Increase supply reliability	◗	As a feasibility study, the concept itself would not increase supply reliability. However, if the project as described in the concept were implemented, supply reliability would be increased by increasing the amount of water that could be consumptively used.
WS-3: Increase amount of stored water	◗	As a feasibility study, the concept itself would not increase the amount of stored water. PG&E facilities are currently operated to maximize hydropower generation. If these facilities were re-operated to provide supply benefit, the dams would be increasing the amount of stored water that could be consumptively used.
WS-4: Promote smart, responsible development	○	As a feasibility study, the concept itself would not promote smart, responsible development. And if implemented, while the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.
WS-5: Reduce reliance on groundwater for irrigation	◗	The concept itself would not reduce reliance on groundwater for irrigation. However, if the project were implemented, the additional water stored for consumptive use could be used in lieu of groundwater for irrigation.
WS-6: Promote a long-term groundwater balance	○	The concept itself would not promote a long-term groundwater balance. Re-operating storage would also not promote a long-term groundwater balance.
WS-7: Maximize water resource availability for all beneficial uses	◗	As a feasibility study, the concept would not maximize water resource availability. However, re-operating storage would optimize the storage, thereby maximizing water resource availability for beneficial use.

Objective	● ◗ ○	*Justification*
WS-8: Decrease the need to import water	◗	The concept itself would not decrease the need to import water. However, re-operating storage could potentially decrease the need to import water if the additional water was delivered to users who import water and was used in lieu of imported water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates. Implementation of the project described in the concept would also not review existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update. Implementation of the project described in the concept would also not identify water demand issues.
WQ-11: Protect and improve surface and groundwater quality	○	As a feasibility study, the concept itself would not protect or improve surface and/or groundwater quality. Implementation of the project described in the concept would also not meet this objective.
WQ-12: Match delivered water quality use	○	The concept itself would not involve treating water, nor does it involve delivering treated water. Additional surface storage would also not involve treating water, nor would it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	As a feasibility study, the concept itself would not use water purification technology as a tool to maximize beneficial uses. Implementing the project described in the concept would also not include water purification elements.

Objective	● ◗ ○	***Justification***
R-14: Increase access for water-based recreation	○	As an implementation plan, the concept itself does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters. Re-operating storage would also not include these elements.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	As a feasibility study, the concept itself would not increase spawning habitat. Implementing alternative operational strategies could have a benefit on resident and migratory fish, but this is likely small and incremental.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections. Re-operating storage would also not meet this objective.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne. Implementing the project described in the concept would also not meet this objective.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	As a feasibility study, the concept would not increase angling and other recreational opportunities. If implemented, re-operating storage would not meet this objective.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed. This objective would also not be achieved if storage were re-operated.
F-20: Enhance flood protection and management	◗	As a feasibility study, the concept would not enhance flood protection and management. If implemented, re-operated storage could potentially include flood protection benefits.

Objective	● ◗ ○	***Justification***
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	●	As a feasibility study, the concept would require the use of an agreed-upon hydrology dataset and/or Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	●	The concept is well-defined enough to complete a quantitative assessment.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute scientific data to the current body of knowledge by completing a feasibility study and developing information about potential locations, costs associated with re-operating storage, and operational scenarios.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters. Implementation of the project described in the concept would also not increase investment in forest management.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	As a feasibility study, the concept would not meet this objective. Re-operated storage could maximize these benefits for a DAC if the additional water served a DAC.
O-26: Achieve equity	◗	As a feasibility study, the concept would not directly achieve equity. However, the benefits realized from additional storage would not be limited to a narrow group; rather, project benefits would be spread across regions, cultures, incomes, and time.

Objective	● ◗ ○	*Justification*
E-27: Protect and enhance natural environment (enhance natural envt)	○	The concept itself would not enhance the natural environment. However, if re-operation included geomorphic goals as well as water supply goals, there is a potential to enhance the natural environment.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation. Re-operating storage would also not meet this objective.
E-29: Protect and restore fisheries	○	As a feasibility study, the concept itself would not protect and restore fisheries. If storage is re-operated, there may be an incremental benefit on resident and migratory fish, but these benefits are likely small.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	◗	As a feasibility study, the concept would not enhance or maintain water supply for beneficial use in agricultural practices. Implementing the project described in the concept could enhance agricultural water supply for partner agencies..
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The purpose of the concept is to assess the feasibility of re-operating PG&E storage in the upper watershed. This helps avoid unnecessary conflict and litigation by identifying and attempting to resolve issues early on. Coordination between water agencies, PG&E, non-governmental organizations, and state/federal agencies would be required.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	◗	As a feasibility study, the concept would not directly promote broadly-supported outcomes that benefit a wide range of interests. If storage is re-operated to capture wildlife or geomorphic benefits in addition to water supply benefits, re-operating storage could provide broadly-supported outcomes that benefit a wide range of interests.

Objective	● ◗ ○	***Justification***
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	◗	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens. The project described in the concept would also need to undergo these screenings to determine if it was the least controversial project.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	As a feasibility study, the concept would not result in agreements that reduce conflicts. If storage is re-operated to capture wildlife or geomorphic benefits in addition to water supply benefits, re-operating storage could result in agreements that reduce conflict.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. This would also be required of the project described in the concept if it were to be implemented.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc. This would also be required of the project described in the concept if it were to be implemented.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	The purpose of this concept is to study the feasibility of re-operating storage; as such, the nature of the concept will help avoid basing decisions on incomplete or inaccurate information.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept will not result in construction of a new or larger on-stream dam. Re-operating storage would avoid new or larger on-stream dams.

Objective	● ◗ ○	*Justification*
CA-39: Avoid harmful impacts to fisheries and other wildlife	◗	The concept would not create harmful impacts to fisheries and other wildlife. Re-operating storage for water supply benefit could potentially create harmful impacts to fisheries and other wildlife. Mitigation measures could be implemented to minimize these impacts.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept would not convert agricultural lands to developed uses. Implementation of the project described in the concept would also not convert agricultural lands.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept would not shift environmental impacts from one area to another. Implementation of the project described in the concept would also not shift environmental impacts.
CA-42: No diminishment of the benefits of existing in-stream flow	◗	The concept does not include elements that would alter existing in-stream flows. Re-operating storage for water supply benefit would change the timing and amount of water being released. This could potentially reduce the benefits seen by existing in-stream flows; mitigation measures could be implemented to maintain these current benefits.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate. This also applies to implementation of the project described in the concept.
CA-44: Avoid dependency on potentially unreliable supply	◗	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. Making additional supply available by re-operating could create dependency on this supply, which is more unreliable than other forms of supply, as it is susceptible to hydrologic year type.

Objective	● ◗ ○	***Justification***
CA-45: Minimize adverse socio-economic and public health and safety impacts	◗	As a feasibility study, this concept does not have adverse socio-economic and public health and safety impacts. Re-operating storage would not have any adverse health and safety impacts. Cost sharing would need to be carefully considered to minimize socio-economic impacts.
CA-46: Avoid end use harm	◗	The concept does not allocate water in ways that create end use harm. It is not known at this time how the additional stored water would be allocated.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation. This would also be required if the project described in the concept were implemented.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs. This also holds if the project described in the concept were to be implemented.

7e: Optimization of Calaveras County Reservation

Calaveras County Water District, Calaveras Public Utility District, Groundwater Basin Authority

Overview

Sponsor(s): Calaveras County Water District (CCWD), Calaveras Public Utility District (CPUD), Groundwater Basin Authority (GBA)

Concept type: Planning

Estimated Costs: unknown

Funding Source(s): unknown

Concept location: Calaveras County

Evaluate the legal feasibility of and options for allowing CCWD/CPUD to assign all or a portion of Calaveras County's area of origin reservation on the Mokelumne. Evaluate potential beneficial uses of the water, including fish, wildlife, recreation, a drought reserve, and consumptive use. This may also include evaluating the feasibility of both new and previously proposed projects. The study would include evaluation of the proposed beneficial uses of the project and clarifying operational parameters. It would also identify impacts, and constraints in the following areas: river flows, domestic water supply, technical, political, environmental (including both species-related and geomorphic), economic, legal, and recreation – recognizing that a more detailed Environmental Impact Report would be required prior to implementing a project. The study will include consultation with members of the MokeWISE MCG.

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	As a feasibility study, the concept does not have elements that promote demand-side management strategies. Implementation of the project described in the concept would also not have elements that would promote demand-side management strategies.

Objective	●	◗	○	*Justification*
WS-2: Increase supply reliability		◗		As a feasibility study, the concept itself would not increase supply reliability. However, if the project as described in the concept were implemented, supply reliability would be increased by increasing the amount of water that could be consumptively used. The amount that could be consumptively used is assumed to be 20,000 AFY or less.
WS-3: Increase amount of stored water		◗		As a feasibility study, the concept itself would not increase the amount of stored water. If the reservation were assigned, stored water could be increased by up to 20,000 AFY.
WS-4: Promote smart, responsible development		◗		As a feasibility study, the concept itself would not promote smart, responsible development. Assigning all or a portion of the reservation would allow the County to maintain its area of origin right, while providing additional benefits to the watershed, which may include flood, water supply, or environmental benefits
WS-5: Reduce reliance on groundwater for irrigation		◗		The concept itself would not reduce reliance on groundwater for irrigation. However, if the project were implemented, the reservation could be used in-lieu of groundwater for irrigation.
WS-6: Promote a long-term groundwater balance		◗		The concept itself would not promote a long-term groundwater balance. However, if the project were implemented, the reservation could be used for groundwater recharge.
WS-7: Maximize water resource availability for all beneficial uses		◗		As a feasibility study, the concept would not maximize water resource availability. However, assigning all or a portion of the reservation for a variety of uses would maximize water resource availability for beneficial uses.

Objective	● ◗ ○	***Justification***
WS-8: Decrease the need to import water	◗	The concept itself would not decrease the need to import water. However, the project described in the concept could potentially decrease the need to import water if the reservation water was delivered to users who import water and was used in lieu of imported water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates. Implementation of the project described in the concept would also not review existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update. Implementation of the project described in the concept would also not identify water demand issues.
WQ-11: Protect and improve surface and groundwater quality	◗	As a feasibility study, the concept itself would not protect or improve surface and/or groundwater quality. If the reservation were assigned, surface water quality could be protected if the water remained in the River; groundwater quality could be improved if a portion of the reservation were recharged.
WQ-12: Match delivered water quality use	○	The concept itself would not involve treating water, nor does it involve delivering treated water. Assigning the reservation would also not involve treating water, nor would it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	As a feasibility study, the concept itself would not use water purification technology as a tool to maximize beneficial uses. Implementing the project described in the concept would also not include water purification elements.

Objective	● ◗ ○	***Justification***
R-14: Increase access for water-based recreation	○	As an implementation plan, the concept itself does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters. Assigning the reservation would also not include these elements.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	As a feasibility study, the concept itself would not increase spawning habitat. Less water in the river corridor generally translates to increased stressors for aquatic organisms that depend on a healthy ecosystem. Assigning all or a portion of the reservation is not expected to increase spawning habitat.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections. Assigning the reservation would also not meet this objective.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne. Implementing the project described in the concept would also not meet this objective.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	As a feasibility study, the concept would not increase angling and other recreational opportunities. Assigning the reservation would not meet this objective.
WR-19: Resolve existing water rights conflicts in the watershed	◗	As a feasibility study, the concept would not resolve existing water rights conflicts in the watershed. However, if the reservation were assigned, Calaveras County would maintain its area of origin rights, while the water could be used for a variety of beneficial uses.

Objective	● ◗ ○	*Justification*
F-20: Enhance flood protection and management	○	As a feasibility study, the concept would not enhance flood protection and management. Reassigning the reservation would not enhance flood protection and management.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	●	As a feasibility study, the concept would require the use of an agreed-upon hydrology dataset and/or Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	●	The concept is well-defined enough to complete a quantitative assessment.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute scientific data to the current body of knowledge by completing a feasibility study and developing information about the legal feasibility of assigning the reservation and the potential beneficial end uses.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters. Implementation of the project described in the concept would also not increase investment in forest management.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	As a feasibility study, the concept would not meet this objective. Assigning the reservation could maximize these benefits for a DAC if the water was assigned to a water district that served a DAC.

Objective	● ◗ ○	*Justification*
O-26: Achieve equity	◗	As a feasibility study, the concept would not directly achieve equity. However, the benefits realized from additional storage would not be limited to a narrow group; rather, project benefits would be spread across regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	○	The concept itself would not enhance the natural environment. If the reservation were assigned, it would likely leave less water in the river corridor, which generally translates to increased stressors for aquatic organisms. Problems caused by less water generally include increased water temperatures; higher concentrations of chemicals (i.e. fertilizers) in the water columns which can disrupt aquatic life cycle; fewer to no episodic high flow events, which leads to riparian encroachment, and fewer instances of channel substrate renewal associated with robust sediment transport events.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation. Assigning the reservation would also not meet this objective.
E-29: Protect and restore fisheries	○	As a feasibility study, the concept itself would not protect and restore fisheries. If the reservation were assigned, it would likely leave less water in the river corridor, which generally translates to increased stressors for fish and other aquatic organisms. The project is not expected to protect and restore fisheries
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	◗	As a feasibility study, the concept would not enhance or maintain water supply for beneficial use in agricultural practices. If a portion of the reservation is assigned for beneficial use by agriculture, then this objective would be met.

Objective	● ◗ ○	*Justification*
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The purpose of the concept is to assess the feasibility of assigning Calaveras County's reservation. This helps avoid unnecessary conflict and litigation by identifying and attempting to resolve issues early on. Coordination between water agencies, non-governmental organizations, and state/federal agencies would be required.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	◗	As a feasibility study, the concept would not directly promote broadly-supported outcomes that benefit a wide range of interests. Assigning all or a portion of the reservation could serve a number of beneficial uses, which would be supported by a wide range of interests.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	◗	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens. The project described in the concept would also need to undergo these screenings to determine if it was the least controversial project.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	◗	As a feasibility study, the concept would not result in agreements that reduce conflict. Assigning all or a portion of the reservation would require agreements between a number of water agencies, state/federal agencies, and other participating entities. These agreements would help reduce conflict by beneficially using a supply that is not currently used, while allowing Calaveras County to maintain its area of origin water right.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. This would also be required of the project described in the concept if it were to be implemented.

Objective	● ◗ ○	*Justification*
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc. This would also be required of the project described in the concept if it were to be implemented.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	The purpose of this concept is to study the feasibility of assigning the reservation; as such, the nature of the concept will help avoid basing decisions on incomplete or inaccurate information.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept itself would not result in the construction of a new or larger on-stream dam. Implementation of the project described in the concept would also not require new or larger on-stream dams.
CA-39: Avoid harmful impacts to fisheries and other wildlife	◗	As a feasibility study, the concept would not generate harmful impacts to fisheries and other wildlife. Assigning a portion of the reservation would likely leave less water in the river corridor, which generally translates to increased stressors for aquatic organisms. Problems caused by less water generally include increased water temperatures; higher concentrations of chemicals (i.e. fertilizers) in the water columns which can disrupt aquatic life cycle; fewer to no episodic high flow events, which leads to riparian encroachment, and fewer instances of channel substrate renewal associated with robust sediment transport events. These outcomes would generate harmful impacts to fisheries and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept would not convert agricultural lands to developed uses. Implementation of the project described in the concept would also not convert agricultural lands.

Objective	● ◗ ○	***Justification***
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept would not shift environmental impacts from one area to another. Implementation of the project described in the concept would also not shift environmental impacts.
CA-42: No diminishment of the benefits of existing in-stream flow	◗	As a feasibility study, the concept would not reduce current in-stream flows. Assigning a portion of the reservation would likely leave less water in the river corridor, which would reduce the benefits seen with existing in-stream flow.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate. This also applies to implementation of the project described in the concept.
CA-44: Avoid dependency on potentially unreliable supply	◗	As a feasibility study, the concept would not create dependency on a potentially unreliable supply. If the reservation were assigned to beneficial uses, those receiving the water could become dependent on the supply, which at some point, will be returned to the County when it is needed.
CA-45: Minimize adverse socio-economic and public health and safety impacts	◗	As a feasibility study, this concept does not have adverse socio-economic and public health and safety impacts. Assigning all or a portion of the reservation is not anticipated to have adverse socio-economic or public health and safety impacts.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm. The feasibility study would identify beneficial uses for the portion of the reservation that would be assigned; as such, there would be no end use harm associated with assigning the reservation.

Objective	● ◗ ○	***Justification***
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation. This would also be required if the project described in the concept were implemented.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs. This also holds if the project described in the concept were to be implemented.

8a: Jeff Davis Water Treatment Plant Replacement

Calaveras Public Utility District

Overview

Evaluate the feasibility of replacing the existing Jeff Davis Water Treatment Plant (WTP), a sand filter water treatment plant, with a state-of-the-art membrane filtration plant. The Jeff Davis WTP was designed in 1970 and is oversized for the current and projected District demands. The project would reduce backwash water requirements which would reduce demand for Mokelumne River supplies.

Sponsor(s): Calaveras Public Utility District

Concept type: Planning

Estimated Costs: unknown

Funding Source(s): unknown

Concept location: Jeff Davis Water Treatment Plant

Assessment

Objective	● ◗ ○	*Justification*
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	As a feasibility study, the concept does not have elements that promote demand-side management strategies. Implementation of the project described in the concept would also not have elements that would promote demand-side management strategies.
WS-2: Increase supply reliability	◗	As a feasibility study, the concept itself would not increase supply reliability. However, if the project as described in the concept were implemented, the amount of Mokelumne River water needed for backwash water use would be reduced, which would likely increase supply reliability for both the CPUD and for downstream users.

Objective	● ◗ ○	***Justification***
WS-3: Increase amount of stored water	○	The concept does not include elements that would store water, nor would it increase the amount of stored water. Implementation of the project described in the concept would also not have elements that would promote demand-side management strategies.
WS-4: Promote smart, responsible development	◗	As a feasibility study, the concept itself would not promote smart, responsible development. However, if the project as described in the concept were implemented, resizing the treatment plant would promote smart, responsible development by properly sizing the plant for currently projected CPUD demands.
WS-5: Reduce reliance on groundwater for irrigation	○	As a feasibility study, the concept itself would not reduce reliance on groundwater. Implementation of the project described in the concept would also not reduce reliance on groundwater for irrigation because no groundwater is currently used in the operation of the treatment plant.
WS-6: Promote a long-term groundwater balance	○	As a feasibility study, the concept itself would not promote a long-term groundwater balance. Implementation of the project described in the concept would also not promote a long-term groundwater balance because no groundwater is currently used in the operation of the treatment plant.
WS-7: Maximize water resource availability for all beneficial uses	◗	As a feasibility study, the concept itself would not maximize water resource availability for all beneficial uses. However, implementation of the project as described in the concept would likely maximize water resource availability for all beneficial uses by reducing the amount of Mokelumne River water that would be used for backwash water.

Objective	● ◗ ○	***Justification***
WS-8: Decrease the need to import water	○	As a feasibility study, the concept itself would not decrease the need to import water. If implemented, the project described in the concept would offset use of Mokelumne River supplies, not the use of imported water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates. Implementation of the project described in the concept would also not review existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update. Implementation of the project described in the concept would also not identify water demand issues.
WQ-11: Protect and improve surface and groundwater quality	○	As a feasibility study, the concept itself would not protect or improve surface and/or groundwater quality. Implementation of the project described in the concept could have some surface water quality benefits because less Mokelumne River water would be used for backwash water, thus leaving more water to dilute constituents and other pollutants. However, because of the relatively small amount of Mokelumne River water being left in the River, this benefit is likely to be negligible.
WQ-12: Match delivered water quality use	◗	As a feasibility study, the concept itself would not involve treating water, nor does it involve delivering treated water. If implemented, the concept would improve the alignment of water quality and use by reducing the need to use potable quality water for backwash purposes.

Objective	● ◗ ○	*Justification*
WQ-13: Use water purification technology as a tool to maximize beneficial uses	◗	As a feasibility study, the concept itself would not use water purification technology as a tool to maximize beneficial uses. However, if implemented, the project as described in the concept would maximize beneficial uses by upgrading the treatment plant and reducing backwash water requirements. These upgrades would reduce Mokelumne River use.
R-14: Increase access for water-based recreation	○	As a feasibility study, the concept itself does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters. Implementation of the project as described in the concept would also not increase access.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	The concept would not contribute to increasing spawning habitat, designating sections of the river for hatchery and wild species, or designating environmental flows. Implementation of the project described in the concept would also not meet this objective.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	As a feasibility study, the concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections. Implementation of the project described in the concept would also not stock hatchery-raised trout.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	As a feasibility study, the concept itself does not include reintroducing salmon into the upper Mokelumne. Implementation of the project described in the concept would also not reintroduce salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	As a feasibility study, the concept itself would not increase angling, harvesting, or other recreational opportunities. Implementation of the project described in the concept would also not increase opportunities.

Objective	● ◗ ○	***Justification***
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed. Implementation of the project described in the concept would also not resolve existing water rights conflicts.
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection. Implementation of the project described in the concept would also not provide flood protection or management.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	As a feasibility study, the concept itself does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis. Implementation of the project described in the concept would also not produce a hydrology dataset or Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	◗	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed. However, the purpose of this concept is to assess feasibility and collect sound, agreed-upon data prior to implementation of the concept.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute scientific data to the current body of knowledge by completing a feasibility study and developing information about the effects of installing a membrane filtration plant.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters. Implementation of the project described in the concept would also not increase investment in forest management.

Objective	● ◗ ○	*Justification*
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	As a feasibility study, the concept would not maximize socio-economic, cultural, recreational, public health, and public safety benefits. If implemented, the project as described in the concept would maximize these benefits because the CPUD serves San Andreas, which is a DAC.
O-26: Achieve equity	◗	As a feasibility study, the concept would not directly achieve equity. However, if the treatment plant were upgraded, the benefits realized from this upgrade would not be limited to a narrow group; rather, project benefits would be spread across all of CPUD's service area, spanning regions, cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	◗	The concept itself would not enhance the natural environment. However, if the treatment plant were upgraded, the plant would use less Mokelumne River water for backwash water. Leaving more water in the River would likely enhance the natural environment of the watershed.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation. If implemented, the project as described in the concept would also not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	○	As a feasibility study, the concept will not protect and restore fisheries. Additionally, modifying the existing water treatment plant backwashing process appears to have very little potential to benefit fishery resources. Although the project proposed in the concept would provide greater efficiency of water treatment plant operations and incrementally reduce water required for filter backwashing, the magnitude of the potential change in water supply is anticipated to be minimal in terms of fishery habitat enhancement.

Objective	● ◗ ○	*Justification*
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	◗	As a feasibility study, the concept would not enhance or maintain water supply for beneficial use in agricultural practices. Implementing the project described in the concept would enhance water supply for agricultural practices because CPUD serves agricultural users within its service area.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The purpose of the concept is to assess the feasibility of upgrading the treatment plant. This helps avoid unnecessary conflict and litigation by identifying and attempting to resolve issues early on.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	◗	As a feasibility study, the concept would not directly promote broadly-supported outcomes that benefit a wide range of interests. However, the project described in the concept would likely promote broadly-supported outcomes. Implementation of the project described in the concept would increase water quality at the treatment plant, serve a DAC, and leave more water in the Mokelumne. These outcomes are broadly supported by a wide range of interests.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	◗	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens. The project described in the concept would also need to undergo these screenings to determine if it was the least controversial project.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	As a feasibility study, the concept would not result in agreements that reduce conflicts. Implementation of the project described in the concept would also not reduce conflict in the watershed.

Objective	● ◗ ○	***Justification***
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. This would also be required of the project described in the concept if it were to be implemented.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc. This would also be required of the project described in the concept if it were to be implemented.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	The purpose of this concept is to study the feasibility of upgrading the treatment plant; as such, the nature of the concept will help avoid basing decisions on incomplete or inaccurate information.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept will not result in construction of a new or larger on-stream dam. If the project as described in the concept is implemented, there would also not be demand for new or larger on-stream dams.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife. On the contrary, the implementation of the project described in the concept would leave more water in the Mokelumne, which would benefit fish and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept would not convert agricultural lands to developed uses. Implementation of the project described in the concept would also not convert agricultural lands.

Objective	● ◗ ○	*Justification*
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept would not shift environmental impacts from one area to another. Implementation of the project described in the concept would also not shift environmental impacts.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows. Implementation of the project described in the concept would also not diminish the benefits of existing in-stream flow.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate. This also applies to implementation of the project described in the concept.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. This also applies to implementation of the project described in the concept.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	As a feasibility study, this concept does not have adverse socio-economic and public health and safety impacts. Implementation of the project described in the concept would provide public health and safety benefits by upgrading the treatment process from a sand filter to a membrane filtration process.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm. This also applies to implementation of the project described in the concept.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation. This would also be required if the project described in the concept were implemented.

Objective	● ◗ ○	***Justification***
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs. This also holds if the project described in the concept were to be implemented.

8b: Rehab of Transmission Main

Calaveras Public Utility District

Sponsor(s): Calaveras Public Utility District (CPUD)

Concept type: Planning and implementation

Estimated Costs: unknown

Funding Source(s): unspecified grant/loan

Concept location: Transmission main that runs from Jeff Davis Water Treatment Plant to Mokelumne Hill, Paloma and San Andreas

Overview

This concept will conduct a study to determine the benefits of replacing all or a portion of the transmission main that conveys treated water from the Jeff Davis water treatment plant (WTP) to Mokelumne Hill, Paloma, and San Andreas. The study would include assessment of areas that are reaching life expectancy, areas of water loss, and recommendations for rehabilitation. Upon completion of the study, the project would include replacing or lining the recommended areas of the current transmission main. The transmission main was installed in the 1970's and has had one large repair since that time. Replacing or lining the transmission main will increase the life expectancy, and likely improve efficiencies and reduce water loss.

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not promote demand-side management strategies.
WS-2: Increase supply reliability	●	The concept would increase supply reliability by replacing old, leaking transmission pipeline. Because this pipeline is reaching life expectancy, there is an increased risk of pipeline bursts which threatens supply reliability.
WS-3: Increase amount of stored water	◗	Because the concept would reduce water losses, it may result in an increase in the amount of stored water.

Objective	● ◗ ○	***Justification***
WS-4: Promote smart, responsible development	○	While the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation.
WS-6: Promote a long-term groundwater balance	○	The concept would not help to promote a long-term groundwater balance.
WS-7: Maximize water resource availability for all beneficial uses	●	The concept would maximize water resource availability for all beneficial uses by increasing efficiency and eliminating leaky pipes. Replacing the pipeline would reduce the amount of water diverted from the Mokelumne to offset the leaks.
WS-8: Decrease the need to import water	○	The concept would not decrease the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	○	The concept would not protect or improve surface and/or groundwater quality.
WQ-12: Match delivered water quality use	●	The concept would reduce water losses, thereby increasing the amount of potable water that could be delivered for potable use.

Objective	● ◗ ○	***Justification***
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	The concept does not include water purification elements.
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	The concept would not contribute to increasing spawning habitat, designating sections of the river for hatchery and wild species, nor designating environmental flows.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	The concept would not increase angling, harvesting, or other recreational opportunities.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection.

Objective	● ◗ ○	***Justification***
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	○	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed.
D-23: Promote the contribution of sound scientific data to current body of knowledge	◗	The concept would contribute scientific data to the current body of knowledge by completing the feasibility study and including information on the amount of anticipated savings and documenting the condition of the old pipeline. However, because this information would be very site specific, there may not be wide application of the data.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	The concept would maximize socio-economic and public health and safety benefits by replacing a leaking transmission pipeline. These benefits would be realized within DAC's, as CPUD serves San Andreas, which is a disadvantaged community.
O-26: Achieve equity	●	The benefits realized from the concept would not be limited to a narrow group; rather, project benefits would be spread across all of CPUD's service area, spanning regions, cultures, incomes, and time.

Objective	● ◗ ○	*Justification*
E-27: Protect and enhance natural environment (enhance natural envt)	◗	This project would likely not provide much in the way of geomorphic benefits to the river corridor, but could potentially be an additional factor in increased water efficiencies, which overall may provide additional waters to the river.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.
E-29: Protect and restore fisheries	○	Reducing loss during transmission is expected to have very little direct or indirect fishery benefit. Presumably, increasing water conveyance efficiency would incrementally reduce the demand on surface waters. However, the incremental magnitude of such a reduction on the ability to provide instream flows or cold water pool management for fishery habitat is expected to be minimal.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	○	The concept does not include elements that would increase agricultural water supply.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	○	While the concept does not prohibit or preclude fostering long-term regional relationships and avoiding unnecessary conflict and litigation, it does not directly address it. Implementation of the concept would not require coordination between a number of different agencies; Calaveras Public Utility District is the only agency that would be involved in the implementation of the concept.

Objective	● ◗ ○	***Justification***
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	Implementation of the concept would reduce transmission losses, thereby increasing efficiency and reducing demand on the Mokelumne, and increase supply reliability. These outcomes are supported by a wide range of interests within the watershed.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would not directly address any current watershed conflicts.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be most complete and accurate.

Objective	●	◗	○	*Justification*
CA-38: Avoid demand for new or larger on-stream dams		●		The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife		●		The concept would not create harmful impacts to fisheries and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses		●		The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another		●		The concept does not include elements that would shift environmental impacts from one area to another.
CA-42: No diminishment of the benefits of existing in-stream flow		●		The concept does not include elements that would alter existing in-stream flows.
CA-43: Avoid closing the process to the public		●		As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply		●		The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply.
CA-45: Minimize adverse socio-economic and public health and safety impacts		●		The concept does not include elements that would create adverse socio-economic and public health and safety impacts.
CA-46: Avoid end use harm		●		The concept does not include elements that would allocate water in ways that create end use harm.

Objective	● ◗ ○	***Justification***
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

8c: Barney Way Septic System Conversion

Calaveras County Water District

Overview

This concept would connect existing residences along Barney Way either into the public sewer system or a new community septic vault system to improve water quality in the Mokelumne River. This project would evaluate options, and would implement the most cost-effective conversion alternative. Barney Way sits alongside the northern side of the Middle Fork of the Mokelumne off of Highway 26, downstream of Schaads Dam.

Sponsor(s): Calaveras County Water District

Concept type: Planning and implementation

Estimated Costs: unknown

Funding Source(s): unknown

Concept location: Barney Way (northern side of the Middle Fork of the Mokelumne River, off Highway 26, downstream of Schaads Dam)

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	The concept does not promote demand-side management strategies.
WS-2: Increase supply reliability	○	The concept would not address and/or increase supply reliability.
WS-3: Increase amount of stored water	○	The concept would not increase the amount of stored water.
WS-4: Promote smart, responsible development	○	While the concept does not prohibit or preclude smart, responsible development, it does not directly promote it.
WS-5: Reduce reliance on groundwater for irrigation	○	The concept would not reduce reliance on groundwater for irrigation.

Objective	● ◗ ○	***Justification***
WS-6: Promote a long-term groundwater balance	○	The concept would not help to promote a long-term groundwater balance.
WS-7: Maximize water resource availability for all beneficial uses	○	The concept does not involve maximizing water resource availability.
WS-8: Decrease the need to import water	○	The concept would not decrease the need to import water.
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update.
WQ-11: Protect and improve surface and groundwater quality	●	Reducing the use of local septic systems through interconnection with a main wastewater treatment facility may provide some incremental water quality benefit within the local watershed. Wastewater leakage from septic systems into the local water supply, including adjacent streams and rivers, reduces the potential for contaminant and bacterial growth that improve water quality.
WQ-12: Match delivered water quality use	○	The concept does not involve treating water, nor does it involve delivering treated water.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	○	The concept does not include water purification elements.

Objective	● ◗ ○	*Justification*
R-14: Increase access for water-based recreation	○	The concept does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	The concept would not contribute to increasing spawning habitat, designating sections of the river for hatchery and wild species, nor designating environmental flows.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	The concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	The concept does not include reintroducing salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	The concept would not increase angling, harvesting, or other recreational opportunities.
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed.
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	The concept does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis.

Objective	● ◗ ○	***Justification***
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	○	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute data to the current body of knowledge through the planning study that would be completed prior to converting the septic systems. Collected and reported information would likely include information on water quality and socio-economic benefits.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters.
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	●	The concept would maximize socio-economic, cultural, recreational, public health, and public safety benefits by removing septic systems, which can create public health and safety impacts. Additionally, Barney Way is located in West Point, which is a DAC.
O-26: Achieve equity	●	The benefits realized from implementing the concept would help achieve equity by addressing public health and safety impacts in a DAC.
E-27: Protect and enhance natural environment (enhance natural envt)	◗	Improvements in water quality, particularly those associated with sewage, are good for river ecosystem and human health environments. However, the incremental benefit of such improvement on fishery habitat is expected to be moderately low.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation.

Objective	● ◗ ○	*Justification*
E-29: Protect and restore fisheries	○	The concept does not include elements that would protect and restore fisheries.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	○	The concept does not include elements that would increase agricultural water supply.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	○	While the concept does not prohibit or preclude fostering long-term regional relationships and avoiding unnecessary conflict and litigation, it does not directly address it. Implementation of the concept would not require coordination between a number of different agencies; Calaveras County Water District is the only agency that would be involved in the implementation of the concept.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	●	Implementation of the concept would increase surface and groundwater quality and engage a disadvantaged community. These outcomes are supported by a wide range of interests within the watershed.
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	●	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	The concept would not directly address any current watershed conflicts.

Objective	● ◗ ○	*Justification*
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA documentation, etc.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	Prior to implementation, the concept would undergo a planning phase that would collect and analyze data that is considered, at the time, to be most complete and accurate.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept would not result in construction of a new or larger on-stream dam.
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept does not include elements that would generate harmful impacts to fisheries and other wildlife. On the contrary, the concept would be expected to increase water quality in the Mokelumne River by removing septic systems, which would likely have fishery and wildlife impacts.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept does not include elements that would convert agricultural lands to developed uses.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept does not include elements that would shift environmental impacts from one area to another.

Objective	● ◗ ○	***Justification***
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply.
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	The concept does not include elements that would create adverse socio-economic and public health and safety impacts. Conversely, the concept would generate public health and safety benefits by removing septic systems from alongside the Mokelumne River.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs.

8d: Lake Camanche Village Recycled Water Project

Amador Water Agency; JVID, CPUD

Overview

The concept involves conducting a feasibility study that would assess converting from existing wastewater treatment ponds to a recycled water plant in the Camanche Village area to allow for recycled water to be used locally.

Sponsor(s): Amador Water Agency (AWA); Jackson Valley Irrigation District (JVID), Calaveras Public Utility District (CPUD)

Concept type: Planning

Estimated Costs: unknown

Funding Source(s): SWRCB, USDA Rural Utilities, IRWM Program

Concept location: North Shore Lake Camanche

Assessment

Objective	● ◗ ○	***Justification***
● ***Fully addressed***	◗ ***Partially addressed***	○ ***Not addressed***
WS-1: Promote demand-side management strategies	○	As a feasibility study, the concept would not promote demand-side management strategies. Implementation of the project described in the concept would also not meet this objective.
WS-2: Increase supply reliability	◗	As a feasibility study, the concept would not increase supply reliability. However, if the project described in the concept were implemented, supply reliability would be increased by approximately 100 AFY by reusing treated wastewater, which would offset groundwater use. As a supply, recycled water is more reliable than groundwater, as recycled water is tied to population. Because of this, AWA could become more resilient against changes in groundwater levels and groundwater quality.

Objective	● ◗ ○	*Justification*
WS-3: Increase amount of stored water	○	As a feasibility study, the concept would not increase the amount of stored water. Implementation of the project described in the concept would also not meet this objective.
WS-4: Promote smart, responsible development	◗	As a feasibility study, the concept itself would not promote smart, responsible development. However, if the project as described in the concept were implemented, hooking the Lake Camanche Village area to receive recycled water would promote smart, responsible development by developing resiliency.
WS-5: Reduce reliance on groundwater for irrigation	◗	The concept itself would not reduce reliance on groundwater for irrigation. However, if the project were implemented, the Lake Camanche Village area would reduce its reliance on groundwater for irrigation, since recycled water would be used for irrigation.
WS-6: Promote a long-term groundwater balance	◗	The concept itself would not promote a long-term groundwater balance. However, if the project were implemented, the Lake Camanche Village area would promote a long-term groundwater balance by using recycled water in-lieu of groundwater for irrigation.
WS-7: Maximize water resource availability for all beneficial uses	◗	As a feasibility study, the concept would not maximize water resource availability. However, if the project were implemented, the use of recycled water will maximize the limited water resources available for the area.
WS-8: Decrease the need to import water	○	As a feasibility study, the concept itself would not decrease the need to import water. If implemented, the project described in the concept would offset groundwater use, not the use of imported water.

Objective	● ◗ ○	*Justification*
WD-9: Review and understand existing agency demand estimates	○	The concept does not include reviewing and understanding existing agency demand estimates. Implementation of the project described in the concept would also not review existing agency demand estimates.
WD-10: Identify water demand issues for timely consideration by the water agencies during their UWMP update	○	The concept does not include identifying water demand issues for consideration in the upcoming UWMP update. Implementation of the project described in the concept would also not identify water demand issues.
WQ-11: Protect and improve surface and groundwater quality	○	As a feasibility study, the concept itself would not protect or improve surface and/or groundwater quality. Implementation of the project described in the concept could have some groundwater water quality benefits because more groundwater would be left in the basin, thus leaving more water to dilute constituents and other pollutants. However, because of the relatively small amount of groundwater that will likely be offset, this benefit is likely to be negligible.
WQ-12: Match delivered water quality use	◗	As a feasibility study, the concept itself would not involve treating water, nor does it involve delivering treated water. If implemented, the project as described in the concept would improve the alignment of water quality and use by reducing the need to use potable quality water for irrigation.
WQ-13: Use water purification technology as a tool to maximize beneficial uses	◗	As a feasibility study, the concept itself would not use water purification as a tool to maximize beneficial uses. However, the project as described in the concept involves treating a portion of the water to tertiary level. This would allow for a wide range of uses for recycled water.

Objective	● ◗ ○	*Justification*
R-14: Increase access for water-based recreation	○	As a feasibility study, the concept itself does not include elements that would increase access to the Mokelumne River from Highway 12 to the headwaters. Implementation of the project as described in the concept would also not increase access.
R-15: Increase angling and other recreational opportunities (increase spawning habitat, etc.)	○	As a feasibility study, the concept would not increase spawning habitat. Additionally, it is not expected that converting an existing wastewater treatment plant process from one mode to another is expected to have virtually no benefit for fishery habitat. Although there is the potential for a small incremental improvement in overall wastewater treatment plant efficiency, the benefit to fishery habitat through increased water supply availability, instream flows, or cold water pool management is anticipated to be minimal.
R-16: Increase angling and other recreational opportunities (stock hatchery-raised fish)	○	As a feasibility study, the concept does not involve stocking hatchery-raised trout in designated areas on the upper Mokelumne, nor does it involve designating and managing wild trout sections. Implementation of the project described in the concept would also not stock hatchery-raised trout.
R-17: Increase angling and other recreational opportunities (reintroduce salmon in upper Moke)	○	As a feasibility study, the concept itself does not include reintroducing salmon into the upper Mokelumne. Implementation of the project described in the concept would also not reintroduce salmon into the upper Mokelumne.
R-18: Increase angling and other recreational opportunities (increase opportunities)	○	As a feasibility study, the concept itself would not increase angling, harvesting, or other recreational opportunities. Implementation of the project described in the concept would also not increase opportunities.

Objective	● ◗ ○	*Justification*
WR-19: Resolve existing water rights conflicts in the watershed	○	The concept is not focused on resolving existing water rights protests to achieve a common understanding of the application of relevant water rights law in the watershed. Implementation of the project described in the concept would also not resolve existing water rights conflicts.
F-20: Enhance flood protection and management	○	The concept does not include elements that would enhance flood protection and/or flood management, nor would the concept enhance ecosystem function in a way that would provide flood protection. Implementation of the project described in the concept would also not provide flood protection or management.
D-21: Use sound, agreed-upon data to evaluate program alternatives (hydrology dataset)	○	As a feasibility study, the concept itself does not involve producing an agreed-upon hydrology dataset and Water Availability Analysis. Implementation of the project described in the concept would also not produce a hydrology dataset or Water Availability Analysis.
D-22: Use sound, agreed-upon data to evaluate program alternatives (describe in sufficient detail)	◗	Because the concept is not well-defined enough to complete a quantitative assessment, a qualitative assessment was performed. However, the purpose of this concept is to assess feasibility and collect sound, agreed-upon data prior to implementation of the concept.
D-23: Promote the contribution of sound scientific data to current body of knowledge	●	The concept would contribute scientific data to the current body of knowledge by completing a feasibility study and developing information about the effects of switching away from wastewater ponds.
O-24: Increase investment in forest management	○	The concept does not include elements that would promote forest management, nor would it help reduce the economic impact of wildfires and other natural disasters. Implementation of the project described in the concept would also not increase investment in forest management.

Objective	● ◗ ○	*Justification*
O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	◗	As a feasibility study, the concept would not maximize socio-economic, cultural, recreational, public health, and public safety benefits. If implemented, the project as described in the concept would maximize these benefits as the Lake Camanche Village area is a DAC. Additionally, the implementation of a public wastewater system with reuse will lift a decade long moratorium on wastewater connections, provide an option to engineered on-site systems, reduce wastewater spills, and enhance the area with a reliable drought resistant water supply.
O-26: Achieve equity	◗	As a feasibility study, the concept would not directly achieve equity. However, if the project as described in the concept was implemented, the benefits realized would be spread across cultures, incomes, and time.
E-27: Protect and enhance natural environment (enhance natural envt)	◗	As a feasibility study, the concept would not protect and enhance the natural environment. However, if the project as described in the concept were implemented, improvements in water quality, particularly those associated with sewage and good for river ecosystem environments. While the project has little to no geomorphic benefits, there are environmental components to the project that are compelling. The project could eliminate failed on-site septic systems, some of which may contribute to the degradation of Lake Camanche. However, the magnitude of these benefits is unknown at this time and may be minimal.
E-28: Protect and enhance natural environment (wild & scenic designation)	○	The concept does not incorporate or seek a wild and scenic designation. If implemented, the project as described in the concept would also not incorporate or seek a wild and scenic designation.

Objective	● ◗ ○	*Justification*
E-29: Protect and restore fisheries	○	As a feasibility study, the concept will not protect and restore fisheries. Additionally, modifying the existing water treatment plant backwashing process appears to have very little potential to benefit fishery resources. Although the project proposed in the concept would provide greater efficiency of water treatment plant operations and incrementally reduce water required for filter backwashing, the magnitude of the potential change in water supply is anticipated to be minimal in terms of fishery habitat enhancement.
A-30: Enhance or maintain the water supply for the beneficial use in ag practices	◗	The concept itself would not enhance or maintain water supply for agricultural users. If implemented, the project described in the concept would provide recycled water for a nearby ranch (initially about 75 AFY), which would maintain supply for agricultural uses.
C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	●	The purpose of the concept is to assess the feasibility of using recycled water in the Lake Camanche Village area. This helps avoid unnecessary conflict and litigation by identifying and attempting to resolve issues early on. Implementation of the project described in the concept would require coordination between EBMUD, JVID, Amador County Environmental Health, AWA, and residents in the Lake Camanche Village area.
C-32: Promote broadly-supported outcomes that benefit a wide range of interests	◗	As a feasibility study, the concept would not directly promote broadly-supported outcomes that benefit a wide range of interests. However, the project described in the concept would likely promote broadly-supported outcomes. Implementation of the project described in the concept would likely increase water quality in Lake Camanche and provide benefits to a DAC. These outcomes are broadly supported by a wide range of interests.

Objective	● ◗ ○	*Justification*
C-33: Promote broadly-supported outcomes that benefit a wide range of interests (least controversial projects)	◗	The concept has passed the preliminary four screening criteria, including the beneficial and compatible screens. The project described in the concept would also need to undergo these screenings to determine if it was the least controversial project.
C-34: Promote broadly-supported outcomes that benefit a wide range of interests (agreements that reduce conflict)	○	As a feasibility study, the concept would not result in agreements that reduce conflicts. Implementation of the project described in the concept would also not reduce conflict in the watershed.
C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	●	As a condition of implementation, the concept would be consistent with all existing licenses, permits, and agreements affecting the Mokelumne River. This would also be required of the project described in the concept if it were to be implemented.
C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River (CEQA/NEPA)	●	As a condition of implementation, the concept would be required to adhere to all applicable regulatory requirements, including applicable CEQA/NEPA regulations documentation, etc. This would also be required of the project described in the concept if it were to be implemented.
CA-37: Avoid basing decisions on incomplete or inaccurate information	●	The purpose of this concept is to study the feasibility of using recycled water in the Lake Camanche Village area; as such, the nature of the concept will help avoid basing decisions on incomplete or inaccurate information.
CA-38: Avoid demand for new or larger on-stream dams	●	The concept will not result in construction of a new or larger on-stream dam. If the project as described in the concept is implemented, there would also not be demand for new or larger on-stream dams.

Objective	● ◗ ○	***Justification***
CA-39: Avoid harmful impacts to fisheries and other wildlife	●	The concept would not create harmful impacts to fisheries and other wildlife. Implementation of the project as described in the concept would also avoid harmful impacts to fisheries and other wildlife.
CA-40: Avoid conversion of agricultural lands to developed uses	●	The concept would not convert agricultural lands to developed uses. Implementation of the project described in the concept would also not convert agricultural lands.
CA-41: Avoid shifting environmental impacts from one area to another	●	The concept would not shift environmental impacts from one area to another. Implementation of the project described in the concept would also not shift environmental impacts.
CA-42: No diminishment of the benefits of existing in-stream flow	●	The concept does not include elements that would alter existing in-stream flows. Implementation of the project described in the concept would also not diminish the benefits of existing in-stream flow.
CA-43: Avoid closing the process to the public	●	As a condition of planning and implementation, the concept would include public involvement to the extent appropriate. This also applies to implementation of the project described in the concept.
CA-44: Avoid dependency on potentially unreliable supply	●	The concept does not include elements that would facilitate downstream users becoming dependent on an unreliable supply. This also applies to implementation of the project described in the concept. On the contrary, supply reliability is increased by using recycled water, a drought-resistant supply.

Objective	● ◗ ○	*Justification*
CA-45: Minimize adverse socio-economic and public health and safety impacts	●	As a feasibility study, this concept does not have adverse socio-economic and public health and safety impacts. Use of recycled water mandates protections of public health and safety. As a condition of implementation, the project described in the concept would be required to follow regulations mandating health and safety impacts. Additionally, the project would provide public health and safety benefits by removing old, potentially leaky septic systems.
CA-46: Avoid end use harm	●	The concept does not allocate water in ways that create end use harm. This also applies to implementation of the project described in the concept.
CA-47: Avoid violating procedural or substantive laws	●	As a condition of implementation, the concept would be required to complete relevant CEQA/NEPA analysis prior to implementation. This would also be required if the project described in the concept were implemented.
CA-48: Avoid interregional inequity	●	Implementation of the concept would not create interregional inequity, either in realized benefits or in costs. This also holds if the project described in the concept were to be implemented.

Appendix N: Scopes of Work / Preliminary Engineering

Appendix N presents the approved scopes (preliminary engineering) for each of the implementation projects. Included at the beginning of the majority of the scopes is a section titled "Problem Statement and MokeWISE Stakeholder Interests." This section is provided to highlight why the project provides value and characterizes MCG member interests in the project. This "Problem Statement and MokeWISE Stakeholder Interests" section is included as context and is not part of the scope of work for each project.

MokeWISE Program Scope of Work:
Project 1a: Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Many West-slope Sierra rivers have lost connectivity with the ocean due to the construction of large rim dams. As a result, upper watersheds have lost important influxes of marine derived nutrients, and salmon populations that once utilized the upper watersheds to spawn have declined with the loss of accessible habitat. On rivers where dam removal is generally not an option, trap and haul programs have shown to be effective at increasing production of salmon in river systems and at returning essential marine nutrients to upper watersheds.

The Reintroduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir Project will conduct a study to determine the feasibility of transporting adult fall-run Chinook salmon upstream of Pardee reservoir and transporting the juvenile salmon back downstream of Camanche Dam. The study will evaluate the benefits of and clarify the short and long-term operations and any mitigation required to support the proposed project. The study will also seek to identify any potential impacts and constraints of proposed actions on domestic water supply, river flows, technical, political, environmental, economic, legal, and recreational issues. The project includes data collection and analysis, capture and transport system design, as well as an alternatives analysis. Based on the alternatives analysis, a final design will be selected. Implementation of the project includes environmental documentation and permitting, stakeholder outreach and coordination, construction, and monitoring. Costs for this project are estimated to be $180,000, with $80,000 for planning and $100,000 for implementation.

Proponents of this project are interested in restoring the ecological values and sustainability of the upper Mokelumne River and its fishery. They view this project as contributing to restoration of beneficial ecological services in the watershed, strengthening the available gene pool in returning Mokelumne River salmon, and as a method to increase production of a key social, economic, cultural and ecological resource.

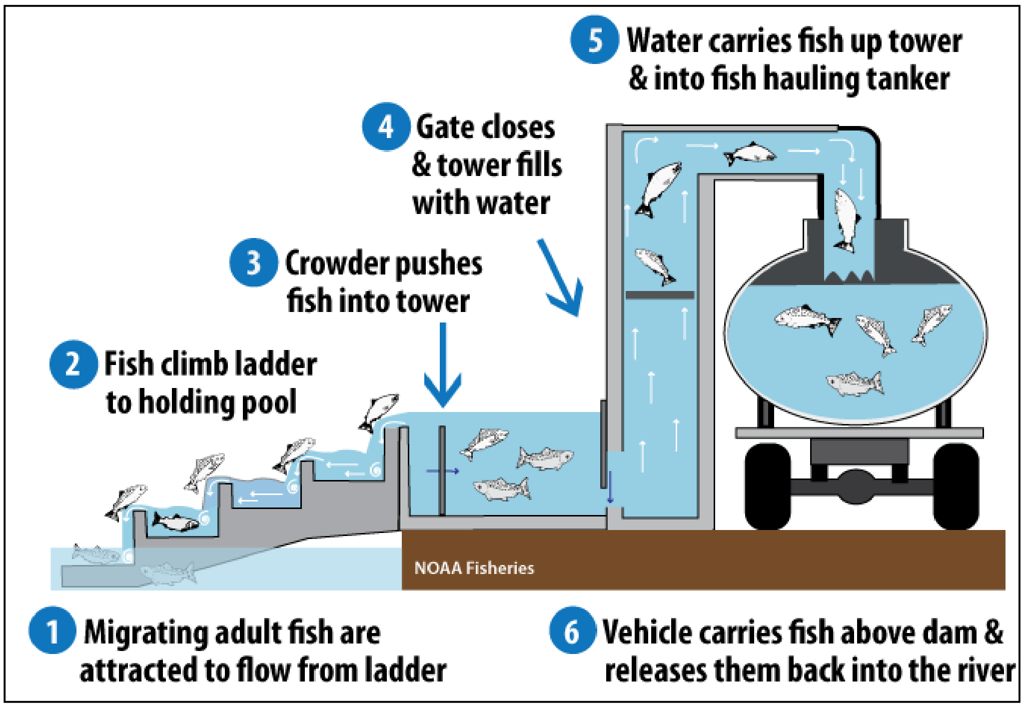
Water agencies are concerned that reintroduction of salmon into the upper Mokelumne watershed could increase their regulatory exposure. They are also concerned that such reintroduction might require changes in temperature or flow requirements that may reduce the availability of water for consumptive use, particularly in times of extended drought and climate change. Consistent with the decision to address climate change in MokeWISE programmatically, the final MokeWISE report will include a table that identifies vulnerabilities associated with this project under climate change and that identifies potential management strategies to address these vulnerabilities.

Background Information

Reference Programs

The National Oceanic and Atmospheric Administration (NOAA) has information about reintroducing and moving fish in instances where fish ladders are not present; this type of operation, referred to as a "trap and haul" operation, is the type of operation being proposed to move adult fall-run Chinook salmon upstream of Camanche Dam and Pardee Dam and move juvenile salmon back downstream of Camanche Dam. A schematic of one type of system that can be used to move adult salmon for trap and haul operations is provided in **Figure 1**.

Figure 1: Schematic of an Adult Fish Trap and Haul Set-Up



Source: NOAA 2015

Trap and haul operations have been implemented in several riverine systems in California, including the San Joaquin and Sacramento Rivers, with efforts on the San Joaquin River dating back to the 1940's (San Joaquin River Restoration Program 2013).

Information from other similar programs in California demonstrate that careful planning and analysis is required to ensure successful implementation of these types of projects. For example, one trap and haul program on the San Joaquin River found increased success with a fish elevator similar to the one shown in **Figure 1** to transport fish, because other options such as moving fish from the river into trucks using dip nets required the fish to be removed from water for a period of time, potentially causing physical stress to the fish (San Joaquin River Restoration Program 2013). Efforts on the San Joaquin River have also shown that it is important to sustain suitable salmon habitat in areas where salmon are being introduced. As such, in addition to trapping and hauling, channel modification projects, projects to reduce impacts caused by gravel mining, flood abatement, and other efforts have been implemented to improve habitat (San Joaquin River Restoration Program 2013).

On the Blue River in Oregon, a salmon restoration project implemented by the United States Army Corps of Engineers (USACE) that involved trap and haul activities was initially unsuccessful due to the fact that trapping infrastructure was placed too close to the dam (the Cougar Dam). For this effort, the USACE found that cold water spilling over the dam was an impediment to restoration as the salmon would not swim up to traps that were located in the cold water. As a result, the USACE constructed a $55 million temperature control tower on the Cougar Dam, after which time salmon were found migrating up the river and into traps (Palmer 2010).

The United States Bureau of Reclamation (USBR) has done additional studies on trap and haul efforts for juvenile vs. adult salmon, and has found that trap and haul programs vary for fish based upon their developmental stage (USBR 2014). Thorough these efforts, USBR found that critical factors to support salmon survival include: suitable water temperatures, adequate and timely flow, and passable watercourses (USBR 2014).

Project Information

Project Description

The purpose of this project would be to conduct a pilot study to determine the feasibility of transporting adult fall-run Chinook salmon upstream of Camanche and Pardee dams and transporting the juvenile salmon back downstream of Camanche Dam. The study would evaluate the benefits of the proposed project and clarify the operations required to support it. The study would also seek to identify any potential impacts and constraints on the following:

- Domestic water supply
- River flows
- Considerations of the following constraints:
    - Technical
    - Political
    - Environmental

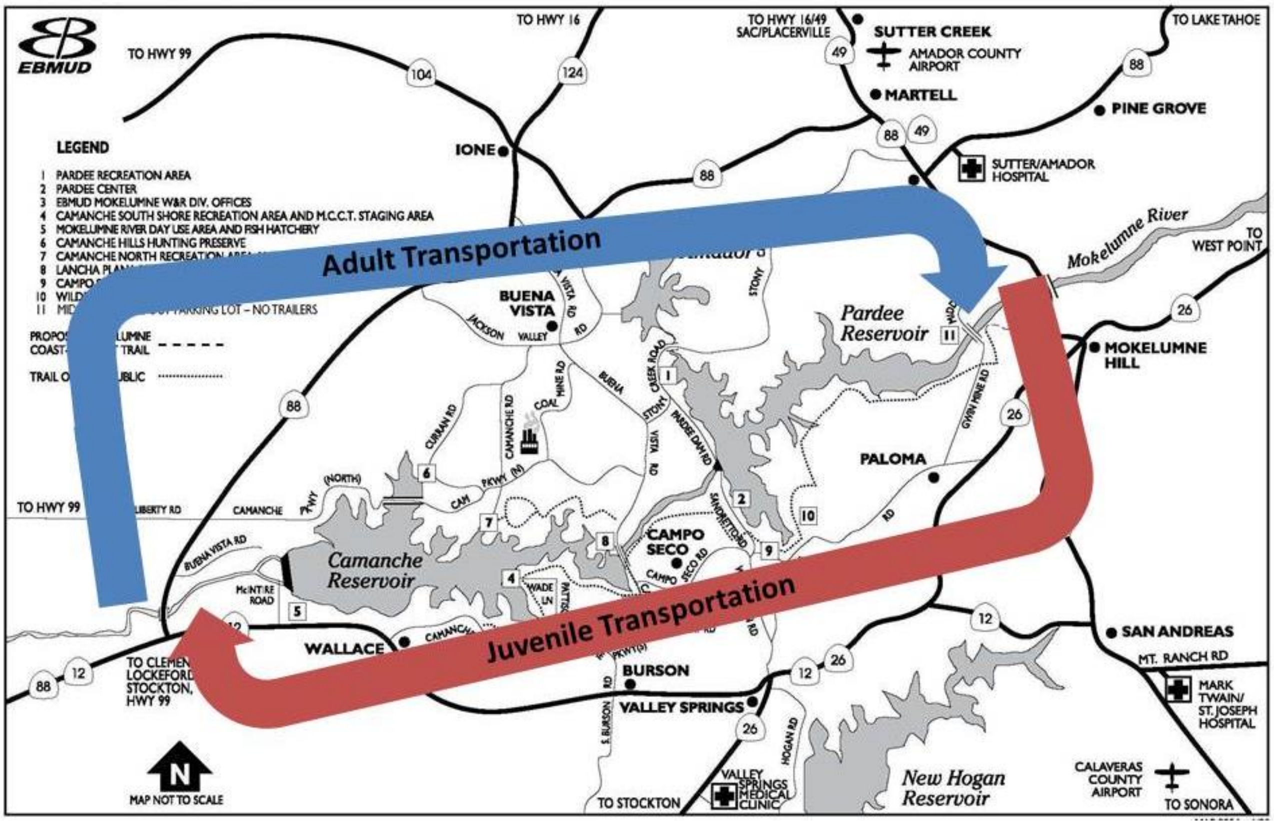
- Economic
- Legal
- Recreation

Prior to implementation, the project will require environmental review under the California Environmental Quality Act (CEQA) and perhaps under the National Environmental Policy Act (NEPA), and will also need to comply with other applicable laws. The study will include coordination with any interested parties. Expected results of expanding current fall-run Chinook salmon habitat include improved resilience of the Mokelumne River population to climate change, enhanced upper watershed ecosystems, and expanded recreational opportunities.

Project Location

The project concept would generally be located immediately upstream of Pardee Dam and immediately downstream of Camanche Dam. Fish and/or eggs would be transported past the approximately 20-mile stretch between the lower part of the Camanche Reservoir and above Pardee Dam, within the upper Mokelumne River. **Figure 2** shows the general area within which the project would be located.

Figure 2: Project Location Map



Project Sponsor

Foothill Conservancy would serve as the lead. The California Sportfishing Protection Alliance (CSPA) would be a co-sponsor.

Scope of Work

Task 1. Data Collection and Analysis

The first step in this project is to conduct data collection and analysis to understand existing conditions that will affect the final re-introduction program. As noted previously, other trap and haul programs in the western United States have found that understanding existing habitat and physical conditions of applicable water bodies is critical to maintaining salmon survival and ultimately to program success.

Subtask 1.1 Determine Habitat Suitability

The project will conduct a habitat suitability assessment. Habitat conditions such as temperature, flow, presence of suitable spawning gravels, cover, and water quality are important factors in successful salmon reproduction.

The purpose of this analysis will be to determine if the existing setting in the Mokelumne River under current operations provides suitable habitat for both juvenile and adult salmon. If habitat is found to be unsuitable, the analysis will include recommendations (e.g. habitat restoration) for additional projects necessary to improve habitat suitability.

Subtask 1.2 Analyze Hydrologic Conditions

Information about the actual instream flows in relevant reaches of the Mokelumne River is abundant. The Joint Settlement Agreement (JSA) specifies in-river flow requirements for the Mokelumne River downstream of Camanche Dam, and the PG&E Project 137 FERC license specifies flows between Salt Springs Dam and Electra Powerhouse. USGS gauges with long records are present below Camanche Dam and upstream of Pardee Reservoir.

The purpose of this task is to analyze hydrologic conditions (base flows and peaking flows) for the stretches of the Mokelumne River within which fish would be introduced. As such, streamflow data from applicable United States Geological Survey (USGS) gages, Pacific Gas and Electric stream ecology monitoring program sites, East Bay Municipal Utility District (EBMUD) monitoring points, and other applicable data sources will be processed to develop monthly and daily hydrographs to the extent practical. Further, streamflow data will also be analyzed for water quality data to the extent feasible.

The purpose of this analysis will be to determine if current flows and operations are conducive to salmon survival in the Mokelumne River for both juvenile and adult salmon. If flows are found to be unsuitable and potentially detrimental to salmon survival, the analysis should include recommendations to address this issue. It is possible that flow constraints could be factored into final design of the project; for instance, salmon could be trucked and hauled to various points of the Mokelumne River at specific times to coincide with suitable flow conditions.

Task 2. Design

Subtask 2.1 Design of the Transport System

The project would capture and truck both juvenile and adult salmon for distances of approximately 20 miles, from below Camanche Dam to above Pardee Reservoir. The design of the transport system should consider the type of vehicles used, routes on which vehicles would move for transportation, back-up fail-safe plans in case vehicles break down, and operational and staffing considerations.

Subtask 2.2 Design of Redd Capping System

The project currently envisions release of up to 100 fall-run Chinook per year upstream of Pardee Reservoir. Dedicated staff will catalogue redds that the transported fish produce and select a limited number for redd-capping. These personnel may also build artificial redds adjacent to selected natural redds and seed the artificial redds with excess eggs transported from the Mokelumne River Fish Hatchery. This subtask involves logistical planning. It also involves designing the capping system that will allow staff to capture the alevins immediately post-emergence and transport them downstream to the Camanche Hatchery. Once the alevins are delivered to the hatchery, hatchery personnel would rear them separately from hatchery-produced juveniles, mark them, and ultimately release them into the lower Mokelumne River.

Subtask 2.3 Alternatives Analysis

The stakeholders participating in the project will review and comment on potential design alternatives for hauling and for the redd-capping systems.

Subtask 2.4 Final Design

The stakeholders will select final designs for the various elements necessary to implement the hauling and redd-capping program. The final design will take into consideration the various habitat parameters analyzed as part of Task 1.

Task 3. Environmental and Permitting

Environmental review will be necessary for the project. The project will definitely require CEQA review. The project will likely also require NEPA review, conditional on several factors, including need for federal permitting, any federal funding that may support that project, or project facilities on federal (likely BLM) land.

Task 4. Implementation of Pilot Study

Subtask 4.1 Stakeholder Outreach and Coordination

In order to ensure success of the project, the on-going pilot project workgroup will invite interested parties and stakeholders, including interested former members of the MCG to review and comment on the efforts of the pilot workgroup as work progresses. The workgroup will address stakeholder concerns in designing the pilot project and will review the results with stakeholders as these results become known.

Subtask 4.2 Operation

Each year, the technical team will determine the number of adult fish that can be obtained from the Mokelumne River Fish Hatchery through communication with hatchery personnel. It is possible that the technical team will track some, or all, adult fish with radio telemetry. Natural redds formed by these fish will be identified and capped to capture emerging alevins. The program has potential to construct artificial redds adjacent to natural redds and plant eggs in the substrate, contributing to the data that is generated from the project on reproduction success and limitations in the system.

Hatchery personnel will determine the number of excess eggs available for transport. The project technical team will transport available eggs from the hatchery to the man-made redds upstream of Pardee Reservoir. Once eggs are placed in the redds, the redds will be capped. The technical team will capture alevins soon after emergence and transport them back downstream to the hatchery.

After the project is designed, personnel needs will be determined. Volunteer labor may help reduce project cost. Work performed by the crew will include tracking adult salmon, identifying natural redds, building man-made redds, depositing eggs in the redds, capping the redds, monitoring capped redds for alevins, removing caps and alevins, and transporting eggs, alevins, and adult salmon. Transportation will likely be via a tanker truck with one trip upstream and one trip downstream each day, seven days a week. Distance trucked would be roughly 20 miles, from below Camanche Reservoir to above Pardee Reservoir.

Potential staff needed:

- Two person crews would be needed for any fish transport activities. Estimated at 1 trip per week for 10 weeks = 160 staff hours.
- For redd surveys, 2-3 person crews, one day per week, for 12 weeks = 288 staff hours.
- Redd capping, emergence trapping: 3 person crews daily for 3 weeks = 504 staff hours

- Juvenile transport – 2 staff needed 1 day per week for 3 weeks = 40

Subtask 4.3 Monitoring Program and Adaptive Management

A monitoring and adaptive management program is necessary to ensure that the program is implemented in a manner that allows for continual achievement of established goals and objectives. The adaptive management program will require monitoring to assess physical characteristics (temperature, habitat, flows, etc.) and also to assess salmon success and mortality rates for both adults and juveniles. Additionally, adaptive management will need to assess potential or actual impacts on domestic water supply resulting from implementation of the pilot study. If program participants decide to consider a longer-term program, they will first assess potential political, economic, legal, and recreational impacts. The adaptive management program, with agreement by the stakeholder group, will set performance measures and will also set thresholds that indicate when adaptive management actions should be taken. The plan should define specific actions to be taken in the event that thresholds are not being met. The stakeholder group should maintain flexibility to modify this plan as necessary to meet established goals and objectives throughout program implementation.

Budget

The total cost of this project is anticipated to be $180,000. Costs associated with the project are broken down as follows:

- Planning Costs: $80,000
  - $10,000 for project definition
  - $50,000 for project evaluation
  - $20,000 for consultation
- Operations Costs: $100,000
  - Fish transporting activities at one staff person once a week for 10 weeks
  - Redd surveys at 2-3 staff persons once a week for 12 weeks
  - Redd-capping and emergence trapping activities at 3 staff persons daily for 3 weeks
  - Juvenile transport activities at 2 staff persons once a week for 3 weeks
- **Total Project Costs: $180,000**

References

National Oceanic and Atmospheric Administration (NOAA). 2015. About Dams & Fish – Trap and Haul. Available at:

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Palmer, Susan. 2010. "Helping Fish Find Their Way – New System Helps Move Salmon Past Cougar Dam." *The Register-Guard.* Available at: http://special.registerguard.com/csp/cms/sites/web/news/cityregion/25199471-41/fish-salmon-dam-river-chinook.csp

San Joaquin River Restoration Program. 2013. Final 2014 Monitoring and Analysis Plan – Study 6, Trap and Haul of Adult Fall Run Chinook. Available at: http://restoresjr.net/flows/MAP/2014_MAP/6-ZJ_StudyWorkplan-Trap&HaulMap8513.pdf

United States Bureau of Reclamation (USBR). 2014. Final Environmental Assessment for the 2014 San Joaquin River Restoration Program Juvenile Fall-Run Chinook salmon Trap and Haul Study. Available at: http://www.usbr.gov/mp/nepa/documentShow.cfm?Doc_ID=16547

MokeWISE Program Scope of Work:
Project 1b: High Country Meadow Restoration Program

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Many higher elevation meadows in the Mokelumne watershed are in a degraded condition, due to a number of factors, including the effects of roads, timber management, tree-brush encroachment, fire exclusion, over grazing, and hoof-channel erosion. These factors that often lead to stream incision, combined with increasing brush and tree encroachment, has reduced available water to meadows and contributed to meadow dewatering and drying earlier in the season. Because of their degraded condition, these meadows no longer function effectively in receiving and holding water through the spring and summer months and slowly releasing it to streams through the drier months. Instead, water tends to run off earlier in the season and the watershed doesn't benefit from the meadows' natural, proper function as the water table drops and encroaching trees transition meadows into forest habitat.

Wildlife habitat also suffers as a result. Aquatic species are adversely affected by alteration of meadow hydrology. Species such as the threatened and endangered Sierra Nevada Yellow-Legged Frog and Yosemite Toad that depend on wet, open meadows are increasingly left with tree and brush covered, dry forests. A comparison of photographs of meadows over the past 100 years shows the extent of tree-brush encroachment on meadows. Restoration of meadows and the watersheds above them would improve natural environmental function, wildlife habitat, and more reliable downstream water yield as a result of anticipated delays in flow release throughout the year.

The High Country Meadow Restoration Project will identify and assess potential meadows for restoration to functioning condition as well as seek funding for the planning phases of identified meadows in the upper Mokelumne River watershed. The project includes involving a stakeholder group and compiling existing data with additional, new meadows identified as in need of restoration in the watershed. Once meadows have been compiled, assessment by a specialist team will be conducted to recommend the type and amount of restoration, and the potential expected benefits to be achieved in each meadow. The collaborative group, potentially the Amador Calaveras Consensus Group (ACCG), will work with the Forest Service, BLM, and other interested former parties from the MCG, to prioritize the meadows on the list for implementation.

The Foothill Conservancy developed this project after working on several meadow restorations with the USFS and the ACCG. While federal funds may be available for meadow restoration work, there is little funding available for prioritizing, analysis and planning. In addition, there is incomplete information on file between the El Dorado and Stanislaus National forests in terms of historic and damaged meadows. This project would fund the compilation of that data, and comprehensive necessary additions, along with assessment of the meadows, to allow a collaborative group to strategically prioritize meadows for restoration. Implementation of the highest-priority restorations through additional phases of grant applications or other funding sources that become available could then take place using the prioritized list.

Conservation groups think that meadow restorations benefit all watershed stakeholders as the benefits derived from restoration include a wide array of categories ranging from water quality and water supply reliability, to environmental services and ecological enhancement.

Based on funding one staff person compiling existing information and the addition of newly identified meadows in need of restoration, and the procurement of a specialist team to assess the complete list, project costs are estimated to be $40,000 plus $10,000 per acre restored.

Background Information

Reference Programs

The specific number of meadows that exist within the upper Mokelumne River watershed is currently unknown; however, it is generally agreed upon that there are many meadows that likely need some level of restoration; therefore, the ultimate purpose of the project will be to evaluate the meadows to determine restoration needs, set priorities for restoring meadows, and estimate restoration costs.

In 2010 the National Fish and Wildlife Foundation (NFWF) developed a Business Plan to guide restoration of meadows within the Sierra Nevada (NFWF 2010). The meadow restoration efforts in the Sierra Nevada have many similarities to the proposed meadow restoration in the Mokelumne Watershed; specifically, in both locations, meadows are recognized as a critical component of watershed hydrology, yet they have been substantially degraded.

The NFWF found that of the estimated 10,000 meadows in the Sierra Nevada, only approximately 30-40 percent exist in in a non-degraded state (USFS 2010). The long-term goal of the Sierra Nevada meadow restoration program is to restore 80-90% of the existing meadows; given the magnitude of meadow restoration needs in the Sierra Nevada and the long-term restoration goals, one of the first steps in the NFWF's meadow restoration efforts was to develop a prioritization methodology (NFWF 2010). The NFWF found that the prioritization methodology should include stakeholder input, be watershed-specific, and have qualitative and quantitative criteria. Additionally, the NFWF's efforts began with identifying a list of ready-to-proceed meadow restoration projects, which would be prioritized due to their ability to move forward before other projects.

The meadow evaluation and prioritization efforts conducted by American Rivers and the NFWF resulted in development of a Meadow Scorecard that was used to rapidly assess the condition of meadows during field work (American Rivers & NFWF 2012). The score card allows field staff to jot down various physical features of each meadow, and then use those features to score the health of each meadow relative to one another. This method ensures that all meadows considered for restoration are evaluated in a similar manner and that data about each meadow is available for the prioritization process. **Appendix A** includes a copy of the Meadow Scorecard for reference (American Rivers & NFWF 2012).

Project Information

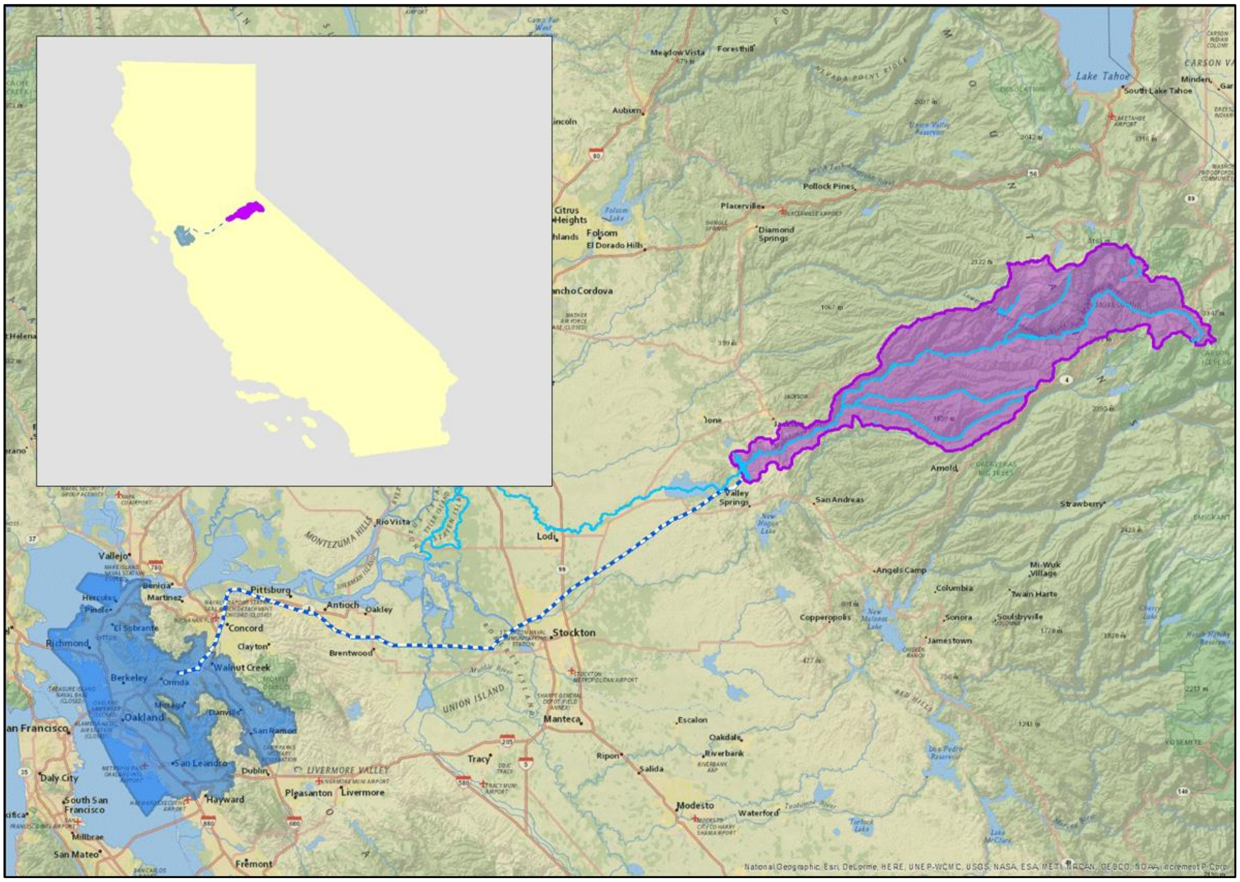
Project Description

The purpose of this project is to develop a two-phased program to restore high-elevation meadows to their approximate natural functions, including providing water supply, water storage, and ecosystem enhancement benefits. The first phase of the program includes compiling available data, assessing meadows within the upper Mokelumne River watershed, and prioritizing meadows for restoration. Phase II includes implementation of the prioritized meadows from Phase I, including securing funding and acquiring the appropriate environmental documentation. Costs of phase 1 may be reduced through volunteer efforts that are ongoing to ground truth the existing data and establish a list that could then be assessed by a specialist team. The project would likely be most successful through coordination and implementation with the Amador Calaveras Consensus Group, a local collaborative group that is closely involved in meadow restoration projects in the watershed.

Project Location

Based on data from American Rivers and the National Fish and Wildlife Foundation (NFWF), roughly 580 acres could potentially be conserved in 21 meadows in the Mokelumne Watershed (American Rivers & NFWF 2012). Phase I of this program will assess all meadows in the upper watershed and determine the number of meadows that can be restored. **Figure 1** shows the location of the upper Mokelumne River watershed (in purple).

Figure 1: Upper Mokelumne River Watershed



Source: Sierra Nevada Conservancy 2014

Project Sponsor

Foothill Conservancy would serve as the lead; no co-sponsor has been identified.

Scope of Work

PHASE I

Task 1. Planning for Meadow Restoration

As previously stated, the number of meadows that exist within the Mokelumne Watershed is currently unknown, but it is anticipated that the restoration needs are extensive. As such, the first step in this effort is to conduct planning work that would identify basic information about the meadows within Mokelumne Watershed.

Subtask 1.1 Pursue Project with Stakeholder Group

It is anticipated that restoration efforts in the Mokelumne Watershed will require integrated efforts among multiple stakeholders. The Amador Calaveras Consensus Group (ACCG) is an established stakeholder group that would likely provide a strong setting for interested parties to participate in formal planning, prioritization, cost estimating, and implementation stages of restoration efforts. Having stakeholder buy-in and support for restoration efforts will help ensure that these efforts are successful on a long-term basis. The stakeholder group should include interested former members of the MCG that guided development of the MokeWISE program.

Subtask 1.2 Map/Compile Meadows in the Mokelumne Watershed

Compile and assess data on:

The first step in mapping is to compile existing data and add any new sites that come from analysis of aerial maps. Some aerial mapping efforts have already been completed in the Mokelumne Watershed by American Rivers, NFWF, Eldorado National Forest and the Stanislaus National Forest. The aerial mapping data should be shared with the established stakeholder group to verify the accuracy and completeness of the data.

<u>Field Assessments</u>

Once meadows have been preliminarily identified, an on-the-ground delineation should be conducted to identify the current extent of existing meadows and conduct an assessment of each meadow utilizing a specialist assessment team. Once complete, the delineation should be able to identify the historic meadow area, current meadow condition, and necessary actions for restoration that will help guide prioritization as well as the future phases of implementation.

Subtask 1.3 Identify Existing Restoration Projects

As stated previously, the Sierra Nevada meadow restoration efforts prioritized restoration projects that were ready-to-proceed (NFWF 2010). Compiling a list of existing restoration projects that could be implemented in a short time period and would provide direct meadow restoration benefits could help move restoration efforts forward in the Mokelumne Watershed. It is assumed that existing projects will be identified and evaluated by the stakeholder group.

Task 2. Prioritize Meadows for Restoration

Subtask 2.1 Determine a Prioritization Process

There are two commonly used methods for prioritization: quantitative and qualitative. Quantitative methods use a structured approach that often involves numerical ranking based on a set of pre-determined criteria. Qualitative approaches typically rely on discussions with stakeholders or the formation of an expert panel that provides input on what should be prioritized. Qualitative approaches can allow for consideration of unique features of individual meadows that cannot be easily classified and ranked in a quantitative scoring process. In some cases, quantitative scoring can be used to inform a qualitative approach.

The stakeholders will agree upon considerations that will be used for the final prioritization process, which may include, but are not limited to:

- Readiness to proceed (see Subtask 1.3)
- Available species that could directly use or colonize meadow – additional consideration may be given if the species are rare, endangered, threatened, or locally important
- Environmental services and ecologic benefits
- Relationship to water supplies, such as groundwater and water reservoirs
- Feasibility, which may include but is not limited to the following considerations:
    - Landowner support
    - Site access for equipment
    - Environmental documentation
- Restoration Costs

PHASE II

Task 3. Implement Restoration Projects

Phase II of the project involves implementing the projects identified in Subtask 2.2. This includes acquiring the appropriate environmental documentation, securing funding, and developing scopes of work for each project to outline the specific restoration efforts needed for each meadow. Each project that is selected by the stakeholder group will be evaluated for potential restoration costs. The scopes of works developed under this task will be used to develop detailed budgets that outline tasks as well as personnel hours, experts, equipment, and other costs that will be required to complete restoration.

Budget

The budget for this project is anticipated to be $40,000 for assessing and prioritizing meadows. Costs associated with the project are broken down as follows:

- Planning Costs (Phase I): $40,000
- Implementation Costs (Phase II): $10,000/acre (this is an estimate that will be refined after Phase I)
- **Total Project Costs: $40,000 + $10,000 * number of acres restored**

Specific implementation tasks have not been provided in this work plan given that further budget and scope development is included as part the second phase of the project (see Task 3). It is assumed that both the acreage of meadowlands and the restoration costs will be updated through implementation of the tasks outlined in this scope. Operational costs for the project are expected to be minimal based upon information from NFWF that demonstrates that completed meadow restoration projects require almost no operational costs (NFWF 2010).

References

American Rivers and National Fish and Wildlife Foundation (NFWF). 2012. Evaluating and Prioritizing Meadow Restoration in the Sierra. Available: http://www.americanrivers.org/assets/pdfs/meadow-restoraton/evaluating-and-prioritizing-meadow-restoration-in-the-sierra.pdf?65c5e7

National Fish and Wildlife Foundation (NFWF). 2010. Business Plan – Sierra Nevada Meadow Restoration. Available: http://www.nfwf.org/sierranevada/Documents/Sierra_Meadow_Restoration_business_plan.pdf

Sierra Nevada Conservancy. 2014. Mokelumne Watershed Avoided Cost Analysis – Inset Map. Available: http://www.sierranevada.ca.gov/our-work/mokelumne-watershed-analysis/Moke_InsetMap.gif

Appendix A: Meadow Scorecard

Draft:9/25/11

Meadow Name ____________________________	Date : ____/____/________ MM DD YYYY
GPS Location: _______°________'_____.____" N _______°________'_____.____" W GPS Datum (e.g., WGS 84, NAD 27) ______________________	
Elevation (ft)___________Slope (°)_____________ County _______________ Landowner ______________	
USGS Quad Name	7.5' or 15' (circle one)
Observers:	

	CONDITION CATEGORY			
Parameter	**Natural Condition**	**Slightly impacted**	**Moderately Impacted**	**Heavily Impacted**
1. Bank Height in Main Channel (measured in the riffle).	Little or no channel incision, Banks 0-2 feet high along >95% of the channel length.	Bank heights of 2-4 feet along less than 25% of the channel length; 0-2 feet elsewhere. .	Bank heights of 2-4 feet along more than 50% of channel length; higher than 4 feet along less than 25% of channel length.	Bank heights > 4 feet along more than 25% of channel length. Note if sections of channel have banks 0-2 feet high.
Score:	4	3	2	1
Second Channel (if present):	4	3	2	1
2. Bank Stability	<5% of bank length is unstable.	5-20% of bank length is unstable.	20-50% of bank is unstable	>50% of bank is unstable.
Score:	4	3	2	1
Second Channel (if present):	4	3	2	1
3. Gullies/ditches outside of main channel	No gullies or ditches outside of the main channel	Ditch or start of a gully outside of the main channel. Combined length of all gullies & ditches is less than 1/10th meadow length.	Combined length of all gullies and ditches up to 1/2 of meadow length	Combined length of all gullies and ditches is greater than 1/2 of meadow length.
Score:	4	3	2	1
4. Vegetation Cover	Graminoids account for 75-100% of the area covered by vegetation	50-75% graminoid cover	Forbs dominate. 25-50% graminoid cover.	Forbs dominate. <25% graminoid cover.
Score:	4	3	2	1
5. Bare Ground	Bare ground covers less than 5% of the meadow area.	Bare ground covers 5-10% of meadow area	Bare ground covers 10-15% of meadow area.	Bare ground covers > 15% of meadow area.
Score:	4	3	2	1
6. Conifer or Upland Shrub Encroachment	No upland shrub or conifer encroachment. Raised, topographically distinct areas may have upland species present, but not the meadow surface.	Few encroaching upland species; <10% of total meadow area	Encroaching upland species cover 10-20% of total meadow area	Encroaching upland species cover >20% of total meadow area
Score:	4	3	2	1
			Total	
			Possible Points	
			Total/Possible	

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Additional Observations:

1. ☐Yes ☐No Evidence of conservation or restoration efforts (check dams, stabilized headcuts, exclosure fencing, etc.) Photo Numbers:______________________________
   Description:____
2. ☐Yes ☐No Headcut present in meadow? Photo Numbers: __________________________ Number of headcuts __________________ .
3. ☐Yes ☐No Fish Observed?
4. ☐Recent ☐Old ☐None Evidence of beavers? Describe ____________________________
5. ☐Yes ☐No Aspen present in or adjacent to meadow?
6. ☐Yes ☐No Accessible by vehicle?
7. Grazing observations. Check all that are present:
   ☐Trails ☐Stubble ☐Dung in channels ☐Hoof prints on banks
8. Human impacts. Check all that are present in the meadow:
   ☐Trail ☐Evidence of OHV use ☐Road ☐Corral ☐Building
9. Adjacent land use. Check all that are present within 200 yards of meadow:
   ☐Culvert ☐Bridge ☐Road ☐Building
10. Gopher disturbance covers _______% of meadow area (from toe-point transects).
11. Willow, alder and aspen cover _________% of meadow area.
12. Comments on ease of/ barriers to restoration (e.g., are impacts localized or disbursed throughout meadow, access, adjacent landuse)

Comments:

MokeWISE Program Scope of Work:
Project 1c: Mokelumne River Day Use Area Floodplain Habitat Restoration Project

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Water users, water purveyors, landowners, resource managers and environmental groups who use, manage and enjoy the lower Mokelumne River have a common interest in sustaining a productive and robust salmon, steelhead, and resident trout fishery in the river. Beyond a direct interest in maintaining aquatic health to avoid the need for regulatory action, many of these entities share the value that the fishery and its aquatic environment are intrinsically positive and an enhancement of life.

The juvenile lifestage of both salmon and steelhead/rainbow trout is widely believed by resource managers of the Mokelumne River to be their most vulnerable lifestage. Riparian and channel improvements in the lower Mokelumne River can help improve juvenile survival by providing both cover and edgewater habitat.

The Mokelumne River Day Use Area (MRDUA) Floodplain Habitat Restoration Project will reconfigure lands included in the MRDUA to create 1 acre of seasonal floodplain that would also serve as habitat for juvenile salmonids and other native fish species within the lower Mokelumne River. The project would include conducting site excavation and materials screening, which will determine which materials are appropriate for use. Finally, the project will conduct gravel placement and recontouring per work previously conducted by the East Bay Municipal Utility District (EBMUD). Costs for this project are estimated to be $150,000, including $111,000 for implementation and a 30% contingency.

Background Information

Previous Restoration Efforts

Since the early 1990's, EBMUD has been working with the California Department of Fish and Wildlife (CDFW) and the United States Fish and Wildlife Service (USFWS) to create salmon spawning habitat in the lower Mokelumne River by placing washed gravel in known spawning areas (EBMUD 2014). Efforts to restore spawning and rearing habitat for salmon and other native fish in the Mokelumne River have been documented in the Central Valley Project Improvement Act and Anadromous Fish Restoration Program Plan (Central Valley Restoration Plan).

Although EBMUD has completed habitat improvement efforts in the lower Mokelumne River, those efforts have focused on the area that is located on approximately the first 0.6 miles of the Mokelumne River below Camanche Dam (**Figure 1**).

Project Information

Project Description

As part of this project, lands included in Mokelumne River Day Use Area (MRDUA) would be reconfigured to create a seasonal floodplain that would also serve as habitat for juvenile salmonids and other native fish species within the lower Mokelumne River. Habitat could be created within existing dredger pools; dredged material would be excavated, screened, and washed to remove the fines and then placed in the dredger pool. As a result of these activities, an area of approximately 1 acre in size would be inundated with seasonal flows, therefore creating habitat. Because this project would reuse materials that are located onsite in existing dredger pools, it would provide for beneficial reuse of materials and resources.

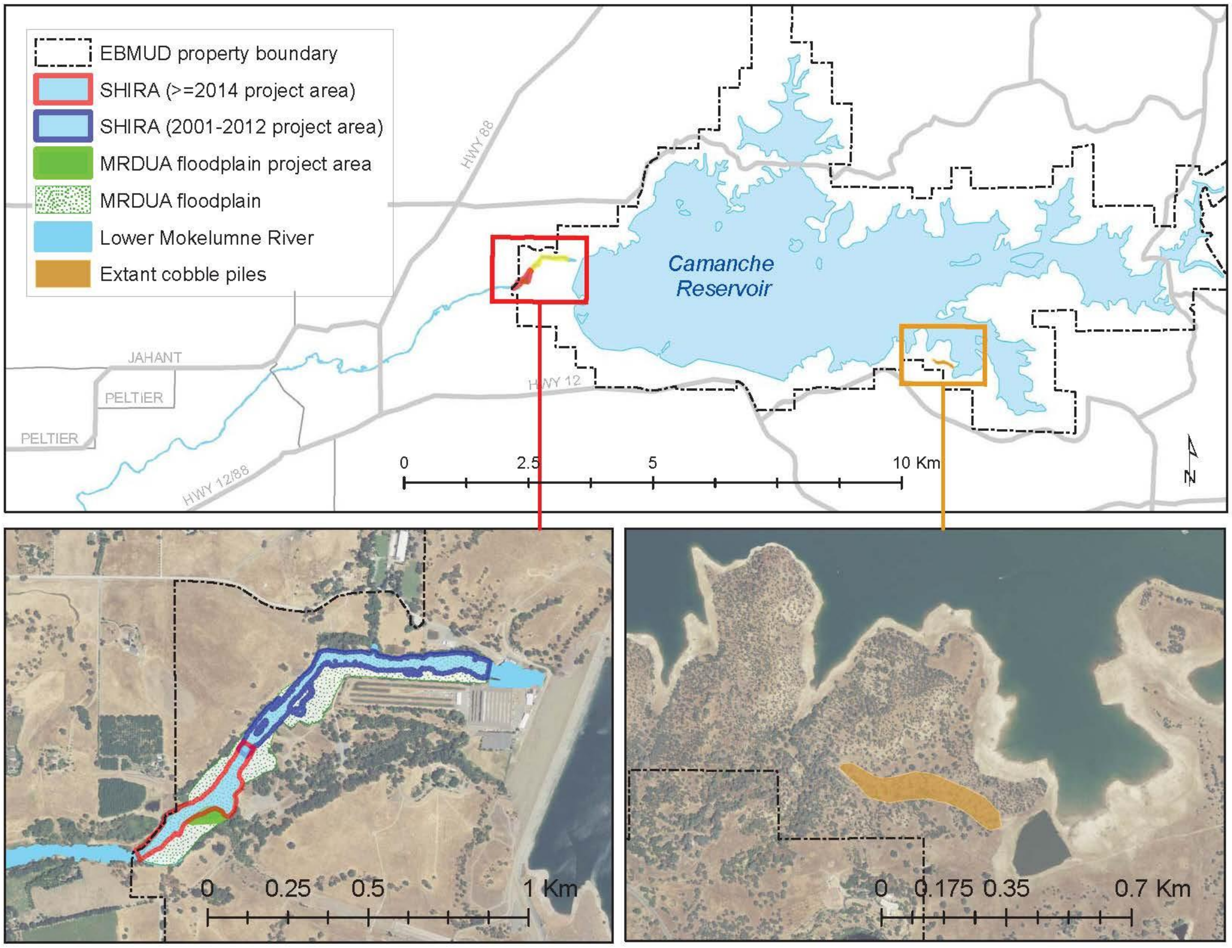
Information from EBMUD suggests that approximately 5,500 cubic yards of material would be excavated and screened. Of this material, approximately 2,500 cubic yards of gravel would be placed and recontoured and 3,000 cubic yards of dredged spoil materials would be placed and recontoured to create a habitat area. The gravel and dredged spoil materials would be deposited in low-lying upland areas and revegetated.

The project would be completed in a manner consistent with the Lower Mokelumne River Watershed Stewardship Plan, which promotes and supports improving spawning habitat for salmon and steelhead trout in the lower Mokelumne River (SJCRCD 2002).

Project Location

East Bay Municipal Utility District (EBMUD or District) owns land immediately downstream of Camanche Dam that it uses to support the District’s water supply operations; this land is known as EBMUD’s MRDUA (**Figure 1**). MRDUA lands include properties that have deteriorated riparian and aquatic habitat associated with historic human modifications such as mining. There is an opportunity to construct restoration projects on the MRDUA land, which, when implemented would improve existing fisheries habitat and provide a degree of flood management. Efforts will focus on restoring the remaining 0.4 miles of the 1-mile reach of the lower Mokelumne River below Camanche Dam (EBMUD 2014). Specifically, efforts will focus on improving fish rearing habitat by recontouring streambank habitat along the MRDUA to create seasonal floodplain habitat for juvenile salmonid rearing as shown in **Figure 1**.

Figure 1: Map of the Proposed Project Area



Source: EBMUD 2014

Project Sponsor

San Joaquin County Resource Conservation District (SJCRCD) would serve as the lead, the California Sportfishing Protection Alliance (CSPA) would be a co-sponsor.

Scope of Work

Given that EBMUD has conducted restoration efforts in the lower Mokelumne River and has completed planning and environmental documentation, the scope provided below focuses on implementation activities.

Task 1. Implementation

Subtask 1.1 Site Excavation

The first step in the project is to excavate dredge spoil material from existing onsite mine tailings. Similar to previously completed efforts, the dredge materials will be dependent on supply, cost, accessibility, and requisite permitting (EBMUD 2014). It is likely that this task will require driving heavy equipment to excavation sites, and moving dredged materials to the proposed screening site(s). As with previous efforts, it is anticipated that materials will be moved in steam-cleaned trucks to ensure that they are not exposed to additional chemicals or substances and that materials will be stored on disturbed areas within the MRDUA.

Subtask 1.2 Material Screening

The San Francisco Regional Water Quality Control Board (Regional Board) has guidelines for reusing dredged materials for restoration activities (Regional Board 2000). While the project is under the jurisdiction of the Central Valley Regional Water Quality Control Board and these guidelines are specific to dredging and restoration in the San Francisco Bay, they can be used as guidelines to understand how to properly screen materials and ensure that the materials are appropriate for recontouring activities.

The Regional Board's guidelines suggest that materials be treated differently if they will be used for either surface or foundational purposes (Regional Board 2000). In this sense, surface materials refer to those that will come into direct contact with flora and fauna, while foundational materials will be the base foundation that lies underneath the surface materials (Regional Board 2000).

Depending upon the logistics of the dredging sites and restoration sites, it is possible that materials will be cleaned onsite (if necessary). If cleaning is necessary, a temporary processing plant may be located onsite and would be removed after restoration is complete.

Subtask 1.3 Gravel Placement and Recontouring

Previous efforts completed by EBMUD suggest that gravel placement and recontouring should take place during late summer months when flows are low (less than 300 cubic feet per second) and non-resident fish are at their lowest abundances (EBMUD 2014). In past efforts the optimal time period has occurred between mid-August and late-September (EBMUD 2014). Recontouring will take place in a manner consistent with final design work, which will ensure that inundation of the MRDUA takes place as planned and in accordance with permitting. Further, after recontouring takes place, all disturbed areas will be re-vegetated with appropriate plants, which should be native grasses or riparian plants.

It is assumed that the following permits and approvals will be required for this project:

- Section 1600 streambed alteration agreement
- California Endangered Species Act Section 2081 and 2090 consultation
- Section 401 Clean Water Act certification from the Central Valley Region of the California Regional Water Quality Board
- Section 404 Clean Water Act authorization
- Endangered Species Act Section 7 consultation
- Central Valley Flood Protection Board permit(s) (if required)
- Coverage under General Permit for Storm Water Discharges Associated with Construction Activities, Construction General Permit Order No. 2009-009-DWQ

Budget

The budget for this project is anticipated to be $150,000. Costs associated with the project are broken down as follows:

- Implementation Costs: $111,000 + 30% contingency
- **Total Project Costs: $150,000**

References

East Bay Municipal Utility District (EBMUD). 2014. Initial Study and Mitigated Negative Declaration for the Lower Mokelumne River Spawning and Rearing Habitat Improvement Project. Available: http://www.ebmud.com/sites/default/files/pdfs/lower_mokelumne_river_spawning_and_rearing_habitat_improvement_project.pdf

San Francisco Regional Water Quality Control Board (Regional Board). 2000. Draft Staff Report – Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines. Available: http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/dredging/beneficialreuse.pdf

San Joaquin County Resource Conservation District (SJCRCD). 2002. Lower Mokelumne River Watershed Stewardship Plan. Available: http://sjcrcd.org/articles/MokP.pdf

MokeWISE Program Scope of Work:
Project 1d: Fish Screens for Riparian Diversions in the Lower Mokelumne River

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Water users, water purveyors, resource managers, landowners, and environmental groups who use, manage and enjoy the lower Mokelumne River have a common interest in sustaining a productive and robust salmon, steelhead, and resident trout fishery in the river. Beyond a direct interest in maintaining aquatic health to avoid the need for regulatory action, many of these entities share the value that the fishery and its aquatic environment are intrinsically positive and an enhancement of life.

The juvenile lifestage of both salmon and steelhead/rainbow trout is widely believed by resource managers of the Mokelumne River to be their most vulnerable lifestage. One of these vulnerabilities stems from lack of swimming ability to escape velocities associated with unscreened instream water diversions. While the magnitude of entrainment of juvenile salmon and steelhead/trout on the lower Mokelumne is unknown, it is likely that effect of entrainment increases in dry years when irrigation starts early and small juveniles stay longer in the river.

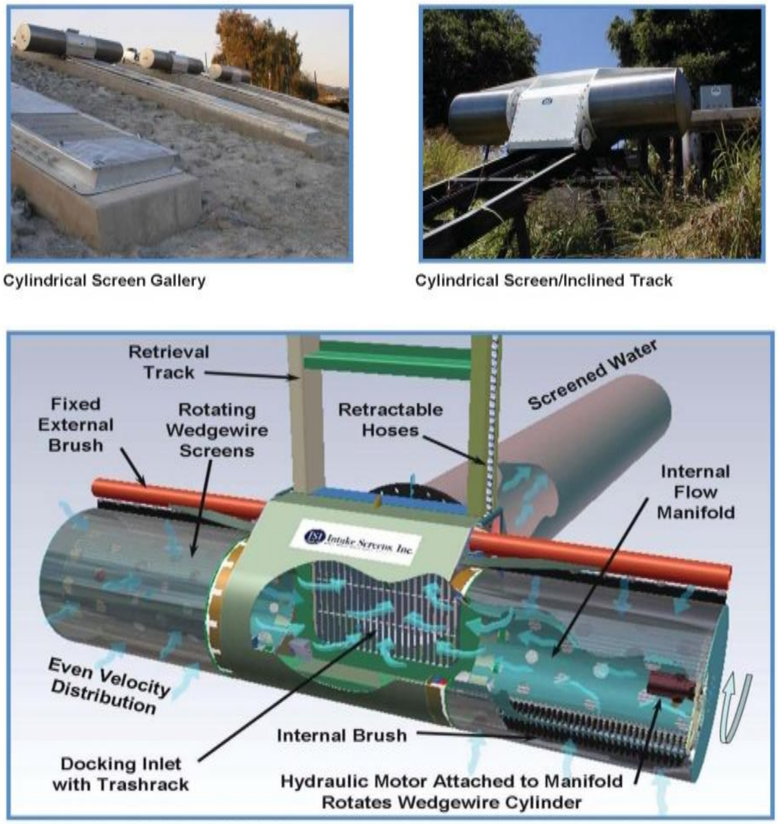
The Fish Screens for Riparian Diversions in the Lower Mokelumne River Project will develop and implement a program to identify and prioritize riparian diversions on the lower Mokelumne River for installation of new fish screens. This includes conducting a diversion assessment and establishing screening design criteria for individual diversions. The project would conduct a funding assessment to determine potential funding sources for screen installation. Working with willing landowners, the project will secure necessary permits, install fish screens, and develop a monitoring strategy. Costs for this project are dependent on the number of fish screens installed and the size of each fish screen. Costs are estimated at $10,000 per cubic feet per second (cfs) screened; thus, screening a 10 cfs diversion would cost $100,000. Total project costs are estimated to be $300,000 for the preliminary assessment and prioritization and $10,000 multiplied by the number of cfs screened.

Background Information

Currently, the four largest pumps and diversions on the lower Mokelumne River are screened, but according to an assessment conducted in the late 1990's, approximately 60 diversions remain unscreened. However, this estimate may be conservative, because the California Fish Passage Assessment Database prepared by CalFish identifies over 400 diversions on the main stem of the Mokelumne River.

Figure 1 provides several examples of typical cylindrical fish screens.

Figure 1: Examples of Typical Cylindrical Fish Screens



Cylindrical Screen Gallery

Cylindrical Screen/Inclined Track

Cut-Away View of Cylindrical Fish Screen

Source: SRCSD 2012

Project Information

Project Description

This project purpose would be to develop and implement a program to identify and prioritize riparian diversions on the lower Mokelumne River for installation of new fish screens. Working with willing landowners, the program would then secure and install fish screens on these riparian diversions to reduce entrainment of fish.

Project Location

The project would be located along the Lower Mokelumne River, specifically in locations with unscreened diversions.

Project Sponsor

Trout Unlimited (TU) would serve as the lead; a co-sponsor has not yet been identified.

Scope of Work

Task 1. Planning and Outreach

The first steps in this project are to: (1) conduct data collection and analysis to understand the extent of existing diversions and analyze the condition of each diversion to assist with the development of a project implementation and funding strategy; and (2) build trust and understanding with landowners that may be candidates for the program. In addition to reviewing publicly available information, one of the primary mechanisms to obtain site-specific information about diversions is through direct outreach to landowners. Trout Unlimited (TU) will work with the San Joaquin Resource Conservation District (SJCRCD), the Lower Mokelumne River Watershed Stewardship Steering Committee (LMRWSSC), Woodbridge Irrigation District, and North San Joaquin Water Conservation District, entities that have well-established landowner relationships in the lower Mokelumne watershed, to conduct extensive outreach in the lower Mokelumne watershed with the goal of obtaining landowner and water user support for the program and identifying specific project implementation opportunities.

Trout Unlimited and the SJCRCD and/or the LMRWSSC will disseminate information about the program and build momentum for its advancement through public meetings, individual contacts and outreach materials. During the outreach events we will discuss the benefits of fish screens, the technical, educational and financial assistance provided to landowners participating in the program, the roles of the various entities engaged in the program and how the program intersects with federal and state priorities. It is important to provide opportunities for landowners to voice their opinions and express their view of the program. Based on outcomes of similar efforts in other processes, TU and SJCRCD anticipates that they will identify and work with a critical mass of landowners interested in providing baseline information to assist with the development of a project implementation and funding strategy. Landowners who voluntarily agree to participate in the program will have an active role in the development of the strategy and other relevant program activities. If initial outreach activities are successful, it is anticipated that landowner interest in participating in the program will continue to increase the program moves forward.

Subtask 1.1 Diversion Assessment

The first step in the analysis is to work with regulators and local stakeholders to verify the number and location of existing diversions.

This assessment will require direct coordination with CalFish to understand the California Fish Passage Assessment Database and its accuracy. If information in the database is deemed accurate, the database will serve as the basis for completing additional analyses.

Additional analyses will involve mapping to identify the location of unscreened diversions on the lower Mokelumne River. Once mapping is completed, field work will be conducted to verify the location of diversions and also determine whether or not diversions are still operational. Field work will also physical and biological analysis, direct coordination with landowners and diverters to gather data pertaining to site conditions that will affect ultimate screening design (see Task 1.2 for more information).

Coordination with landowners will be necessary to ensure that new fish screens are only pursued where the landowner is a willing program participant.

Subtask 1.2 Conduct Cultural Assessment

A cultural resources analysis will be performed to identify areas of high sensitivity that may be affected by construction of any required project element. Existing data records and information will be reviewed and both federally recognized and currently unrecognized Native American tribes within the region will be consulted.

The results of previous cultural resource studies and recorded cultural resources in the records search area will be plotted on 7.5-minute topographic quadrangles. Based on this analysis, an assessment will be prepared to address the sensitivity of the project elements with respect to cultural resources.

Subtask 1.3 Establish Screening Design Criteria

The design of fish screens can vary substantially; as such, it is important to design criteria that will be used to determine which type of screen is appropriate for each diversion. According to the National Oceanic and Atmospheric Administration (NOAA), swimming ability of fish is a primary consideration in designing a fish screen facility (NOAA 1997). Further, information from NOAA indicates that the swimming ability of fish is variable based upon a multitude of factors, including: species, physiological development, duration of swimming time required, behavioral aspects, physical condition, water quality, temperature, lighting conditions, and many others.

In addition, for practical design purposes, design criteria should take into account factors about the diversion, such as:

- Location
- Size
- Piping material

- Average flow
- Diversion capacity
- General conditions (age, condition, etc.)

Subtask 1.4 Screening Design

This task will include execution of a design analysis to consider cost, environmental, permitting, technical, operational, and other programmatic differences of various screening mechanisms. The screen types to be considered in the alternatives analysis will be relevant to the diversion being considered and may vary between diversions. The alternatives analysis should result in a preferred alternative that is selected based upon the design criteria and the type of diversion being screened (refer to Task 1.2 for more information).

Once an alternative has been selected, final design should be completed to establish formal construction and operations that respond to the unique characteristics of each diversion.

Task 2. Funding Assessment

Upon finalizing a design for each diversion, an evaluation will take place to assess potential funding sources for project implementation. The assessment will include identifying and evaluating potential funding sources to determine how each potential funding source may apply to implementation tasks – the analysis will include information about who may apply (type of applicant), likelihood of success (competitiveness of each potential funding source), studies and documentation required for the application process, the potential cost of each application, and grant administration considerations.

Task 3. Prioritize Screens for Installation

Subtask 3.1 Determine a Prioritization Process

There are two commonly used methods for prioritization: quantitative and qualitative. Quantitative methods use a structured approach that often involves numerical ranking based on a set of pre-determined criteria. Qualitative approaches typically rely on discussions with stakeholders or the formation of an expert panel that provides input on what should be prioritized. Qualitative approaches can allow for consideration of unique features of individual diversions that cannot be easily classified and ranked in a quantitative scoring process. In some cases, quantitative scoring can be used to inform a qualitative approach.

The prioritization process may include the following considerations:

- Costs (Task 2)
- Size of diversion
- Access to diversion point

- Likely benefit to be realized by installing screen (reduction in number of entrained fish)
- Environmental documentation

Subtask 2.2 Implement the Prioritization Process

Once a prioritization process has been identified, all diversions being considered will undergo prioritization. This will provide a ranked list, including diversions with the highest priority. Once the prioritization has taken place, adjustments as necessary will be made to the list

Task 4. Screen Installation

Subtask 4.1 Environmental Permitting

This task involves securing necessary permits to install fish screens. Permitting will need to be in compliance with the Fish Screening Criteria of the California Department of Fish and Game, as well as National Marine Fisheries Service (NMFS) Fish Screening Criteria that may vary based upon the types of fish for which screens are being installed. It is anticipated that at a minimum, the following types of permits will need to be acquired from the below-listed agencies:

California Department of Fish and Wildlife

- 1603 Lake and Streambed Alteration Agreement

Regional Water Quality Control Board

- Clean Water Act 401 Water Quality Certification

United States Fish and Wildlife Service and NMFS:

- Section 7 Consultation

Subtask 4.2 Installation

Screen installation will take place in accordance with final design and environmental permitting specifications. It is anticipated that screening will take place at dry points in the year when diversions are not active. If necessary, custom screens will be developed and installed per final design specifications.

Subtask 4.3 Monitoring

Upon final installation, screens will need to be monitored for at least a full year. Depending upon the location of screens, monitoring may require divers to go underwater and videotape fish screens to determine how well they are operating. If necessary, adjustments will be made to ensure that screens are functioning properly and in accordance with design specifications.

Budget

The budget for this project is dependent on the number of fish screens installed and the size of each fish screen. Costs are estimated at $10,000 per cubic feet per second (cfs); thus, screening a 10 cfs diversion would cost $100,000. Costs associated with the project are broken down as follow:

- Preliminary Study and Prioritization: $300,000
    - Assumes a cost of approximately $5,000 per diversion to assess each of the estimated 60 remaining unscreened diversions.
- Implementation: $10,000/cfs
    - Total cost is variable and dependent on total cfs to be screened.
    - Information from Trout Unlimited indicates that there are approximately 1,500 cfs that remain to be screened, which would result in a total implementation cost of $15,000,000 to screen all remaining unscreened diversions (estimated to be 60 diversions).
- **Total Project Costs: $300,000 + $10,000 * cfs to be screened**

References

National Oceanic and Atmospheric Administration (NOAA). 1997. Fish Screening Criteria for Anadromous Salmonids. Available: http://www.westcoast.fisheries.noaa.gov/publications/hydropower/southwest_region_1997_fish_screen_design_criteria.pdf

Sacramento Regional County Sanitation District (SRCSD). 2012. South Sacramento County Recycled Water Feasibility Study – River Intake Alternatives Analysis.

MokeWISE Program Scope of Work:
Project 1f: Riparian Restoration Program – Below Camanche Reservoir

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Water users, water purveyors, local landowners, resource managers and environmental groups who use, manage and enjoy the lower Mokelumne River have a common interest in sustaining a productive and robust salmon, steelhead, and resident trout fishery in the river. Beyond a direct interest in maintaining aquatic health to avoid the need for regulatory action, many of these entities share the value that the fishery and its aquatic environment are intrinsically positive and an enhancement of life.

The juvenile lifestage of both salmon and steelhead/rainbow trout is widely believed by resource managers of the Mokelumne River to be their most vulnerable lifestage. Riparian, upland, and channel improvements in the lower Mokelumne River watershed can help improve juvenile survival by providing both cover and edgewater habitat.

The Riparian Restoration Program below Camanche Reservoir will support the implementation efforts of the Lower Mokelumne Watershed Stewardship Plan, which analyzes and addresses riparian restoration needs. The program will study and evaluate potential areas for restoration below Camanche Reservoir, with a focus on the area from the base of the Camanche Dam to the confluence of the Cosumnes and Mokelumne Rivers.

The San Joaquin County Resource Conservation District convened a stakeholder group in 1999 now known as the Lower Mokelumne River Watershed Stewardship Steering Committee. Committee members and participants (including USFWS, CA Dept. of Fish and Wildlife, EBMUD, USDA NRCS) have already conducted an evaluation of watershed conditions, conducted habitat restoration and monitoring activities, and worked with other agencies and organizations to develop integrated projects with the goal of restoring multiple riparian functions, which could include habitat, floodplain function, and improved groundwater recharge.

Using previous efforts as a guide, this project seeks to build on the successful template for ecosystem-based watershed restoration efforts including the continued encouragement and implementation of voluntary restoration and monitoring activities. Implementation could be scaled or conducted in phases depending on funding availability.

Costs for this project are estimated to be $100,000 for the study, evaluation, and permitting, and $8,000 per acre restored. Per acre restoration costs are subject to volatility due to factors including non-native invasive species removal, construction of levee setbacks, and the need to pay prevailing wage for all projects where public dollars are used to fund any part of a project. Substantial additional funds will be needed to comply with all required state and federal environmental documentation and permitting.

The study should assess the degree to which project(s) would impact individual private properties in advance of implementing projects. Because this would involve working within the floodplains, the projects should be implemented in coordination with the local flood control district. The project(s) would only proceed with the participation and voluntary involvement of willing landowners.

Background Information

Reference Programs

According to SJCRCD, the Lower Mokelumne River Watershed is approximately 80 square miles in size, which is roughly 50,000 acres. The Lower Mokelumne Watershed is located below Camanche Dam, and has historically been deteriorated by mining operations and other anthropogenic activities. The stewardship plan outlines riparian restoration needs through various implementation programs (SJCRCD 2002). The riparian restoration programs are variable, and include the following types of activities:

- Replacing non-native species by re-establishing native plants
- Educating local residents, students, and others about the importance of restoration and native functions of the watershed
- Improve water quality on agricultural or rangelands

Given the large and variable nature of potential restoration efforts in the Lower Mokelumne River Watershed, SJCRCD received a Proposition 50 Grant in 2005 from the State Water Board (Agreement # 04-115-555-0) for work that included the development of a strategic framework to identify and prioritize riparian habitat restoration, enhancement, and protection projects. As a result of this work, SJCRCD in early 2008 released the Lower Mokelumne River Conservation Handbook. The Handbook included a weighted restoration ranking criteria, a list of possible restoration activities and practices, and a guide for individual landowners to conduct an initial assessment of their properties for habitat restoration/enhancement potential.

Under terms of the grant agreement, SJCRCD convened a group of federal and state wildlife agency members, local wildlife interests and local landowners to identify and rank natural resource challenges in the watershed which served as the basis for the ranking criteria. The weighting factors for individual projects includes priorities of funding programs, bonds and/or entities in order to ensure the greatest chance for success when seeking project approval and funding.

Project Information

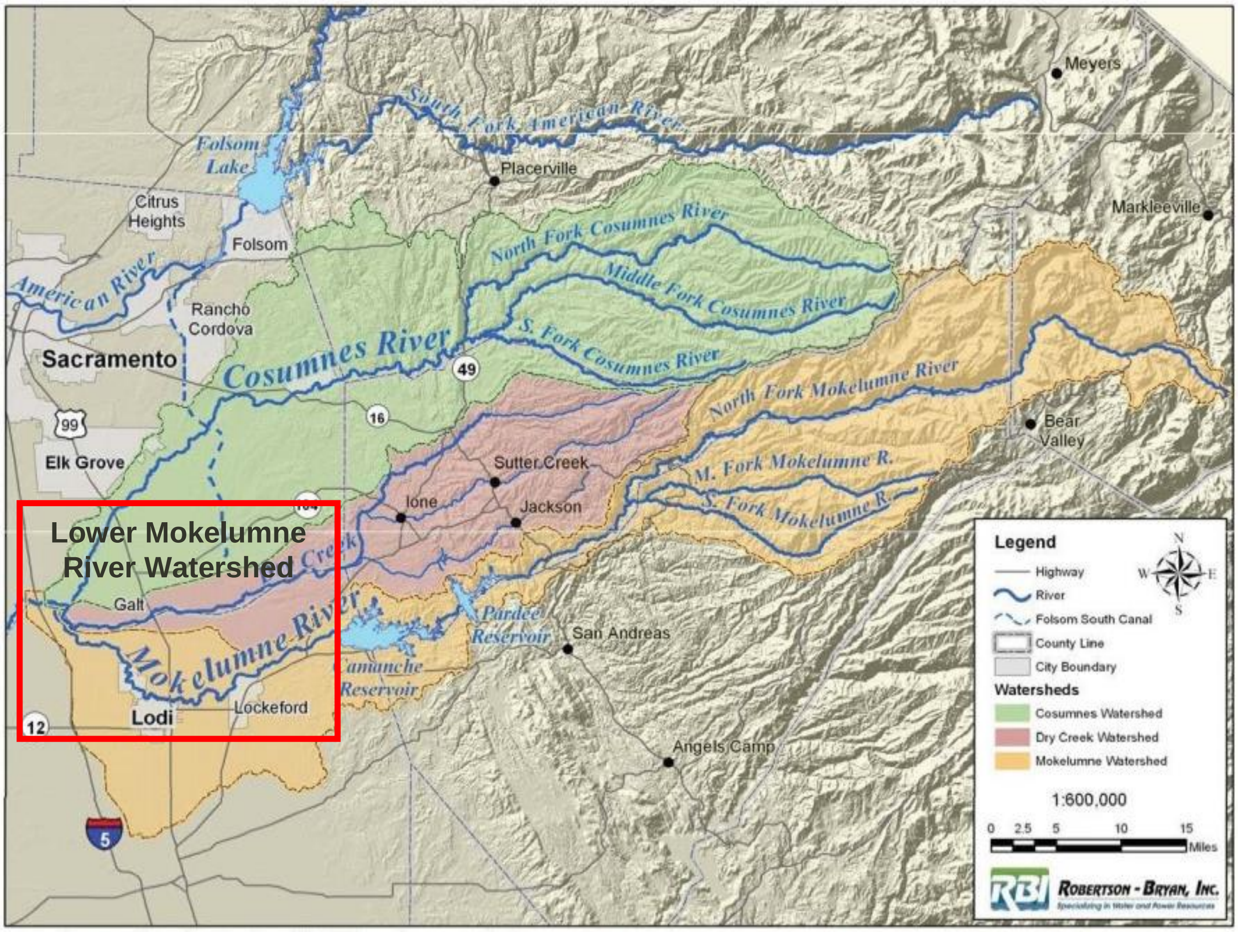
Project Description

The purpose of this project is to support the implementation efforts of the Lower Mokelumne Watershed Stewardship Plan, which analyzes and addresses riparian restoration needs. Specifically, the project will include studying and evaluating potential areas for restoration below Camanche Reservoir; in total, it is anticipated that 50 acres of land will be restored. Restoration efforts, while site specific, must include working with willing landowners. Potential actions include: to create set back levees, re-configure side channels and/or increase riparian buffer areas to maximize available habitat for salmonids. Restoration could also restore floodplain function and promote groundwater storage. Restoration efforts could be scaled or conducted in phases depending on funding availability.

Project Location

Restoration efforts would focus on the area that is known as the Lower Mokelumne River Watershed, which ranges from the base of the Camanche Dam to the confluence of the Cosumnes and Mokelumne Rivers (see **Figure 1**). This watershed is also referred to as the Lower Cosumnes-Lower Mokelumne Watershed by the United States Environmental Protection Agency (SJCRCD 2002).

Figure 1: Lower Mokelumne River Watershed



Source: Robertson-Bryan, Inc. 2006.

Project Sponsor

San Joaquin County Resource Conservation District (SJCRCD) would serve as the lead, the Foothill Conservancy would be a co-sponsor.

Scope of Work

Of the estimated 50,000 acres within the Lower Mokelumne River Watershed, this project aims to restore approximately 50 acres. It is important to note that unlike many watersheds in the state of California, most of the land in the Lower Mokelumne Watershed is privately owned. Therefore, the cooperation of willing landowners is vital to any successful habitat enhancement/restoration program. Due to the limited nature of restoration compared to the size of the watershed, the first step will be to conduct landowner outreach and determine funding availability.

Task 1. Convene Stakeholder Group

In order to ensure success of the project, it is necessary that a stakeholder group be formed to include all interested parties and stakeholders, including interested members of the Lower Mokelumne River Watershed Stewardship Planning Committee and the former Mokelumne Collaborative Group (MCG). It is recommended that this group be convened at the outset of the project to discuss its purpose, solidify project goals and objectives, and guide implementation efforts.

Task 2. Conduct Outreach

To facilitate successful projects, strategic outreach to appropriate partners and applicable landowners is critical. This task can include reaching out to a number of organizations such as the Lower Mokelumne River Stewardship Steering Committee, Farm Bureau, UC Cooperative Extension, Lodi Winegrape Commission, NRCS and Sustainable Conservation. This can occur in many different forms, from attending meetings, to featuring articles in their publications, to distributing applicable information to their members, to meeting one-on-one with interested parties. Through the SJCRCD's relationships with these organizations and local landowners, potential projects and/or interested landowners can be identified. Further, outreach events can be held if deemed necessary to promote potential restoration opportunities.

One key resource to utilize within any outreach effort is the cooperation of local landowners who have already conducted habitat restoration activities or are in the process of restoring habitat. There are multiple locations in the watershed where habitat restoration projects have been completed and landowners are willing to host field days to show their peers how habitat restoration can coexist with or even complement and assist components of their overall farming operation (i.e., integrated pest management).

Task 3. Assess Watershed Condition

SJCRCD completed a study titled the *Historical Assessment of the Ecological Condition and Channel Dynamics of the Lower Mokelumne River: 1910-2001*, which provides a detailed understanding of past riparian functions in the watershed (SJCRCD n.d.). Because this study includes information about past riparian functions of the watershed, it should be used as the basis for assessing the current condition of the watershed. It is possible that this study has outdated information, and should therefore be updated to ensure a complete and current condition assessment of the watershed is available.

Task 4. Establish Restoration Goals

Once a working understanding of the watershed is attained, restoration goals should be established and prioritized in consultation with the stakeholder group. It is anticipated that these goals will focus on the potential (past) riparian functions of the watershed, and will also include a prioritization of the riparian functions that are most important to restore. Additional goals may include restoring floodplain function and promoting groundwater storage.

Task 5. Develop Integrated Projects

The next task will be to develop a suite of integrated restoration projects, each of which, when implemented, would restore multiple riparian functions identified in Task 2. It is anticipated that the stakeholders convened as part of Task 1 will be involved in identifying the integrated restoration projects. Projects could include creating set-back levees, re-configuring side channels and increasing riparian buffer areas.

Depending upon funding available, it is possible that the group will need to prioritize projects for implementation. The group should use the prioritized riparian functions as the basis for this prioritization, and prioritize projects that maximize restoration of priority riparian functions.

Task 6. Implement Integrated Restoration Projects

Once the integrated projects are developed, each project should be implemented in accordance with final environmental, design, and permitting stipulations. Implementation could be scaled or conducted in phases depending on funding availability.

Task 7. Conduct Monitoring

Per information from the USDA, project monitoring is critical to both understand if riparian functions are being restored and also learn lessons about restoration that can be applied to any future prioritization and implementation processes.

Numerous studies indicate that neo-tropical migrant songbirds are the first to respond to habitat restoration enhancement. Previous projects utilized Point Reyes Bird Observatory (now Point Blue) to conduct monitoring, and their activities were paid for by grant funds as part of the overall project. If a landowner enrolls in the programmatic safe harbor agreement established watershed-wide for Valley Elderberry Longhorn Beetle, additional monitoring will be conducted as a part of that agreement.

Budget

The budget for this project is dependent on the number of acres restored and the specific restoration needs of each site. Costs are estimated to be $8,000 per acre restored. Costs associated with the project are broken out as follows:

- Study, Evaluation, and Permitting: $100,000
- Implementation: $8,000 * number of acres restored
    - Total cost is variable and dependent on the total number of acres to be restored and other needs including the extent of non-native invasive species removal or engineering for levee set back work.
    - Permitting can be a substantial additional cost, and previous experience indicates it takes an inordinate amount of time for all final permits to be secured. While a CEQA categorical exemption can be secured for most small scale restoration projects, all projects involving levee set-backs will require a more thorough evaluation. And, any vegetation removal/replacement in the 100 year flood plain will require a CA Flood Protection Board/County Public works permit which at minimum require engineering diagrams and in most cases a full hydrologic study.
- **Total Project Costs: $100,000 + $8,000 * number of acres restored**

References

San Joaquin County Resource Conservation District (SJCRCD). N.D. Special Studies. Available at: http://sjcrcd.org/programs/hstmk.htm

San Joaquin County Resource Conservation District (SJCRCD). 2002. Lower Mokelumne River Watershed Stewardship Plan. Available at: http://sjcrcd.org/articles/MokP.pdf

United States Department of Agriculture (USDA). 2011. Watershed Condition Framework. Available at: http://www.fs.fed.us/publications/watershed/Watershed_Condition_Framework.pdf

MokeWISE Program Scope of Work:
Project 1g: Mokelumne Water Quality, Soil Erosion & Sedimentation Inventory/Monitoring

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Sediment is degrading the quality of Mokelumne River water. High quality water from the Mokelumne River is a very valuable resource. The Mokelumne watershed serves as a domestic water supply and as a critical source of life for aquatic species, including some that are endangered. Erosion and sediment delivery to the river and tributaries is greatest in the winter and spring during periods of high runoff and snow melt. A major source of sediment pollution is concentrated runoff from some roads and trails that have poor drainage, location, design, lack of maintenance, or all of the above. Sediment laden runoff is high in turbidity and bed-load and suspended loads, and it can include other contaminates that degrade water quality. Water in the Mokelumne River at the Tiger Creek Afterbay Reservoir is much lower in quality than water released from Lower Bear River and Salt Springs Reservoirs. Amador Water Agency has not been able to filter highly turbid water in the past. Sediment laden turbid water can contain heavy metals. It can "mask" microbiological contaminants making disinfection more difficult. Sediment laden water is more costly to treat for human consumption. And sediment has been reducing the capacity of the PG&E reservoirs that AWA relies on to back up our water rights.

Turbidity and sediment are adverse to the health of aquatic species. One potentially threatened or endangered species found in the Mokelumne River is the Foothill Yellow-Legged frog. The Sierra Nevada Yellow-legged frog and Yosemite Toad have habitats at higher elevations. High sediment loading of the river or tributaries can alter or eliminate habitat by smothering eggs and young and other bottom dwelling communities. Sedimentation impairs fisheries and can distribute toxic substances through the riparian and aquatic systems. Sedimentation can cement gravels needed for fish spawning, such as for reintroduction of Fall-Run Chinook Salmon.

The federal and state laws and regulations prohibit sediment pollution from what's called non-point sources, such as sediment or chemicals from dispersed locations. Numerous small non-point pollution sources can have a significant cumulative impact on water quality. By documenting the source of each, the hope is this will lead to future public and private actions to reduce degraded water quality.

Conservationists agree to the use of public funds for this inventory-monitoring of erosion-sedimentation in the Mokelumne River watershed. While supportive of the concept of reducing erosion, the Calaveras Planning Coalition (CPC) remains skeptical that restoration efforts will reap significant erosion reduction gains watershed-wide in the face of ongoing erosive activities. However, the project could help to reduce cumulative impacts on water quality. First, the nature and level of private forestry activity will continue to be a major contributor to erosion under the current regulatory system. This project may help to reduce violations if they are present. Second, more aggressive forestry efforts to increase water yield in Calaveras County are likely to result in a new source of increased erosion. While this pilot project in Calaveras has yet to be developed, it is important that the activities comply with State adopted water quality standards called Best Management Practices.

Third, land use authorities in both Amador and Calaveras counties have been reluctant to implement low-impact development techniques to reduce erosion from new development. This may be addressed in future discussions between former Mokelumne Collaborative Group (MCG) stakeholders pursuant to the Land Use Coordination Policy Statement. Finally, wildfires and subsequent timber salvage activity are likely to continue, or to increase as forests transition to a changed climate. Thus, it is hoped that this inventory/monitoring project may lead to reduction of existing and future cumulative impacts.

Also, the CPC is skeptical that existing public land management agencies have the institutional capacity to take on additional activities focused on reducing erosion. However, a USFS land manager said that they are supportive of this proposal, and the project is work is consistent with inventorying of erosion-sedimentation they are doing in the Power Fire Area in Amador County.

Furthermore, the CPC does not want public funds to duplicate any other project that accomplishes the same products, including by the USFS in the Power Fire area.

State Water Bond funds, if secured for sediment reduction projects after completion of this inventory-monitoring project, should only be used to support projects on public lands or publicly maintained roads and trails. Other funding sources may be used to reduce erosion problems on private lands.

Such post-inventory/monitoring funds would be spent on projects, and should leverage other public funds through matching. Funds are to be spent to reduce erosion and sedimentation in the River or tributaries on open or closed roads and trails.

To ensure that the expenditures produce a net benefit and do not perpetuate existing problems, public funds should not be used to re-open closed roads or trails for public use, or to maintain roads on public lands that officials have decided to no longer maintain, or as a substitute for regular maintenance or construction funding for projects on public land or publicly maintained roads and trails. Funds should not be spent as a replacement for other public road and trail funds.

Background Information

The federal Clean Water Act, the federal Anti-degradation policy (40 CFR 131.12), the California Porter-Cologne Water Quality Control Act, and the Regional Water Quality Basin Plan all require control of non-point pollution sources to protect water quality. The Central Valley Regional Water Quality Control Plan specifies that,

> *"The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses."*
>
> *"Waters shall not contain substances in concentrations that result in the deposition of material that causes nuisance or adversely affects beneficial uses."*
>
> *"Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses."*

The State Policy for Water Quality Control states in II. 12,

> "*Monitoring programs must be provided to determine the effects on beneficial water uses including effects on aquatic life and its diversity and seasonal fluctuations."*

The Regional Water Quality Control Board has indicated that monitoring should be required to assure compliance with standards in some areas:

> *"Water quality and sediment monitoring may be required to ensure compliance with these requirements. For paved roads, entities maintaining or constructing road shall implement the Caltrans or equivalent management practices to comply with these requirements. For unpaved roads, entities maintaining or constructing road shall implement all reasonable management practices to control erosion during construction and maintenance activities. By 6 February 2009, county and agency road departments shall submit information describing the management practices that will be implemented to control erosion."*
>
> *"The State and Regional Water Boards entered into agreements with both the U.S. Forest Service and the California Department of Forestry and Fire Protection for use of Best Management Practices (BMPs) to control nonpoint sediment discharges by implementing actions certified by the State Water Board. The Regional Water Board enforces compliance with BMPs, and it may impose control actions if the practices are not applied or do not protect water quality."*

In 2007, the Upper Mokelumne River Watershed Authority (UMRWA) completed the "Upper Mokelumne River Watershed Assessment and Planning Project," which analyzed the watershed's existing hydrologic characteristics and recommended measures for improvement of water quality. Turbidity (sediment), nitrate, and fecal coliform were among the water quality constituents observed to exceed relevant standards (RMC 2007). Section 8.3.7 of the report, F3 – Implement Road Maintenance Practices states, "As a source of impermeable surface with its resulting erosion, increased peak runoff, and transport of contaminants in runoff to the Mokelumne River, the maintenance of existing roads is an important factor in reducing pathogens, particulates, and metals."

The Final Report of the Upper Mokelumne River Watershed Assessment and Planning Project report identified "dirt and gravel road sediment is a major source of runoff contamination (pg. 8-12)." And "protecting and maintaining existing water quality will require consistent ongoing monitoring for detection of changes as well as good management of watershed lands (pg. 8-2). And a key recommendation is to "1. Identify potential water quality responses to watershed land uses, management, and activities" (pg. 9-9, Table 9-1), and it lists the following as an "Outcome Indicator: 4. Anthropogenic (man-caused) stressors identified by general location (page 9-9, Table 9-1: Performance Indicators for Part 2 Project)." And it recommends "…baseline water quality reflecting average monthly conditions be updated by the Authority once per year for the parameters of interest…" (pg. 9-1). "This will ensure that any preexisting or new benchmark exceedances can be tracked." It has been 7 years since this assessment was completed with no notable monitoring to locate "man-caused" erosion-sedimentation.

One way of measuring the degradation of water quality by sediment is to take samples from the river and tributaries. However, this is doesn't pin-point the source of increased sediment levels. The US Forest Service and Cal Fire have been approved California for use of Best Management Practices for water quality protection. These are best practices to control water quality to be employed in the planning, design, implementation, and monitoring of land disturbing activities. The Forest Service checks a sample of disturbed areas to monitor the implementation of BMPs periodically as a means of assessing the overall effectiveness of their BMP program. US Environmental Protection Agency has approved the USFS BMPs as a means of complying with the Clean Water Act. Counties were required to submit erosion control plans to the Regional Water Quality Control Board along their public roads.

However, even with these legal requirements aimed at protecting water quality, gullies and other non-point pollution sources still persist from some roads and trails that are adversely affecting the quality of the Mokelumne River. This project would identify those and provide the basis to set in motion erosion-sediment reduction actions following this inventory-monitoring effort.

This project is aimed at finding and documenting sites that exceed sediment water quality standards.

Project Information

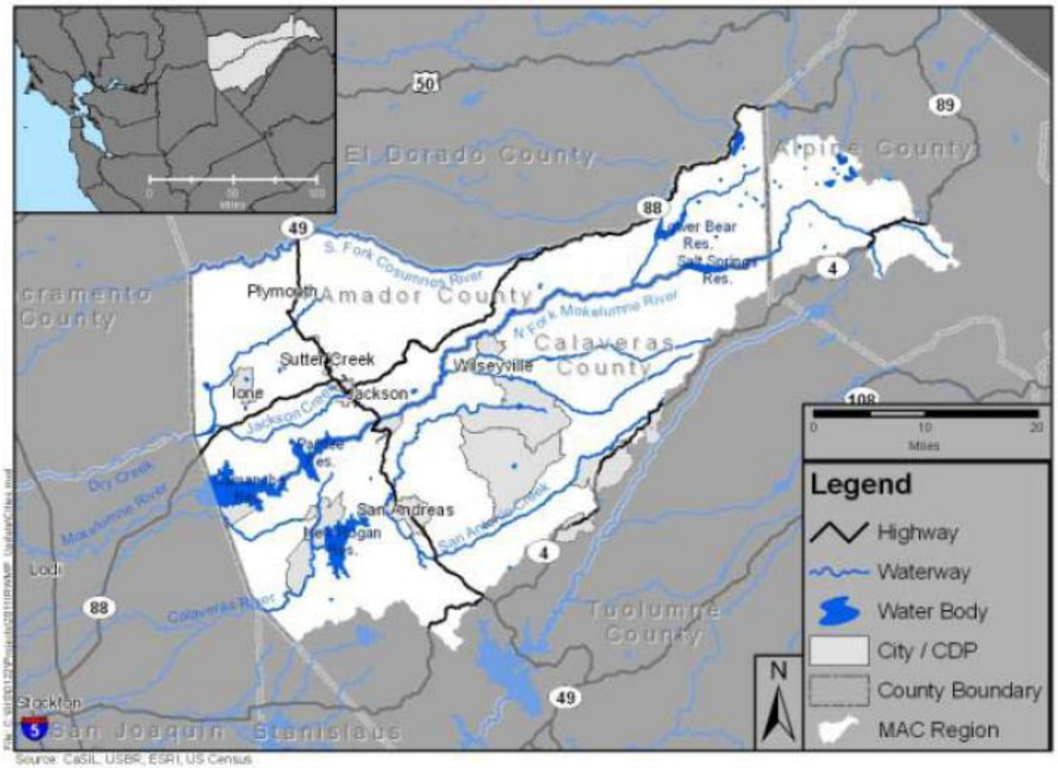
Project Description

This project will identify, assess, prioritize, and publish a report on areas of soil erosion-sedimentation reduction in the Mokelumne Watershed above Pardee Reservoir. The project includes establishing and coordinating with a stakeholder group and evaluating existing data and setting priorities for soil erosion and sedimentation reduction or any other source of pollutants entering the river or tributaries. Once sources of soil erosion and delivery to the Mokelumne River or tributaries have been mapped and digitized for analysis and future reference, a method for prioritizing these for restoration will be developed. Sources of restoration work based on the information produced by this project, would be primarily focused on property owners. Costs for this project are estimated to be $200,000 for planning, inventory, mapping, assessment of erosion-sedimentation reduction options, prioritization, stakeholder coordination, publishing the results, and outreach to seek follow-up erosion-sediment reduction work.

Project Location

The project is located in the MAC region, upstream of Pardee Reservoir (**Figure 1**).

Figure 1: MAC IRWM Region and Project Area above Pardee Reservoir



Project Sponsor

Amador Water Agency is the lead sponsor for this project; no co-sponsors have been identified.

Scope of Work

Task 1. Identification and Assessment for Soil Erosion-Sedimentation Reduction

The first step in this effort is to locate areas in the region that have and are undergoing erosion and delivery of sediment to the Mokelumne River and tributaries. Identification of erosion areas will help to target and prioritize restoration activities to achieve the greatest increase in water quality. Data records, sketches, photographs, and a location map with latitude and longitude coordinates will be produced for each eroding site. Use of GPS data recorders will be used for location, portability of data and recording. GIS layers and database will be used for documentation.

Subtask 1.1 Establish a Stakeholder Group and Land Owner Outreach

Stakeholders with an interest in soil restoration, erosion control and water quality improvement would be gathered into a formal working group to provide the opportunity to review and comment during the planning, prioritization, final documentation, and potential follow-up stages of soil restoration efforts. Outreach will be made to property owners to inform and gain support for this project. Stakeholder buy-in and support for restoration efforts ensures that these efforts are successful in the long-term. The stakeholder group could include interested members of the former MCG which guided development of the MokeWISE program, and the Amador Calaveras Consensus Group (ACCG), which is currently involved in restoration efforts with the United States Forest Service. The stakeholder group will consult the Amador-Calaveras Consensus Group (ACCG) on resource conservation standards developed by the ACCG.

Subtask 1.2 Map Erosion- Sedimentation of the River and Tributaries Upstream of Pardee Reservoir

Office Mapping

Aerial photographs will be used as a tool to target areas of potential erosion-sedimentation.

Field Mapping

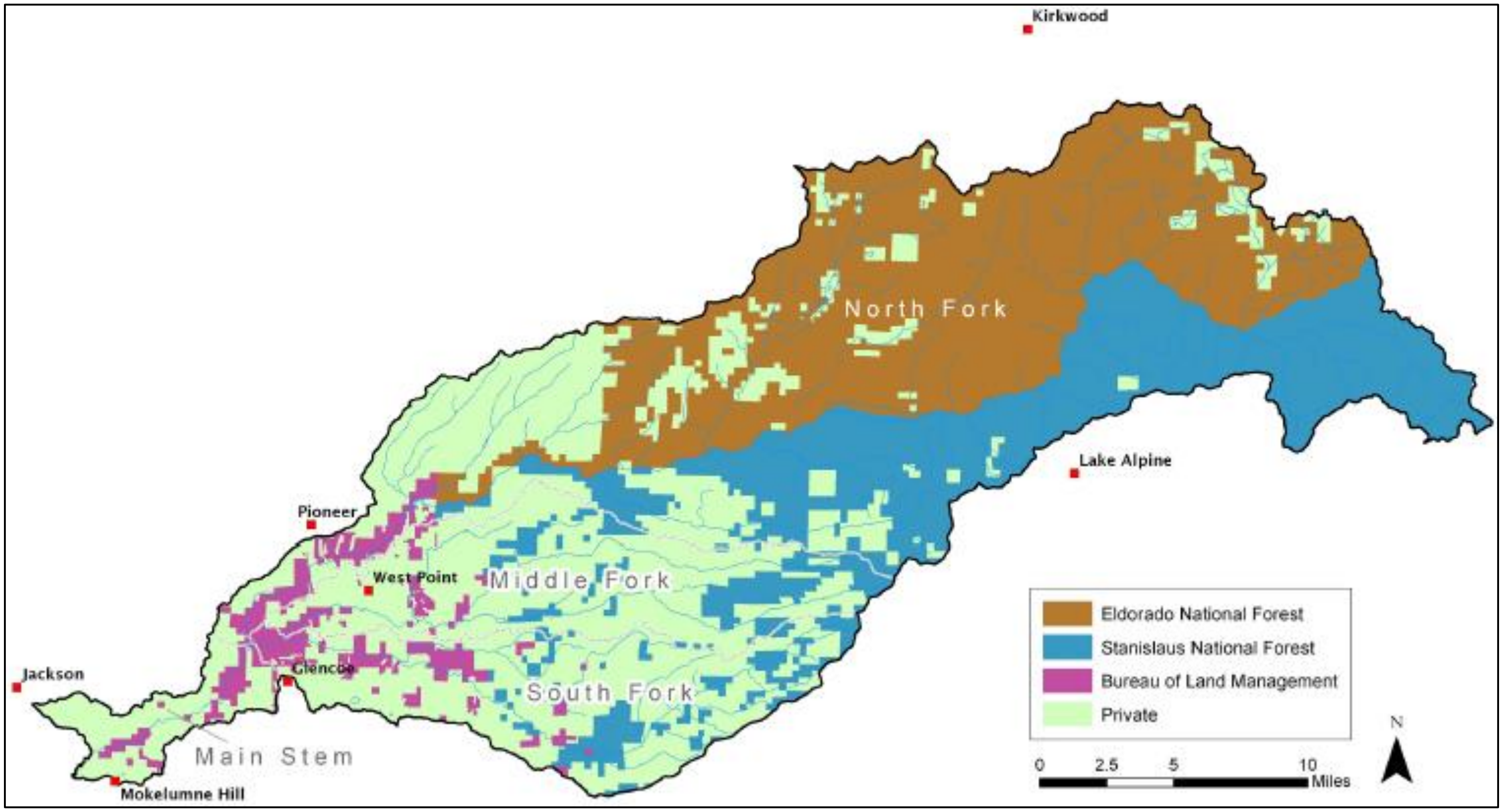
The first step in mapping is to acquire suitable aerial photographs and maps and to travel roads and trails and locate and record data on each erosion site that has or is delivering sediment to the River or tributaries using GPS data recorders. The data will be converted to GIS layers data to create maps and data characterizing the type of soil erosion-sedimentation with a key indicating a tentative method of rehabilitation.

The mapping data would be shared with the established stakeholder group to review the data, and discuss implications and opportunities for rehabilitation work.

Task 2. Prioritize Areas for Soil Erosion-Sedimentation Reduction

Upon completion of Task 1, areas for restoration will be prioritized in coordination with the stakeholder group. All lands within the Mokelumne watershed upstream of Pardee will be identified and assessed with the cooperation of land owners. It is anticipated that grants requested for project work following the completion of this project would only be used on public lands and easements for roads and trails. The status of "closed" roads or trails would not be changed. Factors to consider in setting priorities include past, current, and potential future erosion and sediment delivery to the Mokelumne or tributaries and landowner cooperation.

Figure 2: Major Land Ownership in the Upper Mokelumne River Watershed



Source: Upper Mokelumne River Watershed Assessment and Planning Project, 2007.

Subtask 2.1 Determine Prioritization Process

- Quantities of past, current, and future erosion-sedimentation into the river or tributaries
- Proximity to stream or river channel
- Anticipated restoration methods, including
  - Installing Rolling Dips
  - Rerouting or distributing concentrated drainage
  - Sediment trapping basins
  - Slope restoration
  - Pull back of unstable fill
  - Restoring eroding drainage channels
  - Erosion control with heavy rock or aggregate
- Feasibility, which may include but is not limited to the following considerations:
  - Ability to retain closed road/trail status
  - Site access for heavy equipment
  - Preliminary Assessment of Environmental Fatal Flaws
- Restoration costs
- Stakeholder comments

After discussing the various alternatives for prioritization, the stakeholder group will agree on a process.

Subtask 2.2 Prioritize Restoration Projects

This subtask involves applying the prioritization process determined in Subtask 2.1 to the list of sediment reduction projects. The prioritized list will be presented to the stakeholder group, who will discuss the prioritization and opportunities, and suggest adjustments as necessary.

This task will be further developed after the first phase is completed.

Task 3. Publish Results

This task involves packaging the inventory-monitoring results in a useable format for follow-up work and future monitoring and publishing for use by landowners and state and federal water quality control agencies.

Budget

The budget for this project is anticipated to be $200,000 for outreach, assessing, prioritizing, publishing results in a useable format, and seeking follow-up erosion-sedimentation work.

References

Upper Mokelumne River Watershed Assessment and Planning Project, December 2007, by Upper Mokelumne River Watershed Authority/RMC. Available: http://www.ccwd.org/pdf/pub/M-A-C/2007_umrwa_report.pdf

MokeWISE Program Scope of Work:
Project 2a: Municipal Recycled Wastewater Recharge Program

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Water suppliers are charged with the timely delivery and affordable supply of high quality surface water for our agricultural and municipal clients, and are committed to maintaining that responsibility for their consumers. Water agencies are also interested in protecting their water rights. Some agencies are not in favor of using recycled water for agriculture purposes due to concerns about quality, cost, and transmission of recycled water resources, for primary users as well as any possible secondary and tertiary effects experienced by anyone in the district as a result of using recycled water. However, these agencies understand and are respectful that other entities may not share this view towards recycled water and do not have an official position either in favor or in opposition to other entities that may be interested in the funding and building of particular infrastructure for recycled water, and including general exploration of opportunities to use recycled water.

Other water agencies are interested in developing cost effective recycled water projects as a way to improve water supply reliability for their customers. If recycled water development results in water that is excess to these agencies needs' and downstream needs, then that water could be made available by these agencies in exchange for equivalent financial or other benefit.

The environmental stakeholders in the MokeWISE process are interested in encouraging the recycling and reuse of water of every kind (graywater, process water, blackwater) when and where ever possible. Recycled water is the single largest source of additional water in California. In 2012, about 670,000 acre feet of treated wastewater was put to beneficial use in California, but this is still only a small part of the 5 million acre feet of treated wastewater produced annually in the state.

Recycled water provides a reliable and plentiful supply, and its use can enable the recharge of overdrawn aquifers and preserve the vitality of California's rivers and the Sacramento-San Joaquin Delta. State-of-the-art recycling facilities such as the Edward C. Little West Basin plant in Los Angeles currently produce recycled water types tailored to specific end uses. The state is preparing standards for potable reuse of recycled water. Santa Clara Valley's recently completed Advanced Water Purification Center expects to supply drinking water at some point.

Environmental stakeholders want to ensure that the potential role of recycled water as a present and future water source for the Mokelumne Watershed is not overlooked due to insufficient information or inaccurate assumptions. They would like to see a comprehensive survey of wastewater and graywater availability, and water end uses in the MokeWISE area, including the EBMUD service area, including what water qualities are needed for those purposes. The study would seek to match available sources of wastewater and treatment levels to potential users.

Other entities see that when municipal wastewater is recycled for irrigation and groundwater recharge, it broadens the spectrum of beneficial uses that the water serves. For instance, spreading ponds may also meet year-round and seasonal wildlife habitat needs for resident and migrating birds, and other wildlife. If the pond area has walking and bird watching trails for the public, it could meet recreational needs. Recycled water can also offset Mokelumne River supplies, which can be left in the river to perform in-stream functions or put towards other beneficial uses. Using recycled water for groundwater recharge conserves the natural resource that is the aquifer, while forgoing Mokelumne River water. The recycling project promotes economic benefits by avoiding the costs imposed upon others from alternative water supply projects, like additional dams. If the water recycling project hires local contractors, it can help to improve the economy in the district. The recycling project can help to avoid the divisiveness caused by water supply projects that are geographically inequitable. That is, projects that impose costs in one area (e.g. dams upcountry), while providing benefits to another area (San Joaquin County, Alameda County, etc.)

The Municipal Recycled Wastewater Recharge Program will investigate the potential for using treated, disinfected wastewater to recharge groundwater aquifers in the valley, either directly or indirectly through in-lieu use of the recycled water. This project includes a feasibility study and implementation of the recommendations outlined in the feasibility study. The feasibility study will include completing a groundwater flow analysis, determining the potential for direct recharge, and developing a recycled water demand analysis. This information will inform the development of project alternatives. The recommended project will be further developed through design work. Implementation will include permitting, site preparation, construction, and testing. Costs for this project are estimated to be $15.15 million, with $150,000 for the feasibility study and $15 million for implementation. Implementation costs could be significantly less is the project is completed in phases.

Background Information

Water Supply

The City of Lodi has three sources of water for both potable and non-potable uses: groundwater, recycled water, and surface water purchased from the Woodbridge Irrigation District (WID). As shown in **Table 1**, groundwater is the city's primary supply, comprising between 49 and 67 percent of total supplies.

Table 1: Water Supplies for the City of Lodi

Supply	2010 (AFY)	2015 (AFY)	2020 (AFY)	2025 (AFY)	2030 (AFY)	2035 (AFY)
Woodbridge Irrigation District (Surface Water)	0	6,000	6,000	6,000	6,000	6,000
Groundwater	15,005	15,000	15,000	15,000	15,000	15,000
Recycled Water	7,095	7,861	8,262	8,683	9,126	9,592
Total	**22,100**	**28,861**	**29,262**	**29,683**	**30,126**	**30,592**

Source: City of Lodi, 2011

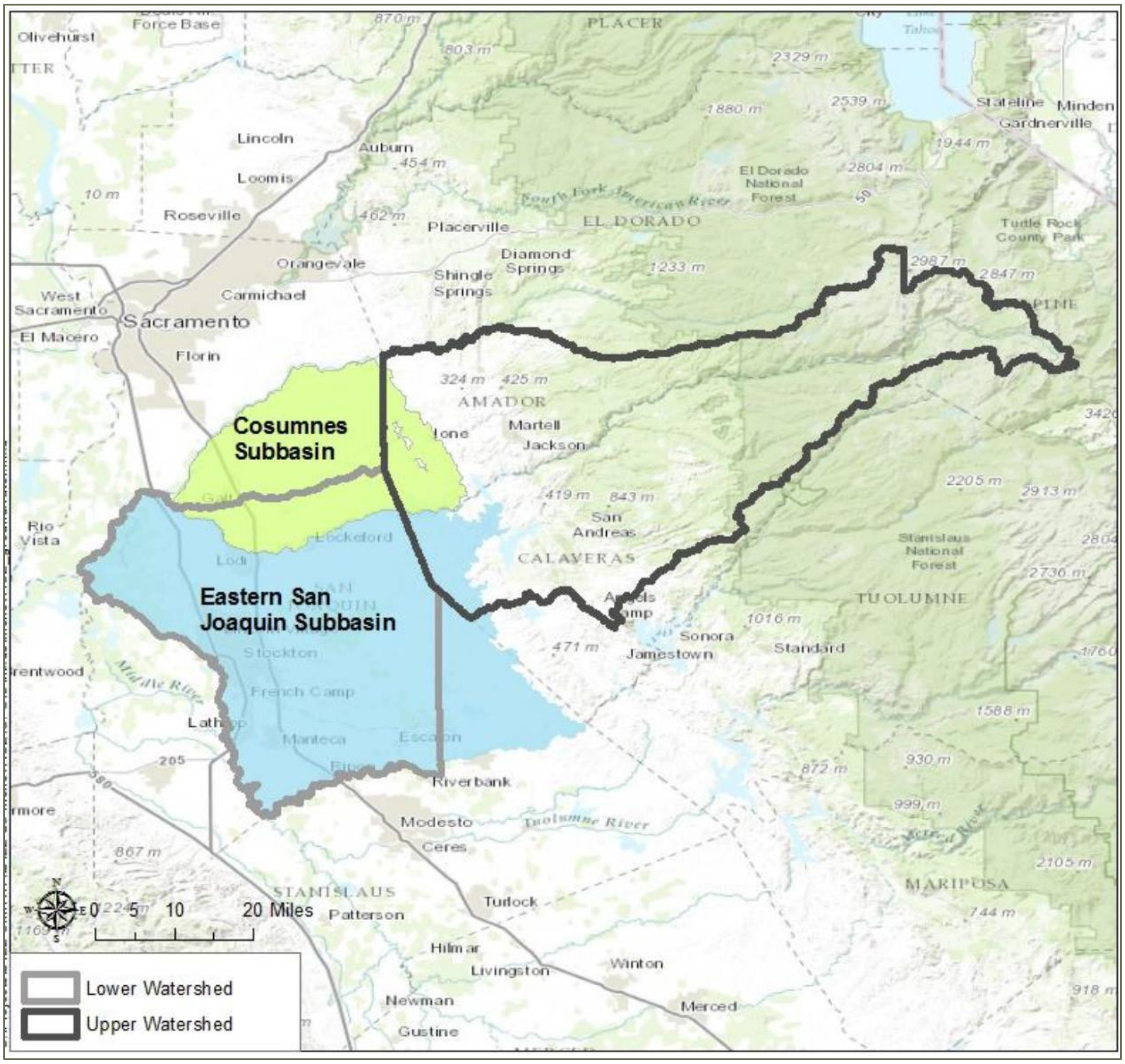
Surface Water

The City of Lodi currently purchases up to 6,000 acre-feet per year (AFY) surface water from WID, which is pumped from the Mokelumne River. The City treats this water at its new surface water treatment facility, which has a capacity of 10 million gallons per day (mgd), or 11,200 AFY (City of Lodi, 2011).

Groundwater

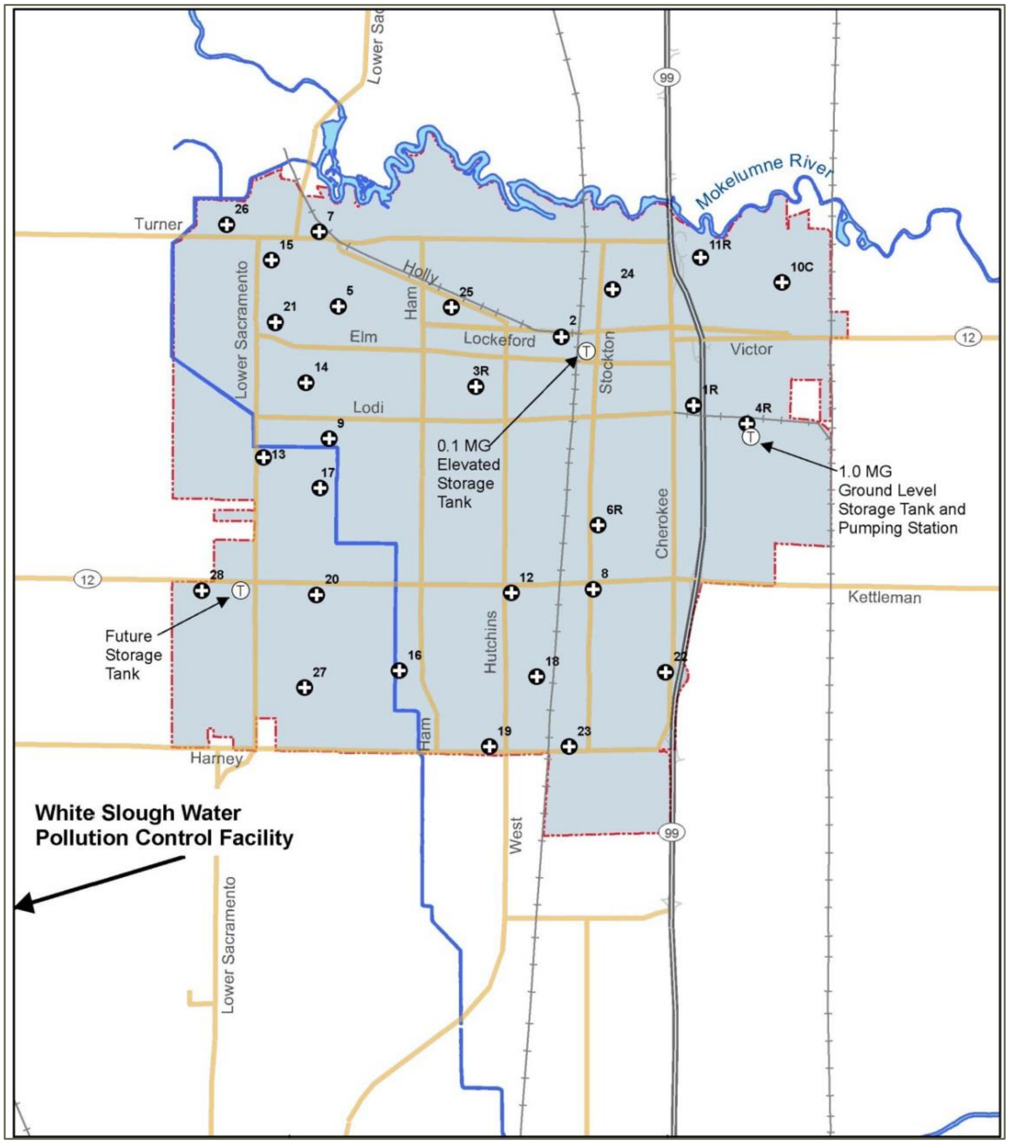
The City of Lodi overlies the Eastern San Joaquin Subbasin of the San Joaquin Valley Groundwater Basin (**Figure 1**). As shown in **Table 1**, groundwater is the primary water supply source for the city, which pumps approximately 15,000 AFY from 26 wells located throughout the city. Up until 2006, when the city entered into an agreement with WID, groundwater was the sole supply of potable water. The City has estimated a safe yield of the aquifer serving Lodi to be approximately 15,000 AFY, with projected pumping to remain within this limit (City of Lodi, 2011). **Figure 2** shows the location of the City's groundwater wells.

Figure 1: Groundwater Basins in the MokeWISE Region



Source: RMC, 2015

Figure 2: Groundwater Wells in the City of Lodi



Source: City of Lodi, 2011

Recycled Water

Wastewater is treated at the City of Lodi's existing White Slough Water Pollution Control Facility (WSWPCF), which currently treats all wastewater to tertiary standards. The WSWPCF currently treats a total of 7,100 AFY wastewater, of which 1,642 AFY is used to meet non-potable demands nearby. The remaining 5,458 AFY is discharged to Dredger Cut, which flows into the Delta. Total capacity of the WSWPCF is 9,592 AFY, with projected recycled water demands of 2,842 AFY for the City (current agricultural use and use at the NCPA power plant).

An additional 3,700 AFY recycled water may be used for an agricultural reuse project included in the City's 2008 Reclaimed Water Master Plan, leaving a potential 3,050 AFY of recycled water available for groundwater recharge or in-lieu use in the long-term (RMC 2015). At present, assuming the 3,700 AFY recycled water project is implemented, 1,758 AFY is available for other recycled water projects. Although the WSWPCF and surrounding lands are part of the City of Lodi, they are located approximately 4 miles west-southwest of the urbanized area of the city.

Recharge

Groundwater recharge through this project would be achieved using either direct recharge or in-lieu groundwater recharge. Direct recharge uses methods frequent referred to as "artificial recharge" because it moves water that would otherwise be elsewhere directly to the groundwater basin. Indirect recharge involves using other supply sources, such as recycled water, in lieu of pumping groundwater, reducing outflow from the basin.

Spreading Basins

Spreading basins hold water over a permeable surface, allowing it to percolate naturally into the aquifer below.

Injection Wells

Injection wells, also called aquifer recharge wells or aquifer storage and recovery (ASR) wells, are active means of moving water into the aquifer. An aquifer recharge well injects water into the aquifer, while an ASR well both injects water into the aquifer and extracts water. Use of an injection well enables artificial aquifer recharge even in areas with impermeable geologic features, or where the use of spreading basins is impractical (USEPA 1999).

In-Lieu

In-lieu groundwater recharge is a passive form of recharge. It occurs when groundwater extraction is reduced, which can be achieved by offsetting groundwater demand with alternate supplies, such as surface water or recycled water. By reducing groundwater pumping, natural inflows to the groundwater basin will recharge the aquifer.

Project Information

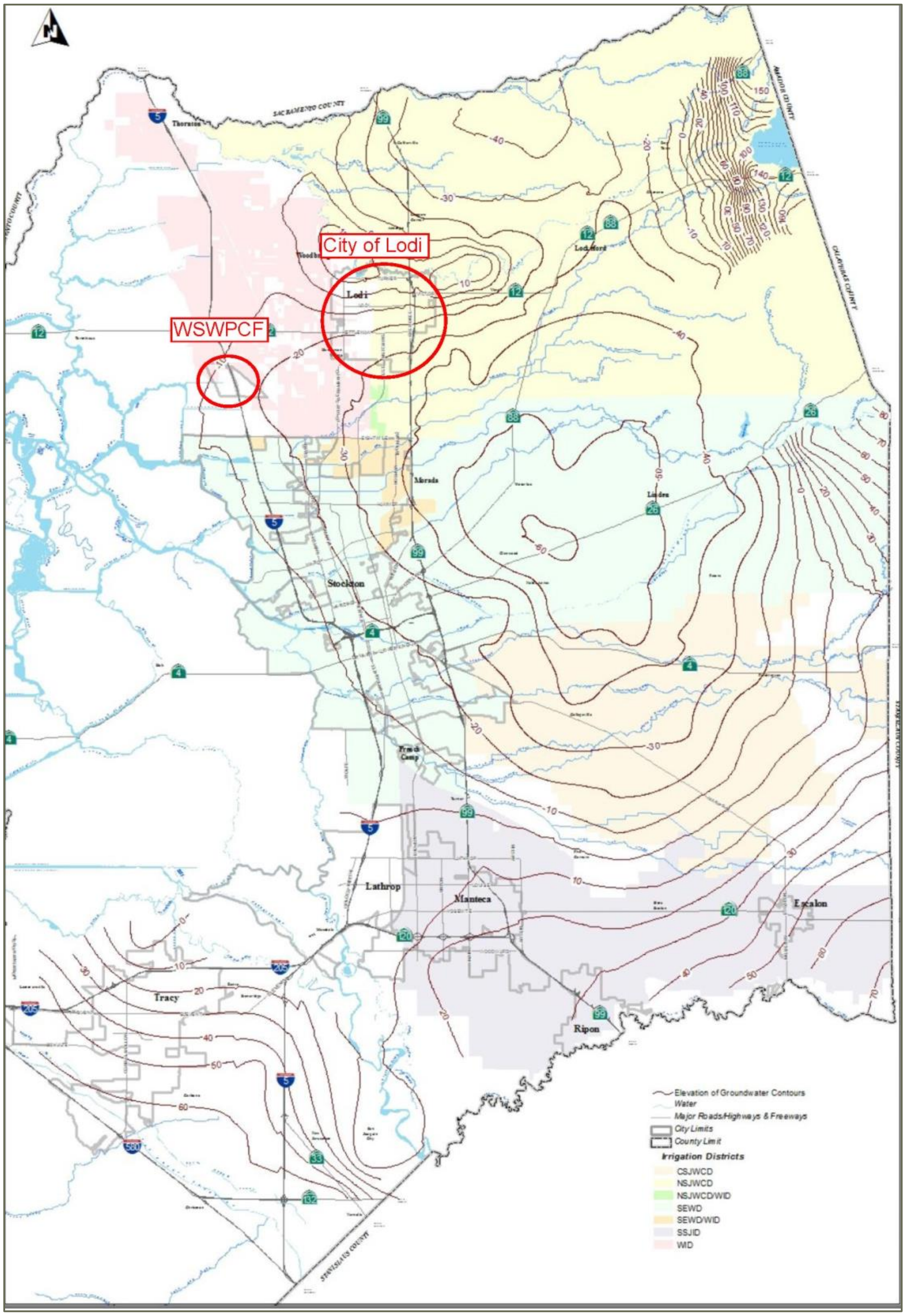
Project Description

The Municipal Recycled Wastewater Recharge Program will investigate the potential for using treated, disinfected wastewater to recharge groundwater aquifers in the valley, either directly or indirectly through in-lieu use of the recycled water. This project includes two components: 1) a feasibility study, and 2) implementation of feasibility study recommendations.

Project Location

The *Municipal Recycled Wastewater Recharge Program* would be located within the city of Lodi, with water recycling provided by the existing Lodi White Slough Water Pollution Control Facility, which currently treats to tertiary. Figure 1 shows the location of the proposed project, while **Figure 3** shows the location of the WSWPCF in relation to the City of Lodi.

Figure 3: Project Location



Source: RMC, 2015

Project Sponsor

City of Lodi is the project sponsor for the *Municipal Recycled Wastewater Recharge Program*. To-date, no additional project sponsors have been identified. Potential project partners include North San Joaquin Water Conservation District (NSJWCD) or Woodbridge Irrigation District (WID).

Scope of Work

Task 1. Develop Feasibility Study

A Feasibility Study will be developed to consider the potential for recycled water use to either direct groundwater recharge or indirect recharge through in-lieu use, in which recycled water offsets groundwater pumping, allowing for natural recharge of the groundwater basin to occur.

Task 1.1 Complete Groundwater Flow Analysis

A thorough understanding of the groundwater basin is required to determine the potential for groundwater recharge as a supply option. This analysis would identify and evaluate the inflows and outflows of the basin, both natural and engineered. The purpose of this analysis will be to provide the basis for developing potential project alternatives and determining the feasibility of direct recharge versus indirect recharge.

Task 1.2 Determine Potential for Direct Recharge

This task will assess the feasibility of implementing direct recharge. Direct recharge can be achieved through percolation, such as with the use of spreading ponds, or injection, in which recycled water is injected into the groundwater basin via injection wells. This task will evaluate the potential for each of these methods, based on the suitability for each method of the local geologic formations. Areas suitable for both of these methods, if applicable, will be identified, and further refined under Task 1.4 Develop Project Alternatives.

Task 1.3 Develop Recycled Water Demand Analysis

This task will assess alternatives for implementing in-lieu recharge. With this method, groundwater pumping is reduced and groundwater is recharged naturally because of the associated offset of demand for groundwater. For the City of Lodi, this could be achieved by increasing recycled water use within its service area. The City currently provides recycled water for users in the immediate vicinity of the WSWPCF, but does not have a recycled water distribution system in place for the urbanized area of the City.

This task will identify potential recycled water customers within the City and evaluate their demand. Due to the distance between the WSWPCF and the urban center of the City of Lodi, this task will also identify potential recycled water demands within the WID and NSJWCD service areas that could potentially be served by the project.

Task 1.4 Stakeholder Coordination

Potential recycled water project opportunities will be discussed with local stakeholders prior to making any implementation decisions. Concerns regarding the use of recycled water for agricultural irrigation in the region must be addressed with the potentially impacted parties in order to make beneficial decisions for all stakeholders involved. This task will include coordination with local stakeholders and potential major users to address concerns that exist or may arise as projects opportunities are explored.

Task 1.5 Develop Project Alternatives

The potential for direct recharge and in-lieu recharge will be used to develop project alternatives for both methods. For direct recharge, injection well and spreading pond sites will be identified, using the geologically-appropriate areas identified in Task 1.2, along with land uses (e.g., spreading ponds would not be located on a lot that currently houses an office building). Direct recharge alternatives shall attempt to locate recharge sites such that they maximize the benefits received by the City. Should recharge sites be best suited downgradient of groundwater wells, the feasibility analysis will consider the potential for water trading with nearby agencies that could benefit from this recharge. For in-lieu groundwater use, project alternatives will include grouping potential recycled water users to maximize demands while minimizing costs. Due to the distance between the WSWPCF and the urbanized areas of the city, the primary cost driver is anticipated to be the length of pipeline necessary to extend service to the users.

Project alternatives will also include preliminary identification of recycled water pipeline routes and sizes to serve each alternative, and consider the potential for connecting to existing recycled water distribution systems that may be owned by neighboring agencies.

Task 1.6 Conduct Cultural Resources Analysis

A cultural resources analysis will be performed to identify areas of high sensitivity that may be affected by construction of any required project element. Existing data records and information will be reviewed and both federally recognized and currently unrecognized Native American tribes within the region will be consulted.

The results of previous cultural resource studies and recorded cultural resources in the records search area will be plotted on 7.5-minute topographic quadrangles. Based on this analysis, an assessment will be prepared to address the sensitivity of the project elements with respect to cultural resources.

Task 1.7 Develop Recommended Project

The Feasibility Study will recommend a preferred project based on criteria such as potential demand served, potential recharge volume, costs, ease of implementation (e.g., level of difficulty to obtain applicable regulatory approval), the need for agreements with other entities, and potential for acquiring outside funding (e.g., grants and low-interest loans). The preferred alternative should aim to maximize the use of available recycled water, or up to 1,700 AFY in the near-term, and up to 3,050 AFY in the long-term. Once a preferred project is identified, the Feasibility Study will develop a more detailed project description, including a refined preliminary pipeline alignment, identification of the estimated facilities required for the preferred projects, and a more refined list of potential customers, should in-lieu recharge be the preferred project. Potential funding sources for the Recommended Project should also be identified.

Task 2. Implementation of Recommended Project

The Feasibility Study completed under Task 1 will form the basis for the implementation project to be completed under Task 2.

Task 2.1 Design

If direct groundwater recharge is selected under the Recommended Project in the Feasibility Study (Task 1), the primary design components would be the recharge site (spreading basins or injection wells), and the conveyance pipeline from the WSWPCF to the recharge area. Depending on the location of the recharge area, pump stations may also be required, along with any additional appurtenances necessary to convey the recycled water to the recharge area. An injection well generally includes the following components (USEPA, 1999):

- Well casing
- Well screen
- Sand/gravel (filter) pack around the screen
- Grout/cement around the casing
- Pump

If in-lieu groundwater recharge is selected as the Recommended Project, primary design components would include conveyance pipelines, and any necessary pump stations or appurtenances to convey recycled water to potential users. During this task, recycled water user agreements should be finalized.

Task 2.2 Environmental Documentation

Upon completion of design, environmental documentation must be completed for the project. It is anticipated that this project would need to undergo analysis under CEQA and NEPA given that federal permitting or funding would likely be part of the project. Should federal funding, and not federal permitting, be part of the project, CEQA-Plus analysis should be sufficient. Given the size of this project, the potential for substantial pipeline construction, and reduction of flows to Dredger Cut (and subsequently the Delta), it is likely that an Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) would be required.

Task 2.3 Construction

Construction of the Project can be divided into the following subtasks:

- Subtask 2.3.1 Permitting
- Subtask 2.3.2 Site Preparation
- Subtask 2.3.3 Construction
- Subtask 2.3.4 Testing

Subtask 2.3.1 Permitting

Permits would be required for the Recommended Project from a variety of entities for construction, water reuse, and changes to discharges. Potential permits that may be necessary for the project are listed in **Table 2.** This list is a preliminary list and should not be considered exhaustive. Formal agreements should be obtained under this subtask should the Recommended Project identify a need for any. Additional permits or agreements should be identified in the Feasibility Study completed under Task 1.

Table 2: Potential Permits for Recommended Project

Agency	Permit
Regional Water Quality Control Board	Waste Discharge Requirements NPDES Permit Recycled Water Master Permit
California Department of Water Resources	Well Drilling
California Department of Public Health	Water Supply Permit
City of Lodi	Conditional Use Construction Permit Encroachment Permit Tree Removal Permit
Local Municipalities and San Joaquin County	Conditional Use Construction Permit Encroachment Permit Tree Removal Permit

Subtask 2.3.2 Site Preparation

Site preparation activities include setting up staging areas, assembling materials and equipment, and clearing ground for construction activities.

Subtask 2.3.3 Construction

Construction activities for any Recommended Project would include excavation for pipelines, pump stations and other conveyance appurtenances. If spreading ponds are included in the Recommended Project, additional excavation would be required at the spreading pond site. Construction of the spreading ponds would require appropriate reinforcement and installation of materials and equipment as required by the design and any applicable regulations and permits. Construction of injection wells would involve drilling the well(s), installing the well(s), and any other equipment necessary for well operation. Should the Recommended Project be in-lieu groundwater recharge from the conversion of non-potable uses from groundwater/potable water to recycled water, construction would primarily involve the conveyance pipelines and any necessary pump stations. It is assumed that pipelines would be constructed within roadway right-of-ways to the extent feasible, and that any disturbance from excavation activities would be restored to before-project conditions following installation of the pipeline.

Subtask 2.3.4 Testing

Prior to delivery of recycled water to customers or direct groundwater recharge activities, all facilities and project components will be tested. Following completion of successful testing and demobilization of equipment and construction sites, construction would be complete and recycled water deliveries or groundwater recharge could commence.

Budget

The estimated budget for the project is $15.15 million. Costs associated with the project are as follows:

- Feasibility Study: $150,000
    - These costs are based on the costs for similar Feasibility Studies, and on the total amount of water that could be used by the project.
- Implementation: $15,000,000
    - Implementation costs could be significantly less if the project is completed in phases.
- **Total Project Costs: $15,150,000**

These costs are based on the costs for similar Feasibility Studies, and on the total amount of water that could be used by the project. It was assumed that implementation costs would average $10,000 per AFY, although these costs could vary depending on the groundwater recharge method selected, size of the final project, pipeline length, location, and any special considerations. Costs for implementation will be developed and refined under Task 1 Feasibility Study.

References

City of Lodi. 2011. 2010 Urban Water Management Plan. August. Available at: http://www.water.ca.gov/urbanwatermanagement/2010uwmps/Lodi,%20City%20of/Lodi%202010%20UWMP_Complete.pdf

RMC Water and Environment (RMC). 2015. MokeWISE Program Final Memorandum: Water Availability Analysis. January 9. Available at: http://mokewise.org/documents

United States Environmental Protection Agency (USEPA). 1999. The Class V Underground Injection Control Study. Volume 21. Aquifer Recharge and Aquifer Storage and Recovery Wells. September.

MokeWISE Program Scope of Work:
Project 2b: Woodbridge Winery Wastewater Reuse

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Water agencies are charged with the timely delivery and affordable supply of high quality surface water for their customers and are committed to maintaining that responsibility. Some water agencies are not in favor of using recycled water for agricultural purposes due to concerns about quality, cost, and transmission of recycled water resources, for primary users as well as any possible secondary and tertiary effects experienced by anyone in the district as a result of using recycled water. These agencies understand and are respectful that other entities may not share this view towards recycled water and do not have an official position either in favor or in opposition to other entities that may be interested in the funding and building of particular infrastructure for recycled water, and including general exploration of opportunities to use recycled water.

The environmental stakeholders in the MokeWISE process are interested in encouraging the recycling and reuse of water of every kind (graywater, process water, blackwater) when and where ever possible. Recycled water is the single largest source of additional water in California. In 2012, about 670,000 acre feet of treated wastewater was put to beneficial use in California, but this is still only a small part of the 5 million acre feet of treated wastewater produced annually in the state.

Recycled water provides a reliable and plentiful supply, and its use can enable the recharge of overdrawn aquifers and preserve the vitality of California's rivers and the Sacramento-San Joaquin Delta. State-of-the-art recycling facilities such as the Edward C. Little West Basin plant in Los Angeles currently produce recycled water types tailored to specific end uses. The state is preparing standards for potable reuse of recycled water. Santa Clara Valley's recently completed Advanced Water Purification Center expects to supply drinking water at some point.

Environmental stakeholders want to ensure that the potential role of recycled water as a present and future water source for the Mokelumne Watershed is not overlooked due to insufficient information or inaccurate assumptions. They would like to see a comprehensive survey of wastewater and graywater availability, and water end uses in the MokeWISE area, including the EBMUD service area, including what water qualities are needed for those purposes. The study would seek to match available sources of wastewater and treatment levels to potential users.

Specifically, environmental stakeholders are interested in how this project would impact Mokelumne flows in all year types. The Woodbridge Winery currently produces 300 AFY of wastewater, which must be blended with 100 AFY of Mokelumne river water to reduce dissolved salts before it is reused or discharged. At present Woodbridge uses its senior riparian rights on the Mokelumne as the source of the blending water. The project proposes to increase the amount of blended water from 400 AFY up to 4000 AFY in wet years, and to a range of 1000 AFY to 2000 AFY in dry years. This blended water would be made available to other nearby wineries. In wet years, the blending water would come from NSJWCD's junior water rights on the Mokelumne, and would require up to 1000 AFY of Mokelumne water. In dry years, the blending water would come from Woodbridge's senior water rights, and would require from 250 to 500 AFY of Mokelumne water. The environmental stakeholders are particularly concerned with the potential increase in use of Mokelumne water in dry years, and are additionally concerned that the Mokelumne water may be used inappropriately in dry years, when flows on the river are already critically low, to irrigate land not covered by Woodbridge Winery's riparian rights.

Other entities see that when municipal wastewater is recycled for irrigation and groundwater recharge, it broadens the spectrum of beneficial uses that the water serves. For instance, spreading ponds may also meet year-round and seasonal wildlife habitat needs for resident and migrating birds, and other wildlife. If the pond area has walking and bird watching trails for the public, it could meet recreational needs. Recycled water can also offset Mokelumne River supplies, which can be left in the river to perform in-stream functions or put towards other beneficial uses. Using recycled water for groundwater recharge conserves the natural resource that is the aquifer, while forgoing Mokelumne River water. The recycling project promotes economic benefits by avoiding the costs imposed upon others from alternative water supply projects, like additional dams. If the water recycling project hires local contractors, it can help to improve the economy in the district. The recycling project can help to avoid the divisiveness caused by water supply projects that are geographically inequitable. That is, projects that impose costs in one area (e.g. dams upcountry), while providing benefits to another area (San Joaquin County, Alameda County, etc.)

The Woodbridge Winery Wastewater Reuse Project will expand the distribution of treated wastewater from Woodbridge Winery to the NSJWCD’s distribution system for use by other entities within NSJWCD’s service area. Implementing this project would require connecting the NSJWCD’s non-potable water conveyance system to Woodbridge Winery’s treated wastewater system, and connecting the NSJWCD’s 4th diversion point from the Mokelumne River this joint conveyance system for blending. The project would include developing a conceptual design report that would include an assessment of feasibility. Pending feasibility, final design and environmental documentation will be conducted and necessary permits will be secured. Implementation will include site preparation, construction, testing. Costs for this project are estimated to be $16.16 million, with $35,000 for the conceptual design report, $100,000 for securing the Waste Discharge Report permit, $25,000 for securing funding, and $16 million for construction. Construction costs could vary greatly depending on the alternative selected.

Background Information

Woodbridge Winery, owned by Constellation Wines US, Inc., is located along the northern bank of Mokelumne River in San Joaquin County, northwest of the City of Lodi. The winery has riparian water rights to the Mokelumne River and uses groundwater for winery processes.

Water Use

Woodbridge Winery is one of many wineries in San Joaquin County, and uses a combination of groundwater, treated wastewater, and raw water from the Mokelumne River for irrigation of approximately 55 acres of grapes. One acre of grapes requires approximately 1.5 AFY for irrigation, or 82.5 AFY for Woodbridge Winery's total acreage of grapes. Additional water use occurs for cleaning of equipment and winemaking processes. Water that is not consumed in these processes become wastewater. For Woodbridge Winery, this amounts to approximately 300 AFY of non-domestic wastewater.

Many of the wineries in the region use a combination of water supply sources, including groundwater, surface water, and irrigation water supplied by the North San Joaquin Water Conservation District (NSJWCD), which also serves other agricultural users. Groundwater is an important water supply, and is the primary supply source for many of the communities in the area. The high quality of the groundwater makes it a valuable municipal supply. The region is seeking to reduce groundwater pumping for agricultural irrigation to help conserve groundwater for municipal and other water supplies, as recycled and reused water is generally acceptable for irrigation purposes, provided salinity is controlled.

Wastewater

Woodbridge Winery owns and operates a wastewater collection and treatment system on-site that is able to accommodate a peak flow of 1.5 mgd during crushing season. The treatment system include solids screening and removal; equalization tanks; Mobilized Film Technology (MFT) that includes preconditioning; MFT bioreactors that include biogas processing with energy capture, and Dissolved Air Flotation (DAF); three 3.3 mg aeration ponds (Upper Ponds); and Lower Ponds. Solids removed from the treatment system are hauled and either landfilled or processed for reuse off-site. The Lower Ponds primarily serve as stormwater detention facilities, and are subject to inundation from the Mokelumne River during flood events (Regional Board, 2012).

Wastewater flows peak in August through October, during the crush period, and are approximately twice the average flow rate for the rest of the year. Stormwater from a portion of the winery is also collected via the wastewater system due to the open nature of the facilities, though excessive stormwater generally results in diversion to the Lower Ponds, bypassing much of the treatment system. Treated wastewater is discharged to on-site Land Application Areas (Regional Board, 2012).

Domestic wastewater (e.g., sewage) is collected in a separate system and discharged to a septic system. This waste stream is not reused (Regional Board, 2012).

Water Quality

Treated wastewater is generally high in salts, as shown in **Table 1**, which summarizes treated wastewater effluent quality from 2010.

Table 1: Treated Wastewater Effluent Quality (2010)

	Annual Mean Result (mg/L)								
	BOD	**Sulfate**	**NO3 as N**	**TKN**	**TN**	**TDS**	**VDS**	**FDS**	pH
2010 Annual Average	53	13	36	4	40	1,580	574	1,006	8.8

Source: Regional Board 2012

Notes: BOD = Biological Oxygen Demand; NO3 as N = Nitrate as Nitrogen; TKN = Total Kjehldhal Nitrogen; TN = Total Nitrogen; TDS = Total Dissolved Solids; VDS = Volatile Dissolved Solids; FDS = Fixed Dissolved Solids

The salt of greatest concern is potassium, although salinity controls are implemented to reduce these during the treatment process. According to the Woodbridge Winery's Waste Discharge Permit, FDS levels must be 775 mg/L or lower for application to crops (Regional Board, 2012).

Wastewater Reuse

Treated wastewater is disposed of via land application areas on-site at the winery. Dispersal methods include flood irrigation (currently used on the vineyards) and sprinkler irrigation (used on cropped land). Due to the high levels of FDS, treated wastewater must be blended with raw water to dilute salts prior to use for irrigation. Woodbridge Winery treats approximately 300 AFY of wastewater, which is blended with approximately 100 AFY of raw water from the Mokelumne River.

Project Information

Project Description

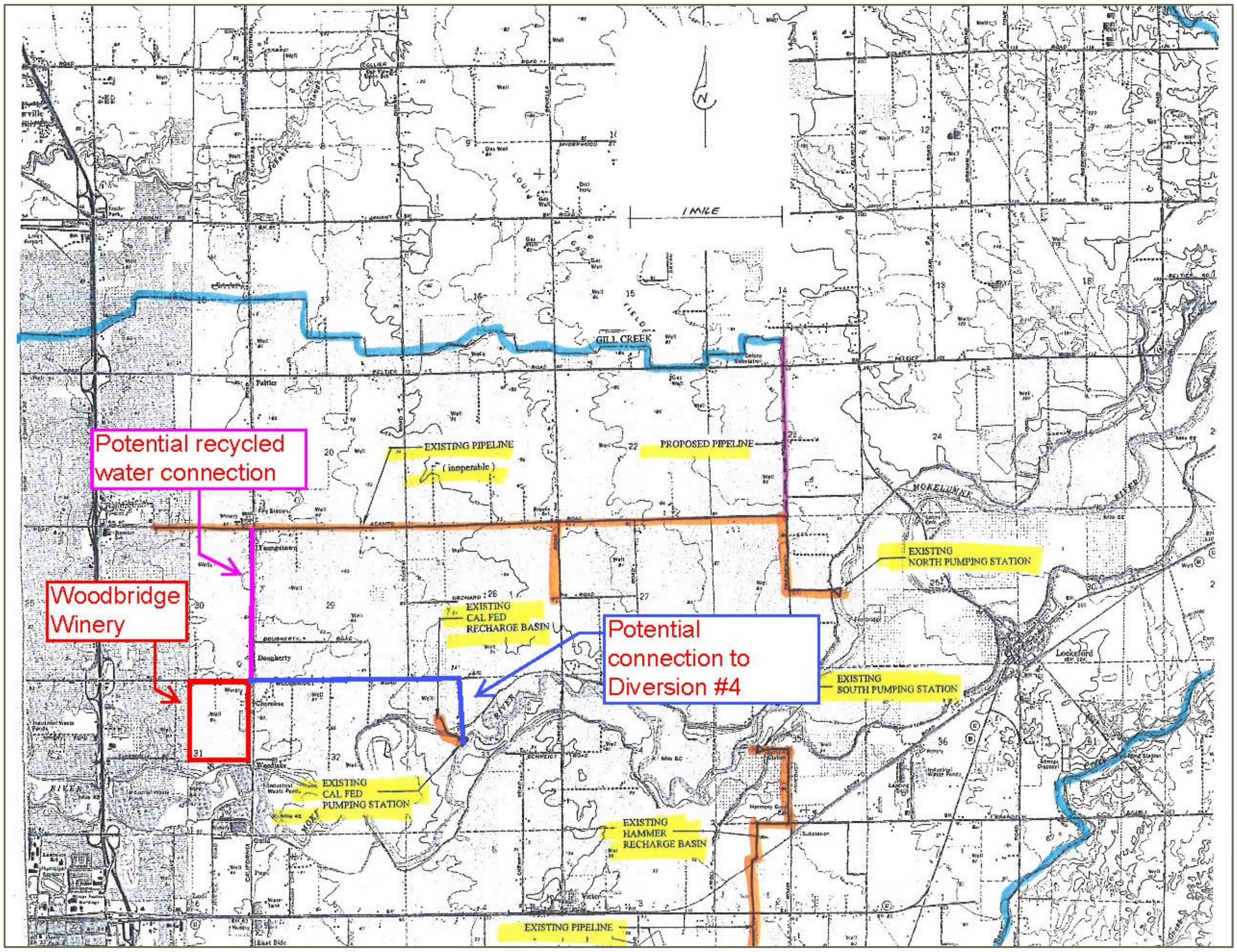
The Woodbridge Winery Wastewater Reuse Project (Project) proposes to expand the distribution of treated wastewater from Woodbridge Winery to the NSJWCD's distribution system for use by other wineries within NSJWCD's service area. To address the salinity of the treated wastewater, blending would continue to be necessary. During dry years, blending would be accomplished using Woodbridge Winery's senior riparian water rights and groundwater, as is the current practice. During normal and wet years, blending would utilize NSJWCD's junior water rights to the Mokelumne River. The maximum amount of water would be diverted during normal and wet years, to increase the availability of non-potable water for irrigation. During normal and wet years, wineries receiving this water would be encouraged to intentionally over-irrigate their crops, which would provide groundwater recharge. Implementing this project would require connecting the NSJWCD's non-potable water conveyance system to Woodbridge Winery's treated wastewater system, and connecting the NSJWCD's 4th diversion point from the Mokelumne River this joint conveyance system for blending.

It is anticipated that between 2,000 and 4,000 AFY of blended water would be available during wet years, with approximately half used by crops and half anticipated to recharge to the groundwater basin. Approximately half this amount would be available during dry years, all of which would be used for irrigation. For all years, this Project would reduce groundwater pumping in the area, thereby helping to protect groundwater levels.

Project Location

The Woodbridge Winery Wastewater Reuse Project would be located at the Woodbridge Winery, in Acampo, and within the North San Joaquin Water Conservation District (NSJWCD) service area. **Figure 1** indicates the general location of the Project.

Figure 1: Proposed Project



Source: NSJWCD, n.d.

Project Sponsor

Woodbridge Winery is the project sponsor for the *Woodbridge Winery Wastewater Reuse Project*, in partnership with North San Joaquin Water Conservation District (NSJWCD) and North Eastern San Joaquin County Groundwater Basin Authority (GBA).

Scope of Work

Implementing this Project would require design, permitting, funding, and construction, along with approvals from the governing bodies of the three project partners.

Task 1. Conceptual Design Report

A Conceptual Design Report would be developed to identify the preliminary project components and refine the project sufficiently to acquire appropriate approvals and outside funding. The Conceptual Design task will include:

1) A feasibility study that will identify potential wastewater reuse projects for the winery and recommend a project;

2) A conceptual design and cost estimate for the recommended project.

These two deliverables combined make up the "Conceptual Design Report" to be developed under this task. The Conceptual Design Report should include a conceptual layout of facilities, estimate of potential water yields, cost estimates, benefit analysis, identification of potential hurdles, schedule, environmental impacts, and permit requirements. The Conceptual Design Report should be detailed enough to provide the basis for applying for funding opportunities.

Should blending occur at the Woodbridge Winery site, both the intake pipeline and the conveyance pipeline would need to connect to the winery. It is estimated that connecting the Woodbridge Winery to NSJWCD's existing Diversion #4 would require approximately 1.5 miles of pipeline, and connecting Woodbridge Winery to the existing NSJWCD's pipelines would require an additional 1 mile pipeline, assuming the blended water would connect to the nearest NSJWCD pipeline at Acampo Rd. and Kennefick Rd. The Conceptual Design Report will assess the feasibility of using the NSJWCD's Acampo Rd. pipeline, as it may be inoperable. Should blending occur at a different location, or the Acampo Rd. pipeline is inoperable, pipelines may need to be longer that assumed in this scope.

Task 2. Funding

Project Partners will seek outside funding wherever possible to fund implementation of the Project. Such funding sources could include State Revolving Fund grants and loans, Integrated Regional Water Management (IRWM) grants, or other grant and loan opportunities. Generally, these funds require preliminary design, sometimes require completion of environmental documentation (see Task 3), and feasibility and/or facilities plans. This task would include preparation of materials to support applications for identified funding opportunities. To the extent practicable, these efforts should be completed by NSJWCD, GBA, and/or the MokeWISE group. The target funding opportunity for this effort will be a California Department of Water Resources IRWM grant, although other opportunities would also be pursued.

Task 3. Final Design

Upon completion of the Conceptual Design Report, approval from appropriate governing bodies, and securing funding, final design will be completed, building on the work completed under Task 1.

Task 4. Environmental Documentation

Upon completion of design, environmental documentation must be completed for the project. It is anticipated that this project would need to undergo analysis under CEQA. Should federal permitting or funding be necessary or pursued by this Project, environmental documentation should be consistent with both CEQA and NEPA.

Task 5. Permitting

Project permits would be required from a variety of entities for construction, water reuse, and potentially changes to diversions. Potential permits that may be necessary for the project are listed in **Table 2**. This list is a preliminary list and should not be considered exhaustive. Formal agreements should be obtained under this subtask should the Recommended Project identify a need for any. Additional permits or agreements should be identified during design of the Project.

Table 2: Potential Permits for Recommended Project

Agency	Permit
Regional Water Quality Control Board	Waste Discharge Requirements NPDES Permit Recycled Water Master Permit
Local Municipalities and San Joaquin County	Conditional Use Construction Permit Encroachment Permit Tree Removal Permit

Task 6. Construction

Construction of the Project can be divided into the following subtasks:

- Subtask 6.1 Site Preparation
- Subtask 6.2 Construction
- Subtask 6.3 Testing

Subtask 6.1 Site Preparation

Site preparation activities include setting up staging areas, assembling materials and equipment, and clearing ground for construction activities. This subtask should also include an assessment of the Acampo Rd. pipeline, if it is selected for the Project and if it is inoperable prior to the project.

Subtask 6.2 Construction

Construction activities for the Project would include excavation for pipelines, pump stations and other conveyance appurtenances. Additional construction could be required for the blending facility (e.g., mixing tank). Should NSJWCD's Acampo Rd. pipeline be the chosen conveyance route, and be inoperable prior to implementation of the Project, construction activities could include rehabilitation of the pipeline, such as lining, cleaning, or replacing sections. It is assumed that pipelines would be constructed within roadway right-of-ways to the extent feasible, and that any disturbance from excavation activities would be restored to before-project conditions following installation of the pipeline. It is assumed that potential users of the water created by the Project are existing NSJWCD customers, and no additional connections are necessary.

Subtask 6.3 Testing

Prior to delivery of blended treated wastewater to NSJWCD customers, all facilities and project components will be tested. Following completion of successful testing and demobilization of equipment and construction sites, construction would be complete and blended, treated wastewater deliveries could commence.

Budget

The budget for this project is estimated to be $16.16 million, but could vary substantially depending on the construction needs of the project (e.g., pipeline lengths, size of mixing facility), or any other considerations. Costs for implementation will be developed and refined under Task 1 Conceptual Design Report. Costs associated with the project can be broken down as follows:

- Conceptual Design Report: $35,000
- WDR Permit: $100,000
- IRWM Funding Application: $25,000
- Construction/Implementation: $16,000,000
    - Assumes reuse for vineyard irrigation, which includes 25,500 linear feet of pipeline, a pump station, contractor costs, professional services, and a 25% construction contingency.
- **<u>Total Project Cost: $16,160,000</u>**

References

North San Joaquin Water Conservation District (NSJWCD). No date (n.d.). Maps. Accessed 26 February 2015. Available: http://www.nsjgroundwater.org/MAPS-Reduced.pdf

Regional Water Quality Control Board (Regional Board). 2012. Waste Discharge Requirements Constellation Brands U.S. Operations, Inc. dba Woodbridge Winery, Woodbridge Winery, San Joaquin County (Order No. R5-2012-0103).

MokeWISE Program Scope of Work:
Project 2c: Amador County Reuse

April 2015

Problem Statement and MokeWISE Stakeholder Interests

The environmental stakeholders in the MokeWISE process are interested in encouraging the recycling and reuse of water of every kind (graywater, process water, blackwater) when and where ever possible. Recycled water is the single largest source of additional water in California. In 2012, about 670,000 acre feet of treated wastewater was put to beneficial use in California, but this is still only a small part of the 5 million acre feet of treated wastewater produced annually in the state.

Recycled water provides a reliable and plentiful supply, and its use can enable the recharge of overdrawn aquifers and preserve the vitality of California's rivers and the Sacramento-San Joaquin Delta. State-of-the-art recycling facilities such as the Edward C. Little West Basin plant in Los Angeles currently produce recycled water types tailored to specific end uses. The state is preparing standards for potable reuse of recycled water. Santa Clara Valley's recently completed Advanced Water Purification Center expects to supply drinking water at some point.

Environmental stakeholders want to ensure that the potential role of recycled water as a present and future water source for the Mokelumne Watershed is not overlooked due to insufficient information or inaccurate assumptions. They would like to see a comprehensive survey of wastewater and graywater availability, and water end uses in the MokeWISE area, including the EBMUD service area, including what water qualities are needed for those purposes. The study would seek to match available sources of wastewater and treatment levels to potential users.

Other entities see that when municipal wastewater is recycled for irrigation and groundwater recharge, it broadens the spectrum of beneficial uses that the water serves. For instance, spreading ponds may also meet year-round and seasonal wildlife habitat needs for resident and migrating birds, and other wildlife. If the pond area has walking and bird watching trails for the public, it could meet recreational needs. Recycled water can also offset Mokelumne River supplies, which can be left in the river to perform in-stream functions or put towards other beneficial uses. Using recycled water for groundwater recharge conserves the natural resource that is the aquifer, while forgoing Mokelumne River water. The recycling project promotes economic benefits by avoiding the costs imposed upon others from alternative water supply projects, like additional dams. If the water recycling project hires local contractors, it can help to improve the economy in the district. The recycling project can help to avoid the divisiveness caused by water supply projects that are geographically inequitable. That is, projects that impose costs in one area (e.g. dams upcountry), while providing benefits to another area (San Joaquin County, Alameda County, etc.)

Considerations for this project include:

- Designing the project to meet the intent of MokeWISE to create environmentally, socially and economically acceptable projects;
- Using the recycled water to serve a broad spectrum of beneficial uses e.g.: landscape, recreational, wildlife, and agricultural uses;
- Providing environmental benefits by forgoing surface water; and
- Providing opportunities for public input and participation.

Water suppliers are charged with the timely delivery and affordable supply of high quality surface water for our agricultural and municipal clients, and are committed to maintaining that responsibility for their consumers. Water agencies are also interested in protecting their water rights. Some agencies are not in favor of using recycled water for agriculture purposes due to concerns about quality, cost, and transmission of recycled water resources, for primary users as well as any possible secondary and tertiary effects experienced by anyone in the district as a result of using recycled water. However, these agencies understand and are respectful that other entities may not share this view towards recycled water and do not have an official position either in favor or in opposition to other entities that may be interested in the funding and building of particular infrastructure for recycled water, and including general exploration of opportunities to use recycled water.

Other water agencies are interested in developing cost effective recycled water projects as a way to improve water supply reliability for their customers. If recycled water development results in water that is excess to these agencies needs' and downstream needs, then that water could be made available by these agencies in exchange for equivalent financial or other benefit.

The Amador Water Agency (AWA) has identified three strategies to meet current and future water demands for the public it serves. These include conservation, reuse, and new water supply projects. AWA recognizes that all three strategies will be needed, but that the timing for implementation will vary. Development of reuse infrastructure can be expensive and seeking consensus among local governmental agencies can be challenging.

Currently, all wastewater collected from the City of Sutter Creek, Amador City, and the Martel area (through the Amador Regional Sanitation Authority, ARSA) is treated and primarily used to irrigate the Castle Oaks Golf Course in the City of Ione. All of the wastewater from the City of Jackson is treated and discharged to Jackson Creek where it is captured in Lake Amador and used for agricultural irrigation. Currently the City of Plymouth has plans for its wastewater to be used for irrigating vineyards southwest of the city. Changes are being considered for the City of Jackson, ARSA, and the City of Ione.

AWA desires planning and implementation for reuse such that reuse water can be utilized on parks, commercial landscapes, school grounds, ball fields, median strips, proposed golf courses, compatible agricultural crops, and potentially on residential front yards to reduce the use of water that can be used for domestic purposes.

The continued development and implementation of the Amador County Regional Reuse Study offers a roadmap for future expanded reuse.

The Amador County Regional Reuse Project will implement Alternative 3 as developed in the 2013 Regional Approach for Reuse Study by Amador Water Agency. The Study considered the feasibility and options for increasing tertiary-treated recycled water production and use in the region. It was determined that the Alternative 3, the decentralized alternative, is the preferred alternative. This would upgrade the recycled water treatment plant located in the City of Jackson to serve local users and construct a recycled water treatment plant located in the City of Sutter Creek to serve users located in Sutter Creek, Amador City, Martell, and the Gold Rush Ranch Development. The project will conduct a refinement study to develop a more detailed project description for Alternative 3. After the refinement study, the project will undergo design and construction, as well as salt and nutrient management planning, permitting and user agreements, and environmental documentation. A recycled water rules and mandatory use ordinance will be finalized and adopted. Costs for this project are estimated to be $21.75 million, with $400,000 for the refinement study and $21.35 million for implementation.

Background Information

Amador Water Agency

The Amador Water Agency (AWA) provides both wholesale and retail treated water to Amador Water System, Central Amador Water System Project, La Mel Heights, and Lake Camanche Village. AWA has rights to a total of 17,200 AFY of Mokelumne River, and uses the PG&E system to store and divert 1,150 AFY under the Central Amador Water Project (CAWP), out of a 2,200 AFY contractual right, and owns and operations the Amador Water System (AWS) under which AWA has contractual rights to up to 15,000 AFY. In addition to AWA's surface water rights, it also pumps groundwater for Lake Camanche Village and La Mel Heights.

Table 1 provides a summary of AWA's current and proposed water supplies; **Figure 1** shows the AWA water systems and service area.

Table 1: AWA Water Supplies

Supply	2010 (AFY)	2015 (AFY)	2020 (AFY)	2025 (AFY)	2030 (AFY)
Surface Water	16,150	17,200	17,200	17,200	17,200
Groundwater	296	369	441	511	581
Recycled Water	0	0	0	0	0
Incidental Transfer to EBMUD*	N/A	N/A	N/A	N/A	N/A
Total	**16,446**	**17,569**	**17,642**	**17,711**	**17,781**

Source: AWA, 2011

*Incidental transfers to EBMUD are not guaranteed for any specified amount, and so are not projected

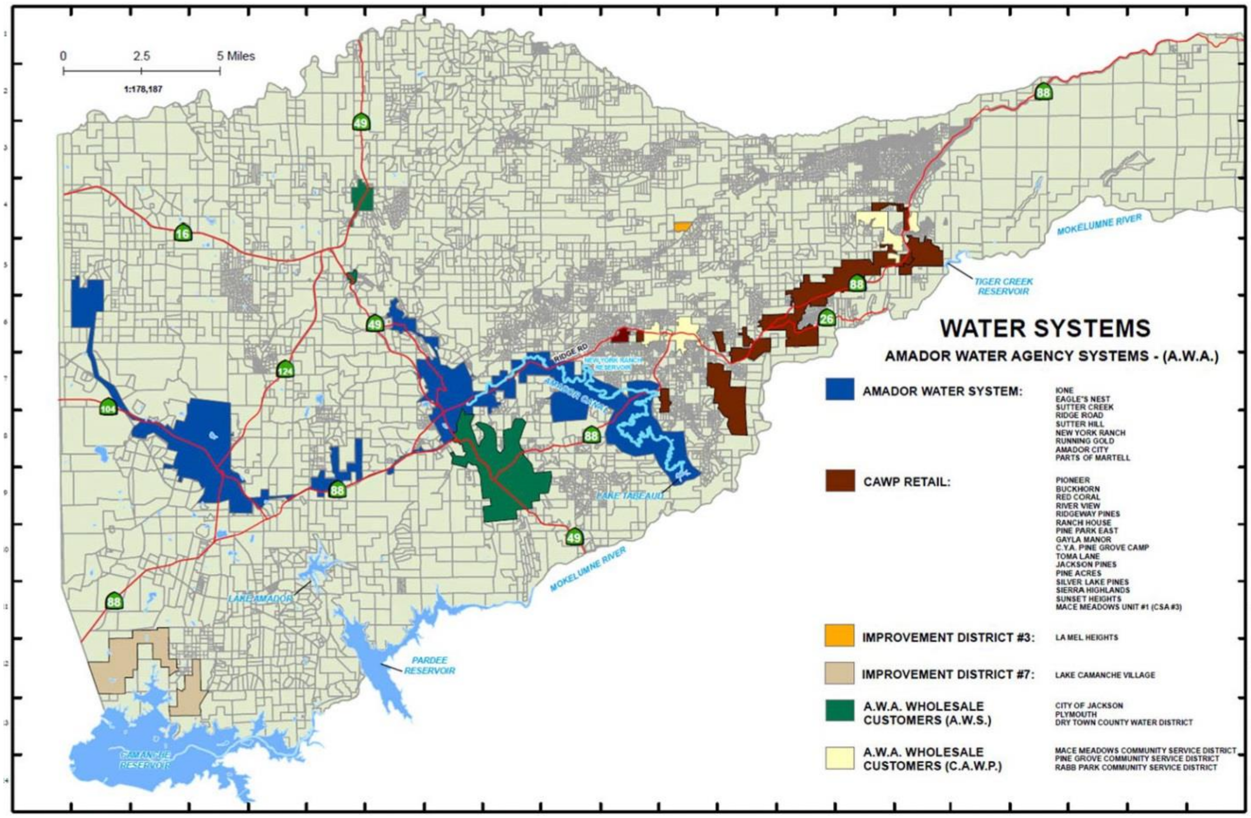
AWA owns and operates three treatment plants, two for the AWS system and one for the CAWP system. These facilities are presented in **Table 2**.

Table 2: AWA Treatment Facilities

System	Facility	Capacity (MGD-ADWF)
AWS	Tanner WTP	6.1
	Ione WTP	3.3
CAWP	Buckhorn WTP	2.6
	Total	**12**

Source: AWA, 2013

Figure 1: Amador Water Agency's Water Systems



Source: AWA, 2013

Jackson Valley Irrigation District

Jackson Valley Irrigation District (JVID) serves agricultural, industrial, and domestic users within its service area, which includes 345 people, of whom, approximately 140 receive water from JVID. JVID sells raw water to its agricultural, industrial, and some domestic users, and sells bottled water to the approximately 61 domestic users without access to private wells. Water provided by JVID is diverted from Jackson Creek and the Mokelumne River. JVID also owns and operates the Lake Amador Resort Area (LARA) treatment plant, which has a capacity of 175 gpm, but generally operations at 150 gpm when necessary. The LARA plant is supplied by water stored at Lake Amador (Amador LAFCO, 2014).

Wastewater in Amador County

Wastewater services in Amador County is provided by the City of Plymouth, City of Jackson, Mule Creek Prison, City of Ione, AWA, and Amador Regional Sanitation Authority (ARSA) – serving Amador City, City of Sutter Creek, and AWA-Martell.

Treatment facilities associated with the ARSA system include the City of Sutter Creek WWTP, City of Ione Castle Oaks Reclamation Plant (COWRP), and the City of Ione Secondary Treatment Plant. AWA wastewater treatment facilities include the Lake Camanche WWTP and the Gayla Manor WWTP. Wastewater from AWA's Martell system is conveyed to the ARSA system for treatment and disposal. The City of Jackson owns one wastewater treatment facility, which must be upgraded if it is to continue discharging to Jackson Creek (AWA, 2013). Most of the wastewater in the project area is treated to secondary before disposal through discharges to local creeks, spray irrigation, or other means.

Project Information

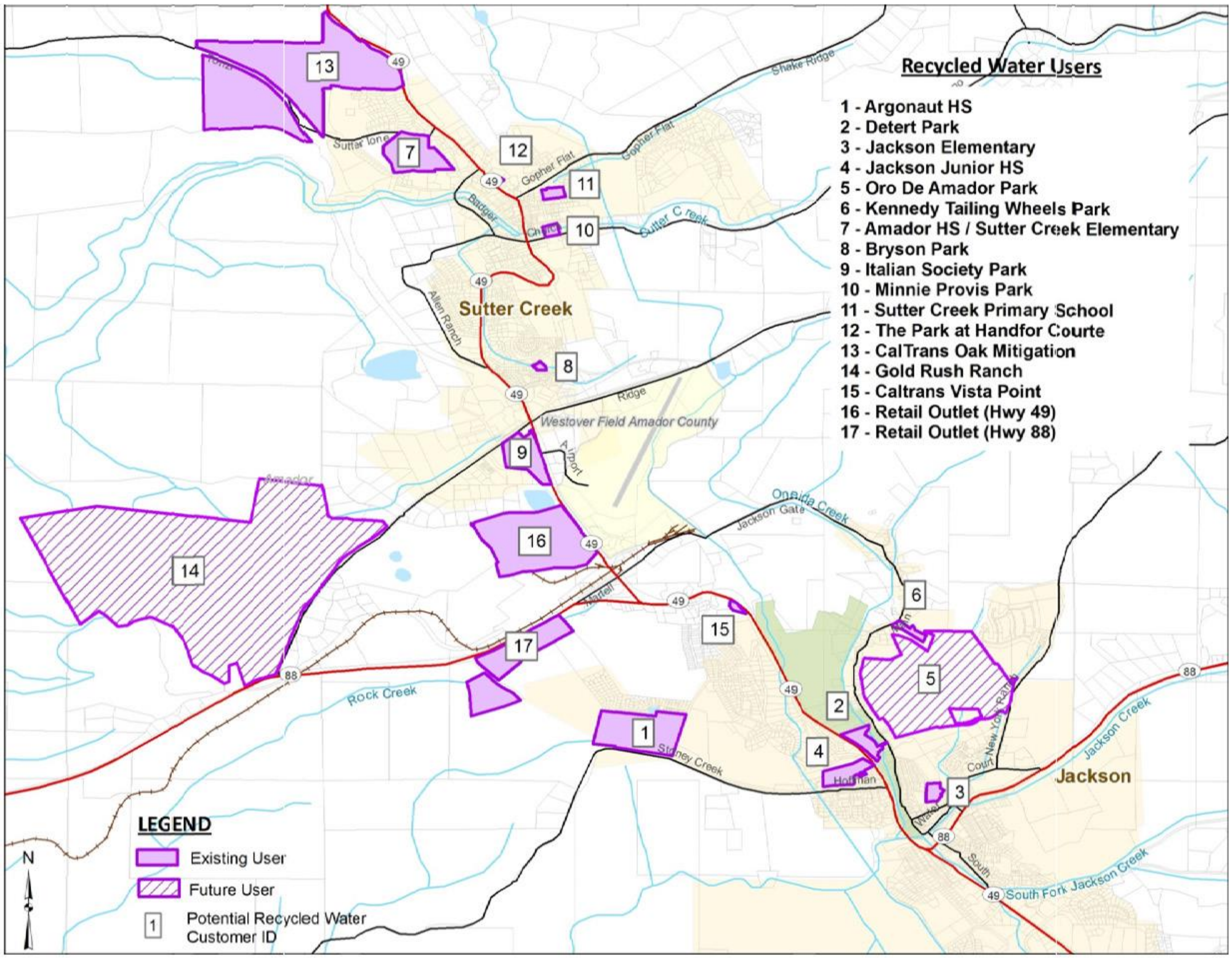
Project Description

The Proposed Project was developed to increase recycled water use in the project area, reduce secondary discharges to the watershed, and protect water supply reliability through increased locally-produced drought resistant supplies. A Regional Approach for Reuse Study (AWA, 2013) was finalized in 2013, and considered the feasibility and options for increasing tertiary-treated recycled water production and use in the region. This report identified three alternatives for serving potential recycled water users shown in **Figure 2**. These alternatives included:

- Alternative 1: A Regional recycled water tertiary plant located in the City of Sutter Creek to serve potential users in the Study area. (Hybrid System)
- Alternative 2: A Regional recycled water tertiary plant located in the City of Jackson to serve potential users in the Study area. (Hybrid System)
- Alternative 3: Upgrade the recycled water treatment plant located in the City of Jackson to serve local users. Construct a recycled water treatment plant located in the City of Sutter Creek to serve users located in Sutter Creek, Amador City, Martell, and the Gold Rush Ranch Development. (Decentralized system)

Based on analysis of the costs, feasibility, and benefits associated with each alternative, Alternative 3, the decentralized option, was determined to be the preferred alternative.

Figure 2: Potential Recycled Water Users



Source: AWA, 2013

Alternative 3: City of Jackson and City of Sutter Creek RWTPs

Alternative 3 is a decentralized system, comprising three phases. Phase 1 would construct a new Recycled Water Treatment Plant (RWTP) near the Sutter Creek WWTP, to serve existing users within the City of Sutter Creek. Phase 2 would expand deliveries of recycled water from the new RWTP constructed in Phase 1 to serve customers in the Martell area, and the new Gold Rush development, once these areas are developed. Phase 2 is anticipated to include construction of a pump station and recycled water transmission main. Phase 3 would serve customers within the City of Jackson, and would involve upgrades to the existing Jackson WWTP to treat to tertiary standards. This would serve to bring the WWTP into compliance with the City of Jackson's discharge permit. Along with upgrades to the WWTP, this phase would include construction of a booster pump station and distribution pipelines. This alternative would serve all of the potential users identified in the Regional Approach to Reuse Study. **Figure 3** shows the proposed Alternative 3 project (AWA, 2013).

Assuming that all of the wastewater in the City of Sutter Creek, City of Martell, Gold Rush, and the City of Jackson would be treated to tertiary and distributed as recycled water through this project, at buildout, up to 3.74 MGD tertiary water could be available, as shown in **Table 3.**

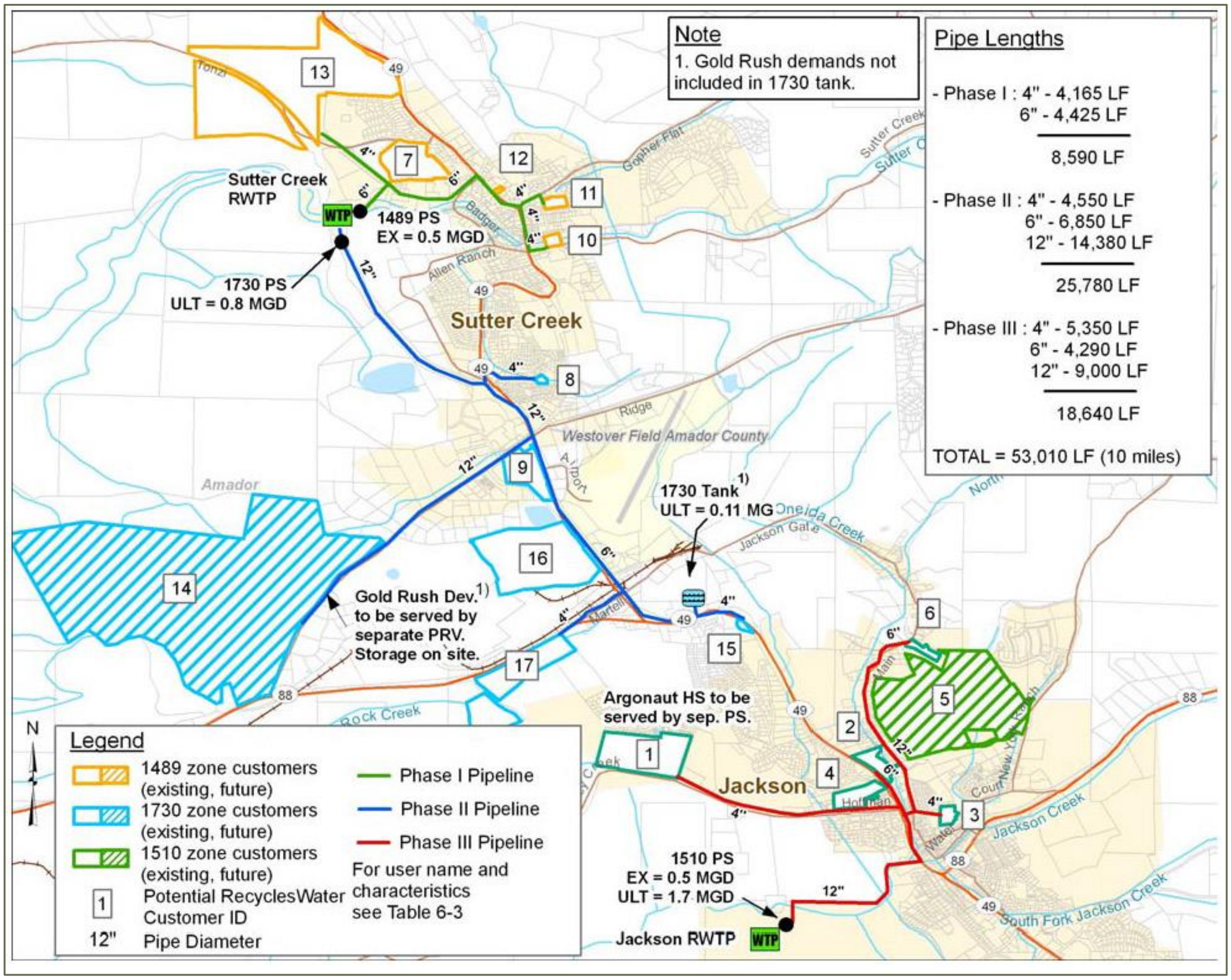
Table 3: Project Wastewater Flows within the Project Area

Community	2020 (MGD)	2025 (MGD)	Buildout (MGD
City of Sutter Creek	0.41	0.49	0.81
City of Martell	0.72	0.97	1.19
Gold Rush	0.14	0.41	0.41
City of Jackson	0.52	0.72	1.33
Total	**1.79**	**2.59**	**3.74**

Source: AWA, 2013

The Regional Approach for Reuse Study's analysis was a high-level, conceptual evaluation, and recommended that a Refinement Study be conducted to develop the final elements necessary to decide on whether implementation should move forward. This Scope addresses the effort necessary to complete the Refinement Study, and provides a cursory overview of what steps may be required should implementation of the refined project move forward.

Figure 3. Alternative 3: City of Jackson and City of Sutter Creek RWTPs



Source: AWA, 2013

Project Location

The Project would be located in Amador County, within the AWA and JVID service areas, as shown in **Figure 3**, above.

Project Sponsor

The Project would be implemented by AWA in partnership with JVID.

Scope of Work

Task 1 describes the work necessary for the Refinement Study, while Task 2 identifies the potential efforts required for implementation of the proposed project.

Task 1. Refinement Study

The Refinement Study will involve developing a more detailed project description for Alternative 3, recommended under the Regional Approach for Reuse Study, and should include the following components:

- Coordinate with the Regional Water Quality Control Board (Regional Board) to approve the use of nutrient "best management practices" (BMPs) in lieu of a Salt and Nutrient Management Plan (SNMP). SNMPs are generally required for groundwater basins, however they are difficult to develop in basins where groundwater is found in fractured rock formations, as is the case in the project area.
- Refinement of demand estimates and potential users, including additional users not initially included in the Regional Approach for Reuse Study. These potential additional users may be identified through public outreach/awareness, proximity to proposed refined distribution system, or requests for service. Preliminary outreach to potential users should be conducted under this component, and where possible, letters of interest for recycled water services solicited.
- Conceptual design for the new Sutter Creek RWTP, including identification of preferred treatment trains, facility sizing, preferring site for the new facility, potential for co-siting with the existing Sutter Creek WWTP and means of reducing costs through increased efficiencies with the existing WWTP, identification for all new on-site facilities, and potential need for additional pipelines or pump stations to deliver secondary influent from Sutter Creek WWTP to serve the new RWTP.
- A cultural resources assessment to identify areas of high sensitivity that may be affected by construction of any required project element. Existing data records and information will be reviewed and both federally recognized and currently unrecognized Native American tribes within the region will be consulted. The results of previous cultural resource studies and recorded cultural resources in the records search area will be plotted on 7.5-minute topographic quadrangles. Based on this analysis, an assessment will be prepared to address the sensitivity of the project elements with respect to cultural resources.
- Refinement of the necessary upgrades to the Jackson WWTP to produce tertiary recycled water. This should include identification of the preferred tertiary treatment train technology, and any other modifications necessary to the existing WWTP to accommodate this treatment train. It should also consider any other necessary storage or pumping needs at the upgraded Jackson WWTP.
- Refinement of proposed distribution and storage systems, including preliminary sizing of pipelines, identification of preferred alignments, storage tank sites and sizes, and pump station sties and sizes.

- Refine the recycled water rules included in Appendix D of the Regional Approach for Reuse Study, to be implemented in the project area, with input from appropriate regulatory agencies, governing bodies, and stakeholders.
- Refinement of Recycled Water Process and Procedures included in Appendix D of the Regional Approach for Reuse Study. These should include design and operation standards, signage, monitoring and testing, procedure for accepting applications for recycled water service, plan review, record drawings, post-construction modifications, separation requirements, backflow prevention, etc.
- Refinement of potential permits and agreements that would be necessary to implement the proposed recycled water project and achieve the project goals. Include a table showing the permits, their anticipated timeline for approval, and any necessary additional information required prior to permit approval (e.g., final design, facilities planning, etc.)
- Refinement of the preliminary cost estimates included in the Regional Approach to Reuse Study, based on the updated project description.
- Identify prudent methods for district-wide long-term financial planning for capital expenditures, operations, and maintenance. The study will report on the willingness of the water utilities to participate in that planning prior to making further financial commitments associated with this project.
- Identify one or more ways in which the water supply will be shared; and one or more ways the capital, operations, and maintenance costs of the project will be shared. Following the study, but before the utilities make further legal commitments, financial commitments, funding applications, or permit applications associated with reservoir reoperation, the utilities will identify water supply and cost sharing options acceptable to the utilities.
- Preliminary development of reuse project implementation schedule.
- Identification of potential funding sources to implement the project, including, but not limited to, Department of Water Resources Integrated Regional Water Management (IRWM) grants, State Revolving Fund grants and loans, U.S. Bureau of Reclamation Title XVI grants, and U.S. Department of Agriculture Rural Development grants.
- Additional public outreach to educate potential customers about wastewater reuse, solicit feedback on conceptual design, solicit input on identification of additional users, refinement of demand estimates for identified users, solicit input on proposed recycled water rules, and address potential public concerns regarding the project.

The Refinement Study should contain sufficient detail for AWA and JVID to decide whether to move forward with implementation of the project. It should also provide sufficient detail to support funding applications, inform environmental documentation, and permitting.

Task 2. Implementation

Implementation of the project following approval from AWA and JVID based on the Refinement Study could include the following subtasks:

Subtask 2.1 Salt and Nutrient Management Planning

Per the State Water Resource Control Board's Recycled Water Policy, Resolution No. 2009-0011, SNMPs are required for groundwater basins, with highest priority given to high priory basins. Basin priorities are based on type and extent of use of the groundwater. Groundwater sources in the project area includes the Cosumnes Groundwater sub-basin and unclassified groundwater aquifers, and a SNMP may be required for the project to move forward. The groundwater in this area is in bedrock fractures, making SNMP develop difficult. However, a nutrient "best management practices" (BMPs) may be implemented instead.

Task 2.1 will develop appropriate nutrient BMPs, or an SNMP, in accordance with guidance provided by the Regional Board during the coordination effort completed under Task 1.

Subtask 2.2 Design

Once approved to move forward with the refined project, preliminary and final design should be completed. This task will include final pipeline alignment, facility siting, component sizing, pump station design and siting, RWTP design and siting, upgrades to Jackson WWTP design, and any other design necessary for construction of the project.

Subtask 2.3 Recycled Water Rules and Mandatory Use Ordinance

Concurrent with Task 2.1, the draft recycled water rules, recycled water processes and procedures and a Mandatory Use Ordinance for recycled water (based on California Water Code §13551) should be finalized and adopted. These rules may need to be finalized to obtain appropriate permits and to pursue identified funding opportunities.

Subtask 2.4 Permitting and User Agreements

Permits necessary for construction of the project and distribution and use of recycled water may include, but are not limited to the permits listed in **Table 4**. User agreements should also be finalized during this task. Note that permitting may be a lengthy process, and adequate time should be given to acquire all appropriate permits.

Table 4: Potential Permits and Agreements for Alternative 3

Agency	Permit
Regional Water Quality Control Board	Waste Discharge Requirements NPDES Permit Recycled Water Master Permit
Division of Water Rights	Petition for Change
California Department of Fish and Game	Petition for Change Streambed Alteration Agreement
Local Municipalities and Amador County	Conditional Use Construction Permit Encroachment Permit Tree Removal Permit
Potential Customers	User Agreements

Subtask 2.5 Environmental Documentation

Prior to project construction, environmental documentation compliant with CEQA and NEPA will be required. Given the size and scope of the proposed project, it is anticipated that an Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) would be the appropriate level of documentation. Environmental documentation may also be necessary for eligibility for certain funding opportunities.

Subtask 2.6 Funding

Outside funding opportunities should be pursued to reduce the local cost burden of the project. Potential funding sources are listed in **Table 5**, although this list is expected to be refined under Task 1, above.

Table 5: Potential Funding Opportunities

Agency/Funding Source	Opportunity
California State Water Resources Control Board (State Board)	State Revolving Fund (SRF) Loan Program for Water Recycling Projects
	Proposition 50 Funding
	Facilities Planning Grant Program
	Proposition 1 Funding
California Department of Water Resources	Proposition 84 Integrated Regional Water Management Implementation Grant
	Proposition 1 Funding
U.S. Bureau of Reclamation	Title XVI Funding
U.S. Department of Agriculture	Rural Development Water and Environmental Programs

Subtask 2.7 Construction

Construction of the project would occur in three phases, consistent with the Refinement Study. As described, Phase 1 would include construction of the Sutter Creek RWTP and delivery of recycled water to adjacent users, Phase 2 would include construction of recycled water distribution system to Gold Rush and Martel developments, and Phase 3 would upgrade the Jackson WWTP and construct recycled water distribution system to serve users in the Jackson area. Construction would require site preparation, such as staging areas, equipment and materials mobilization, and clearing; construction of treatment facilities, pipelines, storage tanks, and pump stations; and site demobilization, such as testing, restoration to pre-construction conditions, and removal of staging areas, equipment, and materials.

Budget

The budget for this project is estimated to be $21.75 million, but could vary substantially depending on the construction needs of the project (e.g., pipeline lengths, size of mixing facility), or any other considerations. Costs for implementation, should the project move forward to construction, are based on the preliminary costs included in the Regional Approach for Reuse Study. Note that these costs do not include the costs for permits or the cost to prepare funding applications. Costs associated with the project can be broken out as follows:

- Refinement Study: $400,000
- Phase 1: $3,660,000
- Phase 2: $8,820,000
- Phase 3: $8,870,000

- **<u>Total Project Costs: $21,750,000</u>**

References

Amador Local Agency Formation Commission (Amador LAFCO). 2014. Municipal Services Review, Jackson Valley Irrigation District. May 22.

Amador Water Agency (AWA). 2014. 2010 Urban Water Management Plan. September 2011. Updated 2014.

Amador Water Agency (AWA). 2013. Regional Approach for Reuse Study. February.

City of Sutter Creek and Amador Regional Sanitation Authority. 2012. Draft Wastewater Master Plan. November 26.

MokeWISE Program Methodology:
Project 4a: Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin

April 2015

Problem Statement and MokeWISE Stakeholder Interests

This study will determine the basis for and feasibility of groundwater banking within the Eastern San Joaquin Groundwater Subbasin. The ultimate goal of a groundwater banking project is to improve overdraft conditions in the Subbasin and identify the potential to improve reliable water supplies for Eastern San Joaquin County, East Bay Municipal Utility District, and the Upper Mokelumne River Watershed region through groundwater banking. The study will include analysis of various issues, impacts and constraints that may affect project implementation through new and evolving legislation, water supply sources, project concepts and design, governance and stakeholder engagement. Water sources included in feasibility and cost evaluation are Mokelumne River and other surface water, locally-generated recycled water, stormwater, and conservation. Using lessons learned from the recent San Joaquin County demonstration project and coordinated public outreach, the study will assess groundwater basins, assess supply alternatives, and if determined to be feasible, define and develop a groundwater banking project. A governance framework will be established that guides the operation of the developed project and may include the Groundwater Sustainability Agency. A final report will be developed that summarizes the alternatives developed and provides discussion relative to the benefits and impacts of each. Costs associated with this study are estimated to be $3.605 million.

The environmental stakeholders in the MokeWISE process have an interest in seeing groundwater aquifers effectively and transparently managed and further understand that such aquifers can be utilized as a water storage option. Development of new groundwater storage projects is viewed by many as having an environmental advantage as compared to the development of new surface water storage projects.

Environmental stakeholders support the concept of protecting aquifers as they serve to provide an emergency water reserve during times of severe drought.

Environmental stakeholders are concerned that water withdrawn from the Mokelumne River and banked in the Eastern San Joaquin groundwater basin may not be subject to proper management. Specifically, they view that withdrawals of groundwater is premature until adequate safeguards and controls, including the development and implementation of appropriate monitoring plans, are in place to ensure that any banked or recharged water does in fact recharge the basin and can be withdrawn by agencies or groups participating in the project(s) when needed. Those stakeholders believe that measurement and modeling tools and governance and institutional structures must be in place to assure a clear accounting of the water added to and withdrawn from the basin. There is the fear that banking of water could lead to an expansion of agricultural operations prior to an establishment of a well understood groundwater accounting framework, fostering an even greater dependence on surface and groundwater supplies.

In light of the above concerns, while environmental stakeholders strongly support the concept of conjunctive management of groundwater basins, they desire that the concept of putting surface water from the Mokelumne River, a resource which should continue to be managed to meet the needs of water interests and in accordance with the public trust, into the Eastern San Joaquin aquifer, be approached cautiously. Environmental stakeholders are concerned that overlying landowners will have unhindered access to groundwater.

Environmental stakeholders also ask that the quantity and timing of Mokelumne diversions for banking in the Eastern San Joaquin groundwater basin be considered as part of project planning. Such project operations have the potential to impact flows in the river that serve important ecological functions.

Environmental stakeholders are interested in the use of independently verifiable data and modeling to determine how much and when water could sustainably be diverted from the Mokelumne River for a groundwater banking project.

Environmental stakeholders are interested in groundwater banking projects and agreements that prioritize arriving at aquifer equilibrium and replenishment before groundwater banking and emphasize clear timelines for when each of those goals will be achieved.

Environmental stakeholders are concerned that unregulated withdrawals of water from the Eastern San Joaquin Basin may in dry years result in increasing saline intrusion into the basin in spite of recharge with Mokelumne water, rendering much of the basin unsuitable for agricultural and potable use.

Some non-government organizations are concerned that the use of water upcountry may have unnecessary significant impacts on the environment that should first be reduced through land use planning and pollution prevention.

Some non-government organizations want to see upcountry district-wide long-term financial planning with meaningful ratepayer involvement by upcountry water utilities prior to any project involving substantial investment for capital, operations, or maintenance.

Some non-government organizations want to ensure that the costs and benefits of this project are equitably shared.

Some non-government organizations want to ensure that water storage and diversion facilities are designed to protect managed public access to the Mokelumne River for recreation, fishing, commerce, and other benefits.

While understanding the desire of some project proponents to keep project details flexible, some non-government entities want the study to result in a project with a certain enough set of components that they can determine whether to support the project following the study.

Some non-government organizations want to know if a successful groundwater banking project is compatible with a wild and scenic designation for 37 miles of the Mokelumne River.

Before the water utilities make further legal commitments, financial commitments, funding applications, or permit applications associated with a groundwater banking project, both the environmental community and San Joaquin County are willing to discuss a Wild and Scenic Designation. It is the desire of both parties that this conversation occur before this time.

Water users and other stakeholders in Eastern San Joaquin County want to ensure that any banking project include the objective to ensure that both overlying groundwater users and project participants have reasonable access to groundwater.

Agricultural interests are concerned that conversion to drip and sprinkler irrigation is not suited for all crop types. Additionally, another common on-farm water conservation method - tail water return systems - may have the unintended consequence of removing a recharge source for groundwater thus not resulting in a supply benefit. Finally, implementing agricultural water conservation in areas overlying an over-drafted groundwater basin may have the unintended consequence of reduced groundwater recharge when using surface water for flood and furlough irrigation.

East Bay Municipal Utility District (EBMUD) has an interest in protecting its water rights and developing cost effective recycled water projects as a way to improve water supply reliability for its customers. If recycled water development results in water that is excess to EBMUD's water rights and downstream needs, then that water could be made available by EBMUD in exchange for equivalent financial or other benefit.

EBMUD also has an interest in protecting its facility operations in order to assure water supply reliability for its customers and to continue to meet any flow obligations as may be in place regarding releases for senior rights holders and or to meet environmental needs. EBMUD has identified the opportunity to work in partnership with San Joaquin County entities to develop a groundwater banking projects. Agreements regarding the development of demonstration projects have recently been entered into, and those agreements outline what must be achieved by the demonstrations in order for any formal project to move forward into an implementation stage.

Overall, EBMUD believes that groundwater banking can provide a mix of water supply and environmental benefits as well as help recharge San Joaquin County's groundwater basin.

Project Information

Project Description

This study will determine the basis for and feasibility of groundwater banking within the Eastern San Joaquin Groundwater Subbasin with the objective of improving reliable water supplies for not only Eastern San Joaquin County, but also the East Bay Municipal Utility District and the Upper Mokelumne River Watershed region. The desired outcomes of a potential project are improved groundwater levels in the vicinity of the groundwater banking location, the development of a reliable alternative water supply for agencies who rely on Mokelumne River water, and also increased flexibility to provide environmental benefits to the Mokelumne watershed. Consistent with the intent of MokeWISE, the study will also consider impacts and benefits to the environment, conduct an analysis of the feasibility of alternative supplies to the Mokelumne River including stormwater capture, locally-generated recycled water, and conserved water, and identify climate change adaptation. This document summarizes the approach for analyzing and developing the proposed project concept in the form of a feasibility study.

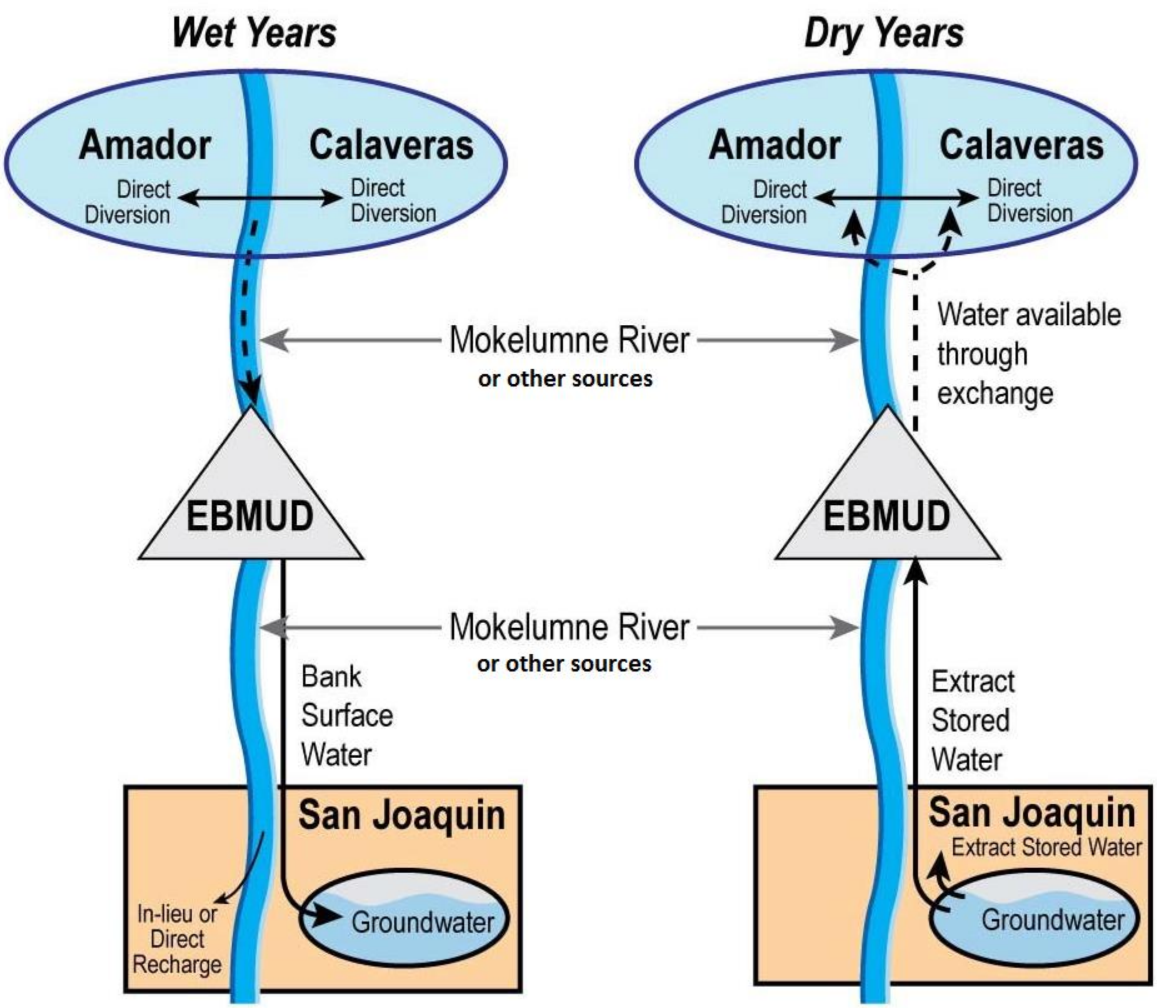
The study will include analysis of various opportunities, impacts and constraints that may affect project implementation through new and evolving legislation, water supply sources, project concepts and design, governance and stakeholder engagement. Operational flexibility is currently maximized by including a variety of potential water sources for banking as described in the MokeWISE Program Water Availability Analysis. Water sources described for feasibility and cost evaluation include the following:

- Mokelumne River and Other Surface Water
- Locally-Generated Recycled Water
- Stormwater
- Water Conservation / Demand Management

The MokeWISE Water Availability Analysis found that agricultural drainage and desalination/demineralization supplies are not anticipated to provide a long-term, regional supply for the MokeWISE program. As such, these supply sources are not considered viable supply alternatives and will not be examined at this stage for the groundwater banking project.

Eastern San Joaquin diversions upstream of Pardee Reservoir are not being considered as part of this study. Other upcountry project partners may envision diversions upstream of Pardee as part of a groundwater banking project. See **Figure 1** below.

Figure 1: Potential Groundwater Banking Project Schematic



Project Location

The study is located in the areas overlying the Eastern San Joaquin Groundwater Basin. A potential project or project(s) will be located within the Eastern San Joaquin Groundwater Region within the WID, NSJWCD, City of Lodi, City of Stockton, and SEWD service areas. Specific locations will be identified as part of this scope of work. Additional facilities to facilitate increased direct diversions in the upper Mokelumne River watershed may be required.

Project Sponsor

The Eastern San Joaquin Groundwater Basin Authority (GBA), Calaveras County Water District, and North San Joaquin Water Conservation District are sponsors of the project. The Calaveras Public Utility District is co-sponsoring. East Bay Municipal Utility District, Amador Water Agency, Jackson Valley Irrigation District, and other water right holders in the upper watershed may also participate in groundwater banking.

Scope of Work

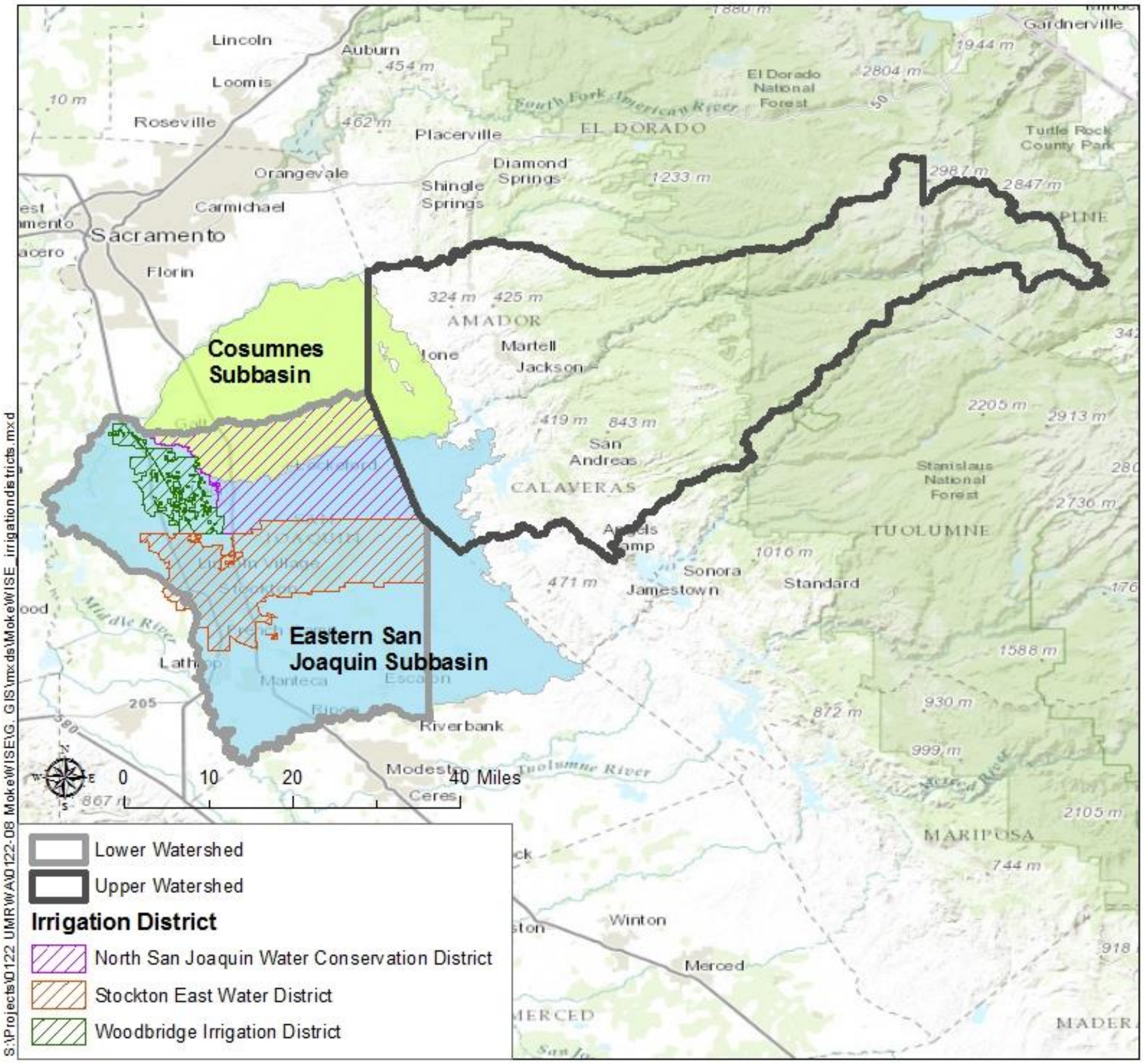
Task 1. Identify Project Study Area

The purpose of this task is to summarize current groundwater basin conditions to develop a basis for quantifying recharge opportunities.

Subtask 1.1 Characterize the Affected Portion of the Eastern San Joaquin Groundwater Basin.

The Eastern San Joaquin Groundwater Basin is identified in DWR's Bulletin 118 and extends under Eastern San Joaquin County and into Calaveras County (**Figure 2**). The basin has been the subject of numerous studies and reports, including the MokeWISE Water Availability Analysis (Jan 2015), the GBA Integrated Regional Water Management Plan 2014 Update, the GBA 2007 IRWMP, the Eastern San Joaquin County Integrated Conjunctive Use Programmatic EIR, and the Freeport Element of the American River Use Strategy Report. These studies should be reviewed and expanded upon, as needed, with the intent of informing the process of creating a groundwater banking program in the region.

Figure 2: Eastern San Joaquin Groundwater Subbasin and Mokelumne Upper and Lower Watersheds



Total agricultural and municipal groundwater pumping in Eastern San Joaquin County is estimated to have averaged 870,000 AFY since the 1970s. The Eastern San Joaquin groundwater subbasin is currently overdrafted at a rate of 70,000 to 80,000 AFY (GBA 2014). Overdraft conditions have created an estimated 1 to 2 million AF of groundwater basin storage which could be used in a groundwater banking or conjunctive use development (GBA 2004). Conjunctive management strategies (i.e. management of groundwater and surface water resources) and groundwater recharge opportunities may help to mitigate groundwater overdraft conditions, as well as serve as a valuable groundwater banking resource to the region. The extent of overdraft conditions and estimated groundwater banking storage should be confirmed as part of this task.

Long-term groundwater overdraft has also had significant effects on groundwater quality. Groundwater level declines have resulted in steep gradients from the west, causing intrusion of highly saline groundwater. Salt intrusion in the groundwater basin has rendered supplies unusable for urban drinking water needs and crop irrigation in some locations. Studies and monitoring to determine the potential sources and extent of the saline front are limited. Results of a USGS Joint Salinity Study (USGS 2006) indicated several possible sources of saline water including surface water infiltration, dissolution of salts near the Delta margin, contributions from underlying deposits, and possible irrigation return flow. Other contaminants of potential concern in the basin include naturally occurring dissolved solids, iron, arsenic, and nitrate concentrations. This task should identify known plumes or pockets of contamination, sources of saline water infiltration, locations of potential water quality risk if present conditions continue, and potential infiltration or injection locations. Additional water quality testing, hydrogeological investigations, and modeling may be needed in order to identify ideal recharge or injection well locations.

Subtask 1.2 Baseline Data Collection to inform Project Scale

This task is focused on the presently available information including, but not limited to, information from the Eastern San Joaquin Basin Groundwater Management Plan, Eastern San Joaquin County IGSM, Eastern San Joaquin IRWM Plan, and similar recently completed documents or data sources.

Steps to be completed under this task include:

- Data gathering and synthesis;
- Identify demand components;
- Identify possible supply components;
- Identify infrastructure available for water conveyance, including potential constraints and capacities;
- Develop preliminary water balance for the Project Area;
- Use MOCASIM to develop a baseline for comparison of banking alternatives.

Subtask 1.3 Coordination with Groundwater Sustainability Agency

The Sustainable Groundwater Management Act (SGMA) was signed by the Governor in 2014 and includes several mandates related the sustainable management of groundwater basins Statewide. Under the SGMA, local government agencies may elect to become a Groundwater Sustainability Agency (GSA) or join into a larger multi-agency GSA. The declaration by an agency or agencies to become the/a GSA shall occur by June 30, 2017.

The SGMA requires that the GSA develop a Groundwater Sustainability Plan (GSP) by January 31, 2020 for basins in critical groundwater overdraft and by January 31, 2022 for all other high and medium priority basins. A GSP is required to include the following:

1. A description of the physical setting and characteristics of the aquifer system;
    a. Historical conditions to the extent available;
    b. Groundwater levels, quality, subsidence, and surface water interactions;
    c. A general discussion of historical and projected water demands and supplies;
    d. A map of the area of the basin and the boundaries of the GSA or GSA's developing a GSP; and,
    e. A map identifying the areas which contribute to the recharge of the underlying basin.
2. Measureable objectives to achieve the Sustainability Goal;
3. Groundwater Management Activities;
    a. Monitoring and management of groundwater levels;
    b. Groundwater quality degradation, inelastic land subsidence, subsidence, changes in surface water flow or quality;
    c. Mitigation of overdraft;
    d. How recharge areas contribute to the sustainability of the basin;
    e. Surface water supplies used or available for groundwater recharge.
4. A Summary of monitoring sites, frequency of measurement, for levels, quality, flow, precipitation, type of well used and the monitoring well's construction information.
5. Monitoring Protocols;
6. A description of the applicability of county and city general plans and how various GSP's may affect general plans.

The Cosumnes Groundwater Sub-basin is designated as medium priority and the Eastern San Joaquin Groundwater Sub-basin as high-priority.

- Since the bulk of the work for the Cosumnes and Eastern San Joaquin Groundwater Sub-basins will be ultimately determined by the Groundwater Sustainability Agency in accordance with SGMA, the scope of this task is narrowed to include the following: Verify the amount of water needed in the proposed project area to reach the sustainability goal of the GSA, consistent with SGMA.
- Identify the desired range of groundwater levels for the proposed project area as specified in the sustainability goal of the GSA, consistent with SGMA.

Coordination with the GSA entities should be ongoing throughout this project in order to position potential projects for inclusion in the GSP and associated funding.

Task 2: Assess Supply Alternatives

Previous efforts have evaluated the possibility of expanding use of Mokelumne River supplies through arrangements such as an in-river exchange or banking Mokelumne supplies in the Eastern San Joaquin County. The purpose of this task is to assess what supplies may be potentially available for direct or in lieu recharge in the proposed project area.

Subtask 2.1 Stormwater Assessment and Inventory

The MokeWISE Water Availability Analysis assessed and quantified potential stormwater supplies and locations. Stormwater potentially available for the MokeWISE program comes from both residential areas and from municipal systems in Stockton and Lodi. Stormwater generated in the City of Lodi and in the City of Stockton may be temporarily captured in stormwater basins for flow attenuation and to meet water quality objectives while providing incidental groundwater recharge. Future urban development will be required to meet Low Impact Development Standards requiring additional storage and treatment creating more opportunities for groundwater recharge. Total stormwater potentially available for reuse within the upper and lower watersheds from both sources is estimated to be roughly 15,100 AFY. While the primary purpose of stormwater and flood water management is not for the purpose of providing a groundwater recharge benefit, there are a number of concepts that the feasibility study will explore, which include:

- Modification of the Woodbridge Irrigation District Canal system to increase residence time of stormwater flows generated by the City of Lodi to increase percolation.
- Retrofit of existing stormwater detention basins in Lodi and Stockton to improve percolation rates of local stormwater captured and also to double as recharge basins for Mokelumne Supplies when available.
- Any project alternative contemplated must also be subject to a strict analysis of impacts to the primary purpose of existing facilities designed to meet a strict flood control or water quality standard.

The EBMUD service area was not considered in the Water Availability Analysis and it is not considered to be a viable source of water supply for San Joaquin County; however, EBMUD is currently embarking on a study that will calculate theoretical stormwater supplies available within the EBMUD service area. Results from the EBMUD analysis should be used to summarize potential stormwater sources, at various scales, that could offset the use of Mokelumne supplies in the East Bay in favor of recharge in Eastern San Joaquin County or to provide flexibility in the management of Mokelumne Supplies for the improvement of fish and wildlife.

The stormwater assessment will include the following subtasks:

- **Identify opportunities for stormwater capture and infiltration at various scales.** Inventory stormwater and floodwater management infrastructure which could be used to increase the recharge of local stormwater runoff.
- **Quantify the potential for increased recharge of captured stormwater.**

- **Prioritize stormwater and floodwater conveyance systems for repair, retrofit, or enhancement.**
- **Determine the engineering and financial feasibility of conveying Mokelumne River water to these sites for recharge.**

Subtask 2.2 Recycled Water Assessment

The MokeWISE Water Availability Analysis assessed the potential for developing recycled water supplies to offset Mokelumne River supply or recharge the groundwater basin. Recycled water potentially available for the MokeWISE program is estimated to be 222,500 AFY. However, due to constraints and challenges associated with treating and delivering recycled water, the total available decreases to approximately 169,400 AFY. Future recycled water opportunities within the upper and lower watersheds accounts for roughly 6,500 AFY of the total recycled water potentially available, with the remainder comprised of recycled water generated within the EBMUD service area.

Despite the significant concerns that exist with the use of recycled water supplies for recharge of the San Joaquin groundwater basin through direct recharge or irrigation of agricultural lands overlying the groundwater basin, this task will include an evaluation of the potential concerns to the use of recycled water based on the source, quality, and end use. These concerns include:

- Impacts to agriculture: some major distributors will not purchase crops irrigated with recycled water; using recycled water for irrigation could therefore result in adverse economic impacts to growers.
- Salt and nitrate loading: using recycled water for recharge and / or irrigation of lands in Eastern San Joaquin County could increase salt and nitrate loading to the basin. Nitrates in runoff leaving agricultural land is regulated by the Regional Water Quality Control Board through the Irrigated Lands Program.
- Public health: depending upon the level of treatment provided, use of recycled water for direct recharge or irrigation of lands overlying the San Joaquin groundwater basin could result in introduction of contaminants of emerging concern (CECs) to the groundwater basin.
- Downstream impacts: use of recycled water could decrease this source for downstream users, thereby potentially decreasing the amount of water available for downstream users.
- Economic and environmental feasibility: piping and pumping recycled water can be prohibitively expensive and environmental impacts extensive.

However, recycled water should not be overlooked as a potential source of recharge provided that the concerns above are addressed. Recycled water generated from within the groundwater basin is acceptable. Utilization of recycled wastewater generated from sources outside the groundwater basin would only be considered through an exchange where it was utilized closer to the source, potentially freeing up surface water supplies in San Joaquin County.

The feasibility study will specifically evaluate the potential for the City of Lodi to provide recycled water for the purposes of groundwater recharge both direct and in-lieu. There may also be opportunities to evaluate small scale projects, such as using winery wastewater for in-lieu applications. With the primary benefit of such small scale projects are driven by the need to make waste disposal more affordable, the study will explore the potential quantity of the secondary benefit of using non-potable water made available by creative waste disposal techniques.

A feasibility analysis for utilizing recycled water as a localized resource to offset other current water supply sources making those supplies available for groundwater banking, both in-lieu and recharge will be conducted through implementation of the following subtask.

- **Assess recycled water availability and evaluate potential recycled water project opportunities.** In this task, potential project opportunities will be identified by performing feasibility analyses for use of recycled water sources to offset use of other supplies that could then be used to recharge the groundwater basin through infiltration and direct injection, as well as in-lieu recharge by irrigating agricultural lands overlying the groundwater basin that would otherwise use groundwater. The concerns listed above should provide the basis for the evaluation.
- **Evaluate the amount of recycled water and the cost of the City of Lodi's options to provide recycled water to growers in a locally acceptable manner.**

Subtask 2.3 Water Conservation / Demand Management Assessment

The MokeWISE Water Availability Analysis assessed water conservation and efficiency as a method for increasing regional water supplies. Results from that analysis should be used to summarize potential water conservation measures that can serve to free up other water supply sources for use in a groundwater recharge project.

Cities, agencies and districts throughout the project area are implementing aggressive conservation programs as outlined in their 2010 UWMPs and Agricultural Water Management Plans (AWMPs). For example, Woodbridge Irrigation District (WID) recently implemented a drip irrigation conversion program. Through this program, WID has made available 6,000 acre-feet per year (AFY) of Mokelumne River supply to the City of Lodi at a cost of $200/AF. Conserved water can provide up to a direct one-to-one offset of potable supplies. This task will be implemented through the following subtasks. Recent modeling conducted for MokeWISE specifically modeled impacts to Mokelumne River flows at varying levels of urban and agricultural conservation; such results could be used to frame the impacts and benefits assessment.

- **Identify water conservation projects and BMPs with the potential for water savings throughout the region.** In this task, BMPs and conservation projects identified in the Water Availability Analysis will be evaluated for their potential to increase supplies for groundwater banking. Both urban and agricultural BMPs and water conservation projects will be evaluated. This task will incorporate relevant work performed as part of the Urban Water Conservation Program (MokeWISE Project 5a), Agriculture Water Conservation Program (MokeWISE Project 5b), and other conservation programs throughout the region.
- **Identify impacts and constraints of expanding water conservation in the region.** This task will identify potential impacts and constraints to downstream river flows, domestic water supply, regional politics, legal issues, the environment, economics, and recreation. Analysis will be performed to evaluate the economic feasibility of the preferred projects and BMPs.
- **Identify gainsharing opportunities so that a portion of conserved water is considered for in-stream use.**
- **Identify the potential for other agriculture demand reduction strategies, including the lease or sale of land for groundwater recharge purposes.**

Particular attention will be paid to conservation measures that result in a net benefit to the groundwater basin.

Subtask 2.4 Surface Water Assessment

The MokeWISE Water Availability Analysis assessed Mokelumne River supplies, as well as Delta water supplies available for both short-term and long-term transfer. The amount of unallocated Mokelumne River water is highly variable depending on the location along the River and the hydrologic year type. Generally, there is more unallocated water downstream and less upstream and generally more in normal and below normal years than in dry and critically dry years. Results from that analysis should be used to describe potential surface water sources for groundwater recharge, identify existing and future infrastructure needed to convey and utilize surface water, and perform a feasibility analysis for utilizing surface water as a source for groundwater banking including preliminary environmental, economic, legal and other constraints. This task will assess potentially available surface supplies through implementation of the following subtasks.

- **Perform feasibility analysis for non-Mokelumne River water surface supplies**. Long-term transfer arrangements and conveyance of non-Mokelumne River surface water supplies using infrastructure such as EBMUD Freeport facilities are outlined in the MokeWISE Water Availability Analysis. This task will further analyze potential non-Mokelumne surface water supply opportunities and potential conveyance alternatives and summarize the costs and benefits of each alternative. Urban Water Management Plans (currently being updated) may provide new or updated information on potential water transfer opportunities. Additionally, this task will identify partners necessary to realize water supply transfers and conveyance and provide guidance on partnership-building.

- **Continue MOCASIM modeling efforts.** Identified new or modified water diversions will continue to be modeled using MOCASIM to assess environmental, water supply, geomorphic and other potential impacts caused by diverting Mokelumne River water for the proposed groundwater banking project. This will be done as a collaborative process including interested former members of the Mokelumne Collaborative Group (MCG) and will represent a continuation of the analysis currently being completed in the MokeWISE program with the goal of identifying operational parameters that may provide a groundwater banking benefit while minimizing impacts or providing benefits to the environment.
- **Evaluate water rights.** Assuming the sources of water identified in the Water Supply Availability Analysis, a more detailed assessment of related water rights issues will be conducted under this task. This analysis will identify key water rights issues associated with each source, including restrictions on the potential supplies and/or limitations to infrastructure required for water diversion and/or conveyance.
This task would also involve identifying partners to apply for a new water right or modify an existing right, if needed to support the preferred operating condition. This task will assess the legal feasibility of and options for allowing CCWD, CPUD, Amador Water Agency, and/or Jackson Valley Irrigation District to apply for and assign all or a portion of their area of origin reservations on the Mokelumne River. Evaluation of beneficial uses and potential constraints will be evaluated accordingly in subsequent tasks.
- **Identify impacts and constraints of utilizing surface water for groundwater banking.** This task will identify potential impacts and constraints to river flows, domestic water supply, regional politics, legal issues, the environment (both species-related and geomorphic), economics, and recreation. The results of this task will be used to inform the groundwater banking project development and identification of preferred alternatives processes.
- **Identify existing and future infrastructure needed to utilize surface water supplies for recharge.** The Mokelumne River has numerous existing diversions and associated canals and pipelines. This task would evaluate the feasibility of utilizing or upgrading existing diversions for conveyance of Mokelumne River water to recharge basins in the Eastern San Joaquin County Groundwater Subbasin. This task would also identify new infrastructure needs and develop preliminary concepts and cost estimates associated with new infrastructure alternatives. Additionally, feasibility of utilizing new surface water allocations for in-lieu groundwater banking will be evaluated. In-lieu banking may also require new or modified infrastructure.
- **Identify gainsharing opportunities to consider that a portion of previously unappropriated water be reserved for in-stream use.**

Task 3. Define Project

Development of a groundwater banking project in Eastern San Joaquin Groundwater Basin will likely require multiple phases or iterations of planning and design. The following tasks describe the project development work that will be completed for the groundwater banking project. Potential water supply sources for the project remain flexible, but must be refined as the preferred alternatives are defined. Information developed as part of the groundwater recharge demonstration project being implemented by EBMUD and San Joaquin County will be utilized to inform project development. Consistent with the intent of MokeWISE, the proposed project will be designed to be environmentally, economically, and socially acceptable. No aboveground storage reservoir between Salt Springs Reservoir and Pardee Reservoir will be considered in this study.

Subtask 3.1 Data Collection and Review

Many studies have been implemented to develop relevant information on potential recharge opportunities in the Eastern San Joaquin Groundwater Basin. Existing information will be collected and reviewed, serving as a foundation for implementation of subsequent tasks.

Subtask 3.2 Identify Potential Well Locations (and in-lieu recharge areas such as irrigation areas)

As part of the groundwater banking project alternatives development process, it will be important to identify best location candidates for infiltration basins, as well as aquifer storage and recovery (ASR) wells and / or separate injection and extraction wells as appropriate. A series of criteria should be developed to identify preferred locations, as well as areas with possible issues. Criteria for identifying locations for infiltration basins and wells should include:

- Soil type and recharge potential
- Distance from existing infrastructure
- Location of demands
- Existing and planned land use
- For agricultural lands, permanent versus temporary crops

The purpose of this task is to identify potential locations for groundwater replenishment projects for further feasibility analysis and design. Taking agricultural lands out of production will need to be evaluated per County policy and within the context of CEQA.

Subtask 3.3 Identify and Evaluate Project Alternatives

Information about the current conditions of the groundwater basins, potential water supply analyses, and coordination needs will be assessed to develop alternative groundwater banking project scenarios, including infrastructure needs, evaluation of the suitability of selected recharge methods (i.e. field flooding, ponding, injection, flood irrigation, etc.) and define the characterization of potential benefits that could be realized under each scenario. Preferred groundwater banking project alternatives will be developed through MokeWISE participants workshops and other collaborative opportunities. Evaluation criteria will consider, at a minimum, economics, water availability, diversity of sources, degree to which projects contribute to a long term groundwater balance, and environmental benefits (including cold water pools, pulse flows, increased summer flows, and enhanced recreation).

For each project alternative, the study will identify the sources of the water supply, including stormwater, recycled water, and conserved water. It will also identify the timing, availability, and amount of the proposed water uses. Water uses may include, but are not limited to, irrigation, water banking, aquifer recharge, and in-stream use. For each alternatives, the study will present current and reliable data on the "population to be served" and its future water requirements if water is to be used for municipal purposes. The study will map and identify the land to be irrigated, its acreage, and its irrigation needs, if the project is seeking water for agricultural purposes.

Concept level diagrams of preferred project alternatives will be prepared, along with conceptual level cost estimates. The evaluation will also include a preliminary analysis of the frequency and magnitude of water supply availability for each water supply type described in the sections above.

Subtask 3.4 Prepare an Economic Assessment of Preferred Project Alternatives

An economic assessment of the preferred groundwater banking project alternatives will be completed. This assessment will include:

- Identification of market valuation of potential groundwater banking project water supplies as compared to local, regional, and state-wide urban and agricultural water supplies.
- Identification of conceptual financing options, including identification of potential grants, low interest loan programs, municipal bonds, and private equity financing.
- Identification of potential purchasers and/or program partners interested in incremental water supply and/or water storage/reliability improvements.
- Alternatives comparison based on a range of cost per acre-foot of annual yield.
- Calculation of potential return on investment.

This task may also include a preliminary market assessment on the feasibility of a program that goes beyond local water resources management and to understand the outside market and answer key questions related to pricing and willingness of other agencies to enter into long-term water banking/transfer partnerships.

Subtask 3.5 Prepare a Detailed Project Alternatives Analysis and Preliminary Design

A detailed alternatives analysis will be conducted on the alternatives developed in Task 5.2. These analyses will include the use of MOCASIM, surface water-groundwater model, reservoir operation models, and Decision Support System models (i.e. WEAP) to evaluate the alternatives in a more detailed manner, evaluating a range of water year types and conditions, to identify those alternatives that provide the greatest flexibility and adaptive management opportunities and therefore are best suited to perform under a wider range of potential future hydrologic conditions. Analyses to be conducted in this task include evaluating how the preferred alternatives perform under a range of anticipated future climate changes and possible regulatory frameworks.

For each project alternative, the study will identify the amount, or possible amounts, of water that will stay in-stream to meet recreation, fish, wildlife, and water quality needs in all water year types.

For each project alternative, the study will identify how public access to the Mokelumne River for fishing, recreation, commerce and other benefits is protected or enhanced.

For each project alternative, the study will identify the degree to which the project would contribute to a long-term balance of water supply and demand.

The analyses will also refine the infrastructure needed to deliver water under the preferred alternatives and consider the operation, maintenance and life-span of required infrastructure. Ultimately, the analyses will include a detailed consideration of both capital and O&M costs in determining the overall alternative costs under a variety of hydrologic scenarios.

To the extent feasible, facilities description(s) and conceptual level plans will be prepared for the alternative(s) selected. These descriptions will identify approximate areas of potential effects, construction methods, excavation quantities, truck trips, etc. to support later preparation of the appropriate level of environmental documentation. The study will evaluate the alternatives in the context of existing uses, licenses and permits. The study will evaluate effects on the operation of the alternatives on upstream water users, EBMUD water users, and flood control beneficiaries.

Subtask 3.6 Prepare Preliminary Environmental and Regulatory Analysis

In this task, environmental and regulatory issues that will likely arise as a result of implementation of the preferred alternative(s) will be determined and summarized. The CEQA Initial Study Checklist will be used to guide the environmental evaluation and determine the best CEQA/NEPA approach. Regulatory/institutional considerations will include the blending of different supplies (groundwater, surface water, recycled water and stormwater), the potential for indirect potable reuse of recycled water, and the possible impacts of existing political relationships and state legislative trends.

The study includes consultation with local land use agencies to identify feasible means of reducing impacts of development associated with new water customers anticipated to be served with water resulting from this project. Results of these consultations with any recommendations shall be published in the study.

The study will identify the compatibility of a Wild and Scenic Designation for the Mokelumne River in conjunction with implementation of any groundwater banking projects.

Subtask 3.7 Prepare Preliminary Financing Plan

In this task, a financing plan would be developed for the preferred project alternatives, identifying possible outside funding programs and funding mechanisms, considering varying economic feasibility over time. This plan will include evaluation of short-term bridge loans that may be required in conjunction with State and Federal grants and loans. It will also identify potential funding mechanisms that could supplement or augment state and federal loans and grants, evaluate project agreements with respect to funding, and provide initial pro forma evaluations of each agency's ability to fund/finance their respective share of the project incorporating identified loans and grants.

The study shall identify one or more ways in which the projects' water supply will be shared; and one or more ways the capital, operations, and maintenance costs of the project will be shared. Following the study, but before the water utilities make further legal commitments, financial commitments, funding applications, or permit applications associated with a groundwater banking project, the water utilities will identify water supply and cost sharing options acceptable to the utilities.

Task 4. Establish Governance Framework

This task will develop the governance framework under which the project alternative(s) would operate. This analysis will identify the advantages and disadvantages of the various governance models, identify potential cooperating and participating agencies, recommend a governance framework for implementation and outline the next steps required towards establishing that framework.

Task 5. Implement Outreach and Coordination

Public and stakeholder outreach are critical components of regional water project development. In order to successfully develop a groundwater banking project in the region, many different stakeholders and interested parties will need to be engaged, coordinated with and consulted along the way.

Subtask 5.1 Coordinate with Stakeholders.

In order to ensure success of the proposed groundwater banking project, it is necessary that a stakeholder group be formed and include all interested parties and stakeholders, including former interested members of the Mokelumne Collaborative Group (MCG), which led development of the MokeWISE program. It is recommended that this group be convened at the outset of the project to discuss its purpose, and solidify project goals. Once the groundwater banking project has been defined, the stakeholder group should determine ultimate objectives for the project that will be used to analyze design alternatives. It is understood that in the course of stakeholder coordination, there may be a need to have confidential contract negotiations between agencies and landowners.

Subtask 5.2 Implement Public Outreach

In this task the project team will reach out to City and County officials, resource agencies, other agency officials, the agricultural community, other interested stakeholders, and the general public to provide information on the program analysis and recommended alternatives consistent with the intent of MokeWISE to create environmentally, socially, and economically acceptable alternatives. This support includes, but is not limited to, development of summary or outreach documents, coordination of meetings with representatives of State and Federal agencies, meeting with water agencies that may participate in the project and presentations to public officials and the general public.

Task 6. Final Report and Documentation

A study report will be prepared summarizing the groundwater banking project alternatives developed, and providing discussion as to the relative feasibility and benefits (e.g., water supply reliability, revenue streams, other economic benefits, other benefits) of each of the identified alternatives and key issues (institutional, regulatory and/or environmental) associated with each alternative. A discussion of the potential return on investment will also be provided, along with recommendations regarding additional detailed analyses needed prior to project implementation.

Budget

The estimated budget for this study is assumed to be $3,605,000, as it includes a wide array of elements, may include some preliminary field investigations, and will require extensive stakeholder coordination, particularly for the Mokelumne supply analyses. Estimated costs associated with the study can be broken down as follows:

- Task 1: $175,000
- Task 2: $930,000
- Task 3: $2,000,000

- Task 4: $100,000
- Task 5: $150,000
- Task 6: $250,000
- **Total Project Cost: $3,605,000**

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MokeWISE Program Methodology:
Project 4b: Amador and Calaveras Counties Hydrologic Assessment

April 2015

Problem Statement and MokeWISE Stakeholder Interests

The current and future rural populations within Calaveras, Amador, and other Sierra Nevada foothill counties is putting increasing pressure on local water resources. Part of that growth is dependent on groundwater supplied from individual or community wells. However, a significant number of wells fail either as a result of droughts or simply due to the structural inability of the local groundwater system to yield the required demand. Furthermore, such failures likely will be exacerbated by climate change due to impacts on groundwater recharge. Because recharge is the small fraction of precipitation remaining after runoff and the soil-water use of the vegetation cover, a small climatic change will have an exaggerated impact on groundwater.

Very little quantitative information is available on the carrying capacities of the local groundwater systems within Sierra Nevada foothill areas. Those groundwater systems occur mostly in poorly permeable fractured rock, within which groundwater storage is limited to the small volume represented by the fracture openings. Natural recharge occurs seasonally from the deep percolation of precipitation during the winter. However, the recharge is the small percentage of precipitation remaining after the loss of precipitation to runoff or the consumptive use of vegetation. This characteristic makes the foothill groundwater systems very sensitive to seasonal, year-to-year, and long-term changes in precipitation.

While the foothill groundwater systems can be described qualitatively, little quantitative information is available. However, making land use and water-resource decisions would be greatly facilitated by developing a quantitative assessment of the local carrying capacity for the foothill groundwater systems. Information is needed regarding the recharge to these systems with respect to precipitation, soils, vegetation cover, topography, geology, and other factors. Information is also needed regarding the sensitivity of yields to drought and potential climate change. Finally, tools are needed so that decision makers can apply such quantitative information to specific situations.

This study seeks to answer questions regarding groundwater recharge in Amador and Calaveras Counties so that sustainable groundwater evaluations can be determined to guide land use decisions and provide direction to water agencies to meet planned water needs.

The estimated preliminary cost for this study is $600,000.

Some entities have many interests affected by groundwater, including the following:

- Approving projects only if there is adequate water to serve them;
- Protecting key agricultural lands;
- Ensuring that land uses do not put conversion pressure on agricultural lands.

In Calaveras County, both local utilities, the Environmental Health Department, and at times the Board of Supervisors have emphasized the unreliability of groundwater for domestic supplies. In addition, it has long been recognized that agricultural operations have limited access to inexpensive alternatives to groundwater. As a result, there has been support to leave groundwater resources to support agricultural activities in Calaveras County, while locating new commercial, industrial, and residential development in proximity to existing community centers, where they can be served by water utilities using surface water supplies. Additional groundwater studies may strengthen the support for such a position.

Considerations for this project include:

- If and how to replace groundwater lost to climate change. This study could provide information on economically, socially, and environmentally sound options.
- If and how to fairly limit the correlative use of groundwater so that the resource is sustained. This study could provide information on promising options.

Project Information

Project Description

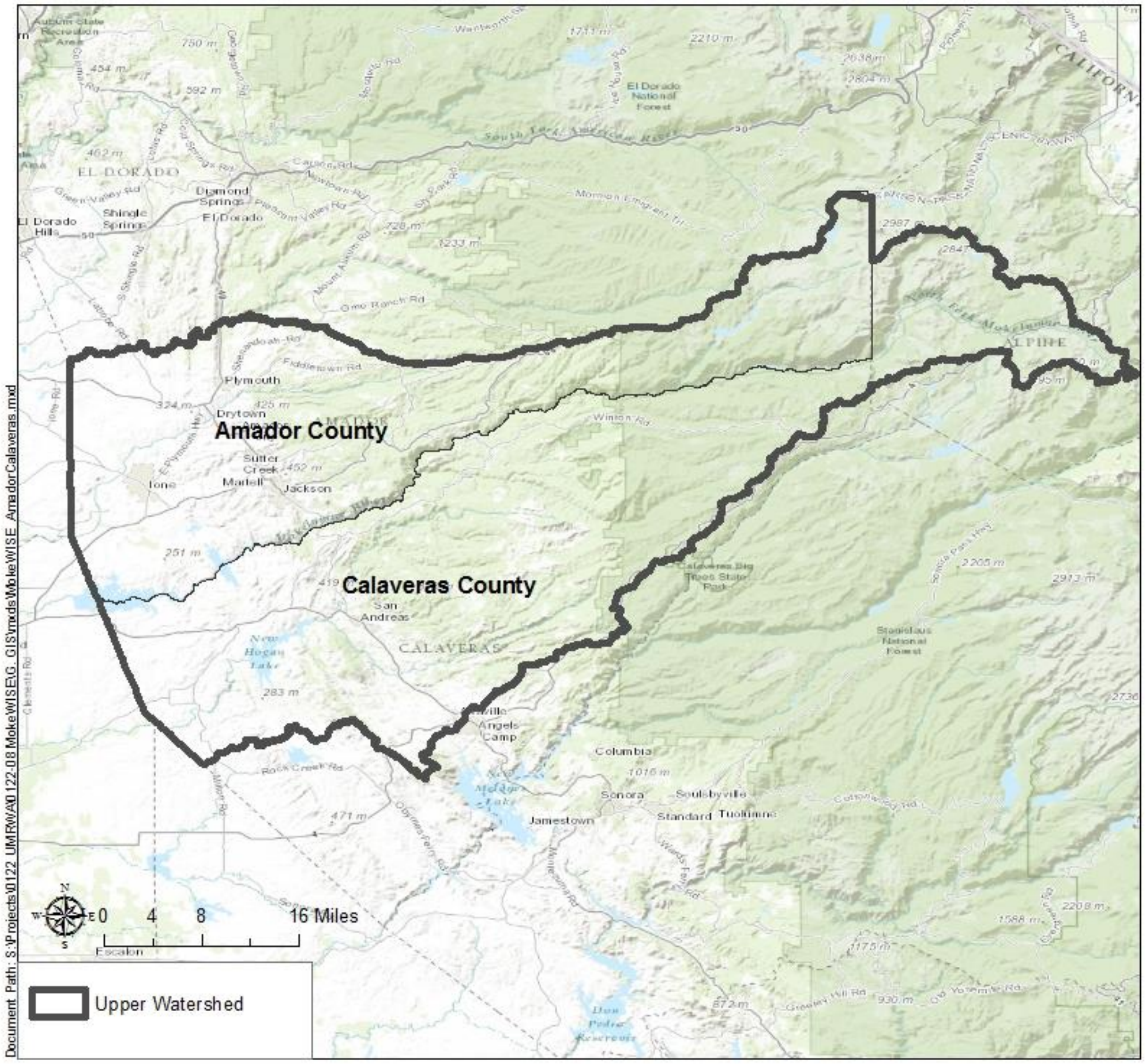
The overall study approach is to characterize the groundwater setting by using watershed water budgets to estimate recharge. Watersheds with streamgaging data would be used. The watershed-scale recharge estimates would be partitioned to smaller geographic scales based on the geographic distribution of precipitation, vegetation cover, soils, geology, and other watershed characteristics. The information derived from gaged watersheds then would be extrapolated to the entire study area. The ultimate work product would be a characterization of the groundwater carrying capacity for the entire study area.

The study will involve characterizing the hydrogeology, existing groundwater use, groundwater recharge and discharge, and groundwater carrying capacity within the foothill areas of Amador and Calaveras Counties.

Project Location

The study will encompass areas within Amador and Calaveras counties, as shown below in Figure 1.

Figure 1: Amador and Calaveras Counties



Project Sponsor

The lead sponsors for this project are Amador Water Agency and Calaveras County Water District. Jackson Valley Irrigation District has been identified as the co-sponsor.

Scope of Work

Task 1. Hydrogeologic Setting

The study area is underlain by a variety of rock and deposits, and the characteristics of those materials have a fundamental influence on the occurrence and availability of groundwater. To characterize the hydrogeologic setting, geologic, lineament, and hydraulic maps will be produced for the study area.

Subtask 1.1 Geology

The geologic setting represents a primary influence on the occurrence and availability of groundwater within the study area. Groundwater occurs in regional distribution of fractured igneous and metamorphic rocks, and it occurs in local distributions of overlying alluvial deposits.

A geologic map will be prepared for the study area from existing mapping. Existing mapping will be compiled from the U. S. Geological Survey, California Geological Survey, geologic journals, university dissertations, and other sources. This mapping will be compiled into an overall geologic map of the study area. To the extent allowed by the existing information, the compiled map will delineate the occurrences of subunits within the igneous and metamorphic rocks.

Subtask 1.2 Geologic Lineaments

Geologic lineaments represent the effects of fracturing and faulting of rocks. Correspondingly, the transmissivity of the underlying rocks often is correlated with the density and other characteristics of mapped lineaments. Lineaments are defined as linear geologic features that can be mapped from aerial and satellite images. However, the density and other characteristics of mapped lineaments depend on both the characteristics of the images and the method used to delineate lineaments on the images. Different image characteristics or delineation methods will produce a different lineament map. Nevertheless, a useful lineament map can be produced with a set of sufficiently detailed images and an objective delineation method.

Based on these considerations, a lineament map will be prepared for the study area. The purpose of the map is to quantify the density and other characteristics of lineaments over the study area. That quantification will be used within other elements of the study to facilitate characterizing the geographic distribution hydraulic conductivity and other hydraulic characteristics of the rocks underlying the study area. The map will be based on existing aerial or satellite digital images. Quantitative procedures will be used to delineate lineaments on the digital images.

Subtask 1.3 Hydraulic Characterization

The transmissivity of the rocks within the study area depends on the fracture characteristics. The water-transmitting and water-storage capacities depend on the abundance, orientations, lengths, apertures, and other fracture characteristics. Correspondingly, well yields reflect these fracture characteristics. Higher aquifer transmissivity and well yields tend to occur in areas with more abundant fractures, multiple fracture orientations, longer fracture traces, and larger apertures. While aquifer transmissivity can be derived from the small-scale mapping and testing of fractures, that approach is impractical for characterizing the overall geographic distribution of transmissivity within study area. The alternative approach will be to identify the statistical patterns represented in the well data for the study area.

The California Department of Water Resources has well-completion reports on most of the existing wells within the study area, and those reports will be used in the characterization of aquifer transmissivity within the study area. The reports contain information on the well location, depth, construction, geologic setting, and other information. A significant number of the reports contain the results of a well-yield test, where the results tend to include information on the pre-test groundwater level, pumping rate, test duration, and water-level drawdown. That information will be translated into the local transmissivity of the groundwater system near the well. The approach will involve three steps as follows:

<u>Compile Data</u>. Well-completion reports will be obtained from the California Department of Water Resources for all the reported wells within the study area. The information within the reports will be entered into a geospatial database. Protocols will be developed and applied to the database to screen for unreliable data and to correct or delete such data.

<u>Estimate Transmissivity</u>. For wells with data on a pumping rate and drawdown, those data will be translated into the aquifer transmissivity at the well. The ratio of the pumping rate over the drawdown is the specific yield for the well. The transmissivity will be estimated by scaling the specific yield based on a factor derived from the Theis or similar equation. This is a well-established general procedure, but specific scaling factors will be developed for the study area.

<u>Characterize Aquifer Physical Properties</u>. Water-transmitting fractures tend to decrease in abundance and aperture with depth below the land surface, with a corresponding decrease in aquifer hydraulic conductivity with depth. The decay in hydraulic conductivity typically crates an effective local base to the groundwater system at several hundred feet below the land surface. The decrease in depth is often described with an exponential, power, or similar decay function. Such a function will be fitted statistically to the transmissivity data to derive both parameter values for the decay function and the effective thickness of the groundwater system. However, the decay function most likely will have a spatial variability corresponding to geographic factors such as geologic unit, topography, lineament characteristics, and other

variables. To incorporate these variables, a geostatistical analysis will be applied to develop a relation describing the geographically variability of hydraulic conductivity throughout the study area. The results of that analysis will be used to develop maps showing aquifer physical properties throughout the study area.

Task 2. Existing Groundwater Use

Water budgets will be used to quantify the hydrologic characteristics of the groundwater systems within the study area. The existing groundwater use will be an element of the water budgets. Correspondingly, groundwater pumping within the study area will be estimated. Additionally, the returns from irrigation and wastewater disposal will be estimated, for returns generated by either groundwater or surface-water use. The approach will involve three steps as follows:

Compile Data. Data will be compiled from existing sources. Land-use and population data will be compiled from sources such as Amador and Calaveras counties, water districts, cities, California Spatial Information Library, U. S. Census, U. S. Geological Survey, National Resources Conservation Service, and other sources. Water-use information will be compiled from Amador and Calaveras counties, water districts, and other sources. Maps showing water-distribution areas will be obtained from cities, water districts, and other water purveyors. Satellite and aerial imagery will be obtained from the U. S. Geological Survey and other sources. Data will be entered into a geospatial database

Estimate Groundwater Pumping. Groundwater pumping by individual users and community water-supply systems will be estimated. For individual residences outside a public or community service area, groundwater pumping will be estimated based on the occurrence of a residence, the unit interior water use per residence, and the irrigated area per residence. For individual agricultural users, groundwater pumping will be estimated from the irrigated acreage and vegetation type. For public or community water-supply systems, groundwater pumping will be estimated from available water-delivery records or the estimate number and type of connections within the service area. Satellite imagery will be an important tool for identifying irrigated acreages. Existing satellite based delineations of irrigated acreages will be obtained from the California Spatial Information Library, U. S. Geological Survey, and National Resources Conservation Service. Those delineations will be supplemented with an analysis of multi-spectral satellite imagery obtained from the U. S. Geological Survey and other sources. That analysis will include delineating the distribution of the Normalized Difference Vegetation Index (NDVI), which is a measure of vegetation vigor. The work product will be a map showing the geographic distribution of gross groundwater pumping throughout the study area.

Estimate Irrigation and Wastewater Returns. Irrigation and wastewater returns, which represent groundwater recharge from irrigation and wastewater disposal, will be estimated, including returns from surface-water use. For irrigation returns, they will be estimated based on the delineation of irrigated areas, applied water, precipitation, potential evapotranspiration, and the effective crop coefficient for the vegetation. While the potential evapotranspiration and precipitation will be derived from existing climatic data, the effective crop coefficient will be derived from the NDVI derived from satellite imagery. However, the calculation of returns is linked to the calculation of groundwater pumping by common data elements, and a certain amount of adjusting of both quantities will be required in order to obtain pumping and return that are consistent with irrigated acreages, crop types, potential evapotranspiration, cultivation and irrigation practices, precipitation, and other factors. For wastewater returns from residences with individual septic systems, returns will be estimated based on the interior water use. For public or community wastewater treatment systems, returns will be estimated based on either available records or on the number and type of connections and the receiving water. The work product will be a map showing the geographic distribution of groundwater returns throughout the study area.

Task 3. Groundwater Recharge

Groundwater recharge will be identified for selected watersheds within the study area and then extrapolated to the overall study area. The extrapolation will be accomplished by developing, from the selected watersheds, a relation that expresses recharge as a function precipitation, soils, vegetation cover, geology, topography, and other factors. The selected watersheds will be analyzed by constructing surface-water and groundwater budgets for each. The approach will involve seven steps as follows:

Compile Data. Existing streamflow, climatic, soils, vegetation, groundwater, and other data will be compiled for the study area. Streamflow data will be compiled from the U. S. Geological Survey, California Department of Water Resources, water districts, and other sources. Climatic data will be compiled from the National Weather Service, California Department of Water Resources, and other sources. Soils data will be compiled from the National Resources Conservation Service. Vegetation data will be compiled from the U. S. Geological Survey, National Resources Conservation Service, and other sources. Multispectral satellite or aerial imagery will be obtained from the U. S. Geological Survey. Groundwater-level and chemistry data will be compiled from the U. S. Geological Survey, California Department of Water Resources, and other sources. The streamflow, climatic, soils, vegetation, groundwater, and other data will be entered into a geospatial database.

Identify Watersheds. Watersheds will be selected for the development of water budgets. The watersheds most likely will have areas ranging from 1 to perhaps10 square miles, but other watershed areas will be considered. Watersheds will be selected to represents a variety climatic, vegetation, and geologic settings. Watersheds will be selected where the boundaries of the local groundwater system coincide with the boundaries of the watershed.

While this is the primary selection criterion, the availability of existing hydrologic data also will be an important consideration.

Collect Supplemental Data. The existing data for the selected watersheds probably will not meet the study needs, and supplemental data will be collected. Most likely, supplemental streamflow and groundwater monitoring will be required. With respect to streamflow, continuous streamflow data will be collected at some sites, while periodic streamflow measurements will be made at other sites. With respect to groundwater conditions, data will be collected in existing wells. Continuous water-level data will be collected in some wells, and periodic water-level measurements will be made in other wells. In addition, water samples from some wells will be analyzed for chloride and other constituents, where the chloride data will be used in the estimation of groundwater recharge. All of the collected data will be entered into a geospatial database.

Estimate Recharge Using Water Budgets. The groundwater recharge within the study watersheds will be identified based on the construction of surface-water and groundwater budgets for each watershed. Recharge will be calculated as the residual of the groundwater budget. Additional, recharge will be calculated independently based firstly on a chloride mass balance approach and secondly on the consumptive use of the vegetation cover. Water budgets will be constructed for average annual conditions. If the existing and supplemental data allow, water budgets with be constructed additionally for a set of representative wet and dry years.

Water-budget components will be quantified based on the compiled and supplementary geologic, climatic, streamflow, and groundwater data data. The surface-water budgets will be used to partition precipitation into runoff and infiltration and to identify stream-aquifer interactions. The principal outflow component of the surface-water budget is runoff, which will be identified by partitioning measured streamflow into runoff and baseflow. The baseflow in turn represents the net groundwater discharge to the stream. The groundwater-budget terms other than recharge will be quantified, and precipitation recharge will be calculated as the difference between the quantified inflow and outflows. The water-budget inflows include the precipitation recharge, streamflow recharge to the groundwater system, and recharge from water-use returns. The outflows include groundwater discharge to the stream, groundwater consumption by phreatophytes, groundwater underflows, and pumping.

Estimate Recharge Using Chloride Method. The chloride method will be used to derive an independent estimate of precipitation recharge. The method involves constructing a chloride budget for the soil profile. The inflow for the budget is the dissolved chloride flux represented by precipitation. The outflow is the chloride flux represented by the deep percolation of precipitation below the rooting zone of the vegetation cover. The percentage of precipitation that becomes recharge is the ratio of the dissolved precipitation chloride over the dissolved percolation chloride. The precipitation flux includes both wet and dry fall, which will be characterized based on existing precipitation data or the collection of supplemental data. The percolation flux will be characterized based on groundwater samples collected form existing wells.

Estimate Recharge Using Satellite Images. Satellite imagery will be used to derive an additional independent estimate of precipitation recharge. An image analysis will quantify the consumptive use of the vegetation cover, and the recharge will be calculated as the difference between the precipitation infiltration and vegetation consumptive use. The image analysis will be based on the Normalized Difference Vegetation Index (NDVI), which is calculated from the red and near infrared reflectances. The NDVI value for a pixel corresponds to the crop coefficient for that pixel. Correspondingly, an appropriately scaled NDVI value multiplied by the potential evapotranspiration yields the actual evapotranspiration. The image analysis will be conducted for a sample set of wet and dry years. For each selected year, monthly images will be analyzed to derive the seasonal variations in consumptive use, and subsequently to calculate the annual consumptive use.

Extrapolate Results. The recharge estimated for the study watersheds will be extrapolated to the overall study area by relating recharge to topographic, geologic, climatic, and vegetation characteristics. To incorporate these variables, a geostatistical analysis will be applied to develop a relation describing the geographically variability of precipitation recharge throughout the study area. The results of that analysis will be used to develop maps showing recharge throughout the study area.

Task 4. Groundwater Carrying Capacity

Assessing the carrying capacity of the groundwater systems within the study area is more complicated than considering just the recharge. The response of groundwater systems to development is characterized by lower groundwater levels and the capture of natural discharge. This is demonstrated by comparing the natural and developed states of a typical groundwater system.

Under natural conditions, groundwater flow is in general accordance with topographic slopes within the watershed. Correspondingly, the boundaries of the groundwater system tend to coincide with the boundaries of the watershed. Groundwater flows in the subsurface down the hillslopes toward the watershed axis, and it then flows down the axis. Often the groundwater table on the hillslopes will intersect the land surface in draws and other topographic features. At those intersections, seasonal seeps and springs that support groundwater dependent vegetation, where the consumptive use of that vegetation represents discharge from the groundwater system. Likewise, the groundwater table along the watershed axis will intersect the stream channel, and that intersection produces seasonal discharge from the groundwater system into the channel. The shallow groundwater table along the watershed axis additionally will support the growth of phreatophytes, where the consumptive use of that vegetation represents another discharge from the groundwater system. Under this natural condition, the discharges from the groundwater water system equal the recharge to the system such that the long-term discharge equals the long-term recharge.

Groundwater development disrupts the natural equilibrium of the groundwater system. The effect of development is the capture the natural discharge from the groundwater system. Pumping causes groundwater levels to decline, including within the shallow-groundwater areas where groundwater is consumed by vegetation or discharges to a stream channel. Corresponding to the reduction in groundwater levels, the consumptive use of groundwater by vegetation is reduced and the groundwater discharge to streams is reduced. The impact is to reduce the acreage or density of groundwater dependent vegetation and to reduce the baseflows in streams. Given sufficient time, these natural discharges will be reduced by the quantity of the net pumping within the watershed, and a post-development equilibrium will be established. That net pumping is the pumping less the wastewater or irrigation returns to the groundwater system, which is identical to the consumptive use of the pumped groundwater.

The groundwater-level declines associated with development depend on the proximity of the pumping to areas of natural groundwater discharge. Furthermore, the declines do not depend on the recharge to the groundwater system, except that the natural discharges are an expression of the recharge. If a water-supply well is located near a natural discharge, the natural discharge will be captured, and a new equilibrium established, with a small long-term groundwater-level decline near the well. If a water-supply well is located distant from a natural discharge, the capture of the discharge will correspond to a large long-term groundwater level decline near the well. With sufficient distance from an area of natural discharge, the decline required to produce a post-development equilibrium will exceed the usable aquifer thickness, and the well will go dry. This will be the case regardless of the natural recharge within the vicinity of the well.

The sustainability of groundwater development within the study area depends on the ability to capture natural discharge. However, the capture of natural discharge will impact groundwater-dependent vegetation and baseflows in streams. To address these issues, response functions will be developed that describe the expected long-term impacts of pumping at particular locations on groundwater levels and natural discharge. This most likely will involve developing groundwater models of the study watersheds and then using the model results to develop relations that can be applied throughout the study area.

Task 5. Outreach and Coordination

Targeted and public outreach are critical components of regional water project development. In order to successfully develop a groundwater supply study project in the region, many different stakeholders and interested parties will need to be engaged, coordinated with and consulted along the way.

Subtask 5.1 Perform Outreach and Public Discussion for Project Development

In this task the project team will reach out to former MokeWISE Mokelumne Collaborative Group (MCG) members, City officials, other agency officials, the agricultural community, other interested stakeholders and the general public to provide information on the program analysis and recommended alternatives. This support includes, but is not limited to, development of summary or outreach documents, coordination of meetings with representatives of State and Federal agencies, meeting with water agencies that may participate in the project and presentations to public officials and the general public. Coordination with former interested members of the MCG and other interested stakeholders will be implemented throughout the project.

Subtask 5.2 Coordinate with Groundwater Sustainability Agency(ies) (GSAS)

The recently signed Sustainable Groundwater Management Act (SGMA) has the potential to greatly affect groundwater management in the region. Assembly Bill (AB) 1739 requires the formation of a groundwater sustainability agency (GSA) to submit a groundwater sustainability plan (GSP). If multiple GSAs and/or multiple GSPs are created within a single basin, they must be coordinated to achieve overall basin sustainability or be subject to state intervention. AB 1739 also outlines new authorities designated to GSAs, including the ability to impose fees. Senate Bill (SB) 1168 would require that each groundwater basin be characterized with a priority and include consideration of adverse impacts on local habitat and local streamflows. SB 1319 would authorize the State Board to designate certain high- and medium-priority basins as probationary basins. Each of these bills has the potential to alter the groundwater landscape within the MokeWISE region, particularly in the lower watershed.

This task includes coordinating with entities participating in the GSAs for the Eastern San Joaquin and Cosumnes Groundwater Subbasins. The GSA(s) will be responsible for developing and implementing the Groundwater Sustainability Plans (GSPs) for the subbasins. Coordination with the GSA entities should be ongoing throughout this hydrologic assessment process in order to position projects for potential inclusion in the GSP(s) and associated funding opportunities.

Study Products

The overall study will result in a number of work products. While some will address scientific audiences, other work products will address the needs of decision makers and the public. The anticipated work products are as follows:

Prepare Technical Report. A technical report will be prepared that describes the study methods and results. The purpose of the report is to describe the study in sufficient detail that it can be critically reviewed with respect to its scientific foundations and results. The primary audience for the report with be technically oriented stakeholders.

Produce Groundwater Atlas. An atlas will be prepared on the study results. The purpose here is to prepare a reference that will be useful to public decision-makers, the public, and other interested parties. The atlas will be a large-format publication that contains maps, graphs, and text that will be understandable by the non-scientific community.

Develop Geospatial Database. All of the basic data compiled or collected for the study will be entered into a geospatial database. The database will store spatial and temporal data, most likely using the ArcGIS format.

Publish Scientific Papers. Scientific papers will be prepared on critical elements of the study and submitted for publication in a peer-reviewed hydrologic journal. The purpose here is twofold. Firstly, the study methods and results will be subjected to independent critical by journal reviewers. Secondly, the study results will be made available to the wider scientific community. A papers will be prepared on the geologic characterization of the study area, and another paper will be prepared on the quantification of recharge.

Budget

The estimated budget for this study is assumed to be $600,000, as it is expected to include some preliminary field investigations and covers a large geographical area.

References

Dunn Environmental, Inc. 2012. *Groundwater Supply Study and Integrated Regional Groundwater Management Plan for the Lake Camanche Water Improvement District No.7*.

RMC Water and Environment (RMC). 2015. MokeWISE Program Final Memorandum: Water Availability Analysis. January 9.

MokeWISE Program Scope of Work:
Project 4d: North San Joaquin Water Conservation District Infrastructure Improvements

April 2015

Problem Statement and MokeWISE Stakeholder Interests

The North San Joaquin Water Conservation District (NSJWCD) Infrastructure Improvements Project involves rehabilitation of the NSJWCD South Pump and Distribution System, which deliveries water from the Mokelumne River to a portion of the NSJWCD service area. The existing pump and distribution system are out-dated and in a state of disrepair and most irrigated farmland along the system relies on groundwater, rather than utilizing surface water. Rehabilitation of the pump and distribution system will allow NSJWCD to more economically delivery surface water to irrigated farmland along the system, reducing reliance on groundwater pumping in the area. This use will result in in-lieu recharge to the groundwater basin underlying NSJWCD.

NSJWCD's existing surface water source is Permit 10477, which allows the district to extract water from the Mokelumne River in years when water surplus to the needs of EBMUD and other prior right holders is available. Rehabilitation of the South Pump and Distribution System will help enable NSJWCD to put the water available under Permit 10477 to beneficial use.

This Project could also allow NSJWCD to leverage its improved distribution system for groundwater banking. Groundwater banking projects would involve the delivery of additional surface water into the NSJWCD service area, from another source (such as EBMUD). NSJWCD would require that some of the banked water be left in the NSJWCD service area and not extracted, as a condition, in order to obtain local benefits from the banking and assist in correcting overdraft. Such an arrangement would bring additional surface water into the NSJWCD region to help reduce groundwater demand, and would allow NSJWCD to spread the costs of its distribution system and operations among additional users, thereby making the use of the system by local farmers more economical.

Environmental stakeholders in the MokeWISE process share the interest in stabilizing and if possible recovering the groundwater levels in northern San Joaquin County. However, these environmental stakeholders are concerned that additional water may be diverted from the Mokelumne River without improving the groundwater water balance in the NSJWCD service area, or with potential harm to aquatic resources, including anadromous fish. They are also concerned that without monitoring and reporting of groundwater pumping and water use there will be no accountability should groundwater levels in the project area trend down over time.

In 2014, California Sportfishing Protection Alliance (CSPA) and NSJWCD entered into a water rights protest dismissal agreement to address these concerns as they related to the use of water under NSJWCD's Permit 10477. The agreement requires NSJWCD to annually report certain groundwater levels in the project area to CSPA as well as to the State Water Resources Control Board. This reporting will provide a certain measure of accountability and will test the effectiveness of terms in a water right permit as a means to provide it. The agreement also limits the delivery of surface water under Permit 10477 to lands already under cultivation to ensure that surface water deliveries are used to reduce groundwater pumping.

The CSPA and NSJWCD agreement only applies to the use of water under Permit 10477. If the improved NSJWCD system is used for a groundwater banking project, these same concerns will need to be addressed as part of that project.

Costs for the NSJWCD Infrastructure Improvements Project are estimated to be $20 million.

Background Information

North San Joaquin Water Conservation District

The North San Joaquin Water Conservation District (NSJWCD) is a California Water Conservation District. The District's jurisdictional area includes approximately 154,000 acres, of which 4,740 acres are within the Lodi city limits and 5,600 acres are within Lodi's sphere of influence. NSJWCD currently has three pump stations on the Mokelumne River and is in the process of building a fourth. The existing three pump stations include the South Pump station (40cfs), a North Pump Station (40 cfs) and a Woodbridge/Cal-Fed Pump station (15 cfs). The North pump is not currently operational. The Woodbridge pump station was used for a recharge project in 2009 and 2010. The South pump station is operational but in need of rehabilitation.

The new fourth pump station is for the Tracy Lake Groundwater Recharge Project, which was funded in part by a federal Water Smart grant in 2011. The balance of the cost of the project was funded by landowner assessments. The Tracy Lake Groundwater Recharge Project will include a new pump station located on the north side of the river, downstream of Woodbridge dam, and will provide water to irrigated vineyards north of the river.

In 1996, NSJWCD adopted a Groundwater Management Plan (GWMP) meeting requirements of Assembly Bill 3030 (AB3030) to address declining groundwater levels. Actions to address the groundwater quality and quantity issues included securing a surface water supply and implementing efficient water application methods. NSJWCD has a 20,000 AFY Mokelumne River water appropriative water right, Permit 10477. Permit 10477 is junior to the rights of Woodbridge Irrigation District and EBMUD, therefore there is generally only water available to NSJWCD under Permit 10477 in normal to wet years. The lack of annual reliability of this water supply has historically meant that farmers were reluctant to invest in the dual surface and groundwater irrigation system necessary to use it when it was available, and preferred to rely on groundwater only. However, currently there is a strong interest by farmers in NSJWCD in using surface water to supplement groundwater supplies and help correct overdraft.

Between 2007 and 2015, NSJWCD has had pending water right petitions related to Permit 10477 to allow it more time to put the full amount of water under the Permit to beneficial use and make various changes to points of diversion and place of use. CSPA, WID and EBMUD all protested the petitions. In 2014, all three protests were resolved by agreement. Also, in 2014, NSJWCD completed environmental review for the change petitions and the use of the full amount of water under Permit 10477 with the requested extension of time. Key aspects of the settlement agreements include:

- Recognition of WID's prior rights.
- Agreement not to interfere with Joint Settlement Agreement ("JSA") fishery flows or activities.
- Commitment to deliver water available under Permit 10477 to previously cultivated lands rather than to serve new demands.
- Commitment to groundwater monitoring and reporting.
- Financial assistance from EBMUD to NSJWCD for its South System.
- Additional wet and dry year water for NSJWCD from EBMUD if a groundwater banking program can be established.

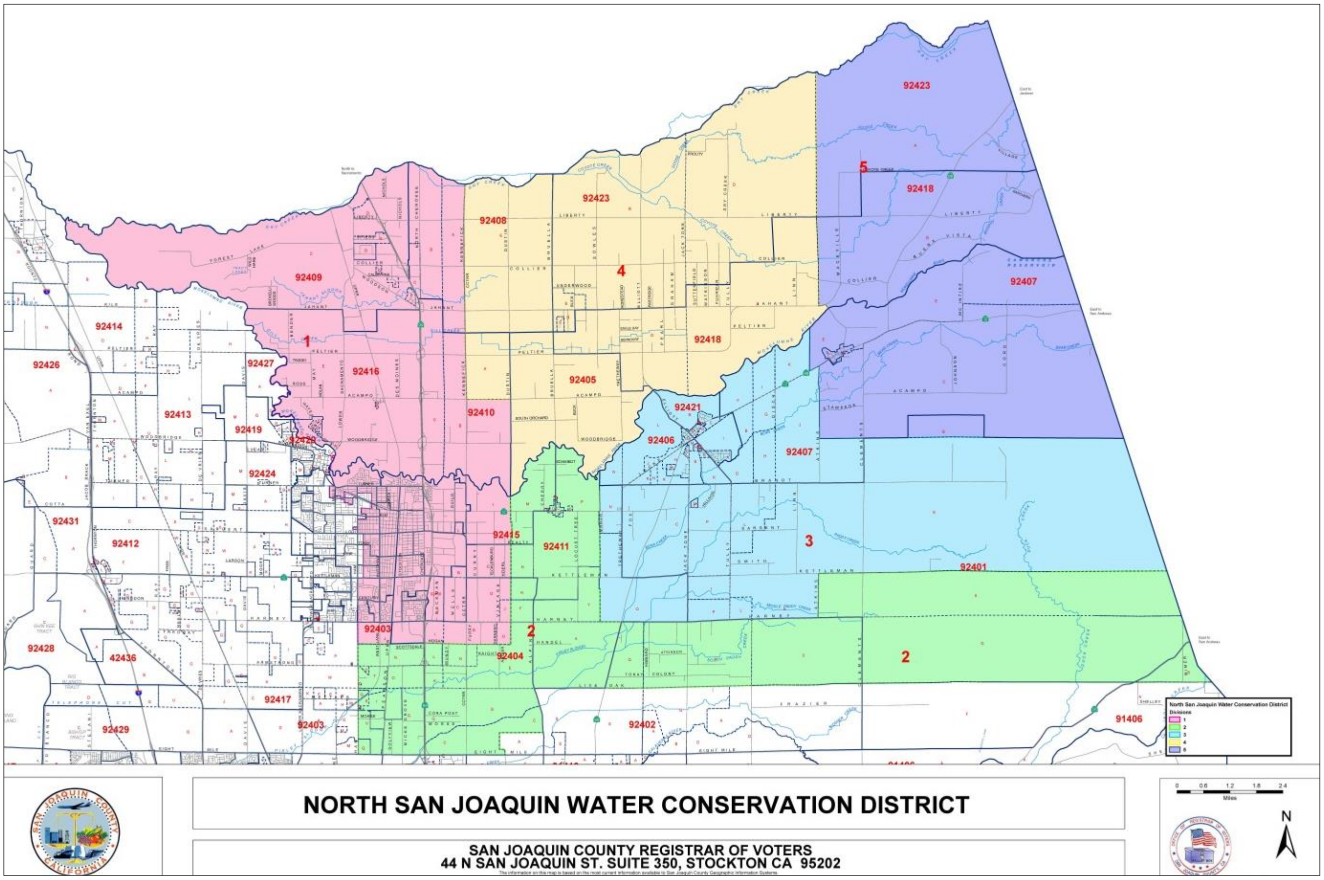
The State Water Resources Control Board approved the NSJWCD water right petitions on March 30, 2015.

Project Information

Project Location

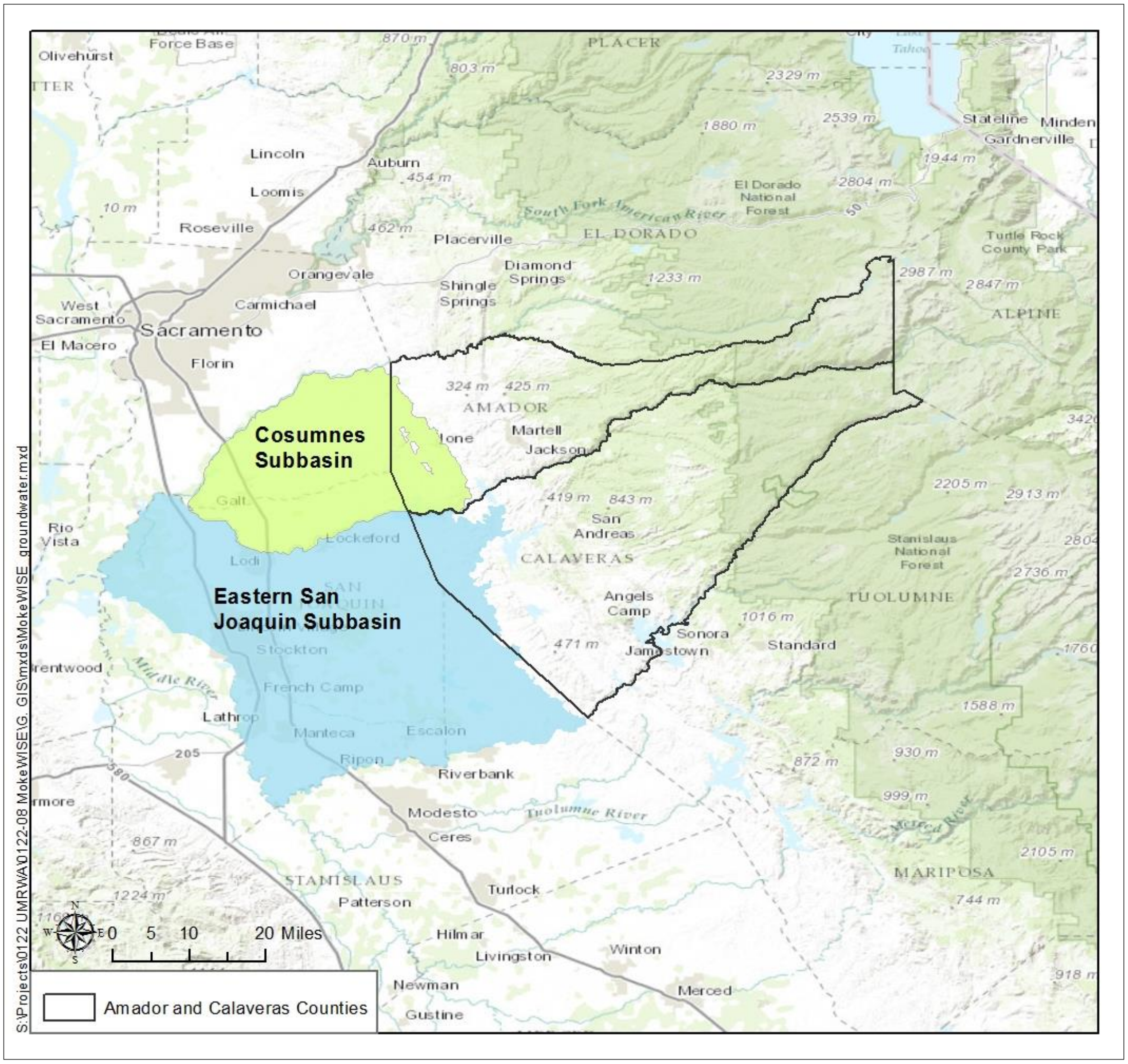
This Project is located within the NSJWCD service area in the lower Mokelumne River watershed. Error! Reference source not found. shows the NSJWCD service area. The lower Mokelumne River watershed is comprised of portions of the Eastern San Joaquin and Cosumnes Subbasins as shown in Error! Reference source not found..

Figure 1: NSJWCD Service Area



Source: NSJWCD Website

Figure 2: Lower Mokelumne River Watershed and Subbasins

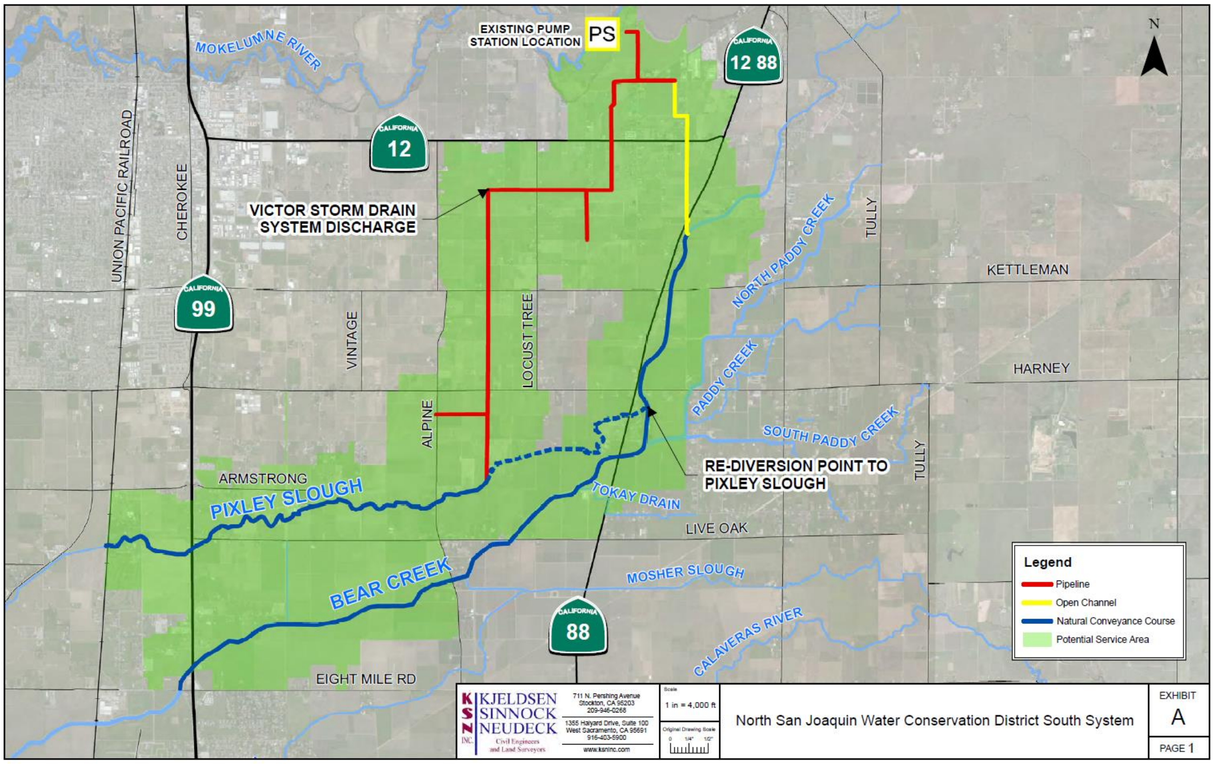


Source: RMC, 2015

Project Description

The NSJWCD Infrastructure Improvements Project (Project) includes the repair and rehabilitation of the NSJWCD South Pump and Distribution System. The existing system consists of a series of older pumps and a network of cast in place concrete pipes and open ditch channels - all of which are located south of the Mokelumne River. See **Figure 3**, below.

Figure 3: Existing NSJWCD South System



There are 10,252 acres of irrigated farmland within 2000 feet of the existing south distribution system, with an estimated annual water demand of 24,400 afa. In most years, this demand is met entirely with groundwater. In recent years when surface water has been available under Permit 10477, 3,000 to 6,000 af was delivered along the south system.

With a current capacity of 30 cfs (at best), the south system can deliver 8,900 af of surface water during the irrigation season. With a rehabilitated capacity of 40 cfs (the permitted capacity per the water right), the south system could deliver 11,900 af during the irrigation season, which would satisfy approximately half of the total water demand along the system which is currently being met with groundwater pumping.

The existing pumps, electrical supply to the pumps, and the pipelines and channels are all outdated and in disrepair, which makes the system expensive to operate. In addition, the existing fish screen only allows for a diversion rate of 30 cfs, while the permitted diversion rate for this pump location is 40 cfs. Finally, the system is a low-head gravity flow system without pressurization. The water level in the existing system would normally only be about six inches above the adjacent irrigated land. The majority of on-farm irrigation systems observed in the South System potential service area are pressure systems such as: sprinklers, drip, and micro-spray. Therefore, to utilize surface water from the existing system, these farmers must pressurize the water with their own facilities before it enters their irrigation systems.

For planning purposes, NSJWCD has evaluated South System infrastructure improvements in two components: (1) replacement or rehabilitation of the pump station, and (2) rehabilitation of the pipeline distribution system.

Construction of a new pump station is recommended due to the age and inefficient configuration of the existing facilities. The new pump station could be designed with a flow rate capacity of 40 cfs (maximum permitted diversion rate). The new pump station would include the installation of two pumps in parallel at a wet well located where the low-lift pump currently exists. A second new 30 cfs capacity fish screen would be installed closer to the center of the river channel to provide for flow rate capacity at 40 cfs (with both screens operating) and redundancy in the event one screen becomes inoperable. A new discharge pipeline would be installed to bypass the existing forebay and connect to the South System conveyance pipeline.

The new pump station would be designed to supply the existing gravity conveyance system, but should include design features (such as pipe material and pump selection) to accommodate the delivery of pressurized water if desired in the future. The pump station platform would be constructed such that all mechanical and electrical equipment would be above the 100 year flood elevation.

The above described modifications to the pump station and fish screen are considered the highest priority improvement for the South System. The next priority improvement is the rehabilitation of the distribution pipeline network. The existing cast-in-place concrete pipelines need to be repaired, slip-lined, or replaced with new PVC pipelines. In addition, some of the open ditch conveyance channels would be replaced with pipeline. If needed to pressurize parts of the system, additional pumps would be installed along the distribution system. The district will likely approach rehabilitation of the distribution system in phases, consistent with available funding.

Project Sponsor

NSJWCD is the lead project sponsor.

Scope of Work

Task 1. Implementation of NSJWCD Infrastructure Improvements

Subtask 1.1 Design

Preliminary design will consider the pump station and distribution system improvements. Distribution system improvements will have the potential to provide long-term energy savings through reduction in pumping costs. This design will be based on a full understanding of the history of NSJWCD infrastructure, especially the southern pump station, southern distribution system, and northern distribution system, as well as their current configuration and condition.

Design drawing elements will be prepared for the recommended infrastructure improvements for the southern pump station and distribution system and the northern distribution system. General drawings will include title sheet, list of drawings, vicinity and location map, symbols and abbreviations, design criteria and hydraulic profile. Plan views of the sites and enclosure mechanical layouts, enclosure elevations, profiles and cross sections depicting major modifications, equipment and piping will also be included. The design submittals will also include an updated preliminary construction schedule and updated construction cost estimates.

Subtask 1.2 Environmental Compliance

NSJWCD has already completed CEQA compliance for the use of water under Permit 10477 at various points of diversion, including the South Pump and Distribution System. If the work proposed for the Infrastructure Improvements involves discretionary permitting or work not otherwise exempt from CEQA, the district will research and prepare the appropriate CEQA and NEPA compliance documents. It is assumed that the necessary documentation will consist of an Initial Study/Mitigated Negative Declaration (IS/MND) because all improvements will be within existing sites.

Subtask 1.3 Regulatory Coordination

Local jurisdictional agencies will be contacted to determine permitting requirements for the proposed improvements. Temporary encroachment permits may be required for construction activities in adjacent public roadways. Permitting requirements will be identified and an approach for compliance will be recommended.

Budget

The estimated budget for implementation of the infrastructure improvements is $2.2 million for the pump station rehabilitation (see below) and $10-18 million for the distribution system rehabilitation and possible pressurization.

PUMP STATION REPLACEMENT PRELIMINARY OPINION OF PROBABLE PROJECT COST

Project Element	Preliminary Cost	
Pump Station Construction	$	1,400,000
30% Contingency	$	420,000
Pump Station Construction + Contingency	$	1,820,000
Design Engineering	$	112,000
Project / Construction Management	$	140,000
Environmental and Permitting	$	125,000
Total Project Cost	**$**	**2,197,000**

At an ENR CCI 20-cities Average of 9962, February 2015.

NSJWCD is currently working with an engineering firm to put together a more specific cost estimate for the distribution system rehabilitation. However, the rough cost estimate is $10-18 million. The specific costs will be determined based on whether or not the pipelines are repaired, replaced or slip-lined and whether or not parts of the system are pressurized.

References

North San Joaquin Water Conservation District (NSJWCD). District Map. Available: http://www.nsjgroundwater.org/MAP-Posted_10-26-11.pdf

RMC, 2015. MokeWISE Program Final Memorandum Water Availability Analysis. January 2015.

MokeWISE Program Scope of Work:
Project 5a: Regional Urban Water Conservation Program

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Environmental stakeholders are very interested in reducing water use by customers of small, medium and large urban water suppliers throughout the Mokelumne watershed and in the EBMUD service area in order to benefit environmental flows, groundwater basin levels, and to avoid the need to seek additional water supply and build new dams. They are interested in ensuring that water not used due to conservation serves the environment or is well accounted for in groundwater banks for use as a reserve in extreme drought.

Environmental stakeholders are concerned that the full benefits of conservation are often not quantified. Water conservation strategies represent environmental benefits and avoided costs from water purchases, litigation and project delays, and new infrastructure, including wastewater treatment capacity. They would like to see feasibility studies consider those benefits and avoided costs.

Known and available demand reduction strategies that environmental interests would like to see instituted and/or widely expanded include metering and irrigation technology, information programs, steeply-tiered pricing, and broader incentives and rebates. They would like to see increased use of technology to eliminate waste: separate metering for irrigation, weather-based and soil moisture-based irrigation controllers, high-tech leak detection, Smartmeters providing real-time usage information. They support programs to fast track universal water meter installation and strong incentives for commercial and multi-family building owners to install sub-meters and facilitate individual unit billing.

The success of water information as a tool for reducing demand is encouraging. Environmental stakeholders would like EBMUD to more quickly expand its Home Water Reports program, which yielded an average 5% reduction in water use by customers in a 2012-2013 pilot. This program could benefit other Mokelumne Watershed urban suppliers as well.

They are interested in adoption of pricing structures at utilities throughout the MokeWISE area that allow every person to meet their essential personal water needs at a reasonable cost, while charging incrementally higher rates for all usage beyond that base amount.

They would like conservation rebates, incentives and technical assistance to be expanded, particularly for conversion of irrigated lawn and landscapes to low- or no-water plantings, and for on-site rainwater catchment and graywater systems.

Environmental interests would be very supportive of projects to slow and infiltrate or store stormwater runoff for later use, for its potential in reducing river diversions, replenishing groundwater, and improving water quality.

Entities understand that when we conserve water in an urban setting, we enhance our ability to serve the full spectrum of uses for which the water is delivered. We can serve more homes and more businesses with less water. When we conserve Mokelumne River water through low water use appliances, or other techniques, we make the most out of the water we have removed from the river. Water conservation provides environmental benefits by allowing us to leave more water in the river to serve in-stream needs. In some circumstances, water conservation can produce economic benefits to water users. Reducing water costs through conservation can improve a business' bottom line and reduce pressures on household budgets. There is some concern that the proposed project does not meet an interest that some entities have regarding how water utility activities should be carried out, including that these activities be carried out in forums with more effective, more valued, and more heeded public participation activities. Unlike other proposed project, there is no provision for coordinating implementation with MokeWISE stakeholders.

Many water agencies have developed, approved, and partially implemented its Conservation Plan. Given the financial downturn, lack of new customer connections, and the current drought, funding a water conservation coordinator as well as funding some portions of conservation plans have been challenging. Outside funding can assist in the implementation of the conservation plan.

The Regional Urban Water Conservation Program will develop a program to reduce demand through implementation of efficient urban water use practices. The program will evaluate existing conservation measures and programs being implemented in the region and identify opportunities for further water efficiency gains. The program will develop a regional conservation plan to pursue funding opportunities, which would then be distributed among participating agencies to fund municipal conservation plan implementation. Costs for this program are estimated to be $80,000, with $60,000 for planning and $20,000 to prepare materials for a funding application.

Background Information

Cities, agencies, and districts throughout the state have been implementing water conservation and efficiency programs for many years. Most recently, requirements set forth in the Water Conservation Act of 2009 (also known as Senate Bill [SB]x7-7) have been driving water conservation to achieve the goals outlined in the state's *20x2020 Water Conservation Plan*. These goals are generally reflected in the 2010 Urban Water Management Plans (UWMPs). Further water conservation goals and progress toward achieving 2010 plan goals are expected in 2015 UWMP updates.

UWMPs are prepared by urban water suppliers that provide over 3,000 acre-feet of water annually, or serve more than 3,000 urban connections. There are multiple UWMPs covering urban water suppliers in MokeWISE region.

Reference Programs

Examples of other regional urban water conservation planning efforts are available. Generally, these examples are for large, single water supply entities with broad coverage in urban areas. Example plans include:

- EBMUD's Water Conservation Master Plan
- San Francisco PUC's Retail Water Conservation Plan
- Metropolitan Water District's Long Term Conservation Plan
- Santa Clara Valley Water District's Water Use Efficiency Strategic Plan

Additionally, the Bay Area Water Supply and Conservation Agency (BAWSCA) administers several water conservation programs in the Bay Area. BAWSCA represents a collection of cities, water districts and private utilities that purchase water on a wholesale basis from the San Francisco regional water system.

Project Information

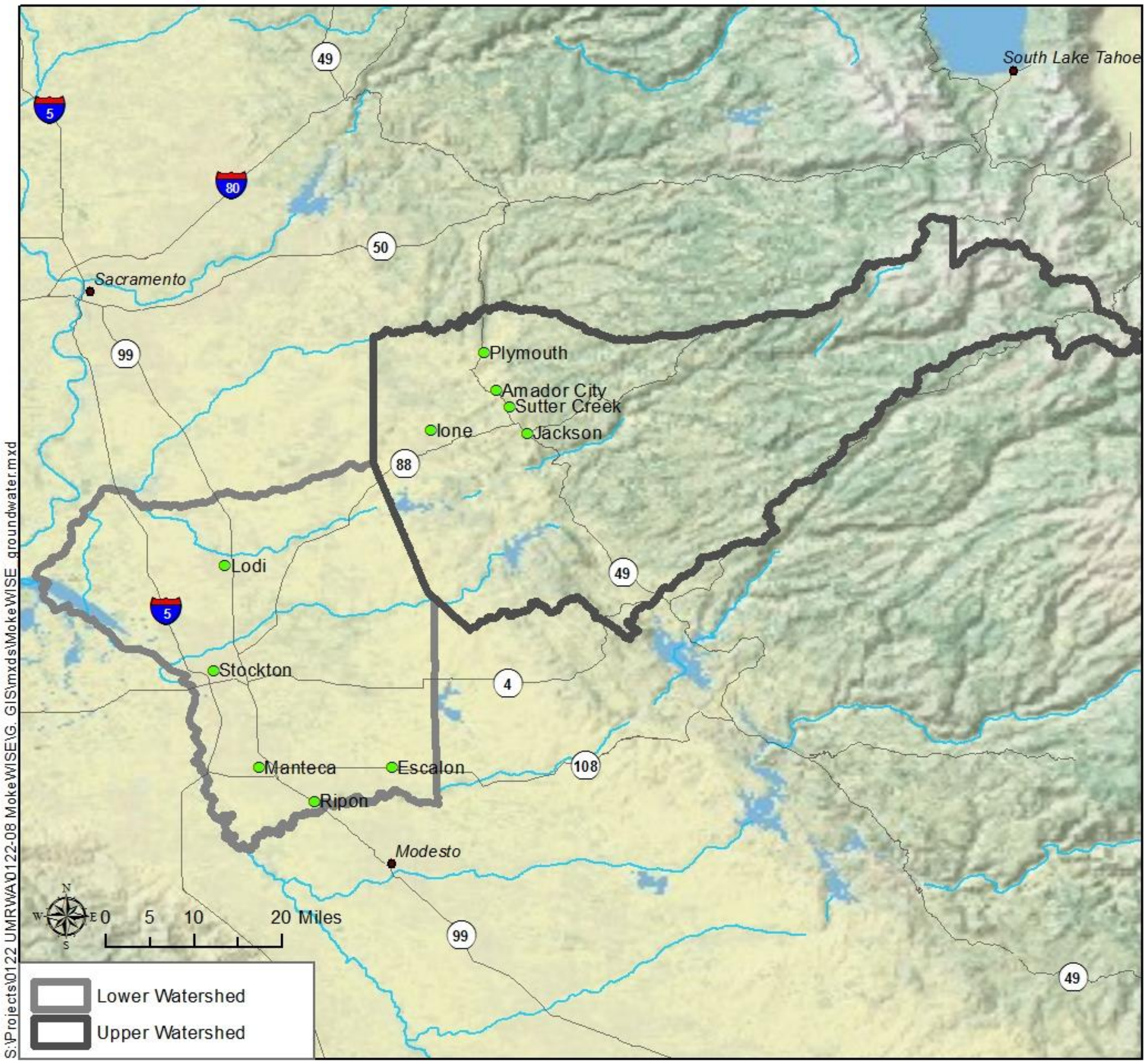
Project Description

The purpose of this project is to develop a program to reduce demand through implementation of efficient urban water use practices. The project will evaluate existing conservation measures and programs being implemented in the region and identify opportunities for further water efficiency gains. The project would develop a regional conservation plan to pursue funding opportunities, which would then be distributed among participating agencies to fund municipal conservation plan implementation.

Project Location

The project concept would focus on urban areas in the Mokelumne watershed (**Figure 1**).

Figure 1: Cities Identified Within the Watershed



Project Sponsor

The urban water conservation project sponsors are the Upper Mokelumne River Watershed Authority, the Eastern San Joaquin Groundwater Basin Authority, the City of Stockton, and the City of Lodi. No co-sponsor has been identified.

Scope of Work

Task 1. Identify Water Conservation Opportunities

The MokeWISE Water Availability Analysis estimated the amount of water that can be made available through expansion of conservation programs within the MokeWISE region. Water conservation and demand management projects which were already planned or in place were noted, as these projects will not create additional water available in the future for beneficial use. However, these existing projects can still be used to guide conservation project implementation in new areas of the region.

Subtask 1.1 Collect and Evaluate Conservation Measures and Programs in the Region

The first step in this project is to collect and evaluate existing water conservation measures and programs already being implemented in the region. The MokeWISE Water Availability Analysis outlines some of these measures and identifies where they are occurring. This task will inventory water conservation measures and programs being implemented in the region. Sources for conservation information will include the Water Availability Analysis, individual UWMPs found within the region, BMP reporting to the California Urban Water Conservation Council (CUWCC), and local conservation plans.

Subtask 1.2 Identify Regional Water Conservation Program Opportunities

Water conservation measures and programs identified in Task 1 can be used to explore expansion opportunities within the region. As part of this task, water conservation opportunities will be identified by performing conceptual feasibility analyses on increasing the penetration of programs within existing geographies, and expanding the geographical extent of existing programs.

In addition to expanding programs already in place, this task will identify new water conservation measures and programs that could be implemented to further reduce demands. Existing plans will be reviewed to identify new measures that could be implemented in the region. An example of the type of conservation measures that may be found in water conservation plans is shown below in **Figure 2**. Additional water conservation plans or measures may be reviewed as well. For instance, the Mokelumne-Amador-Calaveras (MAC) and Eastern San Joaquin (ESJ) Integrated Regional Water Management (IRWM) regions likely have urban conservation projects that can be incorporated into this project.

Figure 2: Example Evaluated and Potential Conservation Measures (EBMUD)

Voluntary Measures for Existing Customers	
Advanced metering infrastructure	High-efficiency toilet rebates
Artificial turf	High-efficiency urinal rebates
Cisterns or rainwater catchment	Landscape and irrigation upgrade incentives
Dental vacuum pump retrofits	Multi-family submetering
Equipment upgrade incentives	Submetering retrofit
Garbage disposal removal	Water use surveys (indoor and outdoor)
Graywater retrofit	Self-adjusting irrigation controller rebates
High-efficiency clothes washer rebates	
Mandatory Measures for New Services	
Advanced metering infrastructure	High-efficiency hose nozzles (water brooms)
Dedicated irrigation meters	Multi-family and commercial unit and irrigation metering
Graywater piping	On-demand hot water systems
High-efficiency clothes washers	Plan check review
High-efficiency dishwashers	Rain sensors
High-efficiency faucets and showers	Self-adjusting irrigation controllers
High-efficiency toilets	Water-efficient landscaping
Supply-Side Measures	
Pipeline leak detection	Distribution system water loss reduction

Source: EBMUD Water Conservation Master Plan, 2011

Task 2. Prepare Regional Conservation Plan

In addition to the UWMPs discussed previously, water conservation plans exist within the region. For example, the Amador Water Agency prepared a water conservation plan in 2009 and the City of Stockton has a dedicated Water Conservation Program. The MokeWISE regional conservation plan would roll existing local plans up to the regional level and expand urban water conservation in new areas.

In this task, a regional water conservation plan will be prepared. This plan will roll up and formalize the region's existing water conservation programs and will include water conservation goals, objectives, tools, and incentives.

In preparing the water conservation plan, existing local water conservation plans and programs will be compiled and evaluated for region-wide application and compliance with the CUWCC BMPs. For each of the BMPs, this task will either (1) document the program as it is currently implemented; (2) document the program with proposed changes to increase the program effectiveness; or (3) outline a new regional conservation program to be implemented for compliance with the BMPs and/or the regional conservation goals. Conservation plan elements may include:

- Initiating a pilot program for replacement of water reliant landscaping
- Utilizing landscaping BMPs to reduce runoff and improve water quality
- Increasing irrigation efficiency
- Expanding water metering and implementing water use based rates
- Detecting leaks
- Capturing rainwater
- Capturing stormwater
- Offering conservation incentives for water-saving technologies
- Preparing education and outreach materials

A draft conservation plan will be prepared using the documentation developed above. The draft plan will be made available for review by interested former members of the Mokelumne Collaborative Group (MCG), other interested parties, and the general public. Feedback will be solicited during a public meeting or workshop. Following receipt of comments, the conservation plan will be finalized.

Task 3. Implementing the Regional Conservation Plan

The regional conservation plan will be used to pursue funding opportunities to implement water conservation measures and programs. Funding received will be distributed among agencies to implement individual local conservation plans.

Subtask 3.1 Identify Funding Opportunities for Water Conservation

Existing and upcoming water conservation funding opportunities will be identified and tracked in this task. Funding opportunities will likely influence the plan development timeline. One potential source of funding is the $100 million identified in Proposition 1 for water conservation, $23 million of which has been recommended by Governor Brown for appropriation in the 2015-2016 budget cycle. IRWM funding through Propositions 84 and 1 may also be potential grant sources.

Subtask 3.2 Prepare and Submit an Application for Water Conservation Funding

The objective of this task will be to prepare and submit a grant application (likely to DWR) to help fund the implementation of opportunities outlined in the MokeWISE regional conservation plan. This task will include the following actions:

- Review the identified grant application packet or project solicitation
- Identify and collect relevant project information
- Draft the grant application and all attachments
- Finalize and submit the grant application following a comment period from the MokeWISE application entities.

Budget

The budget for this project is anticipated to be $80,000. Costs associated with the project are broken down as follows:

- Planning Costs: $60,000
  - $10,000 for identifying opportunities
  - $50,000 for preparing the regional conservation plan
- Grant Funding Costs: $20,000
  - $20,000 for the preparation and submittal of a conservation funding application
- **Total Project Cost: $80,000**

References

East Bay Municipal Utility District. 2011 Water Conservation Master Plan. Available at: https://www.ebmud.com/for-customers/water-conservation-rebates-and-services/water-conservation-master-plan

MokeWISE Program Scope of Work:
Project 5b: Regional Agriculture Conservation Program

April 2015

Problem Statement and Abstract

There are approximately 450,000 acres of agricultural land within the upper and lower Mokelumne River watershed, the majority of which overlies the Eastern San Joaquin groundwater basin. Average demand in San Joaquin County for agricultural use from 1976 through 1996 was 2,571,101 acre-feet; in 2010, average demand had decreased to 1,821,179 acre-feet, roughly 71% of the historical average (Wagner and Bonsignore 2014). The Eastern San Joaquin groundwater subbasin is currently overdrafted at a rate of 70,000 to 80,000 AFY (GBA 2014). These conditions create large-scale channel losses and can create demand for increased diversions from the Mokelumne River. Surface water available for agricultural use in the Mokelumne River portion of the basin is limited. Long-term water supply reliability for agriculture in the Mokelumne River portion of the basin is thus uncertain.

The Regional Agriculture Conservation Program study will develop a program to reduce agricultural water use through evaluation and testing of agricultural management practices. The program will evaluate existing conservation measures and programs already being implemented in the region and identify opportunities for further water efficiency gains. The project will include the study of the feasibility of dry farming, Smart irrigation and controller technology, data and BMP based strategies, and potentially other strategies. Based on identified opportunities, the program would develop a regional agricultural water conservation plan to implement the identified strategies. The plan would be used as the basis for pursuing funding opportunities, which would be distributed among participating members to fund program agricultural water conservation project implementation. Costs for this program are estimated to be $100,000, with $80,000 for planning and $20,000 to prepare materials for a funding application.

This project was identified as having outstanding concerns. These concerns have been characterized and includes as **Appendix A**.

Background Information

Water districts throughout the state have been preparing agricultural water management plans (AWMPs) for several years. Most recently, guidance provided by SBX7-7 has directed agricultural water suppliers to achieve the conservation goals outlined in the state's *20x2020 Water Conservation Plan*.

AWMPs are required to be completed by agricultural water suppliers that provide water to over 25,000 irrigated acres, excluding acres receiving recycled water. Agricultural water suppliers providing water to 10,000 to 25,000 irrigated acres also require AWMPs if specific state funding has been provided. The plans require implementation of certain Efficient Water Management Practices (EWMPs), if locally cost-effective and technically feasible. The EWMPs, along with other practices and products revealed through stakeholder engagement processes, will be evaluated for feasibility and effectiveness for possible implementation in the region.

Reference Programs

Regional agricultural water conservation planning efforts can be found in other parts of the state. For example, the Imperial Irrigation District's (IID) On-Farm Efficiency Conservation Pilot Program was implemented to incentivize agricultural water customers to conserve 20,000 acre-feet in 2013 and 40,000 acre-feet in 2014 by implementing water use efficiency improvement projects on their farms. This voluntary program offered monetary incentives for reductions in agricultural water use based primarily on a District-provided list of water conservation measures. The South San Joaquin Irrigation District's (SSJID) On-Farm Water Conservation Program began in 2011. Since that time, $2.5 million has been invested to maximize water conservation, improve crop yields, and provide growers with financial incentives to make improvements to efficient irrigation practices on individual farms. USDA NRCS Environmental Quality Incentives Program (EQIP) is a cost share program for farmers that provides up to 50% of the cost of management practice installation. Several million dollars in EQIP funds have been distributed in San Joaquin County, including the Lower Mokelumne River Watershed, for water conservation projects including conversion to drip and micro-sprinklers.

Substantial work in these areas has also already been done or is underway at UC Davis, Fresno State, and with the USDA NRCS; this program should seek to learn from and add to the knowledge already available.

Project Information

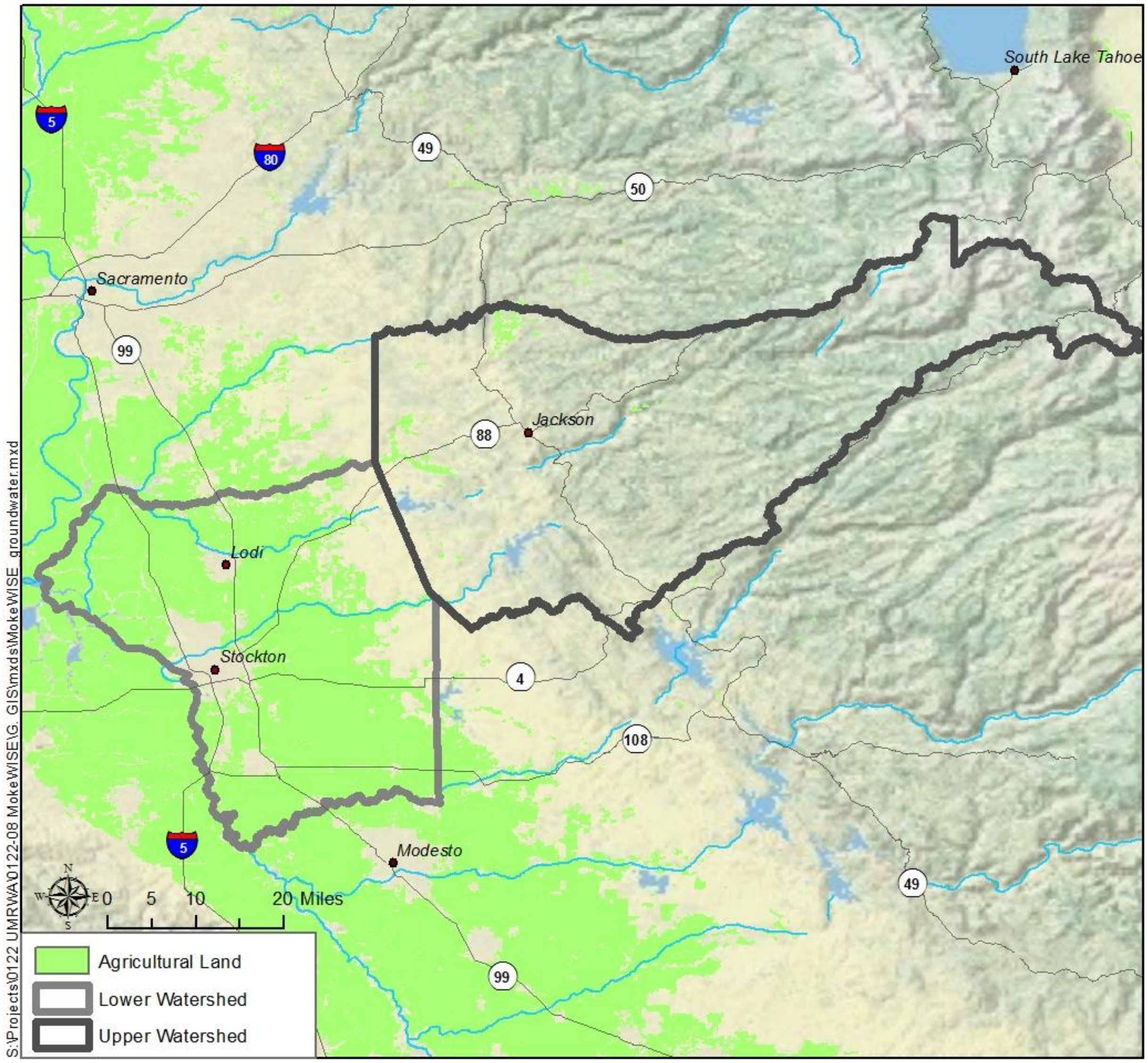
Project Description

The purpose of this project is to develop a program to reduce agricultural water use through evaluation and testing of agricultural management practices. The program would evaluate existing conservation measures and programs already being implemented in the region and identify opportunities for further water efficiency gains. The project would develop a plan to identify management practices to enhance agricultural water conservation. The plan would be used as the basis for pursuing funding opportunities, which would be distributed among participating members to fund agricultural water conservation project implementation.

Project Location

The conservation program would focus on agricultural areas in the Mokelumne watershed (**Figure 1**).

Figure 1: Agricultural Areas within the Upper and Lower Mokelumne Watershed



Project Sponsor

The San Joaquin County Resource Conservation District is sponsoring this project. Jackson Valley Irrigation District has been identified as a co-sponsor.

Scope of Work

Task 1. Identify Water Conservation Opportunities

The MokeWISE Water Availability Analysis estimated the amount of water that could potentially be made available through implementation of four conservation scenarios that were evaluated in a report by the Pacific Institute in 2008 (Cooley, et al. 2008). The four scenarios evaluated were:

- Modest crop shifting - shift 25 percent of irrigated field crop acreage to irrigated vegetable crop acreage[1]
- Smart irrigation scheduling - use irrigation scheduling information to help farmers more precisely irrigate to meet crop water needs and boost production
- Advanced irrigation management - apply regulated deficit irrigation to almonds, pistachios, citrus trees, and vines during stress-tolerant growth stages
- Efficient irrigation technology - shift a fraction of the crops irrigated using flood irrigation to sprinkler and drip systems

Potential water savings from each of the four scenarios were estimated and are shown in **Table 1**. The potential savings associated with each of these strategies assumes that there has been no prior implementation. Because water saving strategies are already being implemented in parts of the San Joaquin Valley, the actual savings that could be achieved may be significantly lower.

Table 1: Potential Agricultural Water Savings from Three BMPs*

BMP Scenario	2005 Savings (AFY)	2030 Savings (AFY)
Smart Irrigation Scheduling	139,102	118,439
Advanced Irrigation Management	64,201	54,664
Efficient Irrigation Technology	32,101	27,332
TOTAL	**235,404**	**200,435**

* Crop shifting was also evaluated in this study, but is not included in this project.

Subtask 1.1 Collect and Evaluate Conservation Measures and Programs in the Region

The first step in this program is to collect and evaluate existing agricultural water conservation measures and programs already being implemented in the region. The

[1] This will not be looked at within this study

MokeWISE Water Availability Analysis outlines the four measures shown in the table above. This task will inventory water conservation measures and programs being implemented in the region. Sources for conservation information will include the Water Availability Analysis, any AWMPs found within the region, and coordination with water district personnel and the local agricultural community.

Subtask 1.2 Identify Regional Water Conservation Program Opportunities

This task will explore opportunities to expand existing agricultural water conservation measures and programs. Water conservation opportunities will be identified by performing conceptual feasibility analyses on increasing existing programs, as well as introducing programs existing in some areas of the region to new locations.

In addition to expanding programs already in the region, this task will also identify new water conservation measures and programs. Programs found in the Reference Programs section above will be reviewed for new measures and strategies, including those found in the CWC Section 10608.48 - Efficient Water Management Practices (EWMPs) that could be implemented in the MokeWISE region. Additional agricultural water conservation plans or measures may be reviewed as well. For instance, the Mokelumne-Amador-Calaveras (MAC) and Eastern San Joaquin (ESJ) Integrated Regional Water Management (IRWM) regions may have agriculture conservation projects that can be incorporated into this project.

Task 2. Prepare a Regional Agricultural Water Conservation Plan

Agricultural water efficiency measures have been implemented in the region for many years. Under the Regional Agricultural Conservation Program, these measures would be coordinated at a larger scale to leverage funding opportunities, ideas, collaborative opportunities and lessons learned to increase agricultural water efficiency practices. Program development may include coordination of AWMPs, development and evaluation of agricultural management practices, and collaborative project implementation.

Subtask 2.1 Consult with Local Agriculture Community

Successfully preparing and implementing a regional agricultural water conservation program will require engagement, consultation and collaboration with the local agriculture community. Growers have both the experience to analyze the feasibility of conservation measures and the potential to implement new or updated water efficiency tools or practices. In this task, workshops will be held to inform the local agriculture community of the purpose and potential benefits of a regional agricultural water conservation program. Project personnel will consult with growers on how to best structure the program and develop preliminary coordination and conservation practices.

Subtask 2.2 Prepare a MokeWISE Regional Agricultural Water Conservation Program.

In this task, a regional agricultural water conservation plan will be prepared. This plan will roll up and formalize the region's existing agricultural water conservation programs and will include water conservation goals, objectives, tools and incentives. Further, the program will provide a platform for collaboration with growers and agencies to test and evaluate different agricultural water management practices for irrigation efficiency.

In preparing the agricultural water conservation program, existing local agricultural water management plans and programs will be compiled and evaluated for region-wide application. Additionally, for each of the state's EWMPs, this task will either (1) document practices currently being implemented successfully; (2) document current practices with proposed changes to increase effectiveness; or (3) outline new regional conservation practices to be implemented to achieve regional agricultural water conservation goals.

A draft regional agricultural conservation plan will be prepared using the documentation developed above. The draft plan will be made available for review by interested members of the prior Mokelumne Collaborative Group (MCG), other interested stakeholders, and the general public. Feedback will be solicited during a public meeting or workshop. Following receipt of comments, the conservation plan will be finalized.

Task 3. Implement the Regional Agricultural Water Conservation Plan

The regional agricultural water conservation plan will be used as a basis to pursue funding to implement water conservation measures and programs. Funding received will be distributed among agencies and individual growers to achieve regional agricultural water conservation goals.

Subtask 3.1 Identify Funding Opportunities for Water Conservation

Existing and upcoming water conservation funding opportunities will be identified and tracked in this task. Funding opportunities will likely influence the plan development timeline. One potential source of funding could be the $100 million identified in Proposition 1 for water conservation, $23 million of which has been recommended by Governor Brown for appropriation in the 2015-2016 budget cycle. IRWM funding through Propositions 84 and 1 may also be potential grant sources.

Subtask 3.2 Prepare and Submit Application for Agricultural Water Conservation Funding

The objective of this task will be to prepare and submit a grant application (likely to DWR) to help fund the implementation of opportunities outlined in the MokeWISE regional agricultural conservation plan. This task will include the following actions:

- Review the identified grant application packet or project solicitation
- Identify and collect relevant project information
- Draft the grant application and all attachments

- Finalize and submit the grant application following a comment period from the application entities.

Budget

The budget for this program is anticipated to be $100,000. Costs associated with the project are broken down as follows:

- Program Planning Costs: $80,000
  - $15,000 for identifying opportunities
  - $50,000 for preparing the regional conservation plan
  - $15,000 for outreach and coordination
- Grant Funding Costs: $20,000
  - $20,000 for the preparation and submittal of a conservation funding application
- **Total Project Costs: $100,000**

References

Wagner and Bonsignore. 2014. *Groundwater Resources Management Report, Documentation of Duck Creek Reservoir Feasibility Investigation and Supporting Documentation of Water Right Application Amendments.* April 2014.

Appendix A: Outstanding Project Concerns

Unresolved Concerns with Project 5b - Regional Agricultural Water Conservation

A statement from Sierra Club, California Sportfishing Protection Alliance, and Foothill Conservancy

All environmental stakeholders strongly support water conservation by agricultural water users. We support a project to evaluate, promote, and seek funding for agricultural water conservation. More specifically, we support each element among the tasks in Project 5b as it is written. The undersigned organizations hope that the project is funded and implemented, and that it in turn is able to create opportunities to identify and fund additional agricultural water conservation projects. We are disappointed that discussions ultimately resulted in certain elements not being included in the project scope.

A general expression of interests and concerns is embodied in many other MokeWISE project descriptions in an opening section entitled "Problem Statement and MokeWISE Stakeholder Interests." This is consistent with what distinguishes MokeWISE from previous planning efforts in the region: projects are considered for their ability to meet multiple interests and to embody multiple values, not just for their effectiveness in meeting the interest of the immediate project beneficiary. Environmental stakeholders in the Mokelumne region are particularly sensitive to this consideration because past regional planning efforts have often not incorporated their interests. This in no small part is why many previous planning efforts have yielded few tangible results. In participating in the design of MokeWISE, several environmental stakeholders sought to explicitly write in the ability to meet multiple interests as a key element both of the process and its work products. We believe that this approach has been substantially successful in MokeWISE, and has led to better relationships among stakeholders and to better project proposals and descriptions.

Different MokeWISE stakeholders undoubtedly have different visions of how conserved water might be managed and used. Some of the possible management scenarios and uses that environmental interests would prefer to see considered would include augmented above-ground carryover storage, underground storage or aquifer replenishment, or increased instream flows in the Mokelumne River.

However, Project 5b, the Regional Agricultural Water Conservation project, was not designed to identify the end use of conserved agricultural water. In deference to the stated interest of MokeWISE representatives of San Joaquin County agriculture, the environmental NGO's removed their suggested language from earlier drafts of the project description that had suggested potential environmental benefits of agricultural water conservation. The environmental NGO's instead suggested adding to their interest statement for the project a few general concerns they had related to agricultural water conservation, such as the possibility that the benefits of such conservation would contribute to or be offset by an increase in cultivated acreage, particularly of crops that hardened water demand. A representative of agricultural interests in San Joaquin County categorically objected to the inclusion of such interest statements by environmental stakeholders in the opening section of the project description.

Several environmental stakeholders suggested as an alternative that the opening section of the project description include factual statements that characterize the problems of agricultural water reliability. An example was a statement that described how recently, permanent crops such as orchards and vineyards had been added in the study area. This too was rejected.

Some substantive options for water conservation were rejected from the scope of the study, such as "modest crop shifting" as recommended in a report cited in the project description. Environmental stakeholders believe that an exploration of this option could yield valuable insights without adversely affecting agricultural interests or presupposing any particular outcome or set of outcomes. To the contrary, we believe it is possible that such an evaluation might lead to possibilities that would be economically beneficial.

We respect the prerogative of agricultural representatives of San Joaquin County to decline to include, in their recommended project, statements that reflect the interests of environmental stakeholders, statements that define potential limits to the benefits of agricultural water conservation, and specific reasonable strategies that might be part of a water conservation portfolio. However, we believe that in so declining to include these in the Project 5b description, the project is thus missing elements that would help to distinguish it as a MokeWISE project. It is for this reason that the undersigned stakeholder organizations are unable to endorse Project 5b in its current form for inclusion on List 1 in the implementation plan.

Sierra Club

California Sportfishing Protection Alliance

Foothill Conservancy

MokeWISE Program Scope of Work:
Project 7a: PG&E Reservoir Storage Recovery

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Amador Water Agency (AWA) seeks to increase the reliability of its water supply for existing water and contract rights and potential future rights. The capacity of some of the PG&E reservoirs that AWA uses for water supply has been reduced by sediment accumulation. AWA wants to firm up existing water supplies during extended periods of PG&E maintenance on water infrastructure, and also during periods of drought, curtailments by the State Water Resources Control Board, and as adaptation to climate change. Finally, AWA also wants to provide a reliable water supply to accommodate future long-term growth needs created by land use agencies.

A reservoir storage recovery project would increase the flexibility and reliability of AWA's and other water supply entities downstream. For example, the PG&E Regulator Reservoir on Tiger Creek has only 60-70% of its capacity available, because of sediment infilling. A potential project in the Tiger Creek Regulator Reservoir would recover up to the original capacity or up to approximately 209 acre-feet. While this is not a large amount, this additional capacity would add flexibility to reservoir operation that would allow PG&E to work longer on the Regulator and associated facilities without putting AWA's water supply at risk of a water outage.

Removal of silt and accumulated sediment from PG&E reservoirs would be a benefit in restoring previous water storage and may help hydroelectric operations. The project would survey PG&E reservoirs to determine the opportunity, and feasibility, and benefits of removing silt from at least seven reservoirs: Tiger Creek Regulator, Tiger Creek Afterbay, Upper Bear, Upper Blue, Lower Blue, Twin and Meadow. Silt removal would also benefit downstream interests such as East Bay MUD and Lodi. Sediment removal from existing impoundments would reduce the risk of sediment re-suspension during high flow periods and reduce suspended sediment loading deposition in aquatic habitats downstream of the reservoirs, thereby improving the quality and availability of habitat for fish and other aquatic resources. The PG&E Reservoir Storage Recovery project would evaluate the feasibility of restoring lost storage capacity of one or more existing reservoir(s) due to sediment in-filling. It would inform stakeholders and the public of findings and develop a proposal, and would develop a strategy for environmental review under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

Environmental stakeholders in the MokeWISE process would like to avoid construction of new reservoirs. They are concerned that new water storage development may have harmful environmental, social, economic and recreational impacts, particularly related to aquatic resources. They are also concerned that development of new surface storage may create precedent for a new dam building era in California in place of more environmentally appropriate approaches to water supply and water use. They support efforts to use existing resources more efficiently to meet water supply needs as well as a variety of other demand reduction and reuse actions. One alternative to building new reservoirs is to make more efficient use of existing reservoirs. Restoring lost water storage capacity in existing reservoirs would be more cost-effective and create less impact than constructing new reservoirs.

Environmental stakeholders also have a general interest in assuring that existing water supply and hydropower infrastructure and its operation are safe, reliable, and environmentally sound.

Water agencies have an interest in protecting their water rights, licenses and facility operations in order to assure water supply reliability for their customers and to continue to meet downstream obligations. Water agencies will participate as a part of a broad coalition of interested parties seeking water supply and/or environmental benefit from this project.

Background Information

Amador Water Agency uses some of PG&E's hydroelectric reservoirs and related facilities for the Agency's water supply. Unfortunately, erosion, and sedimentation in the Mokelumne watershed has, to varying degrees, gradually filled PG&E reservoirs with sediment.

The PG&E Regulator Reservoir is important to Amador Water Agency because the new Gravity Supply Line will deliver water from it to the Buckhorn Water Treatment Plant. Sediment has filled this reservoir to a point that only about 60% of the operational capacity remains for water supply purposes.

The Regulator dam is classified as a Slab and Buttress type, 112 feet high, and 470 feet long. It was put in service in 1931. Some water in the reservoir is from the Tiger Creek watershed (~8 square miles), however, most water in the reservoir is delivered through a concrete canal from either Lower Bear River Reservoir or Salt Spring Reservoir, depending on PG&E's operations. The Regulator has a design capacity of 523 acre-feet and is 13 acres in size, but sediment infill is estimated to have reduced usable storage to approximately 313 acre-feet. The largest impacts of this capacity loss are reduction of PG&E's operational flexibility for power operations and reduction of storage to meet AWA's short-term water supply needs when PG&E canals are shut down for maintenance.

Whenever PG&E does maintenance on either the Regulator Dam or the canal that delivers water to it, the incoming canal water is turned off. This is done in the spring and in the fall every year; occasionally PG&E must make unplanned outages as well. The reservoir level in the Regulator drops during canal outages. Restoring the original reservoir capacity to 523 acre-feet would make additional water available to the AWA Gravity Supply Line, which operates as a syphon, during these outages and in periods of extended drought, State Water Board curtailments, and climate change.

Not only is the capacity reduced by the volume of sediment in the Regulator, but the operational capacity is reduced during periods when the water level in the Regulator reservoir is low. The inflow from Tiger Creek picks up turbidity as it passes through the sediment deposited in the upper end of the reservoir, creating high turbidity throughout the reservoir. This turbidity can plug AWA filters, mask contaminants, make sterilization more difficult, and adversely affect PG&E operations downstream. PG&E has removed sediment from the Regulator in the past and has indicated that it is interested in a project to remove sediment once again. PG&E has periodically removed sediment from the small diversion reservoir on Cole Creek.

Restoring the original capacity of the PG&E Regulator, as well as possibly other PG&E reservoirs, is technically feasible providing environmental issues can be resolved. There have been similar projects in other regions. Part of the assessment process would include surveying and analyzing any local conditions, including potential trace-metal contamination in the sediment, which would constrain or prevent sediment removal at individual reservoirs.

Dams and reservoirs trap sediment that would otherwise be transported downstream. Cleaning out reservoirs would not provide sediment to downstream reaches unless the project is designed to reintroduce suitably sized sediment to downstream reaches during high flows. EBMUD has had success with gravel augmentation to benefit salmon spawning in the Mokelumne River downstream of Camanche Reservoir. The option for reintroduction of desirable sediment to downstream river reaches is an option that could be considered as an element of one or more alternatives, depending on feedback received from the public during the initial Scoping for the project and on technical issues clarified during the study.

Decrease in reservoirs capacities is partially caused by the cumulative effect of numerous small erosion and sediment delivery sources to the Mokelumne River and its tributaries. A logical companion to this proposal to recover storage capacity is the MokeWISE Project 1g, "Mokelumne Water Quality, Soil Erosion, and Sedimentation Inventory/Monitoring" project.

Project Information

Project Description

This project will assess the feasibility of and potential environmental effects of removing sediment from seven PG&E reservoirs in the upper Mokelumne watershed. **Table 1** lists each of the seven reservoirs with areas, capacity and potentially recoverable volume of water.

Table 1: Seven Candidiate Reservoir Characteristics

Name	Reservoir Area (acres)	Gross Capacity (acre-feet)	% Sediment	% Useable	Recoverable Water Supply (acre-feet)
Regulator	13	523	30	60	209.00
TC Afterbay	105	3,960	75	25	2,970.00
Upper Bear	149	6,818	30	70	2,045.40
Upper Blue	354	7,576	30	70	2,272.80
Lower Blue	157	4,300	10	90	430.00
Twin Lakes	114	1,300	10	90	130.00
Meadow Lake	142	5,160	20	80	1,032.00
TOTAL	**1,034**	**29,637**	--	--	**9,089.20**

Source: Reservoir areas (acres) and gross capacities (acre-feet) from the Dam Inventory of the California Division of Dam Safety. Estimates of sediment in-filling is stated as a percent reduction of reservoir capacity and are from estimates made in consultation with PG&E.

**The percentage of usable capacity is 100% minus the sediment percentage, except for the Regulator Reservoir, which is based on the operational limitation of turbidity generated at low water level.*

The study would evaluate the costs and environmental effects of a range of alternatives, and propose a preferred alternative to interested stakeholders and the public. The final report will produce sufficient environmental information and analysis necessary for NEPA and CEQA environmental documentation that will be necessary for the project(s) if it is determined that a project is feasible. This will include, but may not be limited to, identifying and discussing impacts to the biological, social, and environmental, and water supply aspects. In coordination with the stakeholder group, a qualified consultant will prepare a written analysis of the level of review needed under both federal and state statutes. The study will seek to define a project design that avoids undesirable impacts on the environment, including on current operations of PG&E's Project 137. AWA would be the lead sponsor and would seek PG&E's cooperation and stakeholder participation in this effort.

Sediment removal from reservoirs could be beneficial, especially if the larger size fractions of these sediments could be repurposed downstream to provide augmentation to locations within the river/tributary corridors for gravel replenishment. Benefits may need to be assessed based on presence/absence of mercury, and the relative risks of removal/disposal or methylation if left in place. Mercury and other trace metal risks are thought to be generally lower in the Upper Mokelumne than lower down in the watershed around the Motherlode mining belt.

The project would enhance water supply by restoring reservoir capacity and retaining more cold water. This could be beneficial for aquatic species as well as humans, particularly during periods of extended drought as climate change introduces additional uncertainties to the water supply.

An evaluation of the feasibility of sediment removal in and of itself provides no biological benefit to the watershed. Benefit from such an action would be a result of the actual implementation of sediment removal and the associated increase in water storage.

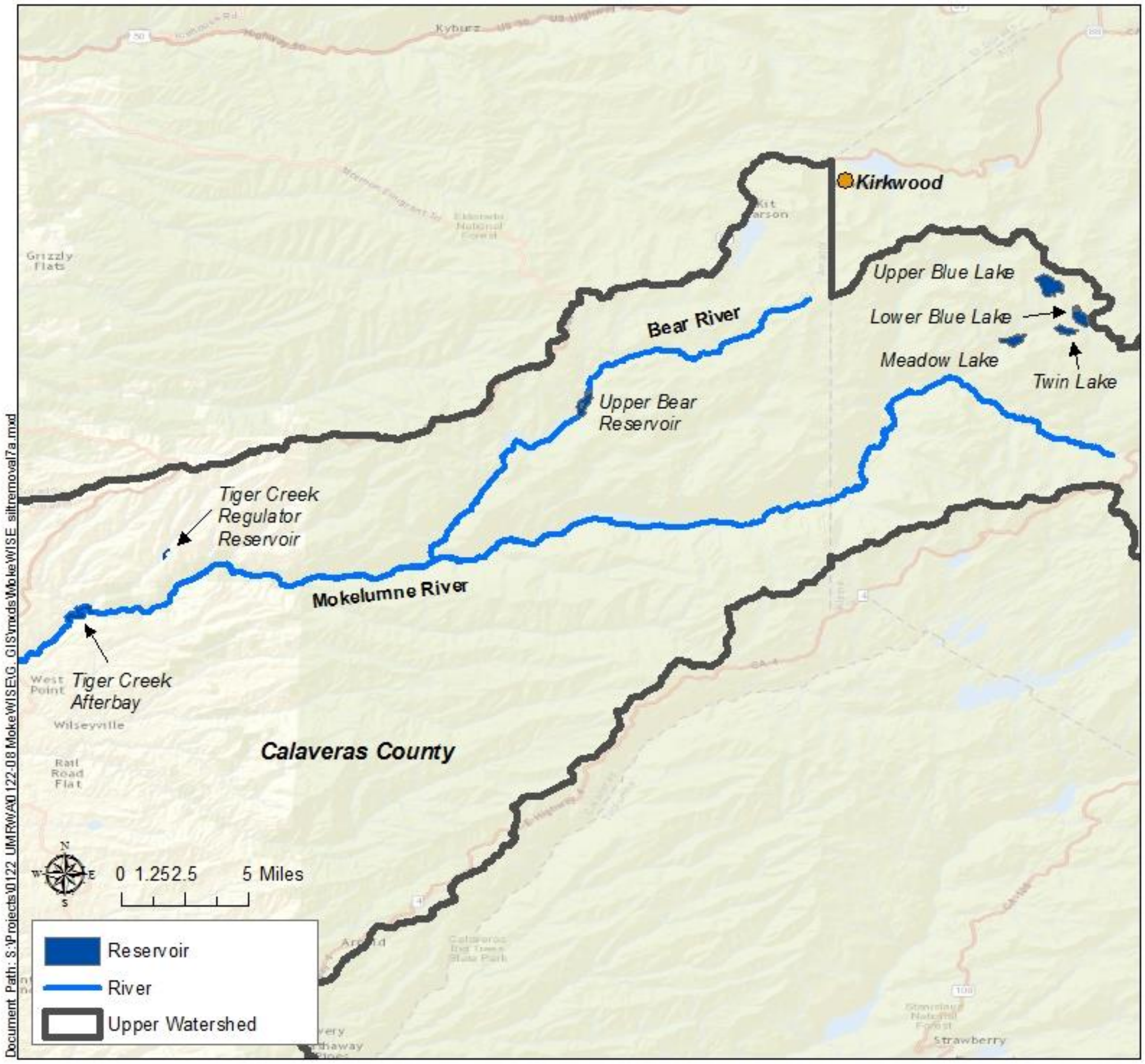
The study will evaluate the cost-benefit ratio of restoring existing reservoirs. It will also evaluate the feasibility and benefits of screening reservoir sediments and using those that fall within a prescribed range for gravel augmentation projects in other areas of the river corridor.

The study will address any legal issues and alternative operational scenarios in the context of existing uses, licenses, and permits. It will include an economic evaluation of the short-term and long-term costs and benefits of the project and include a consultation process with interested stakeholders and the public. It will provide environmental information suitable to develop NEPA and CEQA documentation.

Project Location

This study covers areas located within Amador and Alpine counties as shown in Error! Reference source not found..

Figure 1: Location of Seven Potential Candidate Reservoirs for Storage Recovery



Project Sponsor

Amador Water Agency is the lead sponsor of this study.

Scope of Work

Task 1. Determine Candidate Reservoirs for Assessment

Subtask 1.1 Surveys

This subtask will measure sediment accumulation in the seven candidate reservoirs for potential storage recovery. The seven candidates were developed after consultation with a PG&E representative. Existing information will be reviewed on these seven reservoirs. Based on this review, bathymetric sounding measurements will be taken as necessary to produce contour maps in the areas of sediment accumulation for each candidate reservoir. Cross sections will be drawn in selected places on each to enable locations and estimates of accumulated sediment for potential removal.

Subtask 1.2 Determine Potential Storage Recovery Projects

This subtask will determine the potential volume of storage that can be recovered based on the results of Subtask 1.1. The potential candidates for storage recovery will be ranked. A preliminary engineering feasibility assessment will be conducted on each candidate sufficient to complete an economic evaluation. A cost-benefit economic analysis will be then conducted on each of the seven candidates. A list of potential projects will be produced from those that have a favorable economic value.

Subtask 1.3 Collect Environmental Information & Make Preliminary Assessment

This subtask will collect existing information on physical and biological resources. This will include early consultation with the United States Forest Service and other agencies. Additional on-site information will be collected based on the preliminary engineering design of the project. This will include sampling of sediment deposits in the reservoir for chemical analyses for above background heavy metals and organic compounds. A preliminary assessment of environmental impacts will be conducted on the list of potential projects in Subtask 1.2.

Subtask 1.4 Candidate Reservoirs for Storage Recovery Assessment

This subtask will conduct a second engineering and economic review of the list of candidate reservoirs for storage recovery produced from Subtask 1.3. It will follow a "left side NEPA Triangle" process, similar to that often used by the United States Forest Service, to engage the public and refine a final list of potential candidates for storage recovery. This process will seek to identify project improvements and modifications that address stakeholder concerns while there is still opportunity to refine the project.

Task 2. Develop Alternatives

This task includes developing a range of alternatives, including a no action alternative. Each alternative will be field verified for feasibility. Constraints and opportunities associated with each alternative will be identified. The public and interested stakeholders will be engaged in developing alternatives. Project alternatives will be designed to be economically, socially, and environmentally acceptable.

Task 3. Analyze Alternatives

An extensive alternatives analysis process will be documented in order to determine the most optimal alternative. The alternatives analysis will consider, at a minimum:

- Estimated cost
- Operational constraints
- Legal feasibility
- Institutional feasibility
- Engineering feasibility
- Benefits or impacts to plants, fish, and wildlife, and other relevant resources
- Benefits or impacts to consumptive water use
- Consistency with existing licenses and agreements
- Extended drought
- Climate change

Subtask 3.1 Impacts and Constraints

This subtask will assess the potential environmental, engineering, water supply, economic, recreational, and legal effects of each alternative defined Task 2. The assessment will include an assessment of how each alternative could impact threatened or endangered species, sensitive and other aquatic and terrestrial species, and resources in the surrounding area and their habitat, behavior, or populations. The results of the assessment will be reviewed to determine which potential project, if any, provides necessary supply reliability enhancements, while avoiding or mitigating impacts, including future climate change impacts to wildlife, plants, and recreation.

Any design or mitigation measures that could eliminate or minimize impacts will be incorporated.

Subtask 3.2 Economic Analysis

This subtask will estimate construction costs for each alternative to identify budget-level costs needed to develop the project. This subtask will conduct an economic evaluation of the short-term and long-term costs of the projects.

Subtask 3.3 Technical & Financial Feasibility

This subtask will provide a summary of the technical analyses for each alternative and provide clear information for determining the technical feasibility of each. The summary will provide an overall project plan and timeline including interrelationships between steps, key decision points, and system operations. Funding strategies and criteria will be identified in the summary to maximize the potential for state and federal opportunities. The assessments will be completed in conjunction with a stakeholder group comprised of interested former members of the Mokelumne Collaborative Group (MCG) as well as other interested public and stakeholders. Based on the findings, the collaborative group will identify recommended next steps.

The study shall identify one or more ways in which any new water supply will be shared; and one or more ways the costs of the project will be shared. Following the study, but before the utilities make further legal commitments, financial commitments, funding applications, or permit applications associated with sediment removal, the utilities will identify water supply and cost sharing options acceptable to the utilities.

Task 4. Legal Analysis

This task will conduct a legal analysis of what new or revised agreements and permits may be needed for this project with PG&E. The legal analysis will also define the legal issues that might be related to single or joint execution of any project, including legal responsibility for project execution and project governance. The legal analysis will also define regulatory requirements for the project, including those required by FERC, United States Forest Service, California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, Department of Safety of Dams, and Army Corps of Engineers, Regional Water Quality Control Board, State Water Resources Control Board, and Alpine County.

Task 5. Agency Coordination and Stakeholder Engagement

This task will include a strategy to involve interested public and a stakeholder group including former members of the MCG and other interested stakeholders, notably the Project 137 Ecological Resources Committee. Stakeholder concerns and interests will be identified at the outset of the study, such that the assessment may answer questions and issues. Coordination meetings will be held with water agencies, PG&E, environmental interests, recreation interests, state and federal agencies, and other interested members of the public.

Task 6. Environmental Review

This task will produce sufficient environmental information and analysis necessary for the project under NEPA and CEQA. This will include, but may not be limited to, identifying and discussing impacts on biological resources, public services, recreation, utilities, and water supply. In coordination with the stakeholder group, a qualified consultant will prepare a written analysis of the level of review needed under both federal and state statutes.

Budget

Based on the level of information, extent of investigation, modeling, legal feasibility, analysis, and high degree of involvement and coordination required, this study will cost approximately $350,000. The costs can be broken down as follows:

- Task 1: $150,000
- Task 2: $15,000
- Task 3: $50,000
- Task 4: $35,000
- Task 5: $50,000
- Task 6: $50,000
- **Total Project Costs: $350,000**

References

California Division of Dam Safety Dam Database. Available at: http://www.water.ca.gov/damsafety/damlisting/.

MokeWISE Program Scope of Work:
Project 7b: Raise Lower Bear Feasibility Study

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Water purveyors in Amador County and northern Calaveras County are concerned with short-term water supply reliability in conditions of drought and/or potential curtailments by the State Water Resources Control Board. These water purveyors are also concerned with long-term water supply reliability for existing rights and contracts in the face of drought and climate change. Finally, these water purveyors seek to assure a reliable future water supply that will accommodate growth, including under conditions of drought and climate change.

Water agencies have an interest in protecting their water rights, licenses and facility operations in order to assure water supply reliability for their customers and to continue to meet downstream obligations. Raise Lower Bear Reservoir project was identified as a portfolio component in EBMUDs Water Supply Management Program 2040. Some water agencies interest in the project would be to participate as a part of a broad coalition of interested parties seeking water supply and/or environmental benefit from the project.

Environmental stakeholders in the MokeWISE process are concerned that unnecessary or poorly planned water development may occur that will have harmful environmental, social, economic and recreational impacts, particularly related to aquatic resources. They are concerned that premature water development may create a structural and financial imbalance between water infrastructure and other infrastructure (including transportation and land-use), incentivizing regional development to pay for water infrastructure. They are concerned that the project may enable development that is inconsistent with good land use planning. They are concerned that surface storage development may create precedent for a new dam building era in California in place of more environmentally appropriate approaches to water supply and water use. Environmental stakeholders are also concerned that uncertainty over future water supply may cause water purveyors to oppose long-term river protection, including Wild & Scenic designation for portions of the upper Mokelumne River.

Some non-governmental organizations see the need for the upcountry water agencies to practice transparent decisionmaking processes, and to complete long-range financial planning, with appropriate ratepayer involvement, prior to engaging in capital intensive construction projects. These organizations are interested in seeing that project benefits are equitably reaped, and the burdens equitably distributed.

The Raise Lower Bear Feasibility Study will conduct a study to assess the feasibility of raising Lower Bear Reservoir to:

- Meet short-term and long-term water supply reliability as well as and long-term water supply needs of Amador County and northern Calaveras County, and
- Protect Mokelumne River-related environmental, social and recreational values and resources consistent with the intent of the MokeWISE project, interested stakeholder

concerns, and current laws and regulations at the time of project funding.

- Protect the public's right to managed access the Mokelumne River and its tributaries for fishing, recreation, commerce and other public benefits.

The study will evaluate the feasibility of enlarging Lower Bear Reservoir by raising the existing dam (embankment) by up to 32 feet to increase surface water storage capacity within the upper Mokelumne River watershed and operating the enlarged reservoir to protect the Mokelumne River and its resources consistent with the existing licenses, permits, legal agreements, legal decisions, and operating regimes that currently protect the river's water quality, cultural and historical resources, recreational uses, scenic values. In addition to modifications to the dam itself, the study will evaluate construction of an updated intake structure and spillway, and relocation of adjacent roads and existing recreation facilities. This feasibility study will be a continuation of previous studies and serve to address previously unanswered questions and unresolved issues.

Background Information

The Mokelumne River watershed lies on the western slope of the Sierra Nevada in Alpine, Amador, Calaveras, and San Joaquin counties. Snowmelt from parts of Alpine, Amador, and Calaveras counties contribute to the Mokelumne River runoff. The river's primary tributaries are the North, Middle, and South Forks of the Mokelumne River, with the North Fork draining close to 85% of the Mokelumne River watershed. Flows in the North Fork and some of the significant tributaries are regulated by a series of Pacific Gas & Electric (PG&E) reservoirs located directly upstream of East Bay Municipal Utility District's (EBMUD's) Pardee Reservoir. Snowmelt enters the upper reaches of the Mokelumne River and its tributaries, which then flow into the reservoirs owned by PG&E. Those on-stream reservoirs release flows back into the streams and the river, which progress downstream ultimately reaching Pardee Reservoir (EBMUD, 2012). A significant amount of water is also routed around the North Fork below Salt Springs Dam through a diversion and flume system. The FERC license for PG&E's Project 137 includes streamflows based on a multi-stakeholder settlement agreement. They mimic the natural hydrograph of the river and have been adjusted since the license was issued in 2000, in accordance with a stakeholder-supported adaptive management program, in part to protect sensitive biological resources in the North Fork below Salt Springs Dam and the Bear River confluence.

Lower Bear Reservoir is located approximately 35 miles northeast of the city of Jackson at an elevation of about 5,800 feet above sea level. Originally constructed in 1952 with a usable capacity of 52,025 acre-feet, the reservoir is part of Pacific Gas and Electric's Mokelumne River Hydroelectric Project, Federal Energy Regulatory Commission (FERC) project #137. The reservoir provides storage for hydroelectric operations, recreation, and public water supplies, and its banks are home to a Boy Scout camp and other recreational facilities. In 1978, Amador County Water Agency (now Amador Water Agency) entered into an agreement with PG&E to store up to a maximum of 1,600 acre-feet of water in the Lower Bear reservoir to provide for a firm supply of water in association with its water right application on the Mokelumne River for the AWA's Central Amador Water Project.

Federal agencies have found sections of the North Fork and main stem Mokelumne River downstream of the project to be eligible for designation as a National Wild and Scenic River and they were included in state Wild and Scenic legislation proposed in 2014. Both designations require protecting the river's free-flowing condition and natural character as well as specific, named extraordinary (or "outstandingly remarkable") values. Federal Wild and Scenic studies have named those values as high water quality, scenic beauty, and cultural, and historic. State legislation proposed in 2014 added recreational values because of the number, popularity, long history, quality, and diversity of recreational activities on the river.

Project Information

Project Description

The Raise Lower Bear Feasibility Study will assess the feasibility of raising the existing Lower Bear dam to meet or assist in meeting both short-term and long-term water supply reliability needs and also to meet or assist in meeting long-term water supply needs for Amador County and possibly northern Calaveras County in a way that protects environmental, social, and recreational uses consistent with the intent of the MokeWISE project and environmental stakeholders' concerns. This protection includes operating the enlarged reservoir to protect the Mokelumne River and its resources consistent with the existing licenses, permits, legal agreements, legal decisions, and operating regimes that currently protect the river's water quality, cultural and historical resources, recreational uses, and scenic values.

The study will evaluate the adequacy of current water supplies to meet short-term needs in Amador and northern Calaveras counties. The study will also evaluate specific water supply needs in Amador and northern Calaveras counties that may not be met in the long-term under a series of clearly defined conditions, including various demand and development scenarios, drought and climate change.

The study will evaluate the feasibility of enlarging Lower Bear Reservoir by raising the existing dam (embankment) by up to 32 feet to increase surface water storage capacity within the upper Mokelumne River watershed. The study will provide the height, or possible heights, of the dam; the associated capacity of the reservoir, and the use or uses to be made of the water.

The study will evaluate the feasibility of operating an enlarged Lower Bear River Reservoir consistent with existing uses, licenses, operating goals and norms adopted by the PG&E Ecological Resources Committee for implementation of the Project 137 FERC license, and permits. These uses include PG&E hydropower operations and licenses consistent with current practice and the related settlement agreement, existing water supply contracts between PG&E and Amador Water Agency, existing operational requirements on PG&E to meet downstream water supply needs consistent with the Lodi Decrees, the 1958 agreements between EBMUD and Amador and Calaveras counties, and EBMUD's water supply operations, both for its own customers and for downstream users.

The study will evaluate contractual agreements and/or water rights that are presently available, whether and how they could be modified to meet project purposes, and what new contractual agreements and/or water rights would additionally be needed to meet the target needs. The study will evaluate additional relevant legal issues associated with enlarging Lower Bear River Reservoir. These will include, but not be limited to: consistency with the state and federal Endangered Species Acts, National Forest Management Act, Eldorado National Forest Land and Resource Management Plan, Lodi Decrees, and the county of origin statutes of the California Water Code.

The study will conduct a hydrologic assessment to identify operational alternatives and will use an updated MOCASIM model to simulate those alternatives. Among those alternatives, modeling will evaluate the relative benefits to operations in the event that county of origin filings can be used by Amador and/or Calaveras counties.

The study will evaluate institutional obstacles and opportunities to providing the additional use of Lower Bear Reservoir.

The study will evaluate potential impacts and benefits to the Mokelumne River, including impacts if any on streamflows and the long-term benefit of additional avoided water development. The study will also evaluate the potential for environmental benefits, including but not limited to additional environmental and recreational flow releases for dry years and critically dry years, potential temperature enhancements, recreational site improvements, and others yet to be determined.

The study will evaluate any new infrastructure or infrastructure modifications outside the immediate project area that would be necessary for the project to serve the needs of the target areas.

The study will assess the feasibility of relocating existing recreational areas and transportation infrastructure, and the potential impacts of losing those recreation areas and transportation facilities.

The study will include an economic evaluation of the short-term and long-term costs of the project, including the costs of developing agreements and any needed water rights or water right modifications, condemnation or long-term lease of surrounding PG&E lands and conservation easements, loss of hydropower revenues if any, costs of any needed infrastructure, and range of costs per acre-foot of water that might be delivered under various short-term and long-term conditions.

The study will clarify the operational parameters that will protect instream resources, including wildlife and fish, and evaluate the potential for impacts to existing uses and users (including hydropower, recreation, cultural uses, and water supply).

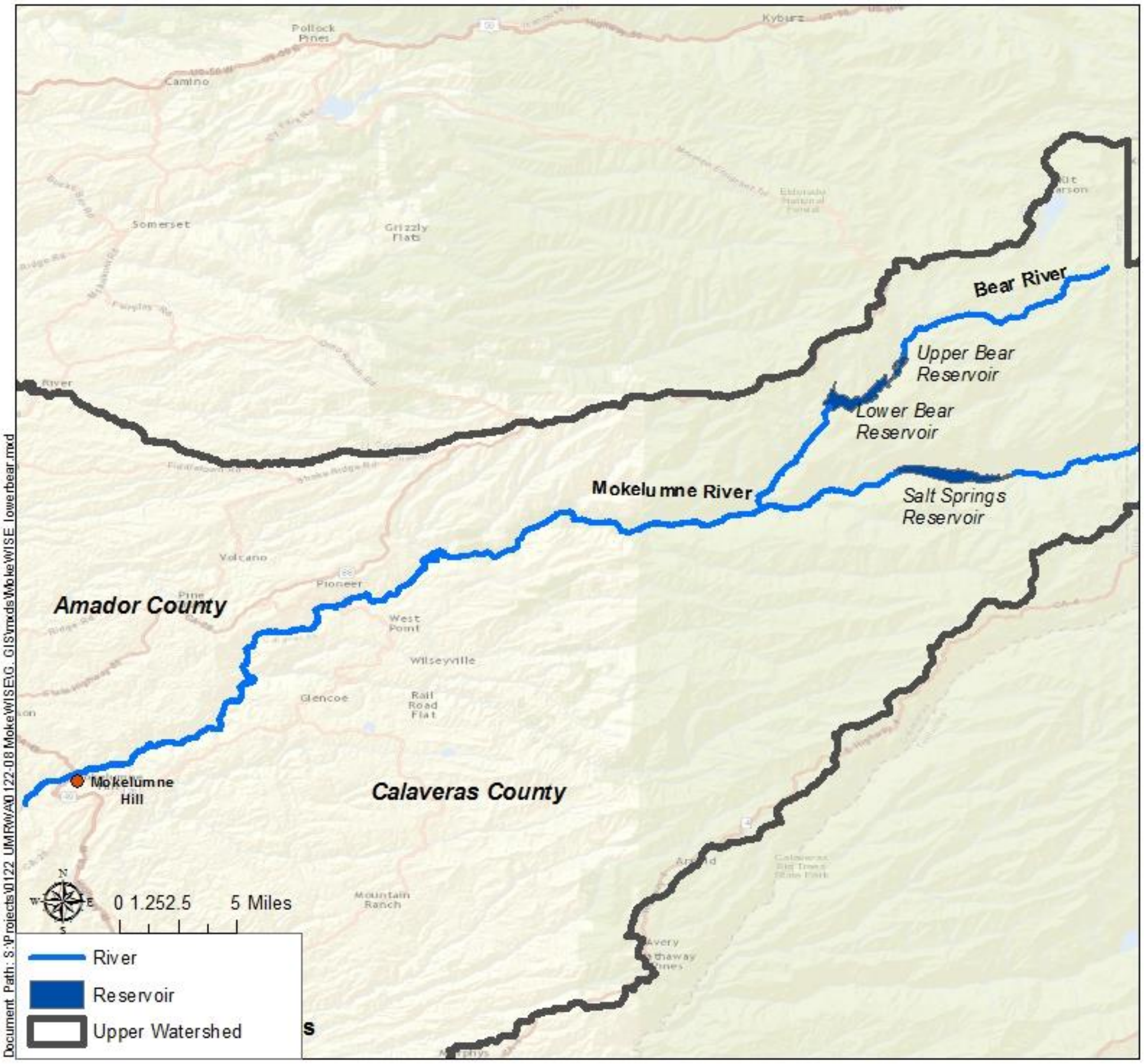
The study will include a consultation process with interested and concerned stakeholders during all phases.

A more detailed Environmental Impact Report and Environmental Impact Statement would be required prior to implementing a project.

Project Location

This study would include the areas located within Amador and Calaveras counties as shown in **Figure 1**.

Figure 1: Location of Bear River and Lower Bear Reservoir



Project Sponsor

AWA, Jackson Valley Irrigation District (JVID), CCWD, and Calaveras Public Utility District (CPUD) are the lead sponsors of this project. No co-sponsors have been identified.

Scope of Work

Task 1. Regional Reliability Needs Assessment

Subtask 1.1 Establish Level of Service Objectives

In order to properly assess current and future reliability needs, level of service (LOS) objectives for future reliability must be established. Working with local water agencies in Amador and Calaveras Counties and interested stakeholders, LOS objectives will be developed that articulate the acceptable frequency, duration, and extent of water supply outages resulting from inadequate storage capacity. These LOS objectives will establish a quantitative benchmark for assessing potential climate change impacts on reliability and articulating a potential need for improved reliability in the future.

Subtask 1.2 Regional Reliability Needs Assessment

This task will include assessing projected future supply reliability for Amador and Calaveras Counties. The reliability assessment will compare projected future supplies and a range of demands in the region, developed in coordination with stakeholders, to quantify projected future supply shortfalls under a range of hydrologic and population change conditions and establish a range of future supply needs. Needs and water demand will be based on widely accepted demographic data including, but not limited to the CA Department of Finance population projections for Amador County; reasonable projections for future water use based on increased levels of conservation, reuse, and efficiency; and a reasonable assessment of the water agencies' financial and technical capacity to expand delivery systems outside their current service areas if doing so is factored into the demand projection.

The study will identify the sources of the water supply, the nature and amount of the proposed water uses, and the locations and the descriptions of any diversions and the storage facilities. The study will present current and reliable data on the "population to be served" and its future water requirements if water is to be used for municipal purposes. The study will map and identify the land to be irrigated, its acreage, and its irrigation needs, if the project is seeking water for agricultural use.

In coordination with stakeholders, three climate change scenarios will be developed to reflect minimal, moderate, and severe climate change impacts. Each scenario will include specific assumptions related to future changes in mean temperatures and precipitation patterns in the Upper Mokelumne River watershed. The existing WARMF model of the Upper Mokelumne River watershed, or another model agreed upon by the stakeholder group, will be used to project the impact of changing temperature and precipitation patterns on supply reliability in the watershed. Supply availability will be overlaid with projected demand patterns to identify any projected changes in the timing, extent, and / or severity of projected outages. These projections will be compared to the LOS objectives developed in Task 1.1 to determine whether or not additional reliability is needed in future years to meet stated LOS objectives. If additional reliability is needed, the analysis will indicate the magnitude and conditions under which reliability improvement is needed.

Based on the results of this analysis, potential measures needed to secure future supply reliability will be identified. This will include a determination of the degree to which additional above- or below-ground storage could mitigate potential climate change impacts on water supplies and / or environmental resources, and will assist in determining the magnitude of additional storage capacity needed to mitigate potential future reliability impacts.

Task 2. Model Updates

This task involves working with PG&E and EBMUD to understand and document current operational parameters. This information has been previously documented and is reflected in the operating logic incorporated in the MOCASIM model of the upper watershed. Following discussions with PG&E and EBMUD staff, model logic will be reviewed and confirmed, or updated if necessary based on new information.

Task 3. Alternatives Development

Subtask 3.1 Alternatives Development

This task includes inspecting and assessing a variety of project alternatives in order to identify operational constraints and opportunities associated with raising Lower Bear Reservoir. Alternatives may include raising Lower Bear Reservoir by several different heights. Each alternative will be designed to carry out the purposes of the project, including its environmental, economic and social goals, consistent with the operations described in the project description.

In order to develop potential alternatives for raising Lower Bear, relevant existing mapping, design drawings, and engineering reports will be gathered and reviewed. Existing site and reservoir drainage, overflow and outfall facilities, water transmission piping, valving, reservoir operation, existing site access, and easements will also be compiled and reviewed. Each potential alternative will be assessed for the following considerations:

- Operational scenarios to optimize operations for a range of beneficial uses, including fish, wildlife, recreation, and consumptive use.
- Potential benefits and / or impacts on fish, wildlife, recreation, cultural and consumptive uses of the river and surrounding lands
- Projected cost and cost of delivered water per acre foot
- Ability to meet LOS objectives for water reliability

- Range of potential beneficial uses and degree to which they enhance existing beneficial uses of the reservoir, Mokelumne River or water
- Degree to which the alternative could lead to imbalances

Subtask 3.2 Operational Issues

For each alternative, the steps to implementation will be discussed along with critical triggers. This task will include reviewing and defining anticipated operational parameters for the alternatives developed in Subtask 2.1. Reservoir operational considerations including timing and duration of filling cycles related to available supply, demands and conveyance capacity, and water quality will be assessed. An assessment will also be performed to gain an understanding of the nature and magnitude of the hydrologic changes that may affect the Mokelumne River, and how those changes may affect the project.

Subtask 3.3 Impacts and Constraints

For each alternative defined in Subtask 2.1, an impacts and constraints analysis will be performed. Benefits, impacts, and constraints on river flows, domestic water supply, technical, political, cultural, environmental (including both species-related and geomorphic), economic, legal, and recreation will be defined. Any mitigation efforts that could minimize impacts will be noted.

The study will identify the challenges associated with trying to mitigate the potential impacts to threatened, endangered, and sensitive species and management indicator species including but not limited to goshawk, American marten, and pacific fisher; given the incomplete nature of habitat mitigation networks both on the Eldorado National Forest and region-wide.

The study includes consultation with local land use agencies to identify feasible means of reducing impacts of development associated with new water customers anticipated to be served with water resulting from this project. Results of these consultations with any recommendations shall be published in the study.

The study will identify the compatibility of securing a Wild and Scenic Designation for the Mokelumne River in conjunction with the reservoir expansion. After the study, but before the utilities make further legal commitments, financial commitments, funding applications, or permit applications associated with reservoir expansion, the utilities will indicate their position regarding a Wild and Scenic Designation in conjunction with a dam raise.

Subtask 3.4 Economic Analysis

Conceptual opinions of probable construction and operation costs will be prepared for each alternative to identify budget-level cost for constructing facilities needed to develop the project. This subtask will conduct an economic evaluation of the short-term and long-term costs of the alternatives, including costs associated with developing agreements, modifying water rights, loss of hydropower revenue, and constructing needed infrastructure. For each alternative, a cost per acre-foot of water delivered will be estimated.

The study shall identify prudent methods for district-wide long-term financial planning for capital expenditures, operations, and maintenance. The study will report on the willingness of the water utilities to participate in that planning prior to making further financial commitments associated with a dam raise.

The study shall identify one or more ways in which the water supply will be shared; and one or more ways the capital, operations, and maintenance costs of the project will be shared. Following the study, but before the utilities make further legal commitments, financial commitments, funding applications, or permit applications associated with a dam raise, the utilities will identify water supply and cost sharing options acceptable to the utilities.

Subtask 3.5 Technical Feasibility

This task will provide a summary of the technical analyses for each alternative and provide clear information for determining the technical feasibility of each. Each summary will provide an overall project plan and timeline including interrelationships between steps, key decision points, and system operations. Funding strategies and criteria will be identified in the summary to maximize the potential for state and federal opportunities, including interrelationships between steps, key decision points, and system operations. Funding strategies and criteria will be identified in the summary to maximize the potential for state and federal opportunities.

Task 4. Alternatives Analysis

The results of the assessment will be reviewed to determine which potential alternative, if any, meets the purposes of the project, including its water supply, environmental, social and economic goals, within the operation scheme detailed in the project description.

An extensive alternatives analysis process will be documented in order to determine the most optimal alternative. The alternatives analysis will consider, at a minimum:

- Operational constraints
- Projected cost of construction and delivered water
- Ability of the involved agencies to finance and construct the project, with potential sources of funding and local share analysis
- Effects on fish and wildlife
- Effects on recreation and other river uses, including cultural uses
- Effects on consumptive use

- Land use impacts, including the growth-inducing impact of providing additional water to areas that are not fully mitigating the environmental impacts of growth and development

The assessment will be completed under the direction of a stakeholder group comprised of interested former members of the Mokelumne Collaborative Group (MCG) as well as other interested stakeholders.

Task 5. Legal Analysis

This task will conduct a legal analysis of what new contracts and/or water rights might be needed to use existing storage to short-term and long-term water supply needs in the target areas. It will evaluate consistency with existing permits and licenses and analyze how conflicts (if any) between current and required legal constructs could be resolved. It will also evaluate what contractual or permit terms could be reasonably included that would protect environmental and recreational values.

This task will also evaluate additional specific legal issues related to the project that affect its feasibility. These include: achieving consistency with the Eldorado National Forest Land and Resource Management Plan and the National Forest Management Act (NFMA); the potential adverse effects on goshawk habitat in a national forest that has not yet implemented its goshawk management requirements under NFMA; effects on the viability of other sensitive species under NFMA (foothill yellow-legged frog, American marten, Pacific fisher); effects to listed and candidate species under the state and federal Endangered Species Acts; conformity of the project with the Forest Service's visual quality objectives for the area (LRMP/NFMA); the legal implications of incidental take of endangered species under the Endangered Species Act; legal issues regarding condemnation of surrounding lands and conservation easements; and the likelihood of achieving the agreement of all signatories to the Project 137 Settlement Agreement and the U.S. Forest Service to any modifications to facilities or operations that may be necessary for reservoir enlargement; and the likelihood of securing PG&E approval to expand the reservoir.

Task 6. Agency Coordination and Stakeholder Engagement

The study will proceed in collaboration with a targeted stakeholder group including former members of the MCG and other interested stakeholders. Key stakeholder concerns and interests will be identified at the outset of the study, such that the assessment may answer these questions and / or address these issues.

Coordination meetings will be held with water agencies, PG&E, environmental interests, recreation interests, and state and federal agencies.

The study shall identify ongoing means of providing timely information and meaningful opportunities to participate for ratepayers and other interested parties. The study will report on the willingness of the water utilities to provide such a process.

Budget

Based on the level of information, extent of investigation, modeling, legal feasibility, and high degree of involvement and coordination required, this study will cost approximately $750,000.

References

Amador Water Agency. 2011. *Urban Water Management Plan*. September 2011. Available at: http://www.water.ca.gov/urbanwatermanagement/2010uwmps/Amador%20Water%20Agency/UWMP%20Final%20Report%20092911.pdf

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East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April 2012.

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MokeWISE Program Scope of Work:
Project 7d: Re-operation of Existing Storage

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Water purveyors in Amador County and northern Calaveras County are concerned with short-term water supply reliability in conditions of drought and/or potential curtailments by the State Water Resources Control Board. These water purveyors are also concerned with long-term water supply reliability for existing rights and contracts in the face of drought and climate change. Finally, these water purveyors seek to assure a reliable future water supply that will accommodate growth, including under conditions of drought and climate change.

Environmental stakeholders in the MokeWISE process are concerned that unnecessary or poorly planned water development may occur that will have harmful environmental, social, economic and recreational impacts, particularly related to aquatic resources. They are concerned that premature water development may create a structural and financial imbalance between water infrastructure and other infrastructure (including transportation and land-use), incentivizing regional development to pay for water infrastructure. They are concerned that the project may enable development that is inconsistent with good land use planning. They are concerned that surface storage development may create precedent for a new dam building era in California in place of more environmentally appropriate approaches to water supply and water use. Environmental stakeholders are also concerned that uncertainty over future water supply may cause water purveyors to oppose long-term river protection, including Wild & Scenic designation for portions of the upper Mokelumne River. They want the results of the study to identify project design, project operations, and permit conditions to ensure that any proposed projects achieve the MokeWISE objectives of being economically, socially, and environmentally acceptable and compatible with Wild and Scenic protection for the Mokelumne River. Environmental stakeholders are also concerned about the high cost of new dam projects and preferentially seek to diversify the uses of existing water storage facilities on the Mokelumne River and tributaries to meet local water supply needs.

Some non-governmental organizations are concerned that the ultimate use of the water for future development may have unnecessary significant impacts on the environment that should first be reduced through land use planning and pollution prevention. If the re-operation projects ultimately involve substantial investments, these entities see the need for the upcountry water agencies to practice transparent decision-making processes, and to complete long-range financial planning, with appropriate ratepayer involvement, prior to engaging in such a project. Finally, these entities want to ensure that the benefits of the project are equitably reaped, and the burdens equitably distributed.

Water agencies have an interest in protecting their water rights, licenses and facility operations in order to assure water supply reliability for their customers and to continue to meet downstream obligations. Water agencies are willing to consider the possibility of reservoir reoperation scenarios with the understanding that it will retain existing water rights or licenses and ownership of facilities. Further reoperation would be considered if it can be shown to benefit water agency customers by providing a more reliable water supply, a financial benefit, and/or a benefit to the Lower Mokelumne. Reoperation would require reimbursement, either financial or another equivalent method, to cover the cost(s) associated with reoperation, including the costs of regulatory approvals required and to compensate for ongoing expenses or revenue losses as may be a part of possible scenarios envisioned.

The Re-operation of Existing Storage Project will conduct a study to assess the feasibility of re-operating and diversifying the use of existing storage in the Mokelumne River Watershed to:

- Meet short-term and long-term water supply reliability as well as the long-term water supply needs of Amador County and northern Calaveras County.

- Protect Mokelumne River-related environmental, social and recreational values consistent with the intent of the MokeWISE project, interested stakeholder concerns, and current laws and regulations at the time of project funding.

- Protect the public's right to managed access the Mokelumne River and its tributaries for fishing, recreation, commerce and other public benefits.

The study will evaluate opportunities for re-operating and diversifying existing storage in Pacific Gas & Electric Company's (PG&E) Mokelumne River Project (FERC No. 137) and in East Bay Municipal Utility District's two large storage reservoirs further downstream, consistent with the existing licenses, permits, legal agreements, legal decisions, and operating regimes that currently protect the river's water quality, cultural and historical resources, recreational uses, scenic values.

Costs for this project are estimated to be $750,000.

Background Information

The Mokelumne River watershed lies on the western slope of the Sierra Nevada in Alpine, Amador, Calaveras, and San Joaquin counties. Snowmelt from parts of Alpine, Amador, and Calaveras counties contribute to the Mokelumne River runoff. The river's primary tributaries are the North, Middle, and South Forks of the Mokelumne River, with the North Fork draining close to 85% of the Mokelumne River watershed. Flows in the North Fork and some of the significant tributaries are regulated by a series of Pacific Gas & Electric (PG&E) reservoirs located directly upstream of East Bay Municipal Utility District's (EBMUD's) Pardee Reservoir. Snowmelt enters the upper reaches of the Mokelumne River and its tributaries, which flow into the reservoirs owned by PG&E. Those on-stream reservoirs release flows back into the streams and the river, which progress downstream ultimately reaching Pardee Reservoir (EBMUD, 2012). A significant amount of water is also routed around the North Fork below Salt

Springs Dam through a diversion and flume system. The FERC license for PG&E's Project 137 includes streamflows based on a multi-stakeholder settlement agreement. They mimic the natural hydrograph of the river and have been adjusted since the license was issued in 2000, in accordance with a stakeholder-supported adaptive management program, in part to protect sensitive biological resources in the North Fork below Salt Springs Dam and the Bear River confluence.

Federal agencies have found sections of the North Fork and main stem Mokelumne River between Salt Springs Reservoir and Pardee Reservoir to be eligible for designation as a National Wild and Scenic River, and they were included in state Wild and Scenic legislation proposed in 2014. Both designations require protecting the river's free-flowing condition and natural character as well as specific, named extraordinary (or "outstandingly remarkable") values. Federal Wild and Scenic studies have named those values as high water quality, scenic beauty, cultural and historic. State legislation proposed in 2014 added recreational values because of the number, popularity, long history, quality and diversity of recreational activities on the river. EBMUD operates two major storage reservoirs on the Mokelumne River whose maximum surface elevations are less than 600 feet above msl: Pardee Reservoir and Camanche Reservoir. Pardee Reservoir is EBMUD's primary storage reservoir for delivering water to its service area located in Alameda and Contra Costa Counties. Camanche Reservoir, located immediately downstream of Pardee Dam, is used primarily to store water for delivery to downstream water users and for flood control. These two reservoirs are operated in a coordinated fashion to optimize uses. One of these uses is the maintenance of cold water for the Mokelumne River Fish Hatchery immediately downstream of Camanche Dam and for the lower Mokelumne River generally. The Lower Mokelumne Joint Settlement Agreement, which took effect in 1998, requires EBMUD to make streamflow releases and carry out other measures to protect salmonids in the lower Mokelumne. A Partnership committee composed of EBMUD, resource agencies and other stakeholders meets quarterly to discuss operational options and protections and enhancements for the fishery. The lower Mokelumne fisheries have consistently out-performed those on most Central Valley rivers in terms of annual escapement exceeding the long-term average and progress towards achieving the Central Valley Project Improvement Act (CVPIA) doubling goal for salmon.

Amador Water Agency has contractual rights to a pre-1914 water right on the Mokelumne River and certain tributary streams. Currently, the place of storage for that 15,000 afa water right is in PG&E reservoirs: the so-called "upper lakes" reservoirs at higher elevations in Alpine County and the Upper Bear River Reservoir in Amador County, as well as Lake Tabeaud. PG&E must annually draw down the upper lakes in winter to avoid damage to the old, earthen dams, which reduces AWA's carryover storage for dry years. AWA also has a water right for its Central Amador Water Project that relies on water stored in Lower Bear River Reservoir and an additional water right pending that would similarly store and convey water. The agency pays PG&E for storage and generation foregone related to its Lower Bear water right. Jackson Valley Irrigation District has a 1927-priority right to water from direct diversion from the Mokelumne.

Project Information

Project Description

The Re-operation of Existing Storage Project will conduct a study to assess the feasibility of re-operating and diversifying the use of existing storage in the Mokelumne River Watershed to meet short-term and long-term water supply reliability and also to meet long-term water supply needs for Amador County and northern Calaveras County. The study will evaluate opportunities relating to existing storage in Pacific Gas & Electric Company's (PG&E) Mokelumne River Project (FERC No. 137) and in East Bay Municipal Utility District's two large storage reservoirs further downstream. The study will evaluate re-operation and diversifying the use of storage in a way that protects the environmental, social and recreational uses consistent with the intent of the MokeWISE project and environmental stakeholders' concerns. The study will require that re-operation scenarios be consistent with existing protections provided by current licenses, permits, legal agreements, legal decisions, and operating regimes that protect the river's water quality, cultural and historical resources, recreational uses, scenic values.

The study will evaluate the adequacy of current water supplies and existing uses of storage facilities to meet short-term needs in Amador and northern Calaveras counties. The study will also evaluate specific water supply needs in Amador and northern Calaveras counties that may not be met in the long-term under a series of clearly defined conditions, including various demand and development scenarios, drought and climate change. The study will identify the sources of the water supply, the nature and amount of the proposed water uses, and the locations and the descriptions of the diversions and the storage facilities. The study will present current and reliable data on the "population to be served" and its future water requirements if water is to be used for municipal purposes. The study will map and identify the land to be irrigated, its acreage, and its irrigation needs, if the project is seeking water for agricultural purposes.

The study will evaluate alternatives in the context of existing uses, licenses and permits. These uses include PG&E and EBMUD's hydropower operations and licenses, existing water supply contracts between PG&E and Amador Water Agency, existing operational requirements on PG&E to meet downstream water supply needs consistent with the Lodi Decrees, and EBMUD's water supply and reservoir operations, both for its own customers and for downstream water users and flood control beneficiaries.

The study will evaluate contractual agreements and/or water rights that are presently available, whether and how they could be modified to meet project purposes, and what new contractual agreements and/or water rights would additionally be needed to meet the target needs.

The study will conduct a hydrologic re-operation assessment to identify alternatives and will update the MOCASIM model to simulate those alternatives.

The study will evaluate institutional obstacles and opportunities to adding uses.

The study will evaluate potential impacts and benefits to the Mokelumne River, including impacts if any on streamflows and the long-term benefit of avoided water development. The study will identify the amount, or possible amounts, of unappropriated water that will stay in-stream to meet recreation, fish, wildlife, and water quality needs in all water year types.

The study will evaluate any new infrastructure or infrastructure modifications that would be necessary to serve the needs of the target areas.

To the degree that the study evaluates groundwater recharge or in-lieu use in San Joaquin County, this study will demonstrate the degree to which the project could achieve or contribute to a long-term balance of water supply and demand, and to restoration of the groundwater basin, for any water projects that provide irrigation water or groundwater recharge in the San Joaquin Groundwater Basin.

The study will include an economic evaluation of the short-term and long-term costs of re-operation and diversification, including the costs of developing agreements and any needed water rights or water right modifications, any change in hydropower revenues, costs of any needed infrastructure, and range of costs per acre-foot of water that might be delivered under various short-term and long-term conditions.

The study will clarify operational parameters, will evaluate the potential for impacts to existing uses and users (including hydropower, flood control, and water supply), and will propose mitigation measures for any such impacts.

The study will evaluate the degree to which proposed projects provide managed public access to the Mokelumne River and its tributaries for fishing, recreation, commerce and other public benefits and associated maintenance needs.

The study will explain how any proposed project avoids the waste, the unreasonable use, the unreasonable method of use, and the unreasonable method of diversion of water.

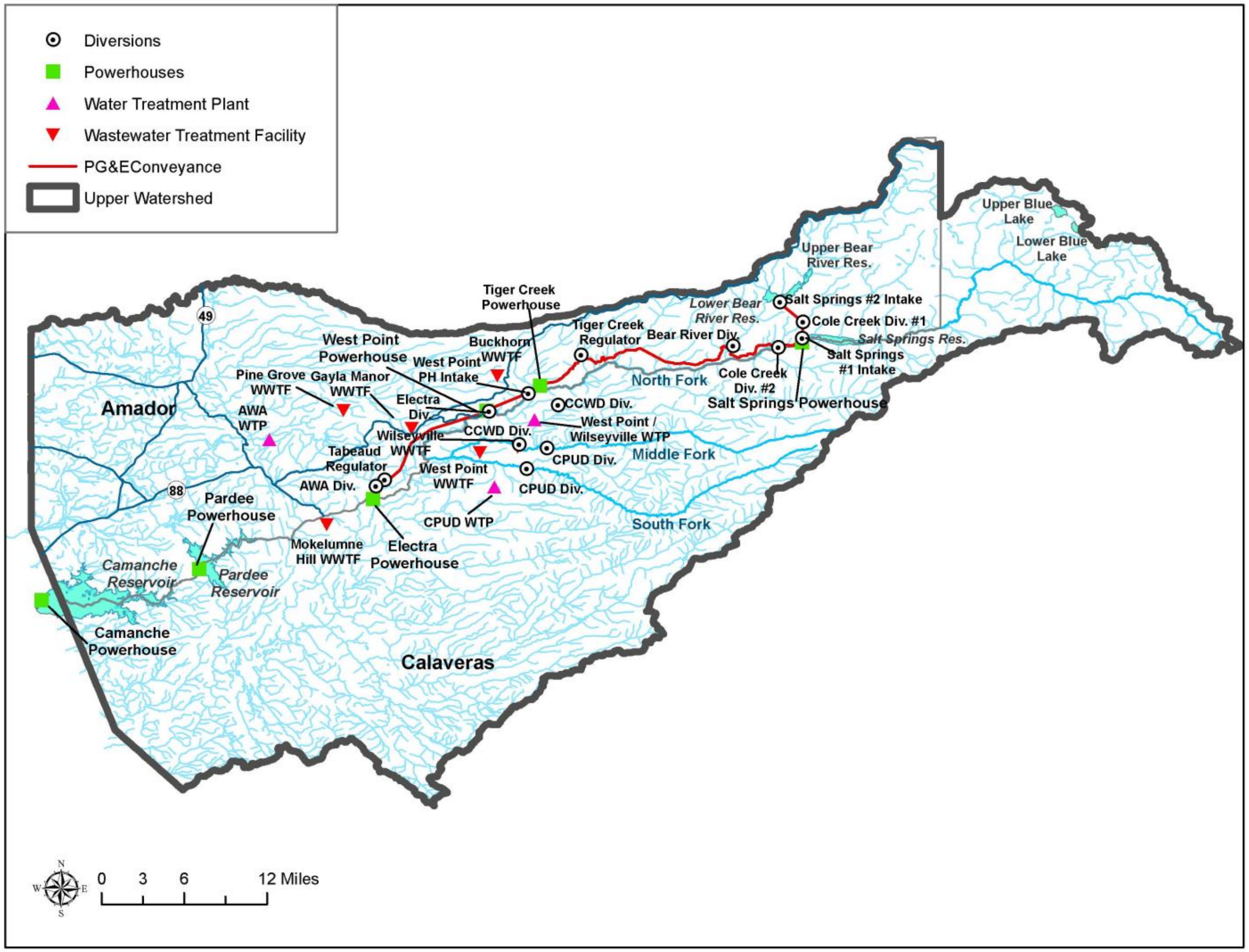
The study will include a consultation process with interested and concerned stakeholders at all stages, from design through approval of results.

More detailed environmental analysis under CEQA and NEPA could be required prior to implementing a project.

Project Location

The concept would be located in the PG&E and EBMUD reservoirs in the Mokelumne River watershed. Reservoirs in the higher portions of the watershed include the Blue Lakes complex, Lower Bear and Salt Springs, all owned by PG&E. The project would extend downstream to include Pardee and Camanche Reservoirs. **Figure 1** shows the reservoirs and major diversion points of the PG&E system.

Figure 1: Major Reservoirs and Facilities in the Upper Mokelumne River Watershed



Project Sponsor

The Upper Mokelumne River Watershed Authority (UMRWA) is the lead sponsor of the concept and California Sportfishing Protection Alliance (CSPA) is the co-sponsor.

Scope of Work

The Re-operation of Existing Storage Project will conduct a study to assess the feasibility of re-operating existing storage in the Mokelumne River Watershed to meet both short-term and long-term water supply reliability and also to meet long-term water supply needs for Amador County and northern Calaveras County. The study will evaluate opportunities relating to existing storage that exists in Pacific Gas & Electric Company's (PG&E) Mokelumne River Project (FERC No. 137) and in East Bay Municipal Utility District's two large storage reservoirs further downstream.

Task 1. Determine Project Need

This task will assess projected future supply reliability for Amador and Calaveras Counties. The reliability assessment will compare projected future supplies and a range of demands in the region. Developed in coordination with stakeholders, the assessment will quantify projected future supply shortfalls under a range of hydrologic and population change conditions and establish a range of future supply needs. Needs and water demand will be based on widely accepted demographic data including, but not limited to the CA Department of Finance population projections for Amador County; reasonable projections for future water use based on increased levels of conservation, reuse, and efficiency; and a reasonable assessment of the water agencies' financial and technical capacity to expand delivery systems outside their current service areas, if doing so is factored into the demand projection.

The study will identify the sources of the water supply, the nature and amount of the proposed water uses, and the locations and the descriptions of any diversions and the storage facilities. The study will present current and reliable data on the "population to be served" and its future water requirements if water is to be used for municipal purposes. The study will map and identify the land to be irrigated, its acreage, and its irrigation needs, if the project is seeking water for agricultural use.

In coordination with stakeholders, at least three climate change scenarios and three demand development scenarios will be developed. The climate change scenarios will reflect minimal, moderate, and severe climate change impacts to address potential changes in supply reliability. Each scenario will include specific assumptions related to future changes in mean temperatures and precipitation patterns in the Upper Mokelumne River watershed. The existing WARMF model of the Upper Mokelumne River watershed will be used to project the impact of changing temperature and precipitation patterns on supply in the watershed, particularly as it relates to potential curtailment of water rights during drought. Supply availability will be overlaid with projected demand patterns to identify potential supply shortfalls.

The demand management scenarios will reflect minimal, modest, and aggressive demand. . Each scenario will include specific assumptions related to land use, economic growth, population growth, efficiency, and conservation within Amador and northern Calaveras counties. The assessment will determine the impact of each demand management scenario on three temporal horizons that could include 2020, 2040, and 2070.

To the degree to which information is available, the study will explain how any proposed project avoids the waste, the unreasonable use, the unreasonable method of use, and the unreasonable method of diversion of water.

Task 2. Legal Analysis

The legal analysis includes two components. The first component will evaluate consistency with existing permits and licenses and analyze how conflicts (if any) between current and required legal constructs could be resolved. Existing permits and licenses that could be affected include PG&E and EBMUD's hydropower operation agreements and licenses; water supply contracts between PG&E and Amador Water Agency (AWA); the collective Lodi Decrees; and EBMUD's water supply operations to meet contractual obligations to downstream users,

The second component will analyze new contracts and/or water rights that may be needed to use PG&E's and EBMUD's existing storage facilities to meet short-term and long-term water supply needs in the target areas. This includes an analysis of how currently available water rights could be modified to meet the project purpose. The second component of the legal analysis will also include an evaluation of what contractual or permit terms could be reasonably included that would protect environmental and recreational values.

Task 3. Model Updates

This task involves working with PG&E and EBMUD to understand and document current operational parameters. This information has been previously documented and is reflected in the operating logic incorporated in the MOCASIM model of the upper watershed. Following discussions with PG&E and EBMUD staff, model logic will be reviewed and confirmed, or updated if necessary based on new information.

Task 4. Assess Re-operation Scenarios

Once the MOCASIM model has been updated to reflect current PG&E and EBMUD operations, the model will simulate a series of alternate scenarios with the goal of maximizing water supply benefits while protecting environmental uses and values. The assessment will clarify operational parameters for each scenario to include in the MOCASIM model. For each scenario, the assessment will detail potential benefits and impacts to instream flow, fish, wildlife, recreation, scenic beauty, cultural and historical resources and consumptive use. The study will evaluate the degree to which proposed projects will provide managed public access to the Mokelumne River and its tributaries for fishing, recreation, commerce, and other benefits and associated maintenance needs.

All scenarios will comply with all existing water rights and regulations governing instream flows, including those established by the Joint Settlement Agreement (JSA), the Lodi Decrees, and the FERC 137 relicensing agreement. The study will screen scenarios so that proposed operations are consistent with existing uses, licenses, operating goals and norms adopted by the Lower Mokelumne River Partnership established by the Joint Settlement Agreement for the implementation of Lower Mokelumne River Project 2916 FERC license and by the PG&E Ecological Resources Committee for implementation of the Project 137 FERC license and so that operations do not adversely affect the river's scenic beauty, cultural and historic resources, water quality, or recreational values as they exist today.

Task 5. Technical Feasibility

Subtask 5.1 Implementation Issues

The assessment will outline the opportunities and constraints for each scenario, as well as assess reservoir operational considerations including timing and duration of filling cycles related to available supply, demands and conveyance capacity, and water quality. The assessment will also quantify the impacts to hydropower generation and to both required and otherwise currently existing streamflows for each scenario.

Subtask 5.2 Economic Analysis

The feasibility analysis will include an economic component that will determine the costs associated with re-operating storage, including the cost of delivered water. These costs will include any staffing and/or additional infrastructure or infrastructure modification needed to realize the benefits of re-operation. The analysis will also determine the potential cost associated with any change in hydropower generation.

The study shall identify prudent methods for district-wide long-term financial planning for capital expenditures, operations, and maintenance. The study will report on the willingness of the water utilities to participate in that planning prior to making further financial commitments associated with reservoir reoperation.

The study shall identify one or more ways in which the water supply will be shared; and one or more ways the capital, operations, and maintenance costs of the project will be shared. Following the study, but before the utilities make further legal commitments, financial commitments, funding applications, or permit applications associated with reservoir reoperation, the utilities will identify water supply and cost sharing options acceptable to the utilities.

Subtask 5.3 Institutional Feasibility

The assessment will summarize the willingness of EBMUD and/or PG&E to re-operate facilities under each operating scenario, based on coordination with representatives from these agencies.

The study includes consultation with local land use agencies to identify feasible means of reducing impacts of development associated with new water customers anticipated to be served with water resulting from this project. Results of these consultations with any recommendations shall be published in the study.

The study will identify the compatibility of a Wild and Scenic Designation for the Mokelumne River in conjunction with the reoperation projects. After the study, but before the utilities make further legal commitments, financial commitments, funding applications, or permit applications associated with reservoir reoperation, the utilities will indicate their position regarding a Wild and Scenic Designation in conjunction with reservoir reoperation.

Task 6. Alternatives Analysis

The stakeholder group tasked with overseeing the project will review the results of the assessment to clearly define the potential benefits and impacts of each operating scenario to fish, wildlife, recreation, consumptive use, scenic beauty, water quality, and cultural and historical resources. The study shall identify ongoing means of providing timely information and meaningful opportunities to participate for ratepayers and other interested parties. The study will report on the willingness of the water utilities to provide such a process.

An extensive alternatives analysis process will be documented. The alternatives analysis will consider, at a minimum:

- Operational constraints
- Projected cost of the project and delivered water
- Benefits or impacts to fish and wildlife
- Benefits or impacts to recreation
- Benefits or impacts to consumptive use
- Institutional feasibility

Task 7. Agency Coordination and Stakeholder Engagement

The project will proceed in collaboration with a targeted stakeholder group including former members of the Mokelumne Collaborative Group (MCG) and other interested stakeholders. Key stakeholder concerns and interests will be identified at the outset of the study, such that the assessment may answer these questions and/or address these issues.

Coordination meetings will be held with water agencies, PG&E, environmental interests, recreation interests, and state and federal agencies.

Budget

Based on the extent of investigation, modeling, and coordination with PG&E and other agencies required, it is assumed that the Feasibility Study will cost approximately $750,000.

References

RMC, 2007. Upper Mokelumne River Watershed Assessment and Planning Project. Final Project Report. August 2007.

MokeWISE Program Scope of Work:
Project 7f: Reliability and Replacement Assessment for Dams at Blue and Twin Lakes

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Water purveyors in Amador County and northern Calaveras County are concerned with short and long-term water supply reliability in conditions of drought, curtailments by the State Water Resources Control Board, and climate change. These water purveyors want to firm up existing water supply reliability for their existing rights and contracts to better prepare for increasingly long droughts and adapt to climate change over the next 50-75 years. Of particular concern is the receding snowpack with drought and climate change, which is a natural reservoir that slowly melts during the summer refilling reservoirs.

The purpose of the study is to determine the engineering and environmental feasibility of maintaining or improving the function of Upper and Lower Blue Lakes and Twin Lakes dams. A considerable amount of Amador Water Agency's pre-1914 water right is backed up with water stored in these small reservoirs. A problem has been identified with the safety of these dams. PG&E has reported to the Federal Energy Regulatory Commission (FERC; Letter to Frank Blackett, Regional FERC Engineer, March 10, 2014) that a geotechnical consultant has reported the Upper Blue Lake Dam is likely to fail in an earthquake:

> "…*the saturated portion of the Upper Blue dam is likely to fully liquefy during postulated seismic shaking…"*

One potential earthquake source is Waterhouse Peak Fault (PG&E Letters to Frank Blackett, Regional Engineer, FERC, Jul. 31 & Sept. 30, 2014), which is very close to the Blue Lake dams. PG&E is continuing studies of this fault, and they are answering questions from FERC. The dams on Lower Blue and Twin Lakes appear to have the same soil characteristics and potential for liquefaction as Upper Blue Dam. The loss of water stored in these reservoirs would be a major problem for Amador County. This water would be lost if State or Federal dam safety regulators order these reservoirs drained for safety. The combined capacity of these three reservoirs is 13,176 ac-ft. Loss of water in these dams from an earthquake or from an order to drain them for safety by state or federal dam regulators could require AWA to severely restrict or ration water to customers during an extended drought or a State ordered drought curtailment of senior water right.

One of the questions raised by FERC (Nov. 25, 2014 FERC letter to PG&E) is why the recommended strengths from triaxial lab tests yield significantly higher values than the triaxial tests documented in the 1999 Woodruff report.

At present, PG&E nearly empties these reservoirs in the fall because of safety issues in the winter. Replacing these old dams could accomplish the goals of maintaining stability during an earthquake and improving local water supply reliability by storing "carry-over" water through the winter. There could also be a benefit if the reservoir storage capacity were increased slightly.

Environmental stakeholders in the MokeWISE process are concerned that unnecessary or poorly planned water development could have harmful environmental, social, economic and recreational impacts, particularly related to aquatic resources. They are concerned that premature water development may create a structural and financial imbalance between water infrastructure and other infrastructure (including transportation and land-use), incentivizing regional development to pay for water infrastructure. They are concerned that new surface storage development may create precedent for a new dam building era in California in place of more environmentally appropriate approaches to water supply and water use. Environmental stakeholders are also concerned that uncertainty over future water supply may cause water purveyors to oppose long-term river protection, including Wild & Scenic designation for portions of the upper Mokelumne River. Environmental stakeholders thus believe that this project may offer opportunities to avoid many undesirable consequences by firming up the reliability and possibly increasing the operational flexibility of these existing surface storage facilities.

Environmental stakeholders also have a general interest in assuring that existing hydropower infrastructure and its operation are safe and reliable.

Some non-governmental organizations are concerned that the ultimate use of the water for future development may have unnecessary significant impacts on the environment that should first be reduced through land use planning and pollution prevention. If the dam replacement projects ultimately involve substantial water utility investments, these organizations see the need for the upcountry water agencies to practice transparent decision-making processes, and to complete long-range financial planning, with appropriate ratepayer involvement, prior to engaging in such a project.

Water agencies have an interest in protecting the reliability of water available to them under existing contractual agreements for water allocated pursuant to senior water rights, in order to assure water supply reliability for their customers and to continue to meet downstream obligations. Water agencies are generally willing to participate as a part of a broad coalition of interested parties seeking water supply and/or environmental benefits from this project.

Background Information

Pacific Gas & Electric (PG&E) owns and operates Upper and Lower Blue and Twin Lakes Reservoirs. Their consultant, AMEC, has been conducting seismic stability studies on Upper Blue Lake dam. In December 2013, PG&E submitted a field investigation report to FERC by AMEC with data on field borings in Upper Blue Lake dam and its soil properties. Since that time, AMEC through PG&E has performed additional dam stability analyses based on the recommended properties. PG&E submitted a report to Federal Energy Regulatory Commission (FERC) on March 3, 2014. These reports are classified by PG&E as "Critical Energy Infrastructure Information (CEII), Do Not Release." In the report, AMEC assesses seismic stability using ground motions from two separate potential seismic sources. In a PG&E letter to FERC, they disclosed that AMEC has found Upper Blue Lake dam is likely to liquefy in an earthquake. FERC acknowledges the risk of dam failure in their letter to PG&E on November 25, 2014, where they refer to a

"Category III Potential Failure Mode (PFM) associated with the dam's (Upper Blue Lake) performance under extreme seismic loading, and recommendations of the Ninth Independent Consultant."

PG&E also has consultants studying the Waterhouse Peak Fault, which may be located on the east side of the lake. PG&E reported to FERC in July 2014, that the Waterhouse Peak Fault is considered Active by California's definitions. They have researched other sources of earthquakes and concluded that the Carson Fault, a part of the Sierra Nevada Frontal fault system, continues to have the highest slip rate of nearby faults and could generate a Magnitude 7.1 earthquake with a minimum possible acceleration at the dam of 0.38g. The California Geologic Survey has mapped a potential earthquake fault approximately 6 miles to the east toward Markleeville.

All three of the dams on these lakes are classified as an ERRK (earth and rock) type by the California Division of Dam Safety. They appear to be constructed of a similar silty, sandy soil. The following information is from the State Division of Dam Safety:

Upper Blue Lake Dam is in Alpine County, is owned by PG&E, was constructed in 1901, has a capacity of 7,576 acre-feet (AF), an area of 354 acres, a drainage area of 2 square miles, a crest elevation of 8,131 feet, is 31 feet high and 790 feet long, and is a homogenous earth embankment.

Lower Blue Lake Dam is also in Alpine County, is owned by PG&E was constructed in 1903, has a capacity of 4,300 AF, an area of 157 acres, a drainage area of 4.8 square miles, a crest elevation of 8,055 feet, and is 48 feet high and 1,050 feet long.

Twin Lakes Dam is in Alpine County, is owned by PG&E, was constructed in 1902, has a capacity of 1,300 AF, an area of 114 acres, a drainage area of 0.8 square miles, a crest elevation of 8,171 feet, is 22 feet high and 1,260 feet long, and is classified as an ERRK.

Total storage capacity of these three reservoirs is 13,176 AF.

There are at least 2 listed threatened or endangered species in the area. PG&E monitoring shows that Yosemite Toad-Western Toads were present at Upper Blue Lake Reservoir and Twin Lakes in 2014 (January 2015). Sierra Nevada Yellow-Legged frogs were also found at Upper Blue Lake. Populations or modifications of the habitats of these species would need to be addressed and provided for in the feasibility and environmental analysis.

Project Information

Project Description

The Blue and Twin Lakes Dams Reliability and Replacement Assessment will:

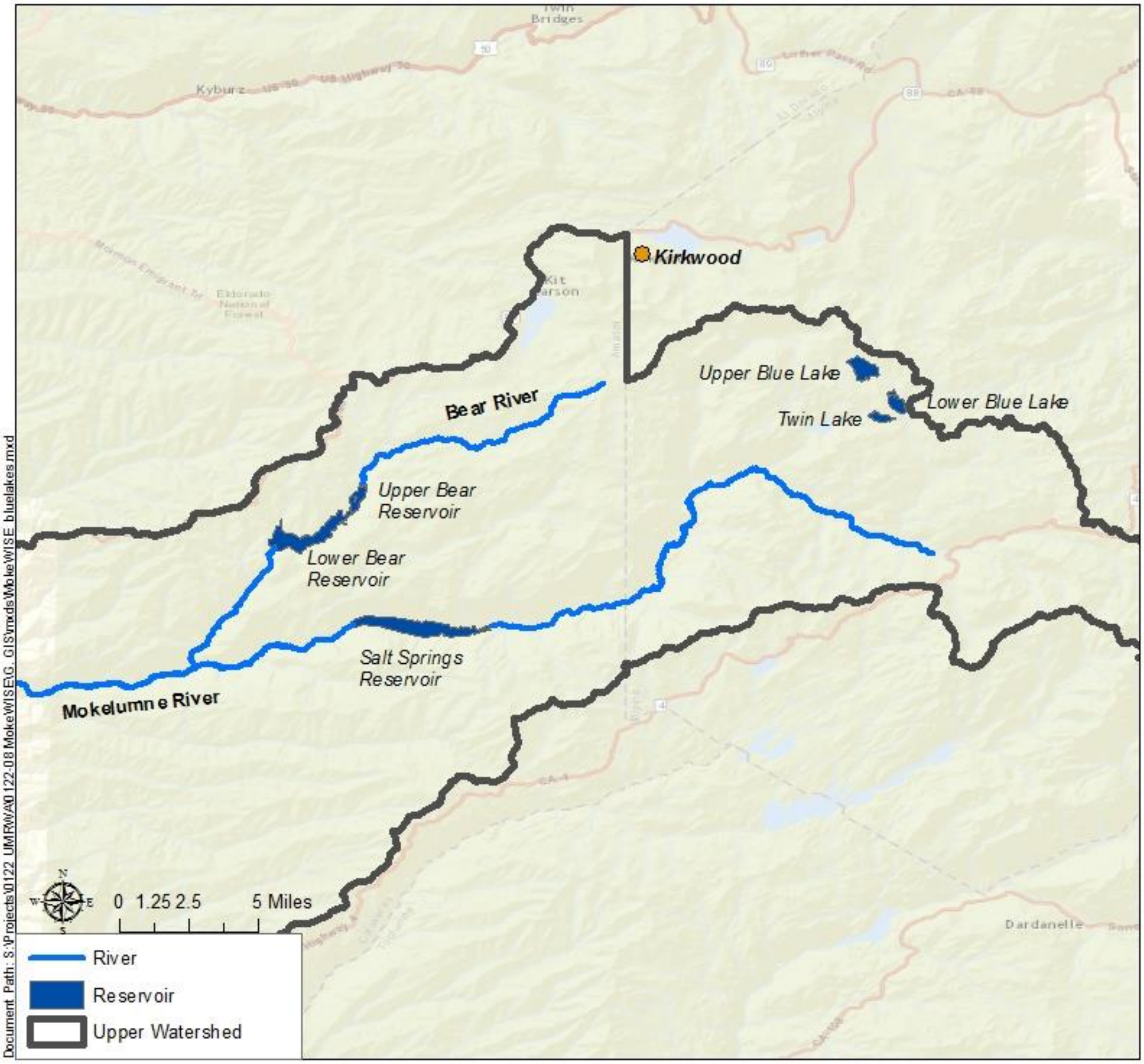
- Review existing engineering, geology, and environmental information on the area and dams;
- Conduct geotechnical field and laboratory investigation and testing to independently determine the safety of these dams during earthquakes and without lowering the water levels during the winter;
- Review the long-term reliability and risk of losing storage in these reservoirs;
- Identify and evaluate feasible replacement options and costs;
- Identify legal alternatives related to these dams and the water stored within them;
- Evaluate the feasibility and changes required to allow water to be stored safely during winter;
- Evaluate the hydrology of the area, including under conditions of drought and climate change. The study will identify the amount, or possible amounts, of unappropriated water that will stay in-stream to meet recreation, fish, wildlife, and water quality needs in all water year types;
- Evaluate potential impacts on threatened and endangered aquatic and other species;
- Evaluate the feasibility and cost-benefit of increases in water storage for domestic use by agreement or increased capacity;
- Produce an Engineering Feasibility Analysis of alternatives and cost-benefits to increase seismic stability and increase storage;
- Assess and document the existing environmental conditions and potential impacts of replacing the 3 dams. Include consideration of water, environmental, social and recreational opportunities and impacts;
- Evaluate dam replacement options that will protect cultural, recreational, and historic resources;
- Evaluate dam replacement options that will continue the flow regime in PG&E's current FERC license and incorporated settlement agreement;
- Identify the sources of the water supply, the nature and amount of the proposed water uses, and the locations and the descriptions of the diversions and the storage facilities. The study will present current and reliable data on the "population to be served" and its future water requirements if water is to be used for municipal purposes. The study will map and identify the land to be irrigated, its acreage, and its irrigation needs, if the project is seeking water for agricultural purposes;
- Explain how any proposed project avoids the waste, the unreasonable use, the unreasonable method of use, and the unreasonable method of diversion of water;

- Include consultation with local land use agencies to identify feasible means of reducing impacts of development associated with new water customers anticipated to be served with water resulting from this project. Results of these consultations with any recommendations shall be published in the study;
- Involve interested public and stakeholders, including the Project 137 Ecological Resources Committee, in all phases of the project, from design through final project approval with the public and stakeholders to review the draft and work. Attempt to resolve any identified concerns;
- Develop a process through which interested stakeholders and members of the public could review material related to the project when that material is classified "Critical Energy Infrastructure Information" by PG&E and the Federal Energy Regulatory Commission;
- Identify ongoing means of providing timely information and meaningful opportunities to participate for ratepayers and other interested parties. After the study, but before the utilities make further legal and financial commitments, funding applications, or permit applications associated with reservoir reoperation, the utilities will indicate their willingness to provide such a process;
- Recommend next steps.

Project Location

This study includes areas located within Alpine county as shown in **Figure 1**.

Figure 1: Blue and Twin Lakes, Alpine County



Project Sponsor

Amador Water Agency is the lead project sponsor.

Scope of Work

Task 1. Gather and Review Information

Subtask 1.1 Review Existing Information

Review existing information on engineering, geology, seismology, hydrology, and environmental information on the area and dams, including the impact of climate change on hydrology and water storage in the area, the MokeWISE Plan and water analysis, and the California Water Plan 2013 Update. This includes all existing reports from the Ninth Independent Consultant referred to in the FERC November 25, 2014, letter, mapping and dating of the Waterhouse Peak Fault, all possible earthquake generation sources, soil drilling and sampling methods and results, laboratory testing data, hydrology of the watersheds, environmental surveys, including threatened, endangered, and sensitive plant and animal species. "Critical Energy Infrastructure Information" will be requested and Non-Disclosure agreements will be used if agreeable with PG&E and FERC.

Subtask 1.2 Conduct Geotechnical Testing

Conduct geotechnical drilling, sampling, and lab testing on the three dams for an independent assessment of information relating to the seismic stability of the dams.

Subtask 1.3 Conduct Seismic Analysis

Identify potential earthquake locations, sources, and characteristics. Analyze the stability of these dams during earthquakes individually based on the existing and new information available.

Task 2. Evaluate Dam Safety and Operations

Subtask 2.1 Analyze Storage

Analyze the long-term reliability and risk of losing storage in these reservoirs. Create computer models of the dams and earthquake simulations to determine the risk of failures.

Subtask 2.2 Evaluate Engineering Feasibility

Evaluate the engineering feasibility and changes required to allow water to be stored safely during winter.

Subtask 2.3 Develop Feasibility Analysis Report

Develop an Engineering Feasibility Analysis to identify a range of alternatives and cost-benefits to increase seismic stability including increased storage.

Subtask 2.4 Evaluate Area Hydrology

Evaluate the hydrology of the area, including under conditions of drought and climate change. The study will identify the amount, or possible amounts, of water that will stay in-stream to meet recreation, fish, wildlife, and water quality needs in all water year types.

Task 3. Establish a Level of Service[1]

Subtask 3.1 Develop Level of Service Objectives

Develop level of service (LOS) objectives for future reliability. Working with local water agencies and utilities in Amador County and interested stakeholders, LOS objectives will be developed to define the acceptable frequency, duration, and extent of water supply outages resulting from inadequate storage capacity. These LOS objectives will establish a quantitative benchmark for assessing potential climate change impacts on reliability and articulating a potential need for improved reliability in the future.

Subtask 3.2 Develop Climate Change Scenarios

Develop a minimum of three climate change scenarios to reflect a range of climate change impacts. Each scenario will include specific assumptions related to future changes in mean temperatures and precipitation patterns in the Upper Mokelumne River watershed.

Subtask 3.3 Assess Water Supply Reliability

This task will include assessing projected future water supply reliability for Amador County. The reliability assessment will compare projected future supplies and a range of demands in the region to quantify projected future supply shortfalls under a range of hydrologic and population change conditions and establish a range of future supply needs. Supply availability will be overlaid with projected demand patterns to identify any projected changes in the timing, extent, and / or severity of projected outages. These projections will be compared to the LOS objectives developed in Task 1.1 to determine whether or not additional reliability is needed in future years to meet stated LOS objectives. If additional reliability is needed, the analysis will indicate the magnitude and conditions under which reliability improvement is needed.

Subtask 3.4 Unreasonable Use Avoidance Documentation

Document how any proposed project avoids the waste, the unreasonable use, the unreasonable method of use, and the unreasonable method of diversion of water.

[1] This task may have already been completed in other studies and the resulting information could be used here.

Task 4. Develop Alternatives

Develop alternatives to rehabilitate or replace the dams located at Blue and Twin Lakes. Consistent with MokeWISE Program objectives, alternatives will be designed to be socially, environmentally, and economically acceptable. Potential alternatives may include a no project alternative, rehabilitation of all three dams, and/or storing the water in Salt Springs to back up the water rights associated with the upper reservoirs. Include consultation with local land use agencies to identify feasible means of reducing impacts of development associated with new water customers anticipated to be served with water resulting from this project. Results of these consultations with any recommendations shall be published in the study.

Task 5. Analyze Alternatives

Subtask 5.1 Economic Analysis

This task will evaluate the feasibility and cost-benefit of each alternative developed in Task 4. These costs will include any staffing costs associated with coordination between AWA and PG&E and/or legal counsel, as well as any infrastructure costs associated with rehabilitation or replacement of existing structures. The analysis will also consider potential costs associated with a reduction in hydropower generation. The economic analysis will also consider the potential cost of impacts associated with seismic failure of any or all of the three dams.

The study shall identify one or more ways in which the capital, operations, and maintenance costs of the project could or may be shared. Following the study, but before the utilities make further legal commitments, financial commitments, funding applications, or permit applications associated with reservoir replacements or enhancements, the utilities will identify cost sharing options acceptable to the utilities.

Subtask 5.2 Legal Analysis

The legal analysis will evaluate consistency of alternatives with existing permits and licenses and demonstrate how conflicts (if any) between current and required legal constructs could be resolved. Existing permits and licenses that could be affected include PG&E's hydropower operations and licenses, water supply contracts between PG&E and Amador Water Agency (AWA), Lodi Decrees, and EBMUDs water supply operations to meet contractual obligations to downstream users. The legal analysis will also define the legal issues that might be related to single or joint execution of any project, including legal responsibility for project execution and project governance. The legal analysis will also define regulatory requirements for the project, including those required by FERC, USDA Forest Service, California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, Department of Safety of Dams, and Army Corps of Engineers, State Water Resources Control Board, and Alpine County.

Subtask 5.3 Environmental Analysis

This task includes an assessment of the potential environmental effects and any needed mitigation of each alternative. Include consideration of water, environmental, social and recreational opportunities and impacts. The assessment will identify how each alternative could impact threatened, endangered species, sensitive and other aquatic and terrestrial species and resources in the surrounding area and their habitat, behavior, or populations. The assessment will propose project design that avoids potential impacts to these resources. The assessment will also identify construction impacts, including direct impacts (air, road use, staging, materials disposal, etc.) and indirect impacts such as water operations during construction.

Subtask 5.4 Review of Alternatives Analysis Findings

Interested stakeholders and public will review the results of the assessment to clearly define the potential benefits and impacts of each alternative to fish, wildlife, recreation, and consumptive use.

An extensive alternatives analysis process will be documented. The alternatives analysis will consider, at a minimum:

- Seismic Safety
- Engineering feasibility
- Legal feasibility
- Estimated cost
- Benefits or impacts to fish and wildlife and other environmental issues
- Benefits or impacts to consumptive use
- Institutional feasibility
- Consistency with existing licenses and agreements (see Task 5.2)

Based on the findings, the Collaborative Group will identify recommended next steps.

Task 6. Agency Coordination and Stakeholder Engagement

The project will include a strategy to involve interested public and a stakeholder group including former members of the Mokelumne Collaborative Group (MCG) and other interested stakeholders, notably the Project 137 Ecological Resources Committee. Stakeholder concerns and interests will be identified at the outset of the study, such that the assessment may answer questions and issues. Coordination meetings will be held with the public, water agencies, PG&E, environmental interests, recreation interests, and state and federal agencies.

Task 7. Environmental Review Strategy

This task will produce all environmental information and analysis necessary for NEPA and CEQA documentation that will be necessary for the project(s). This will include, but may not be limited to, identifying and discussing impacts to biological resources, public services, recreation, water supply, utilities, and land use and population. In coordination with the stakeholder group, a qualified consultant will prepare a written analysis of the level of review needed under both federal and state statutes.

Budget

This investigation, analysis, and environmental assessment is estimated to cost $2,500,000.

References

2014, March 10; PG&E Letter to Frank Blackett, Regional FERC Engineer.

2014, July 31; PG&E Letter to Frank Blackett, Regional Engineer, FERC.

2014, September 30; PG&E Letter to Frank Blackett, Regional Engineer, FERC.

2014, November; FERC Letter to PG&E from Frank Blackett, Regional Engineer, FERC.

2015, January; "2014 Amphibian Surveys for Foothill Yellow-legged Frog (Rana boylii), Sierra Nevada Yellow-legged Frog (Rana sierra) and Yosemite Toad-Western Toad (Anaxyrus canorus – Anaxsyrus boreas); PG&E and Garcia and Associates."

MokeWISE Program Scope of Work:
Project 8b: Rehabilitation of Transmission Main

April 2015

Abstract

The Rehabilitation of Transmission Main Project will conduct a study to determine the benefits of replacing all or a portion of the transmission main that conveys treated water from the Jeff Davis Water Treatment Plant (WTP) to Mokelumne Hill, Paloma, and San Andreas. The study will include assessment of areas that are reaching life expectancy, areas of water loss, and recommendations for rehabilitation. Upon completion of the study, the project includes replacing or lining the recommended portions of the current transmission main. Costs for this project are estimated to be $5.2 million, with $200,000 for the study and $5 million for implementation.

Background Information

Calaveras Public Utility District

Calaveras Public Utility District (CPUD) supplies treated water to Mokelumne Hill, San Andreas, Paloma, Glencoe, and other outlying areas in the Upper Mokelumne Watershed. The boundary covers approximately 21,543 acres. CPUD obtains its water from the South Fork of the Mokelumne River at a diversion dam and pump station located near the confluence of the Licking and South Forks of the Mokelumne River. Water is then pumped to the Jeff Davis Reservoir and gravity fed to a treatment plant (Calaveras County, 2008).

The CPUD service area population is approximately 5,000 people, and water use is approximately 1,120 AFY (RMC, 2015).

Water Rights

CPUD has various water diversion and storage rights on the Mokelumne River system and the Calaveras River. Treated water is delivered from the Mokelumne River system and a small amount of agricultural water is delivered from the Calaveras River. On May 8, 1940, an agreement was made with the East Bay Municipal Utility District (EBMUD) which entitles CPUD to a diversion of 12.5 cubic feet per second (cfs) from the South, Middle and Licking Forks of the Mokelumne River. CPUD's maximum entitlement, including direct diversion and diversion from storage is 10,950 AFY (Calaveras County, 2008).

Water Supply

The primary water supply to CPUD is from the South Fork of the Mokelumne River. Water is pumped from the river at a small diversion dam up through a pump station (3,300 gallon per minute capacity) and transported via a three-mile pipeline (9.17 million gallons per day capacity) to the Jeff Davis Reservoir. From there, it enters the treatment plant and then flows through transmission mains to storage tanks located in Rail Road Flat, Mokelumne Hill, Paloma, and San Andreas. From there, the water is delivered into the distribution system (Calaveras County LAFCO, 2013).

The estimated safe yield of CPUD's current water supply is 4,370 AFY. This includes a safe yield of 1,370 AFY from Schaads Reservoir on the Middle Fork of the Mokelumne River. CPUD has the right to store and release 1,800 AFY from Schaads. Another 3,000 AFY of safe yield is from the South Fork of the Mokelumne River when used in conjunction with CPUD's Jeff Davis Reservoir. CPUD has a right to store 2,300 AF of water in Jeff Davis Reservoir. CPUD also has a right to store 400 AF from the Calaveras River watershed at its Redhawk Reservoir. This water is not connected to CPUD's treated water system and is only used to supply immediate downstream agricultural users (Calaveras County LAFCO 2003b). CPUD has not supplied those agricultural users since approximately 2002, and is not actively operating the Redhawk Reservoir (Calaveras County LAFCO, 2013).

Project Information

Project Description

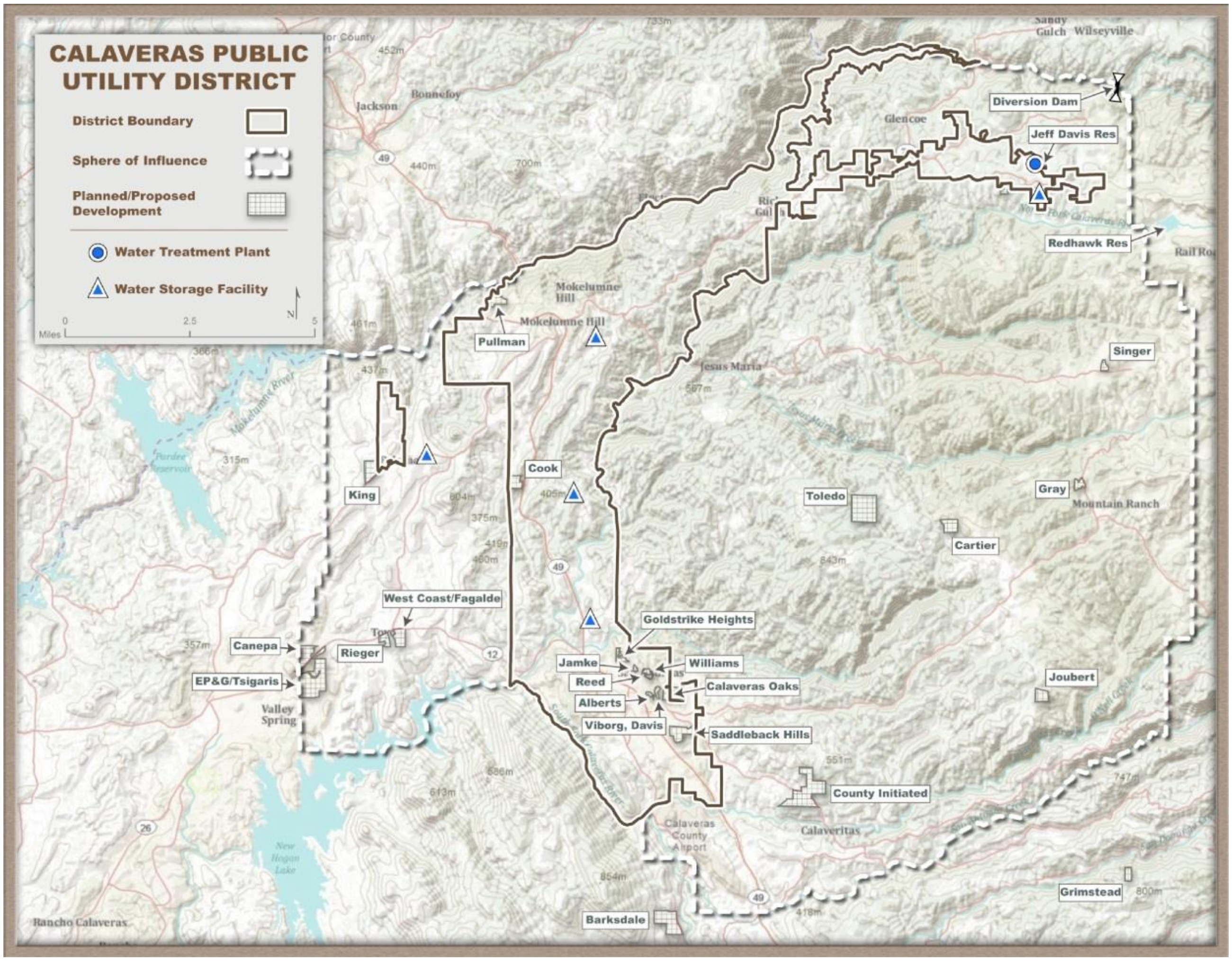
This concept will conduct a study to determine the benefits of replacing all or a portion of the transmission main that conveys treated water from the Jeff Davis Water Treatment Plant (WTP) to Mokelumne Hill, Paloma, and San Andreas. The study will include assessment of areas that are reaching life expectancy, areas of water loss, and recommendations for rehabilitation. Upon completion of the study, the project would include replacing or lining recommended portions of the current transmission main. The transmission main was installed in the 1970s and has had one large repair since that time. Replacing or lining the transmission main will increase the life expectancy, and likely improve efficiencies and reduce water loss.

CPUD has approximately 23 miles of distribution pipeline. The transmission system consists of 18 miles of mains constructed primarily of cement, mortar-lined and –coated steel pipe ranging from 16 to 27 inches in diameter. The main transmission line from the Jeff Davis WTP to the communities of Mokelumne Hill and San Andreas is 18-inch concrete lined steel pipe. Distribution feeder lines serving the two communities and outlying areas are comprised of 4-inch to 12-inch steel or plastic pipe (Calaveras County LAFCO, 2013).

Project Location

The transmission main is located within the CPUD district from the Jeff Davis WTP to the Mokelumne hill, Paloma, and San Andreas areas. **Figure 1** shows the CPUD boundary and Jeff Davis Reservoir.

Figure 1: CPUD Boundary and Jeff Davis Reservoir



Source: Calaveras County LAFCO, 2013

Project Sponsor

CPUD is the lead sponsor of the concept. Currently, a co-sponsor for this Concept has not been identified.

Scope of Work

Task 1. Data Collection and Pipeline Evaluation

Because the transmission pipeline is reaching the end of its expected useful life, there is an increased risk of pipeline breaks, which threatens supply reliability. Existing mapping, design drawings, engineering reports and other data related to the transmission will be gathered and reviewed. A field investigation will be conducted to evaluate the effectiveness of the current transmission main and location of potential minor leaks and water losses.

Task 2. Transmission Main Feasibility Study

The Transmission Main Feasibility Study will be conducted to determine if all or a portion of the transmission main should be replaced. The study will include an assessment of areas that are reaching the end of their useful life, areas of water loss, and recommendations for rehabilitation.

Subtask 2.1 Conduct Assessment

A condition assessment of the current state of the transmission main will be performed in order to identify areas of leaks / water loss, pressure issues, and significant corrosion.

Subtask 2.2 Develop and Evaluate Improvement Options

A preliminary evaluation of improvement options will be conducted to identify and evaluate recommendations for rehabilitation of all or a portion of the current transmission main. This task will involve determining the value of the benefit provided by each of the proposed alternatives for rehabilitation in terms of risk reduction. A cost/benefit and risk analysis will be prepared for each rehabilitation alternative recommendation. This analysis will also include the anticipated efficiency and savings achieved by each alternatives. The benefits will then be compared against the costs of each alternative to determine which alternative is more feasible. Preliminary recommendations will be developed based on this analysis. A detailed opinion of probable construction cost will be provided for each alternative to identify budget level cost for rehabilitation a portion or all of the transmission main.

The recommended rehabilitation project will be identified, which will include all or a portion of the transmission main, depending upon the results of the risk and cost analyses.

Subtask 2.3 Recommended Project Delivery Method

Traditional design-bid-build and alternative project delivery approaches such as design-build, contractor-led design-build, and engineer-led design-build will be evaluated. Each project delivery option will have various implications on the degree of decision-making and risk allocated to CPUD. A recommendation will be made as to the most cost- and schedule-efficient delivery approach for project implementation.

Task 3. Implementation Planning

This task involves developing an implementation plan for the project including the following:

- Implementation schedule (including permitting, design, and construction) and proposed phasing of the project based on cost-effectiveness, estimated benefits, and implementation constraints
- Outreach strategies for moving the project forward through the design and construction phase

Operational plans will be developed for the rehabilitation of the transmission main, including strategies for optimizing performance and minimizing costs.

Task 4. Environmental and Permitting

Subtask 4.1 Environmental

An environmental analysis will be performed to help determine any potential fatal flaws or major mitigation requirements that might be associated with replacing a portion or all of the transmission main. This analysis will include identification of potential environmental impacts and mitigation measures needed for compliance with CEQA and NEPA, as appropriate, and preparation of required CEQA/NEPA documentation.

Subtask 4.2 Permitting

This task includes identification and preparation of all permits necessary for implementation of the project. Strategies to address the project's regulatory requirements, institutional issues, and challenges, particularly the approach to regulatory compliance will be assessed. The Stormwater Pollution Prevention Plan (SWPPP) required for construction will be prepared.

Task 5. Design and Construction

Subtask 5.1 Design

Design plans will be created which will show proposed locations of the transmission main replacement. Progress drawings, specifications, a construction sequencing plan, and a construction cost estimate will be submitted throughout this task until the final design plans are complete. Design milestones will depend upon the delivery method selected. Assistance with the procurement of qualified contractors will be provided in order to perform the rehabilitation.

Subtask 5.2 Engineering Services during Construction

This task will vary depending upon the delivery approach selected. All of the facilities that will require demolition during construction will be identified. Proper project management is necessary to keep the project on schedule. This task will include typical services needed for implementation of the updated transmission main including pre-construction meetings, review of contractors' submittals, inspections and monitoring of permit compliance, system performance testing, and preparation of record drawings after completion of the project construction.

Subtask 5.3 Construction

This task includes mobilization, demolition of existing facilities, site preparation, and construction of all new facilities, demobilization, performance testing, and startup. Depending on the level of funding, construction can be implemented in phases.

Budget

Based on costs submitted for the 2015 MAC IRWMP Update, the budget for this project is estimated to be $1.03 million. Costs associated with the project are broken down as follows:

- Planning: $30,000
- Implementation: $1,000,000
    - These costs represent the immediate goal of treating critical sections. The cost for rehabilitation of the entire distribution system is much greater in magnitude and will be approached in a phase manner.
- **Total Project Cost: $1,030,000**

References

Calaveras County LAFCO. 2003b. Service Review Study: Public Agency Water Purveyors. December 2003.

Calaveras County, 2008. General Plan Baseline Report. January 2008.

Calaveras County LAFCO, 2013. Calaveras Public Utility District Sphere of Influence Update. December 2013.

RMC, 2015. MokeWISE Program Final Memorandum Water Availability Analysis. January 2015.

MokeWISE Program Scope of Work:
Project 8c: Barney Way Septic System Conversion

April 2015

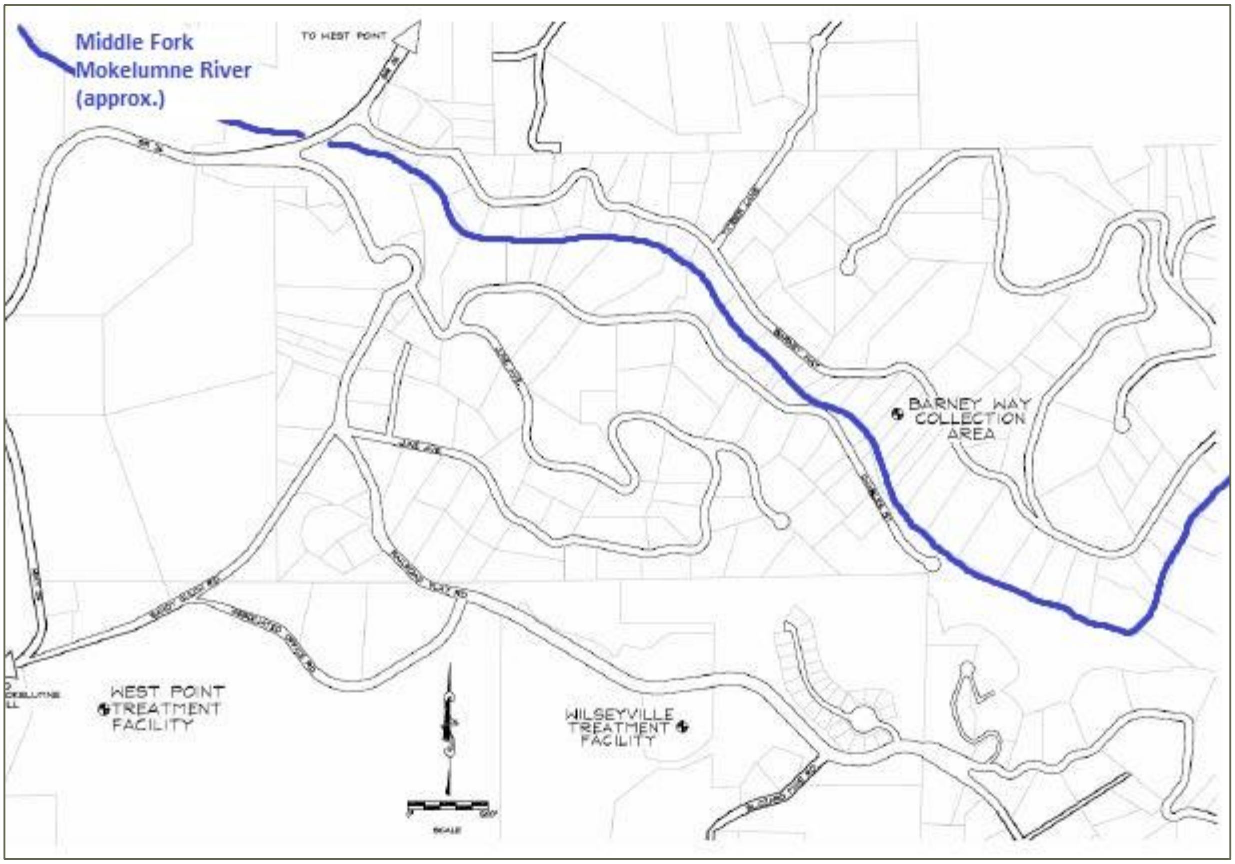
Abstract

The Barney Way Septic System Conversion Project will convert 40 residences along Barney Way from individual septic systems either to a sanitary sewer, which would convey wastewater to the West Point treatment facility, or to a new community septic system. This would result in the decommissioning or abandoning of existing septic systems. The project includes conducting a preliminary evaluation to determine feasibility, engaging in public outreach, design, permitting, and construction. Costs for this project are estimated to be roughly $4.3 million and include planning, engineering, construction, and a 10% contingency.

Background Information

Approximately 40 residential parcels along Barney Way in Calaveras County are currently served by individual septic systems. There is concern that these septic systems are not properly maintained or may be experiencing failures. These parcels are located along the Middle Fork of the Mokelumne River and failing or improperly designed systems may be polluting the river, an important water supply in the region. Calaveras County Water District (CCWD) is seeking to reduce the risk of sewage spills from these parcels by either converting these parcels to sewer, or to a community septic system that would be easier to maintain and monitor than individual systems. There are two treatment facilities within the vicinity of the Barney Way Collection Area, the West Point Treatment Facility and the Wilseyville Treatment Facility, as shown in **Figure 1**.

Figure 1: Treatment Facilities near Barney Way Collection Area



Source: CCWD, 2014

Existing Treatment

Wastewater in the region is treated onsite in septic systems or is conveyed to one of two treatment facilities.

Septic System

Septic systems collect wastewater from residences or small communities in a tank, in which solids settle out, and liquid effluent is dispersed in a leach field. Septic systems, when designed and sited properly, are an effective and safe means of wastewater treatment, but they do require maintenance, such as occasional solids removal. Some areas may not be ideal for septic systems due to elevated groundwater levels, proximity to waterbodies, or community density.

West Point Treatment Facility

The West Point Treatment Facility treats liquid effluent from 165 septic tanks in the community of West Point. The facility has a physical and permitted capacity to treat an average dry weather flows are 58,000 gallons per day (gpd). Treatment processes include recirculation of raw influent with recycled water (1/3 influent, 2/3 recycled water), sand filtration, chlorine disinfection, and storage in irrigation storage ponds for later disposal via spray irrigation during the dry season. This facility is manually monitored and operated (CCWD, 2014). CCWD is considering a project to expand West Point Treatment Facility to accommodate flows currently treated at the Wilseyville treatment facility (see below).

Wilseyville Treatment Facility

The Wilseyville treatment facility has a capacity of 9,000 gpd and serves 28 connections. Unlike the West Point facility, the Wilseyville facility receives both liquids and solids. This facility is comprised of an aerated storage pond, which is chlorinated, and an effluent dispersal irrigation field (which is rarely used). Treated effluent is generally disposed of via percolation and evaporation (CCWD, 2014). Wilseyville is considered to be at buildout. If CCWD moves forward with the project to expand the West Point Treatment Facility, the Wilseyville facility would be abandoned, and its flows would be treated at West Point.

Reference Programs

As communities grow, extensive use of septic systems can result in water quality concerns. In these cases, conversion from septic to sewering with centralized treatment can help resolve issues associated with failing or improperly operating septic systems. For communities in which the cost to connect to sanitary sewers is prohibitive, conversion to community septic systems can also be an attractive solution.

Septic-to-Sewer Conversion

Conversion from septic or other on-site wastewater treatment to a sewer system and centralized treatment can help resolve many of the issues associated with failing onsite septic systems, and serves to protect ground and surface water quality, along with public health. Conversion to sewer, however, can be costly, depending on the distance to the nearest sewer main and whether the existing conveyance and treatment facilities have the capacity to accommodate the additional flow.

Costs have delayed or prevented conversion to sewer for many communities within California. For example, in the Coachella Valley, many communities use on-site septic systems that are frequently undersized, improperly designed or maintained, or exceed recommended densities. This has contributed to groundwater quality and public health concerns in an area that is dependent on groundwater. Communities in this area are actively pursuing outside funding to support a conversion to sanitary sewers, requiring installation of gravity sewer pipelines, lift stations, and sewer force mains to connect to the existing sewer collection and treatment system (CVRWMG, 2013).

Clustered (Decentralized) Wastewater Management

Community systems can be a cost-effective solution to improve wastewater management when connecting to the sanitary sewer is deemed too costly. Clustered wastewater systems, also called decentralized wastewater systems, collect wastewater from a cluster of residences (such as a mobile home park, street, or small community) and treat wastewater from these residences using various on-site wastewater treatment methods. For example, Sea Ranch, in Sonoma County, California, serves 600 homes using two large clustered systems. The Auburn Lake Trails Subdivision, near Cool, California in El Dorado County, uses small community systems to serve 134 homes. By consolidating treatment, maintenance can be more cost effective, and systems are typically better maintained through community management as opposed to leaving the responsibility to each individual homeowner. However, these systems do require effective management to ensure that they are, indeed, properly maintained. Examples of successful management programs in California include the use of operating permits, formal maintenance contracts, and surface and groundwater quality monitoring (U.S. EPA, 2012).

Project Information

Project Description

The Barney Way Septic System Conversion Project (project) would convert 40 residences along Barney Way from individual septic systems either to a sanitary sewer, which would convey wastewater to the West Point treatment facility, or to a new community septic system. This would result in the decommissioning or abandoning of existing septic systems, reducing the risk of pollution to the Middle Fork of the Mokelumne River that is currently posed by the existing septic systems. **Table 1** shows the anticipated flows from Barney Way that would need to be accommodated by the selected system. This Scope of Work will address the anticipated tasks necessary to accomplish this conversion.

Table 1. Projected Wastewater Flows from Barney Way

	2013	2023	2033	2043
Proposed Connections	31	40	40	40
Average Dry-Weather Flows (gpd)	6,045	7,800	7,800	7,800
Peak Wet-Weather Flows (gpd)	18,135	23,400	23,400	23,400
Annual Average (gpd)	**6,831**	**8,814**	**8,814**	**8,814**

Source: CCWD, 2014

Project Location

The Project would be located in at Barney Way, in Calaveras County, along the northern side of the Middle Fork of the Mokelumne River, off Highway 26, and downstream of Schaads dam (**Figure 1**).

Project Sponsor

The project is sponsored by the Calaveras County Water District.

Scope of Work

Task 1. Preliminary Project Evaluation

A preliminary evaluation will be conducted to determine the feasibility of converting to sewer compared to converting to a community system. This evaluation will identify project alternatives, and selected a preferred alternative. Considerations will include projected project costs (for CCWD and for individual homeowners), treatment capacity of the West Point Treatment Facility, community preference, potential outside funding opportunities, timing, and ability to address water quality issues. This evaluation will also identify the potential permits, agreements, and / or regulations that may be required for implementation.

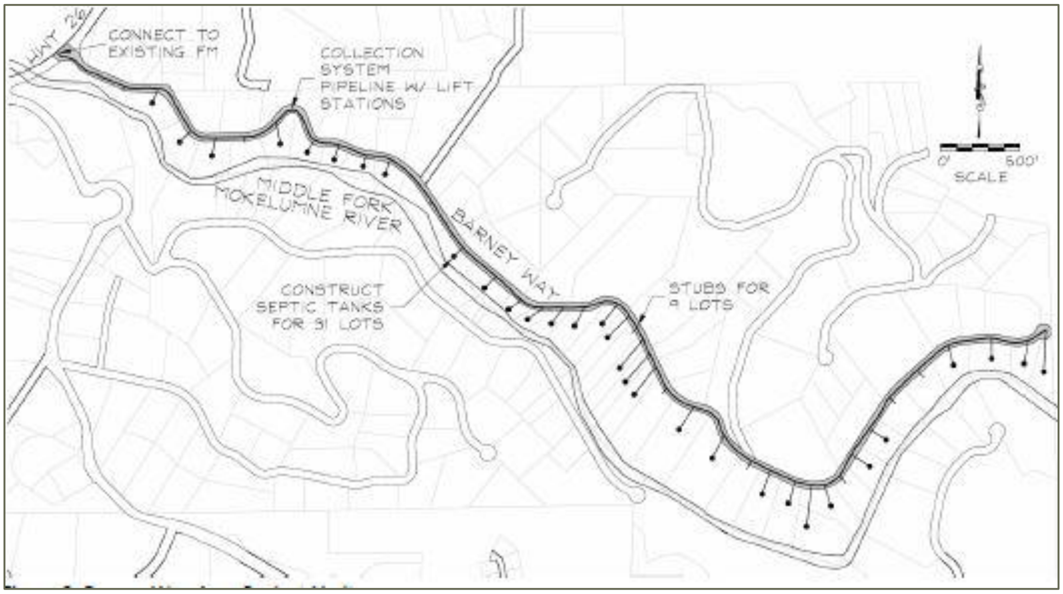
Task 2. Public Outreach

CCWD's Alternatives Evaluation (CCWD 2014) found that there was uncertainty regarding community support for the Barney Way project. Public outreach will be critical to a successful project, and and public participation at all key steps of this project is a high priority. Public Outreach activities will include public meetings to solicit input on potential project alternatives, educational materials and/or meetings to inform residents of the need for and benefits of the project and workshops at each phase of the project.

Task 3. Design

This task would involve completing preliminary and final design for the recommended project alternative. Should the recommended project be conversion to sewer, project components would include the new collection system, one or more lift stations, connection to CCWD's existing facilities at Highway 26, and service lateral stubs. Because flows would be treated at West Point Treatment Facility, which is designed to treat liquid effluent only, the failing septic tanks would be replaced with new tanks for solids removal, unless West Point is upgraded. **Figure 2** shows the extent of the proposed work, should conversion to sewer be the recommended project.

Figure 2: Proposed Project – Conversion to Sewer



Source: CCWD, 2014

Should a community treatment system be the preferred alternative, project components would include a new collection system and service lateral stubs, and may require one or more lift stations. It would also require design of the community treatment system itself.

Regardless of the selected alternative, this task will also delineate how existing septic systems will be taken out of service (e.g., decommissioned, removed, and/or abandoned).

Task 4. Community System Management Program *(Community System alternative only)*

Should the recommended project be a community system, a Community System Management Program should be developed. Some communities in California have found that an Operating Permit is an effective Community System Management Program. An Operating Permit focuses on performance measures of the system, has limited permit cycles (e.g., 3-5 years), can require inspections prior to reissuing permits, and provides for continuous oversight of the systems. There are three key elements to an Operating Permit management program (U.S. EPA, 2012):

- Renewable or revocable operating permits issued to the system owner.
- Specific and measurable performance criteria and regular submission of compliance reports.
- An inventory and tracking system for system permits and inspection/compliance reports.

Other management programs may be more appropriate for the Barney Way community and should be explored in addition to the appropriateness of an Operating Permit management system. This task is not required if the recommended project is conversion to sewer.

Task 5. Environmental Documentation

Regardless of the selected project alternative, environmental documentation compliant with CEQA and potentially NEPA will be required. Given the location, type, and size of the project, it is anticipated that a Mitigated Negative Declaration (MND) is likely the most appropriate environmental documentation, unless further evaluation finds that a different level of environmental documentation would be necessary to satisfy the requirements of CEQA and potentially NEPA.

Task 6. Permitting

Permits necessary for construction of the project may include, but are not limited to those listed in **Table 2**.

Table 2: Potential Permits for Implementation

Agency	Permit
Regional Water Quality Control Board	Waste Discharge Requirements NPDES Permit
Local Municipalities and Calaveras County	Conditional Use Construction Permit Encroachment Permit Tree Removal Permit

Task 7. Funding

Outside funding opportunities should be pursued to reduce the local cost burden of the project. Potential funding sources could include State Revolving Fund (SRF) loans, USDA Rural Development funds, Proposition 84 Integrated Regional Water Management (IRWM) program funding, and funding made available by Proposition 1 through a variety of programs.

Task 8. Construction

Construction of the proposed project would include:

- Site Preparation: mobilization of materials and equipment, staging areas, clearing, and other preparation activities.
- Construction: excavation for the new collection pipeline and lift station(s), installation of collection pipelines, lift stations, community septic tank and service laterals,

construction of the new treatment system (if necessary), and connection to CCWD's collection system (if necessary).

- Testing and demobilization: testing of the new system, connection to residences, cleanup, restoration of pipeline alignment to pre-construction conditions, and demobilization of equipment, materials, and staging areas.
- Decommissioning of existing septic tanks: likely to be completed by the homeowners, this would involve decommissioning, abandoning, or removing existing septic tanks, as appropriate.

Budget

The budget for this project is $4.291 million. These costs are preliminary, and would be refined under Task 1, above. Costs to upgrade West Point treatment facility are not included; costs for a community treatment system alternative have not been estimated. Costs associated with the project are broken down as follows:

- Planning: $171,500
  - Includes environmental compliance, grant application, and property owner coordination.
- Engineering: $430,000
  - Includes design engineering and administration, construction management, and grant administration.
- Construction: $2,974,000
  - Construction costs include 6,710 linear feet of 6 foot gravity sewer lines, 5 lift stations, 2,750 linear feet of force main, and encroachment permit compliance.
- Contingency (20%): $715,000
- **Total Project Cost: $4,291,000**

References

Calaveras County Water District (CCWD). 2014. Alternatives Evaluation for West Point & Wilseyville Treatment Facilities and a Proposed Barney Way Collection System. May.

Coachella Valley Regional Water Management Group (CVRWMG). 2011. Coachella Valley Integrated Regional Water Management Implementation Grant Proposal. January.

Coachella Valley Regional Water Management Group (CVRWMG). 2013. Coachella Valley Integrated Regional Water Management Implementation Grant Proposal – Round 2. March.

U.S. Environmental Protection Agency (U.S. EPA). 2012. Case Studies of Individual and Clustered (Decentralized) Wastewater Management Programs: State and Community Management Approaches. June.

MokeWISE Program Scope of Work:
Project 8d: Lake Camanche Village Recycled Water Project

April 2015

Abstract

The Lake Camanche Village Recycled Water project will develop a study to explore the feasibility of upgrading the Lake Camanche Wastewater Treatment Plant to tertiary treatment and providing recycled water for local use. The feasibility study will include a treatment plant update assessment and demand assessment. The study would also identify project alternatives and conduct an alternatives assessment in order to select a preferred alternative. Costs for this project are estimated to be $150,000.

Background Information

Lake Camanche Village

Lake Camanche Village is located on the northern shore of Lake Camanche, a reservoir located on the Mokelumne River in Amador County. The village has approximately 240 residences, with a buildout of 395 parcels. It receives water and wastewater service from the Amador Water Agency (AWA). **Figure 1** shows the AWA wastewater service areas; Lake Camanche Village is located in the southwestern portion of the map.

Amador Water Agency

AWA provides both wholesale and retail treated water to Amador Water System, Central Amador Water System Project, La Mel Heights, and Lake Camanche Village. AWA has rights to 17,200 AFY of Mokelumne River, and uses the PG&E system to store and divert 1,150 AFY under the Central Amador Water Project (CAWP) out of a 2,200 AFY contractual right. AWA owns and operates the Amador Water System (AWS) under which AWA has contractual rights to up to 15,000 AFY. In addition to AWA's surface water rights, it also pumps groundwater to serve Lake Camanche Village and La Mel Heights.

Table 1 summarizes AWA's current and proposed water supplies; **Figure 1** shows the AWA water systems and service area.

Table 1: AWA Water Supplies

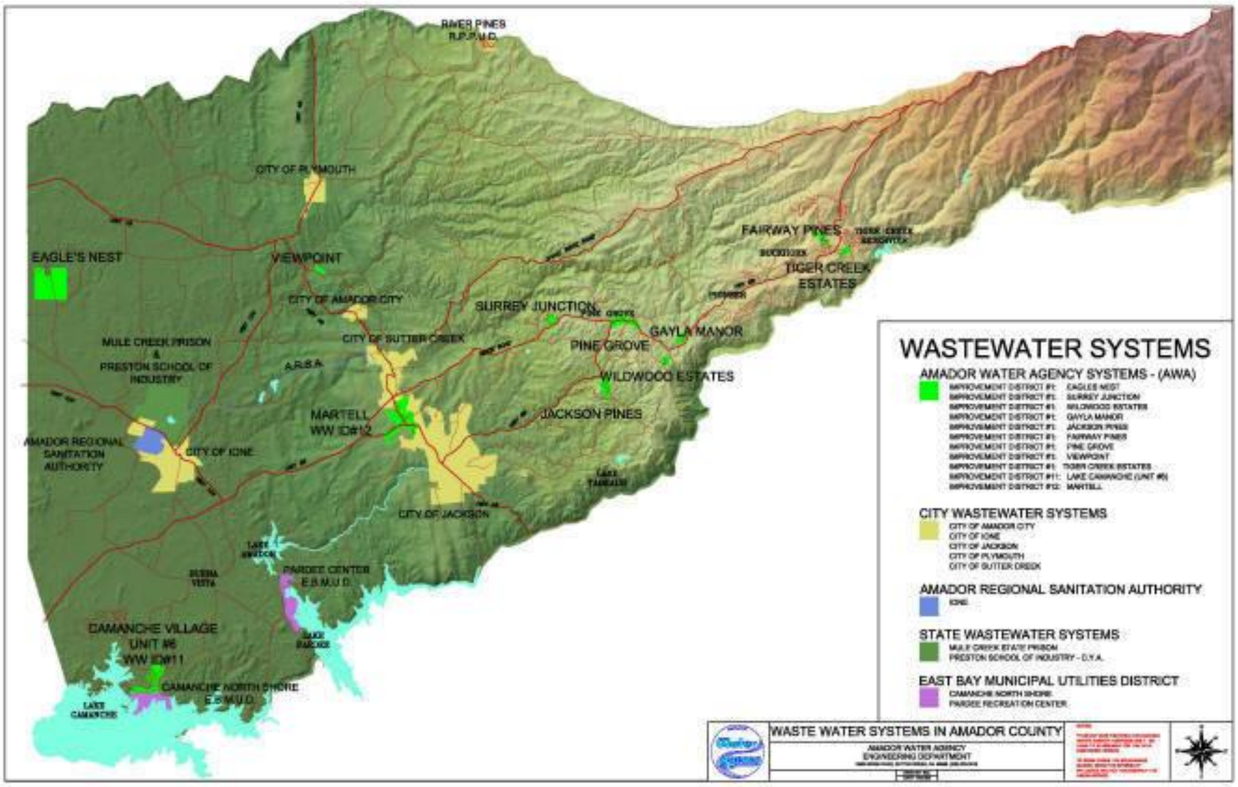
Supply	2010 (AFY)	2015 (AFY)	2020 (AFY)	2025 (AFY)	2030 (AFY)
Surface Water	16,150	17,200	17,200	17,200	17,200
Groundwater	296	369	441	511	581
Recycled Water	0	0	0	0	0
Incidental Transfer to EBMUD*	N/A	N/A	N/A	N/A	N/A
Total	**16,446**	**17,569**	**17,642**	**17,711**	**17,781**

Source: AWA, 2011

*Incidental transfers to EBMUD are not guaranteed for any specified amount, and so are not projected

AWA also provides wastewater treatment services to Lake Camanche Village, along with the communities of Fairway Pines, Tiger Creek Estates, Gayla Manor, Wildwood Estates, Surrey Junction, Jackson pines, Pine Grove, Martell, Viewpoint Estates, and Eagles Nest (AWA, n.d.). AWA owns two wastewater treatment facilities: Lake Camanche WWTP and the Gayla Manor WWTP. Wastewater from Lake Camanche Village is treated at the former.

Figure 1: Amador Water Agency's Wastewater Service Areas

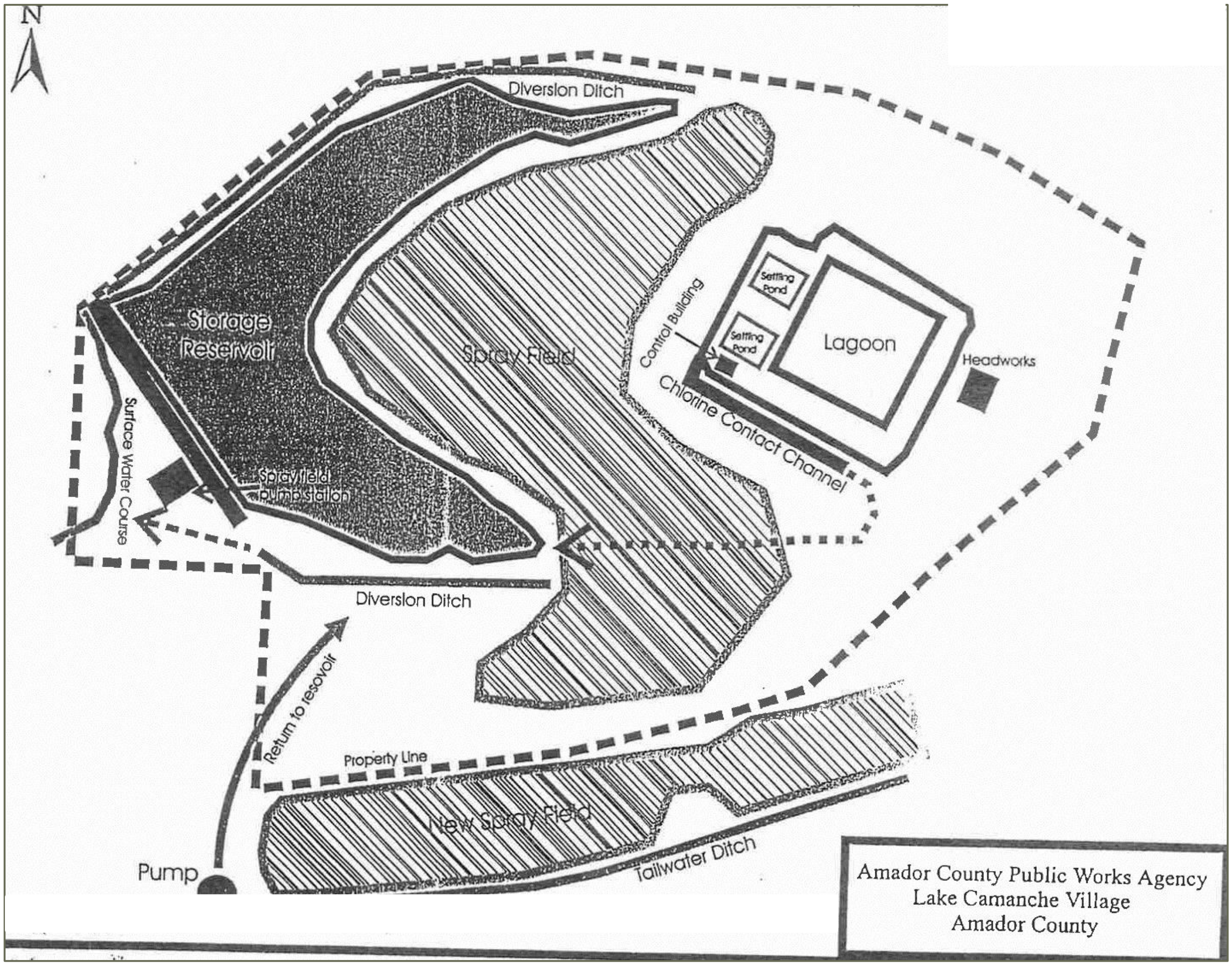


Source: AWA, n.d. (http://www.amadorwater.org/waste_wtr_srv_area.html)

Lake Camanche Wastewater Treatment Plant (WWTP)

The Lake Camanche WWTP has unknown capacity, as accurate flow meters were not in place at the time the Waste Discharge Requirements (WDRs) were adopted in 2001. It is regulated under the Central Valley Regional Water Quality Control Board's Order no. 5-01-033, as well as Cease and Desist Order No. R5-2003-0126. Wastewater collected by the Lake Camanche system is treated using a 7 acre-foot (AF) aerated facultative pond, two 0.08 AF settling basins, chlorination facilities, a 19.5 AF unlined storage pond, and a 12-acre effluent sprayfield. Average flow to the facility between 2002 and 2005, which serves 243 residences, ranged from 41,000 to 90,000 gallons per day (gpd) (AWA 2006). Complete buildout of Lake Camanche Village is 395 parcels. The facility was designed for a buildout capacity of 281,000 gpd, but the spray field and storage pond were not built for this capacity. The facility had a history of violations, with three documented spills between 2003 and 2006, as the storage pond does not have the capacity to accommodate existing flows (RWQCB, 2006). There were no reported spills in 2012 or 2013, and a moratorium is in place for new wastewater services (Amador LAFCO, 2014). The Lake Camanche WWTP layout is provided in **Figure 2.**

Figure 2: Lake Camanche WWTP



Jackson Valley Irrigation District (JVID)

Jackson Valley Irrigation District (JVID) serves agricultural, industrial, and domestic users within its service area. JVID sells raw water to its agricultural, industrial, and some domestic users, and sells bottled water to the approximately 61 domestic users without access to private wells. Water provided by JVID is diverted from Jackson Creek and the Mokelumne River. JVID also owns and operates the Lake Amador Resort Area (LARA) treatment plant, which has a capacity of 175 gpm, but generally operations at 150 gpm when necessary. The LARA plant is supplied by water stored at Lake Amador (Amador LAFCO, 2014).

Recycled Water

Tertiary-treated recycled wastewater can be used for non-potable purposes in compliance with Title 22 of the California Code of Regulations. Recycled water is a local, drought proof supply, and can be used to offset demands for potable water, thereby conserving potable supplies. Common applications of recycled water include irrigation, landscape irrigation in public parks, ornamental fountains, and industrial uses such as cooling towers. There is limited recycled water use within Amador County.

Project Information

Project Description

The Proposed Project will develop a study to explore the feasibility of upgrading the Lake Camanche WWTP to tertiary treatment and providing recycled water for local use. There is potential for this recycled water to be distributed via a regional system.

Project Location

The Project would be located in Amador County, at the Lake Camanche WWTP, within the AWA service area, as shown in **Figure 1**, above.

Project Sponsor

The project is sponsored by the Amador Water Agency (AWA) in partnership with Jackson Valley Irrigation District (JVID).

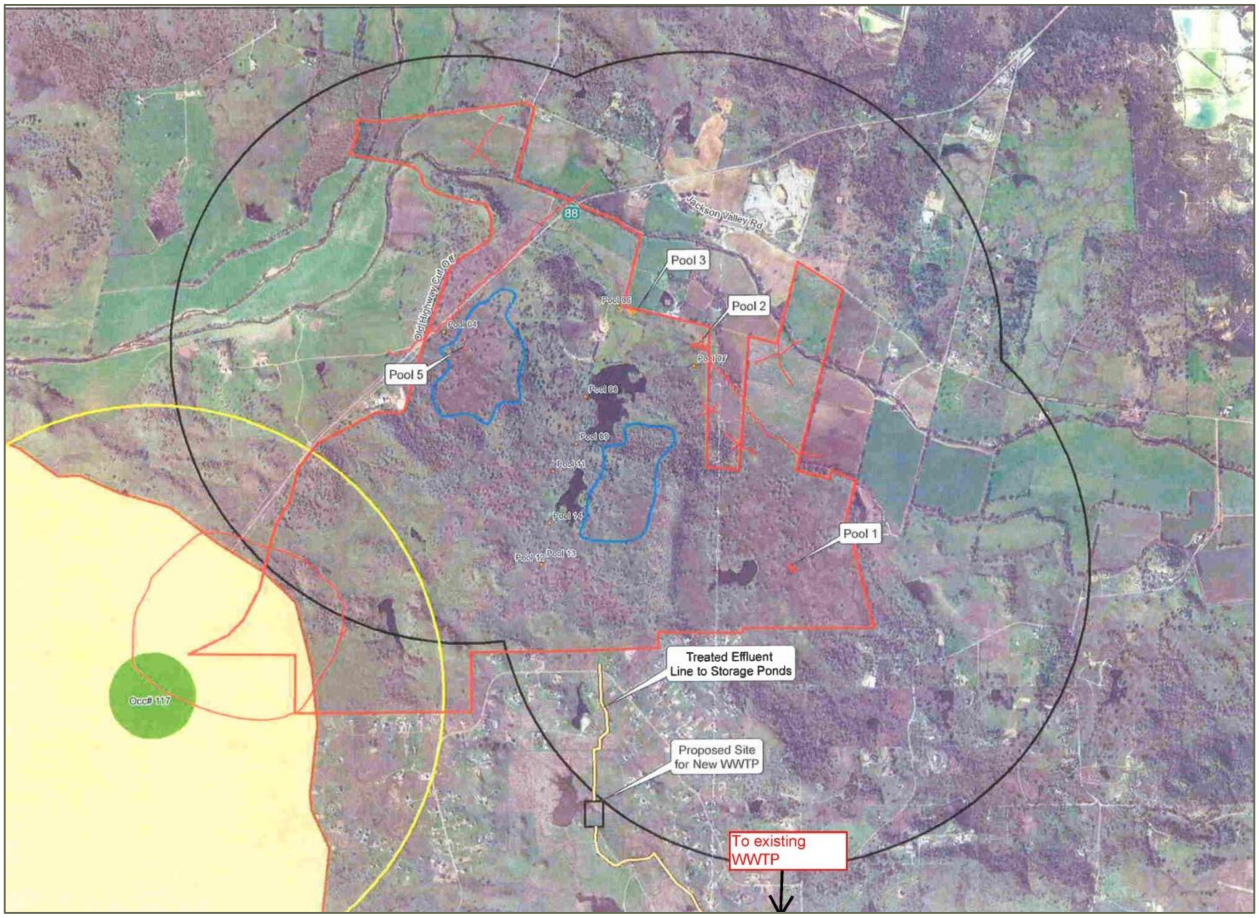
Scope of Work

Task 1. Treatment Plant Upgrade Assessment

The Lake Camanche WWTP would require upgrades to increase its capacity sufficiently to provide service to all residences in Lake Camanche Village. Buildout at Lake Camanche Village is anticipated to produce 281,000 gpd. Upgrades should, at minimum, include an increase to this capacity.

In addition to evaluating upgrades to the existing WWTP, the feasibility of constructing a new WWTP should be evaluated. A preliminary site for a new WWTP has been identified, approximately 1.5 miles northwest of the existing WWTP, as shown in **Figure 3**.

Figure 3: Proposed Site for New WWTP



Task 2. Demand Assessment

Task 2 would identify potential demand for recycled water that could be produced by the upgraded Lake Camanche WWTP.

Task 3. Project Alternatives

Upon identification of potential recycled water customers and demands, project alternatives will be developed to maximize recycled water reuse. Potential project components could include pipelines, storage facilities, and pump stations.

Task 4. Alternatives Assessment

Once project alternatives have been identified, this task will assess the feasibility of each alternative. Evaluation criteria could include, but are not limited to, cost, permitting, complexity/ease of implementation, confidence that demand could be served, compliance with relevant regulations and permits, potential for outside funding, and other considerations.

Based on this assessment, a preferred alternative will be selected. This preferred alternative will be refined enough to support decision-making, funding applications, and coordination on preliminary permitting.

Budget

Based on similar efforts, the Feasibility Study is anticipated to cost approximately $150,000 to complete.

References

Amador Local Agency Formation Commission (Amador LAFCO). 2014. Amador Municipal Services Review: Amador Water Agency. May 22.

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Amador Water Agency (AWA). 2006. Staff Report, Administrative Civil Liability Order for the Amador County Service Area No. 3, Lake Camanche Village WWTP, Amador County. 5 January 2006.

City of Sutter Creek and Amador Regional Sanitation Authority. 2012. Draft Wastewater Master Plan. November 26.

Regional Water Quality Control Board (RWQCB). 2006. Administrative Civil Liability Order for Amador Water Agency, Amador County Service Area No. 3. Lake Camanche Village Wastewater Treatment Plant, Amador County. January 26.

State Water Resources Control Board (SWRCB). 2014a. Transmittal of Compliance Order No. 03-10-14R-004. October 17.

State Water Resources Control Board (SWRCB). 2014b. Questions and Answers on the Recent Order to Public Water Systems with Vulnerable Water Supplies.

Appendix O: Policies and Initiatives

Appendix O provides the MCG-approved policies and initiatives for inclusion in the Implementation Plan.

9a: Land Use Coordination Policy

Sponsor(s): Calaveras Planning Coalition, MyValleySprings.com

Estimated Costs: $25,000

Funding Source(s): uknown

Concept location: MAC and ESJ Regions

Policy Statement

Develop a program to improve coordination between willing water agencies, land use agencies, and concerned members of the public.

Initiative

MokeWISE Stakeholders acknowledge the importance of maintaining a cooperative working relationship between water agencies and local land use agencies to ensure that there is an adequate domestic water supply available to serve the communities within the Mokelumne Watershed. The MokeWISE Stakeholders also understand that there are challenges to maintaining a cooperative working relationship that should be recognized and overcome to ensure that there is a safe and adequate water supply to meet the current and future needs.

In addition, the stakeholders acknowledge existing statutes (SB 221 and SB 610) that impose such planning requirements on water agencies and local land use agencies for land use developments that meet certain conditions.

There are various means by which water and local land use agencies can work together to not only ensure that there is adequate water to serve existing and future needs, but to maintain the environmental integrity of the Mokelumne River, up and downstream. Incorporating the following implementation measures into current procedures and processes can assist with maintaining a cooperative long-term relationship between both entities.

- While updating agency General Plans and Urban Water Management Plans, the local land use agencies should meet and coordinate with local water agencies and members of the public to get an understanding of existing water demands and infrastructure needs to serve existing land use demands, as well as future needs. Policies should be incorporated into the General Plan to ensure that adequate water supply and wastewater disposal are available prior to development and sustained.

- The local land use agency should coordinate with responsible water agencies and members of the public to ensure that there is adequate water supply and infrastructure when a new development proposal is submitted. To ensure this coordination, the project should be routed to the responsible water agency, local interest groups and individuals that have previously expressed a concern, for comments and conditions. The water agencies and other commenters must commit to responding to the local land use agency within the allotted timeframe and provide detailed comments and/or conditions to ensure their requirements are met.
- Local land use agencies should include the responsible water agency, local interest groups and individuals that have previously expressed a concern on pre application meetings for potential developments within their service area.
- Water agencies, Counties and Cities, local interest groups and concerned members of the public should strive to hold periodic meetings to discuss various topics such as:
    - Variability in available water supply, which may fluctuate in drier years requiring the need to implement stricter conservation measures.
    - Existing water supply demands based upon development or proposed development to ensure that current and future water supply needs can continue to be met.
    - Water conservation methods that can be quickly implemented during summer months and drought years to help maintain adequate water supply levels.
    - Facility and infrastructure needs for future growth and demands.
    - How future growth could have impacts on wastewater and drainage facilities downstream.
    - Strategies to sustain and improve surface and groundwater quality.

Statement of MokeWISE Support

MokeWISE Stakeholders support a more defined and transparent approach to improving the coordination between willing water agencies and local land use agencies to ensure that there is adequate water supply to serve existing and future needs and the public interest.

9b: Sustainable Forestry Policy

Sponsor(s): UMRWA (pending)

Estimated Costs: $0

Funding Source(s): uknown

Concept location: MAC and ESJ Regions

Policy Statement

MokeWISE Stakeholders support the development and implementation of sustainable forestry practices within the upper portion(s) of the Mokelumne River Watershed. A sustainable forest is ecologically rich and resilient, with full native biodiversity, where natural processes, structure, and function, including fire, sustain the native ecology and a diverse range of ecosystem services. Sustainable forestry considers and incorporates natural processes, functions, and structure as well as compatible management activities to restore and maintain resilient, healthy forest ecosystems and ecosystem services. A sustainable forest reduces the frequency and intensity of wildfires that threaten life, property, or important ecological resources. A sustainable forest protects watershed soil integrity and water quality and quantity.

Initiative

MokeWISE Stakeholders have been made aware of Principles and Policies adopted by the collaborative Amador-Calaveras Consensus Group (ACCG). MokeWISE Stakeholders encourage their use to help guide sustainable forestry operations within the region.

The ACCG developed the Principles and Policies to assist in the evaluation of projects or programs proposed for lands within their interest area (note that ACCG doesn't own or manage land, yet their interest area encompasses a large portion of the upper watershed). Further, the ACCG uses the Principles and Policies to make project sponsorship or endorsement decisions.

Principles, which could also be considered as initiatives, have been identified as follows:

- Design and implement activities that protect and restore forest ecosystem resiliency, structures, processes and functions within local watersheds;
- Seek forest and watershed planning solutions that benefit all three components of ACCG's vision: the local environment, community and economy;
- Use adaptive management best practices supported by the most appropriate peer-reviewed, ecology based science available; and

- Plan forest activities using the most comprehensive and current assessment of local watersheds and forests and the communities and economies they support.

A number of associated Policies have been identified. Policies address desired project outcomes. Projects or programs that are developed to help the region achieve sustainable forests should take into consideration these Policies. Policies are grouped under the following categories: natural environments; communities; and economies.

Statement of MokeWISE Support

MokeWISE Stakeholders support the Amador-Calaveras Consensus Group's Principles and Policies to Guide Operation as adopted on August 18, 2010 (Attachment A).

Other Efforts of which MokeWISE Stakeholders are Aware

MokeWISE Stakeholders are aware of other efforts underway regarding efforts that relate, directly or indirectly, to forestry practices in the watershed:

- The projects of the Amador-Calaveras Consensus group, including but not limited to the multi-year ACCG Cornerstone Project on the Eldorado and Stanislaus National Forests.
- Work being performed by the Pacific Forest and Watershed Lands Stewardship Council in Amador County to guide sustainable forestry practices on PG&E lands in its program as well as the lands it will donate to federal and state agencies within the upper portion of the Mokelumne River Watershed; and
- An effort as championed by Calaveras County Supervisor Cliff Edson to finance and develop a Calaveras County-wide program aimed at increasing water production from local forests and creating a payment for ecosystem services program.
- Forest and watershed projects on private lands that are funded by the Natural Resource Conservation Service, Sierra Nevada Conservancy and CalFIRE.

MokeWISE Stakeholders acknowledge these and other efforts to promote sustainable forestry within the upper watershed and will consider if and how best to support efforts believed to be appropriate for the watershed as they move beyond the concept stage.

Appendix A: Amador Calaveras Consensus Group (ACCG) Principles and Policies to Guide Operations, Adopted by ACCG August 18, 2010

Introduction

The Principles and Policies to Guide Operations detailed below are intended for the use of the ACCG in guiding projects the ACCG controls, manages, sponsors or is considering endorsing. The ACCG recognizes that not all of the principles and policies may be applicable or necessary on every project. Further, the ACCG recognizes that conforming with the principles and policies will require a balanced approach as projects will need to strike a balance between environmental, community and economic objectives. Entities seeking ACCG endorsement of projects should consider how their projects evaluate or integrate the principles and policies.

Principles:

- Design and implement activities that protect and restore forest ecosystem resiliency, structures, processes and functions within local watersheds.
- Seek forest and watershed planning solutions that benefit all three components of our vision: the local environment, community and economy.
- Use adaptive management best practices supported by the most appropriate peer-reviewed, ecology-based science available.
- Plan forest activities using the most comprehensive and current assessment of local watersheds and forests and the communities and economies they support.

Policies to Guide Operations:

Natural Environments

- Reduce the frequency and intensity of wildland fires that threaten life, property or important ecological resources.
- Protect watershed soil integrity and water quality and quantity.
- Promote the eradication of ecologically harmful invasive species.
- Identify, manage, and enhance wildlife and plant habitat and wildlife corridor connectivity.
- Plan and implement projects using a landscape perspective that recognizes their cumulative effects.
- Prioritize and strategically target projects and treatment areas using the best assessment and the most appropriate adaptive management techniques available.
- Reduce forest fuel loads to manageable, ecologically sustainable levels using site-appropriate methods: including but not limited to mechanical and/or prescribed burning methods.

- Establish and maintain monitoring and data collection activities that improve local knowledge of forest conditions from the stand to landscape and watershed levels.
- Promote the adaptation of management strategies and methods using the best available peer-reviewed science-based research.

Communities

- Treat everyone with dignity and respect, being mindful of their respective roles and responsibilities.
- Reduce the potential for damage to life and property by:
    - Promoting the creation and maintenance of fire-safe communities through community-endorsed fuel hazard reduction projects in the forests' interface with local communities and the built environment.
    - Promoting the use of defensible space and fire-resistant building materials and design.
- Respect and be sensitive to Native American cultural sites, practices and resources.
- Respect and be sensitive to historical sites.
- Include area stakeholders in project planning and implementation.
- Foster cooperative partnerships that maximize effectiveness and regional competitiveness of the local workforce and businesses.
- As appropriate, provide community education and involvement opportunities to local communities.
- Protect scenic beauty and locally important sites.
- Enhance or do no harm to other healthy forest-based activities.

Economies

- Work to create local sustainable jobs with livable wages.
- Work to diversify the local economy with sustainable jobs and businesses.
- Implement and use adaptive management and sustainable practices in forest and watershed work.
- Practice continuous quality improvement in the work done to learn from it and improve future work.

- Mimic nature’s circular process that recognizes “underutilized materials” as valuable feedstock for diverse sustainable, value-added products, services and infrastructure.
- Encourage local investment, purchasing and ownership of forest enterprises.
- Use regional networks and markets to optimize local benefits.

9c: Watershed Coordinator Initiative

Sponsor(s): San Joaquin County Resouce Conservation District, Upper Mokelumne River Watershed Authority

Estimated Costs: $50,000/year per watershed coordinator

Funding Source(s): uknown

Concept location: MAC and ESJ Regions

Policy Statement

MokeWISE Stakeholders recognize the value of having one or more watershed coordinators for the upper and lower watersheds to work with the various landowners, agencies, and interest groups within the Mokelumne River Watershed to facilitate collaborative efforts designed to improve and sustain the health of the watershed.

Initiative

MokeWISE Stakeholders support funding efforts, through state grant programs or other, to establish and maintain one or more watershed coordinators to work under the direction of the San Joaquin County Resource Conservation District (lower watershed) and / or UMRWA (upper watershed).

Statement of MokeWISE Support

MokeWISE Stakeholders support funding efforts to retain one or more watershed coordinators to work under the direction of the San Joaquin County Resource Conservation District (lower watershed) and / or UMRWA (upper watershed) to facilitate collaborative interregional efforts to improve and sustain the health of the Mokelumne Watershed.

9f: MokeWISE Project Public Involvement Initiative

Sponsor(s): Upper Mokelumne River Watershed Authority (UMRWA) and the Eastern San Joaquin Groundwater Basin Authority (GBA)

Estimated Costs: $20,000 for anticipated annual meeting management and facilitation expenses incurred over a 5-year period; actual yearly costs will vary dependeing on MokeWISE project activity

Funding Source(s): It is anticipated that if a project or study is projected to commence "shortly," the project sponsors should work cooperatively with UMRWA and/or the GBA to address any financial commitment to support their effort(s)

Concept location: MAC and ESJ Regions

Policy Statement

MokeWISE stakeholders recognize that transparent and inclusive planning processes, with formal opportunities for public participation, lead to better outcomes. State law requires issued state permits and licenses allowing for the diversion and storage of surface water be in the public interest. MokeWISE Stakeholders recognize that conflicts over public interest issues can stall and/or extend the state permit and license approval process for years.

This proposal provides support for interregional MAC and ESJ stakeholders to work, at the programmatic level, on MokeWISE implementation. Participation would focus on discussing the progress of specific MokeWISE Implementation Plan projects and identifying larger programmatic issues or changes that should be made in response to new information and funding opportunities. MokeWISE stakeholders believe that careful consideration of potential funding opportunities provides the best possible outcomes for MokeWISE projects and studies and that meeting annually to discuss opportunities is in the best interest of the watershed. Public involvement is also critical to the successful implementation of MokeWISE and public workshops can provide the public with a valuable avenue for providing feedback about MokeWISE implementation.

Initiative

Interested stakeholders in the Mokelumne Watershed and members of the public will meet annually to monitor, comment on, and discuss the implementation of MokeWISE studies and projects.

Statement of MokeWISE Support

MokeWISE stakeholders support ongoing participation of interested stakeholders and members of the public to oversee MokeWISE implementation and track implementation of individual MokeWISE projects. Continuing engagement with former Mokelumne Collaborative Group (MCG) members and the public on a regular basis constitutes an important element needed for success of MokeWISE projects.

Appendix P: Sample Memorandum's of Understanding

Appendix P provides example MOU's for the Implementation Tier to consider when drafting their MOU.

MEMORANDUM OF UNDERSTANDING
among
CITY OF COACHELLA/COACHELLA WATER AUTHORITY, COACHELLA VALLEY WATER DISTRICT, DESERT WATER AGENCY, CITY OF INDIO/INDIO WATER AUTHORITY, MISSION SPRINGS WATER DISTRICT, AND VALLEY SANITARY DISTRICT
for
DEVELOPMENT AND IMPLEMENTATION OF THE COACHELLA VALLEY INTEGRATED REGIONAL WATER MANAGEMENT PLAN

This Memorandum of Understanding (MOU) dated August 27, 2014 is entered into among the City of Coachella/Coachella Water Authority, Coachella Valley Water District, Desert Water Agency, City of Indio/Indio Water Authority, Mission Springs Water District, and Valley Sanitary District (collectively known as Members) for the purpose of coordinating water resources planning activities undertaken by the water entities. This MOU restates the agreement of the founding Members and incorporates all supplements to the original MOU listed below:

- Supplement 1 – April, 29 2010 – Consultant Retention IRWM Plan
- Supplement 2 – March 13, 2012 – Consultant Retention Plan Update and DAC Outreach
- Supplement 3 – August 8, 2012 – Implementation Grant Round 1
- Supplement 4 – February 22, 2013 – Consultant Retention CV-Strategies Outreach

WHEREAS, each Member has adopted a Resolution of commitment approving this MOU and committing to develop, update, and implement the Coachella Valley Integrated Regional Water Management Plan (CVIRWMP).

WHEREAS, it is in the interests of the Members and the region served by the Members that these water resources are responsibly managed and conserved to the extent feasible; and

WHEREAS, the Members wish to coordinate their long term water supply planning efforts in accordance with Section 10531 of the *Integrated Regional Water Management Planning Act of 2002* and Division 43 of the *Safe Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act* of 2006 (Acts); and

WHEREAS, the Members anticipate the potential need for future agreements on specific activities, projects or programs and with other affected agencies to further coordinate long term water supply planning.

NOW, THEREFORE, it is mutually understood and agreed as follows:

SECTION 1:
AUTHORITY OF MEMBERS

1.1. The Coachella Water Authority is a joint powers authority formed as a component of the City of Coachella and has statutory authority over water supply.

1.2. Coachella Valley Water District is a public agency of the State of California organized and operating under County Water District Law, California Water Code section 30000, et seq, and Coachella District Merger Law, Water Code section 33100, et seq. Coachella Valley Water District is a State Water Project Contractor and Colorado River Contractor empowered to import water supplies to its service area, and has statutory authority over water supply.

1.3. The Desert Water Agency is an independent special district created by a special act of the state legislature contained in chapter 100 of the appendix of the California Water Code. Desert Water Agency is also a State Water Project Contractor empowered to import water supplies to its service area, replenish local groundwater supplies, and collect assessments necessary to support a groundwater replenishment program as provided for in the Desert Water Agency Law and has statutory authority over water supply.

1.4. The Indio Water Authority is a joint powers authority of the City of Indio and the Indio Housing Authority and has statutory authority over water supply.

1.5. Mission Springs Water District is a County Water District formed under Section 30000 et seq of the California Water Code and has statutory authority over water supply.

1.6. The Valley Sanitary District is an independent special district governed under the California Sanitary Act of 1923. The District provides collection, wastewater treatment and water reuse services for customers in the eastern Coachella Valley since 1925.

SECTION 2:
MEMBERSHIP CRITERIA

Membership criteria for participation as a Member includes:

2.1. Possess a water management responsibility in the Coachella Valley. This criterion could apply to but is not limited to the following entities:

   a. Wholesale or retail water providers
   b. Agricultural, recycled, and raw/surface water providers
   c. Wastewater providers
   d. Surface water rights holders
   e. Regional flood/stormwater managers

2.2. Commit to adopting the 2014 CVIRWM Plan prior to membership and participate in future Plan Updates, as well as commit to good faith effort as a part of the CVRIWMG to approve the future Plan Updates

2.3. Actively participate in management and implementation of Coachella Valley IRWM program. This includes regular attendance at meetings of CVIRWMG, Planning Partners, and other essential meetings, as well as efforts necessary to review and comment on work products

2.4. Participate in funding current and future program costs.

2.5. Commit to transparency and accountability in governing body actions that relate to the Coachella Valley IRWM program.

2.6. Commit to adopt the MOU and abide by the Ground Rules.

2.7. Commit to work toward consensus in supporting the water management needs of the entire Coachella Valley.

SECTION 3:
DEFINITIONS

The abbreviations and capitalized words and phrases used in this MOU shall have the following meanings:

3.1. Acts — mean Section 10531 of the Integrated Regional Water Management Planning Act of 2002 and California Water Code Division 43, known as the Safe Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006

3.2. Coachella Valley Region — the watershed bounded on the North by the San Bernardino Mountains, Little San Bernardino Mountains and Mecca Hills Area, on the East by Mortmar and Travertine Rock, on the South by the Santa Rosa Mountains and San Jacinto Mountains and on the West by Stubbe Canyon.

3.3. CVWD — Coachella Valley Water District

3.4. CVIRWMG — Coachella Valley Integrated Regional Water Management Group

3.5. CWA — Coachella Water Authority

3.6. DWA — Desert Water Agency

3.7. IRWMP — Integrated Regional Water Management Plan

3.8. CVIRWMP — Coachella Valley Integrated Regional Water Management Plan

3.9. IWA — Indio Water Authority

3.10. Planning Partners — primary stakeholder group for the Coachella Valley IRWM Program that provides direct input to the Members

3.11. MSWD — Mission Springs Water District

3.12. VSD — Valley Sanitary District

SECTION 4:
PURPOSES AND GOALS OF THIS MOU

4.1. Purpose and Goals:

4.1.1. The purpose of this MOU is to memorialize the intent of the Members to coordinate and share information concerning water supply planning programs and projects and other information, and to improve and maintain overall communication among the Members involved. It is anticipated that coordination and information sharing among the Members will assist the agencies in achieving their respective missions to the overall well-being of the region. Coordination and information sharing shall focus on issues of common interest in Section 3.2.

4.1.2. The execution of the original MOU by the Members formed the Integrated Regional Water Management Group consisting of the Members, in accordance with the Acts. The Integrated Regional Water Management Group shall be named the Coachella Valley Integrated Regional Water Management Group (CVRIWMG) and shall be comprised of the Members listed in Section 1 and compliant with the membership criteria in Section 2.

4.1.3. The original goal of the Members was to prepare and adopt an IRWMP for the Coachella Valley Region, which was accomplished in 2010 and updated in 2014. Further their future goal is to implement projects, activities and programs individually or jointly in groups that address issues of common interest, as the group so identifies.

4.2. Common Issues and Interest:

4.2.1. Water supply programs and projects that may provide mutual benefits in improving water supply reliability and/or water quality.

4.2.2. Coordination of near-term and long-term water supply planning activities.

4.2.3. Development of regional approaches to problem-solving and issues resolution as well as to further common interest.

4.3. Future Agreements by Members: The Members acknowledge that by virtue of commitments and intentions stated within this MOU, the need for certain other considerations that will facilitate the update and implementation of the CVIRWMP for the Coachella Valley Region will emerge. Those considerations will be subject to the agreement of the parties and documented in subsequent supplements.

SECTION 5: JOINT PLANNING FOR PROJECTS AND PROGRAMS

5.1. Projects, Programs and Actions which are part of the Coachella Valley Integrated Regional Water Management Plan: it is the intent of the Members that they coordinate and collaborate to address the common issues identified. By consensus, the Members may develop and implement actions, projects and programs individually or jointly in groups of two or more, or enter into additional agreements in furthering those goals. This section shall not be construed as a means of removing general benefit projects from the management oversight of CVRIWMG, nor as a method of circumventing the decision resolution process outlined in the governance documents of the CVRIWMG. Applicable projects and programs include, but are not limited to the following:

5.1.1. Water conservation programs and other demand management programs.

5.1.2. Water recycling, desalination, groundwater basin management, and water quality improvement programs and projects.

5.1.3. Water banking, conjunctive use and transfer arrangements.

5.1.4. Water storage development to improve system reliability, efficiencies, and flexibility.

5.1.5. Project and program planning and development to solicit external funding.

5.1.6. Other meritorious projects or programs consistent with the purposes of this MOU.

5.2. Communication and Coordination: It is the intent of the Members to generally meet on a monthly basis in order to carry out the purposes and goals of this MOU. The frequency and location of meetings are subject to the discretion of the Members and may be changed when appropriate.

The Members will also coordinate with stakeholders in the Coachella Valley through Planning Partners meetings and other correspondence at a frequency determined by the Members. The Planning Partners will provide opportunity for public comment on decisions directly related to the CVIRWMP development and implementation that are made by the governing bodies of the Members.

SECTION 6:
TERMS AND CONDITIONS

6.1. Term: The term of this MOU is indefinite. Any Member may withdraw from the MOU by written notice given at least 45 days prior to the effective date.

6.2. Construction of Terms: This MOU is for the sole benefit of the Members and shall not be construed as granting rights to any person other than the Members or imposing obligations on a Member to any person other than another Member.

6.3. Good Faith: Each Member shall use its best efforts and work wholeheartedly and in good faith for the expeditious completion of the objectives of this MOU and the satisfactory performance of its terms.

6.4. Rights of the Members: This MOU does not contemplate the Members taking any action that would:

6.4.1. Adversely affect the rights of any of the Members; or

6.4.2. Adversely affect the customers or constituencies of any of the Members.

6.5. This document and participation in this CVIRWMP are nonbinding, and in no way suggest that a Member may not continue its own planning and undertake efforts to secure project funding from any source.

6.6. Members shall contribute personnel and financial resources necessary to undertake the CVIRWMP efforts of the CVIRWMG. It is expected that Members will contribute equal shares to the current and future CVIRWM program costs as agreed by the CVIRWMG. These will be documented in subsequent supplements to the MOU.

6.7. From time to time, the CVIRWMG may apply for and receive funding from state or federal agencies, or other entities for projects of mutual benefit within the IRWM Region. The CVIRWMG may appoint a member agency or consultant to administer and coordinate the use of such funding. The administering agency shall not have any additional authority above the CVIRWMG Members regarding project implementation, funding redistribution or any other decisions related to such projects.

IN WITNESS WHEREOF, the parties have executed this Memorandum of Understanding as of the day and year indicated on the first page of this MOU.

Jim Barrett
Coachella Valley Water District

Brian Macy
Indio Water Authority

Arden Wallum
Mission Springs Water District

Dave Luker
Desert Water Agency

Kirk Cloyd Coachella Water Authority

Joseph Glowitz
Valley Sanitary District

MEMORANDUM OF UNDERSTANDING
TO CONDUCT INTEGRATED REGIONAL WATER MANAGEMENT PLANNING
FOR THE UPPER SANTA MARGARITA WATERSHED

This Memorandum of Understanding ("MOU") is made and entered into this 31st day of August 2010 ("Effective Date") among the RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT, hereinafter called "DISTRICT", the COUNTY OF RIVERSIDE, hereinafter called "COUNTY", and the RANCHO CALIFORNIA WATER DISTRICT, hereinafter called "RCWD".

RECITALS

A. WHEREAS, the Department of Water Resources is administering a grant program for Integrated Regional Water Management or "IRWM" Planning and;

B. WHEREAS, DISTRICT, COUNTY, and RCWD, each hereinafter individually called "AGENCY" and collectively "AGENCIES", are willing to cooperate and work collaboratively with the stakeholders of the Upper Santa Margarita Watershed in Riverside County to prepare the IRWM Plan for the geographic area described on Exhibit 'A' attached hereto ("Planning Region") as accepted by the Department of Water Resources in the Regional Acceptance Process; and

C. WHEREAS, the AGENCIES collectively cover the entire planning area to be covered by this IRWM Plan that contains significant need for major public infrastructure and conservation projects; and

D. WHEREAS, the AGENCIES collectively have made significant investments in planning for flood control, management and water conservation, water supply and reliability, recycled water, habitat preservation and conservation and related water management strategies; and

E. WHEREAS, the AGENCIES collectively and with the Stakeholder Advisory Committee represent all entities significant to water management planning in the area; and

F. WHEREAS, the AGENCIES have the authority and willingness to act in the best interest of the Planning Region in planning and implementing IRWM efforts; and

G. WHEREAS, the AGENCIES are committed to conduct planning efforts in an open accessible process including the Stakeholder Advisory Committee and the public; and

H. WHEREAS, RCWD is willing to take the lead funding role in contracting for planning, making application for funding and implementing funded efforts on behalf of Eastern Municipal Water District and Western Municipal Water District and the Planning Region; and

I. WHEREAS, the AGENCIES have the institutional and fiscal capacity and systems to carry out planning and implementation efforts; and

J. WHEREAS, the AGENCIES are willing to provide funding or in-kind assistance as set forth herein and as mutually agreeable in separate board actions; and

K. WHEREAS, the AGENCIES previously executed a Memorandum of Understanding in 2007, which expires on December 31, 2010 and all AGENCIES wish to continue the efforts under this agreement which supersedes the 2007 agreement; and

L. WHEREAS, The AGENCIES will each benefit from their participation in this MOU.

NOW, THEREFORE, the AGENCIES hereby mutually agree as follows:

1. RCWD shall facilitate the completion of work required to collect and compile existing plans and current information into an IRWM Plan and submit a grant application to the State for funding consideration.

2. Each AGENCY hereby designates its General Manager or Chief Executive to represent its board as the person charged with the authority to review and approve the IRWM Plan for the Planning Region or extending this agreement.

3. The MOU authorizes that applications be made to the California Department of Water Resources or other State or Federal Departments to obtain Integrated Regional Water Management Planning and Implementation Grants pursuant to the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Public Resource Code Section 75001 et seq.), and the Disaster Preparedness and Flood Prevention Bond Act of 2006, (Public Resource Code Section 7096 et seq.), or future sources of funding and to enter into agreements to receive grant funds for the Upper Santa Margarita IRWM Watershed Planning area. The General Manager of RCWD is hereby authorized and directed to prepare the necessary data, conduct investigations, file such applications, and execute grant agreements with the California Department of Water Resources, contract to disburse funds to designated partners or sub-grantees, and to make changes as needed to contracts or other documents to implement the IRWM process to the benefit of the Planning Region.

4. This MOU authorizes the establishment of a Stakeholder Advisory Committee (hereinafter "Committee") subject to the terms of this MOU and any applicable rules that the AGENCIES may promulgate. The AGENCIES will review and select by consensus the members of the Committee from stakeholder organizations in the Planning Region. Stakeholders represent their agency or organization and serve at the pleasure of the AGENCIES and may not be required to contribute funds except in-kind services. No more than one representative of any organization shall be named to the Committee. The representative shall represent all interests of the organization and the region. The Committee acts in an advisory role to the AGENCIES for plan goals and priorities outreach and project

integration. Stakeholders need not be a member of the Committee to participate in the planning process. The Committee may become dormant or be disbanded if no planning efforts are ongoing or it is no longer needed.

5. The plan, application and related efforts provided for in this MOU aggregate, compile and integrate existing plans and documents as well as solicit new projects and programs. Nothing in these plans, documents or actions, limits the authority of the AGENCIES or their powers or modifies any of the referenced plans, ordinances or actions of the AGENCIES, committee members or stakeholders.

6. Nothing contained within this MOU binds the parties beyond the scope or term of this MOU unless specifically documented in subsequent MOU amendments or contracts. Moreover, this MOU does not require any commitment of funding beyond those voluntarily committed by separate board actions but recognizes in-kind contributions of AGENCIES and stakeholders.

7. The AGENCIES cannot be assured of the results or success of the IRWM plan and application for funding. Nothing within this MOU should be construed as creating a promise or guarantee of future funding nor shall any liability accrue to the AGENCIES from any third party or one of the AGENCIES should funding not be forthcoming. Nor shall any additional liability accrue to RCWD by its willingness to act as lead for contracting and application on behalf of the AGENCIES.

8. This MOU may be terminated by any of the AGENCIES with 120 days notice to all AGENCIES and stakeholders. The term of this MOU is from its effective date shown above to December 31, 2015, unless extended or replaced by other agreements.

9. Withdrawal of AGENCIES or addition of other agencies not included will be allowed with the concurrence of the parties and upon execution of this agreement's terms by their governing board.

10. Any notices sent or required to be sent to any party shall be mailed to the following addresses:

RIVERSIDE COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT
1995 Market Street
Riverside, CA 92501

COUNTY OF RIVERSIDE
4080 Lemon Street, 14th Floor
Riverside, CA 92501-3656

RANCHO CALIFORNIA WATER DISTRICT
42135 Winchester Road
Temecula, CA 92590

11. Each AGENCY, to the fullest extent permitted by law, shall defend, indemnify and hold harmless the other AGENCIES, their consultants, and each of their directors, officers, agents, and employees from and against all liability, claims, damages, losses, expenses and other costs including costs of defense and attorneys' fees, arising out of or resulting from or in connection with the performance of the work performed pursuant to this MOU; such obligation shall not apply to any loss, damage or injury, as may be caused solely and exclusively by the fault or negligence of an AGENCY.

12. This MOU is to be construed in accordance with the laws of the State of California.

13. If any provision of this MOU is held by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions shall be declared severable and shall be given full force and effect to the extent possible.

14. Any action at law or in equity brought by any of the parties hereto for the purpose of enforcing a right or rights provided for by this MOU shall be tried in a court of competent jurisdiction in the County of Riverside, State of California, and the parties hereto waive all provisions of law providing for change of venue in such proceedings to any other county.

15. This MOU is the result of negotiations between the parties hereto and with the advice and assistance of their respective counsel. No provision contained herein shall be construed against DISTRICT solely because, as a matter of convenience, it prepared this MOU in final form.

16. Any waiver by AGENCIES of any breach by the other of any one or more of the terms of this MOU shall not be construed to be a waiver of any subsequent or other breach of the same or of any other term hereof. Failure on the part of any of the respective AGENCIES to require from the others exact, full and complete compliance with any terms of the MOU shall not be construed as in any manner changing the terms hereof, or stopping the respective AGENCIES from enforcement hereof.

17. This MOU may be executed and delivered in any number of counterparts or copies, hereinafter called "COUNTERPART", by the parties hereto. When each party has signed and delivered at least one COUNTERPART to the other parties hereto, each COUNTERPART shall be deemed an original and, taken together, shall constitute one and the same MOU, which shall be binding and effective as to the parties hereto.

18. This MOU is intended by the parties hereto as their final expression with respect to the matters herein, and is a complete and exclusive statement of the terms and conditions thereof. This MOU shall not be changed or modified except by the written consent of all parties hereto.

ATTACHMENT A

GEOGRAPHIC DESCRIPTION OF THE PLANNING REGION

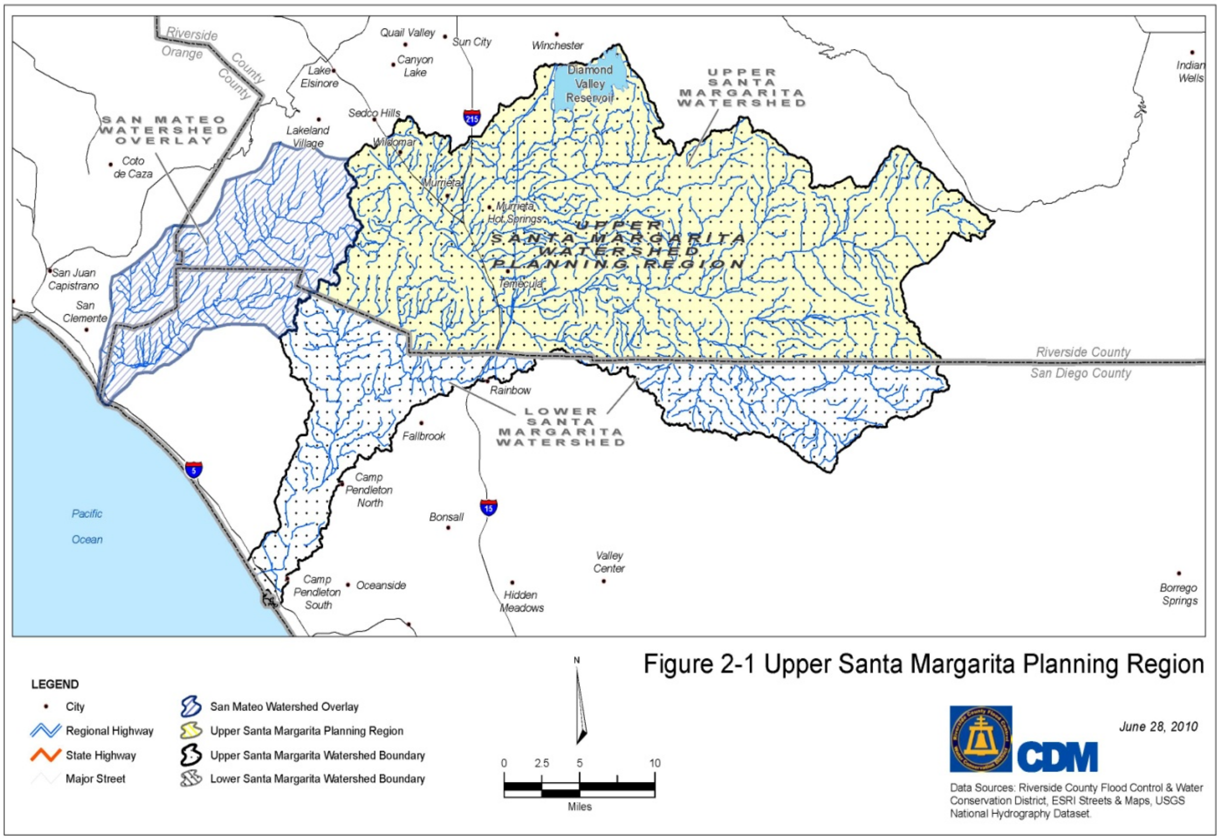

Figure 2-1 Upper Santa Margarita Planning Region

RECOMMENDED FOR APPROVAL: **COUNTY OF RIVERSIDE**

By Marion Ashley
MARION ASHLEY , Chairman
Riverside County Board of Supervisors

APPROVED AS TO FORM:

PAMELA J. WALLS
County Counsel

By
DAVID HUFF
Deputy County Counsel

Dated August 6, 2010

ATTEST:

KECIA HARPER_IHEM
Clerk of the Board

By
Deputy

(SEAL)

AUG 31 2010 3.14

RECOMMENDED FOR APPROVAL: **RANCHO CALIFORNIA WATER DISTRICT**

By Matthew O. Stone
MATT STONE, General Manager

By Lisa Herman
LISA HERMAN, Board President

APPROVED AS TO FORM:
JAMES GILPIN
~~C. MICHAEL COWETT~~
Legal Counsel

By

ATTEST:

KELLI E. GARCIA
Secretary of the Board of Directors

By Kelli E. Garcia

Memorandum of Understanding
NPDES – Santa Margarita IRWM

WHEN DOCUMENT IS FULLY EXECUTED RETURN
CLERK'S COPY
to Riverside County Clerk of the Board, Stop 1010
Post Office Box 1147, Riverside, Ca 92502-1147
Thank you.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on AUG 31 2010.
(to be filled in by Clerk of the Board)

RECOMMENDED FOR APPROVAL:

By Sten Thomas
for WARREN D. WILLIAMS
General Manager-Chief Engineer

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

By Marion Ashley
MARION ASHLEY, Chairman
Riverside County Flood Control and Water Conservation District Board of Supervisors

APPROVED AS TO FORM:

PAMELA J. WALLS
County Counsel

By
DAVID HUFF
Deputy County Counsel

Dated____________________

ATTEST:

KECIA HARPER-IHEM
Clerk of the Board

By
Deputy

(SEAL)

AM:cw
P8/132612

Memorandum of Understanding
To Conduct Integrated Regional Water Management Planning for the Upper Santa Margarita Watershed

AUG 31 2010 11.2

Exhibit 2 - MOU

MEMORANDUM OF UNDERSTANDING
among
CITY OF COACHELLA/COACHELLA WATER AUTHORITY, COACHELLA VALLEY WATER DISTRICT, DESERT WATER AGENCY, CITY OF INDIO/INDIO WATER AUTHORITY, AND MISSION SPRINGS WATER DISTRICT
for
DEVELOPMENT OF AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN

This Memorandum of Understanding (MOU) dated Sept. 9,2008 is entered into among the City of Coachella/Coachella Water Authority, Coachella Valley Water District, Desert Water Agency, City of Indio/Indio Water Authority, and Mission Springs Water District (collectively known as Partners) for the purpose of coordinating water resources planning activities undertaken by the water agencies.

WHEREAS, each Partner has adopted a Resolution of commitment pledging to create an Integrated Regional Water Management Plan (IRWMP).

WHEREAS, it is in the interests of the signatory Partners and the region served by the Partners that these water resources are responsibly managed and conserved to the extent feasible; and

WHEREAS, the Partners wish to coordinate their long term water supply planning efforts in accordance with Section 10531 of the *Integrated Regional Water Management Planning Act of 2002* and Division 43 of the *Safe Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act* of 2006 (Acts); and

WHEREAS, the Partners anticipate the potential need for future agreements on specific projects or programs and with other affected agencies to further coordinate long term water supply planning.

NOW, THEREFORE, it is mutually understood and agreed as follows:

SECTION 1:
AUTHORITY OF PARTNERS

1.1 The Coachella Water Authority is a joint powers authority formed as a component of the City of Coachella and Redevelopment Agency of the City of Coachella and has statutory authority over water supply.

1.2 The Coachella Valley Water District is a public agency of the State of California organized and operating under County Water District Law, California Water Code section 30000, et seq, and Coachella District

Merger Law, Water Code section 33100, et seq. Coachella Valley Water District is a State Water Project Contractor and Colorado River Contractor empowered to import water supplies to its service area, and has statutory authority over water supply.

1.3 The Desert Water Agency is an independent special district created by a special act of the state legislature contained in chapter 100 of the appendix of the California Water Code. Desert Water Agency is also a State Water Project Contractor empowered to import water supplies to its service area, replenish local groundwater supplies, and collect assessments necessary to support a groundwater replenishment program as provided for in the Desert Water Agency Law and has statutory authority over water supply.

1.4 The Indio Water Authority is a joint powers authority formed as a component of the City of Indio and Redevelopment Agency of the City of Indio and has statutory authority over water supply.

1.5 Mission Springs Water District is a County Water District formed under Section 30000 et seq of the California Water Code and has statutory authority over water supply.

SECTION 2: DEFINITIONS

The abbreviations and capitalized words and phrases used in this MOU shall have the following meanings:

2.1 Acts – mean Section 10531 of the Integrated Regional Water Management Planning Act of 2002 and California Water Code Division 43, known as the *Safe Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act* of 2006

2.2 Coachella Valley Region – the watershed bounded on the North by the San Bernardino Mountains, Little San Bernardino Mountains and Mecca Hills Area, on the East by Mortmar and Travertine Rock, on the South by the Santa Rosa Mountains and San Jacinto Mountains and on the West by Stubbe Canyon.

2.3 CVWD – Coachella Valley Water District

2.4 CVRWMG – Coachella Valley Regional Water Management Group

2.5 CWA – Coachella Water Authority

2.6 DWA – Desert Water Agency

2.7 IRWMP – Integrated Regional Water Management Plan

2.8 IWA – Indio Water Authority

2.9 MSWD – Mission Springs Water District

SECTION 3:
PURPOSES AND GOALS OF THIS MOU

3.1 **Purpose and Goals:**

3.1.1 This MOU is to memorialize the intent of the Partners to coordinate and share information concerning water supply planning programs and projects and other information, and to improve and maintain overall communication among the Partners involved. It is anticipated that coordination and information sharing among the Partners will assist the agencies in achieving their respective missions to the overall well-being of the region. Coordination and information sharing shall focus on issues of common interest in Section 3.2.

3.1.2 The execution of this MOU by the Partners shall constitute the formation of a Regional Water Management Group consisting of the Partners, in accordance with the Acts. The Regional Water Management Group shall be named the Coachella Valley Regional Water Management Group(CVRWMG).

3.1.3 It is the goal of the Partners to prepare and adopt an IRWMP for the Coachella Valley Region and to implement projects and programs individually or jointly in groups that address issues of common interest, as the group so identifies.

3.2 **Common Issues and Interest:**

3.2.1 Water supply programs and projects that may provide mutual benefits in improving water supply reliability and/or water quality.

3.2.2 Coordination of near-term and long-term water supply planning activities.

3.2.3 Development of regional approaches to problem-solving and issues resolution as well as to further common interest.

3.3 **Future Agreements By Partners:** The Partners acknowledge that by virtue of commitments and intentions stated within this MOU, the need for certain other considerations that will facilitate the preparation of an IRWMP for the Coachella Valley Region will likely emerge. These include and are not limited to:

3.3.1 Developing a Scope of Work

3.3.2 Determining the cost sharing of projects

3.3.3 Establishing methods for project management

3.3.4 Establishing a project timeline

SECTION 4:
JOINT PLANNING FOR PROJECTS AND PROGRAMS

4.1 **Projects and Programs Covered by this MOU:** it is the intent of the Partners that they coordinate and collaborate to address the common issues identified. The Partners may develop and implement projects and programs individually or jointly in groupings of two or more, or enter into additional agreements in furthering those goals. Applicable projects and programs include, but are not limited to the following:

4.1.1 Water conservation programs and other demand management programs.

4.1.2 Water recycling, desalination, groundwater basin management, and water quality improvement programs and projects.

4.1.3 Water banking, conjunctive use and transfer arrangements.

4.1.4 Storage development to improve system reliability, efficiencies, and flexibility.

4.1.5 Project and program planning and development to solicit external funding.

4.1.6 Other meritorious projects or programs consistent with the purposes of this MOU.

4.2 **Communication and Coordination:** It is the intent of the Partners to meet on a monthly basis in order to carry out the purposes and goals of this MOU. The frequency and location of meetings are subject to the discretion of the Partners and may be changed when appropriate.

SECTION 5: GENERAL PROVISIONS GOVERNING MOU

5.1 **Term:** The term of this MOU is indefinite. Any Partner may withdraw from the MOU by written notice given at least 45 days prior to the effective date.

5.2 **Construction of Terms:** This MOU is for the sole benefit of the Partners and shall not be construed as granting rights to any person other than the Partners or imposing obligations on a Partner to any person other than another Partner.

5.3 **Good Faith:** Each Partner shall use its best efforts and work wholeheartedly and in good faith for the expeditious completion of the objectives of this MOU and the satisfactory performance of its terms.

5.4 **Rights of the Partners and Constituencies:** This MOU does not contemplate the Partners taking any action that would:

5.4.1 Adversely affect the rights of any of the Partners; or

5.4.2 Adversely affect the customers or constituencies of any of the Partners.

5.5 This document and participation in this IRWMP are nonbinding, and in no way suggest that a Partner may not continue its own planning and undertake efforts to secure project funding from any source.

5.6 It is expected that Partners will contribute the personnel and financial resources necessary to develop the IRWMP.

IN WITNESS WHEREOF, the parties have executed this Memorandum of Understanding as of the day and year indicated on the first page of this MOU.

Exhibit 2 - MOU

Tim Brown, City Manager
City of Coachella:

Tim Brown, Executive Director
Coachella Water Authority:

Steve Robbins, General Manager/Chief Engineer
Coachella Valley Water District:

Dave Luker, General Manager
Desert Water Agency:

for

Glenn Southard, City Manager
City of Indio:

for

Glenn Southard, Executive Director
Indio Water Authority:

Arden Wallum, General Manager
Mission Springs Water District:

SUPPLEMENT TO MEMORANDUM OF UNDERSTANDING among CITY OF COACHELLA/COACHELLA WATER AUTHORITY, COACHELLA VALLEY WATER DISTRICT, DESERT WATER AGENCY, CITY OF INDIO/INDIO WATER AUTHORITY, AND MISSION SPRINGS WATER DISTRICT for DEVELOPMENT OF AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN

This Supplement dated April 29, 2010 is entered into among the City of Coachella/Coachella Water Authority, Coachella Valley Water District, Desert Water Agency, City of Indio/Indio Water Authority, and Mission Springs Water District (collectively known as Partners) for the purpose of coordinating water resources planning activities undertaken by the water agencies.

WHEREAS, each Partner is a party to a Memorandum of Understanding (MOU) for Development of an Integrated Water Management Plan (IRWMP) dated September 9, 2008; and

WHEREAS, the Partners wish to supplement the MOU for the purpose of retaining a consultant to assist in preparing an IRWMP;

NOW, THEREFORE, it is mutually understood and agreed as follows:

SECTION 1: RETENTION OF CONSULTANT

1.1 The consultant's scope of work, fees and contract terms shall be approved by the Partners.

1.2 Mission Springs Water District (MSWD) shall retain a consultant selected by the Partners and administer the consultant agreement as directed by the Partners.

SECTION 2: PAYMENT

2.1 MSWD shall initially pay the consultant per the terms of the consulting agreement and as approved by the Partners, and then invoice each partner for reimbursement of one-fifth (1/5) of the payment that has been made to the consultant.

2.2 Each Partner shall pay the invoice within 14 days of receipt of invoice.

SECTION 3:
PARTICIPATION

3.1 Each Partner retains the right to withdraw its participation in the MOU, as stipulated by the MOU in Section 5.1.

3.2 A withdrawing Partner remains obligated for reimbursement of its share of consulting fees to be paid pursuant to agreement with the consultant executed prior to that Partner's withdrawal from participation.

SECTION 4:
MISCELLANEOUS

4.1 Abbreviations, capitalized words and phrases used in this supplement shall have the same meaning as in the MOU.

4.2 All terms of the MOU remain unchanged, except, as supplemented herein.

4.3 This Supplement may be executed in any number of counterparts, each of which shall be deemed original, but all of which, when taken together, shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

Gene Rogers, Interim City Manager
City of Coachella

Gene Rogers, Executive Director
Coachella Water Authority

Steve Robbins, General Manager-Chief Engineer
Coachella Valley Water District

Dave Luker, General Manager
Desert Water Agency

Tara Lee Adams, City Manager
City of Indio

Tara Lee Adams, Executive Director
Indio Water Authority

Arden Wallum, General Manager
Mission Springs Water District

SUPPLEMENT TO MEMORANDUM OF UNDERSTANDING

Gene Rogers, Interim City Manager
City of Coachella:

Gene Rogers, Executive Director
Coachella Water Authority:

Steve Robbins, General Manager-Chief Engineer
Coachella Valley Water District:

Dave Luker, General Manager
Desert Water Agency:

Tara Lee Adams, Interim City Manager
City of Indio:

Tara Lee Adams, Interim Executive Director
Indio Water Authority:

Arden Wallum, General Manager
Mission Springs Water District:

Gene Rogers, Interim City Manager
City of Coachella:

Gene Rogers, Executive Director
Coachella Water Authority:

Steve Robbins, General Manager-Chief Engineer
Coachella Valley Water District:

Dave Luker, General Manager
Desert Water Agency:

Tara Lee Adams, Interim City Manager
City of Indio:

Tara Lee Adams, Interim Executive Director
Indio Water Authority:

Arden Wallum, General Manager
Mission Springs Water District:

Gene Rogers, Interim City Manager
City of Coachella:

Gene Rogers, Executive Director
Coachella Water Authority:

Steve Robbins, General Manager-Chief Engineer
Coachella Valley Water District:

Dave Luker, General Manager
Desert Water Agency:

Tara Lee Adams, Interim City Manager
City of Indio:

Tara Lee Adams, Interim Executive Director
Indio Water Authority:

Arden Wallum, General Manager
Mission Springs Water District:

SUPPLEMENT TO MEMORANDUM OF UNDERSTANDING

Gene Rogers, Interim City Manager
City of Coachella

Gene Rogers, Executive Director
Coachella Water Authority

Steve Robbins, General Manager-Chief Engineer
Coachella Valley Water District

Dave Luker, General Manager
Desert Water Agency

Tara Lee Adams, City Manager
City of Indio

Tara Lee Adams, Executive Director
Indio Water Authority

Arden Wallum, General Manager
Mission Springs Water District

SUPPLEMENT TO MEMORANDUM OF UNDERSTANDING

SECOND SUPPLEMENT TO
MEMORANDUM OF UNDERSTANDING
among
CITY OF COACHELLA/COACHELLA WATER AUTHORITY, COACHELLA VALLEY WATER DISTRICT, DESERT WATER AGENCY, CITY OF INDIO/INDIO WATER AUTHORITY, and MISSION SPRINGS WATER DISTRICT
for
DEVELOPMENT OF AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN

This SECOND SUPPLEMENT dated March 13, 2012, is entered into among the City Of Coachella/Coachella Water Authority, Coachella Valley Water District, Desert Water Agency, City Of Indio/Indio Water Authority, and Mission Springs Water District (collectively known as Partners) for the purpose of coordinating water resources planning activities undertaken by the water agencies.

WHEREAS, each Partner is a party to a Memorandum of Understanding (MOU) for Development of an Integrated Regional Water Management Plan (IRWMP) dated September 9, 2008; and

WHEREAS, each Partner is a party to a first Supplement to that MOU for the purpose of retaining a consultant to assist in preparing an IRWMP dated April 29, 2010; and

WHEREAS, each Partner wishes to supplement the MOU a second time for the purpose of retaining consultants and entering into grant funding contracts with the Department of Water Resources (State) for Proposition 84, Chapter 2 as follows:

A. Agreement Number 4600009468, for Disadvantaged Communities Outreach (DAC grant), in the amount of $500,000.
B. Agreement Number 4600009342, for updating the existing IRWMP (Planning grant), in the amount of $1,000,000.

NOW, THEREFORE, it is mutually understood and agreed as follows:

SECTION 1:
AGREEMENTS

1.1 The Coachella Valley Water District (CVWD), designated by the Partners as lead agency for the Coachella Valley IRWMP, shall have overall responsibility for executing and administering Proposition 84 grant agreements as directed by the Partners.

1.2 CVWD shall retain consultants selected by the Partners and administer consulting agreements as directed by the Partners.

1.3 Partners shall share equally with CVWD all necessary costs, risks, and obligations for satisfying the terms of the Proposition 84 grant agreements with the State.

SECTION 2:
DAC AND PLANNING GRANT INVOICING AND PAYMENT

2.1 CVWD will establish an escrow account, and, upon signing this amendment, each Partner will deposit $50,000 into that account for a total balance of $250,000 to ensure that outstanding invoices can be paid if the State fails to provide reimbursements.
2.2 CVWD will receive invoices from consultants on a monthly basis, and will pay invoices from the escrow account.
2.3 No less than quarterly, CVWD will invoice the State. CVWD will deposit funds received from the State into the escrow account for payment of invoices.
2.4 If outstanding invoices exceed $250,000 more than reimbursement from the State, the escrow account balance will drop to zero and the Partners will postpone grant work until State reimbursements are received.
2.5 CVWD will not be responsible for making payments which are neither backed by reimbursements from the State, nor by funds in the escrow account described in Section 2.1.
2.6 Upon completion of the Proposition 84 grant agreements, the funds remaining in the escrow account will be distributed equally to the Partners.
2.7 The sole purpose of escrow account funds is for paying consultant invoices for the DAC and planning grants after the invoices have been reviewed and approved by the Partners. The funds may not be used for any other purpose without the consensus of the Partners.

SECTION 3:
PARTICIPATION

3.1 Each Partner retains the right to withdraw its participation in the MOU as stipulated by the MOU in Section 5.1
3.2 A withdrawing Partner remains obligated for reimbursement of its share of costs to be paid pursuant to any agreements executed prior to that Partner's withdrawal from participation.

SECTION 4:
MISCELLANEOUS

4.1 Abbreviations, capitalized words and phrases used in this supplement shall have the same meaning as in the MOU.
4.2 All terms of the MOU remain unchanged, except, as supplemented herein.

4.3 This Second Supplement may be executed in any number of counterparts, each of which shall be deemed original, but all of which, when taken together, shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

CITY OF COACHELLA/ COACHELLA WATER AUTHORITY

____

COACHELLA VALLEY WATER DISTRICT

____

DESERT WATER AGENCY

____

CITY OF INDIO/INDIO WATER AUTHORITY

____

MISSION SPRINGS WATER DISTRICT

____

4.3 This Second Supplement may be executed in any number of counterparts, each of which shall be deemed original, but all of which, when taken together, shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

CITY OF COACHELLA/ COACHELLA WATER AUTHORITY

____

COACHELLA VALLEY WATER DISTRICT

3.13.12
____

DESERT WATER AGENCY

____

CITY OF INDIO/INDIO WATER AUTHORITY

____

MISSION SPRINGS WATER DISTRICT

____

4.3 This Second Supplement may be executed in any number of counterparts, each of which shall be deemed original, but all of which, when taken together, shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

CITY OF COACHELLA/ COACHELLA WATER AUTHORITY

____

COACHELLA VALLEY WATER DISTRICT

____

DESERT WATER AGENCY

David K. Luker

____

David K. Luker
General Manager

CITY OF INDIO/INDIO WATER AUTHORITY

____

MISSION SPRINGS WATER DISTRICT

____

4.3 This Second Supplement may be executed in any number of counterparts, each of which shall be deemed original, but all of which, when taken together, shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

CITY OF COACHELLA/ COACHELLA WATER AUTHORITY

____

COACHELLA VALLEY WATER DISTRICT

____

DESERT WATER AGENCY

____

CITY OF INDIO/INDIO WATER AUTHORITY

Debra L Kaye
____

MISSION SPRINGS WATER DISTRICT

____

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

CITY OF COACHELLA/ COACHELLA WATER AUTHORITY

____

COACHELLA VALLEY WATER DISTRICT

____

DESERT WATER AGENCY

____

CITY OF INDIO/INDIO WATER AUTHORITY

____

MISSION SPRINGS WATER DISTRICT

____

THIRD SUPPLEMENT TO
MEMORANDUM OF UNDERSTANDING
among
CITY OF COACHELLA/COACHELLA WATER AUTHORITY, COACHELLA VALLEY WATER DISTRICT, DESERT WATER AGENCY, CITY OF INDIO/INDIO WATER AUTHORITY, and MISSION SPRINGS WATER DISTRICT
for
DEVELOPMENT OF AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN

This THIRD SUPPLEMENT dated August 8, 2012, is entered into among the City Of Coachella/Coachella Water Authority, Coachella Valley Water District, Desert Water Agency, City Of Indio/Indio Water Authority, and Mission Springs Water District (collectively known as Partners) for the purpose of coordinating water resources planning activities undertaken by the water agencies.

WHEREAS, each Partner is a party to a Memorandum of Understanding (MOU) for Development of an Integrated Regional Water Management Plan (IRWMP) dated September 9, 2008; and

WHEREAS, each Partner is a party to a first Supplement to that MOU for the purpose of retaining a consultant to assist in preparing an IRWMP dated April 29, 2010; and

WHEREAS, Each Partner is a party to the second Supplement to that MOU for the purpose of retaining consultants and entering into grant funding contracts with the Department of Water Resources (State) for Proposition 84, Chapter 2 as follows:

A. Agreement Number 4600009468, for Disadvantaged Communities Outreach (DAC Grant), in the amount of $500,000.
B. Agreement Number 4600009342, for updating the existing IRWMP (Planning Grant), in the amount of $1,000,000.

WHEREAS, each partner wishes to supplement the MOU a third time for the purpose of entering into grant funding contracts with the Department of Water Resources (State) for Proposition 84, Chapter 2, Agreement Number 4600009560, for an IRWM Implementation Grant (Implementation Grant) in the amount of $4,000,000.

NOW, THEREFORE, it is mutually understood and agreed as follows:

SECTION 1:
AGREEMENTS

1.1 The Coachella Valley Water District (CVWD), designated by the Partners as lead agency for the Coachella Valley IRWMP, shall have overall responsibility for executing and administering this Implementation Grant as directed by the Partners.

1.2 The Grant administration costs reimbursed to CVWD shall be limited to $100,000 as described in EXHIBIT C, Table 1, Budget Category GA of the Implementation Grant Agreement.

1.3 The purpose of the Implementation Grant is to fund four individual projects, each of which has a Local Project Sponsor responsible for individual project management, oversight, compliance, and operations and maintenance. Local Project Sponsors are expected to act on behalf of CVWD in the fulfillment of Grantee responsibilities where specified in the Implementation Grant Agreement. The four individual projects and their Local Project Sponsors are listed in the Implementation Grant Agreement as follows:

- Regional Water Conservation Program — CVWD
- Short-Term Arsenic Treatment Project — Pueblo Unido Community Development
- Groundwater Quality Protection Program — Mission Springs Water District
- Groundwater Quality Protection Program — City of Cathedral City

1.4 The Regional Water Conservation Program equally benefits each of the five Partners.

SECTION 2:
REGIONAL WATER CONSERVATION PROGRAM
INVOICING AND PAYMENT

2.1 Each Partner will pay their share of costs to implement programs and shall submit invoices to CVWD for reimbursement no less than quarterly.

2.2 No less than quarterly, CVWD will invoice the State. CVWD will distribute funds received from the State to the Partners based on invoices submitted by the Partners.

2.3 No Partner shall be expected to make payments for any project or program that are greater than their individual share of costs, without first receiving funds from each Partner sufficient to cover their individual share of the cost.

2.4 CVWD will not be responsible for making payments which are neither backed by reimbursements from the State, nor by funds from the Partners as described in section 2.3 above.

SECTION 3:
PARTICIPATION

3.1 Each Partner retains the right to withdraw its participation in the MOU as stipulated by the MOU in Section 5.1

3.2 A withdrawing Partner remains obligated for reimbursement of its share of costs to be paid pursuant to any agreements executed prior to that Partner's withdrawal from participation.

SECTION 4:
MISCELLANEOUS

4.1 Abbreviations, capitalized words and phrases used in this supplement shall have the same meaning as in the MOU.

4.2 All terms of the MOU remain unchanged, except, as supplemented herein.

4.3 This Second Supplement may be executed in any number of counterparts, each of which shall be deemed original, but all of which, when taken together, shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

CITY OF COACHELLA/ COACHELLA WATER AUTHORITY

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COACHELLA VALLEY WATER DISTRICT

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DESERT WATER AGENCY

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SECTION 3:
PARTICIPATION

3.1 Each Partner retains the right to withdraw its participation in the MOU as stipulated by the MOU in Section 5.1

3.2 A withdrawing Partner remains obligated for reimbursement of its share of costs to be paid pursuant to any agreements executed prior to that Partner's withdrawal from participation.

SECTION 4:
MISCELLANEOUS

4.1 Abbreviations, capitalized words and phrases used in this supplement shall have the same meaning as in the MOU.

4.2 All terms of the MOU remain unchanged, except, as supplemented herein.

4.3 This Second Supplement may be executed in any number of counterparts, each of which shall be deemed original, but all of which, when taken together, shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

CITY OF COACHELLA/ COACHELLA WATER AUTHORITY

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COACHELLA VALLEY WATER DISTRICT

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DESERT WATER AGENCY

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SECTION 3:
PARTICIPATION

3.1 Each Partner retains the right to withdraw its participation in the MOU as stipulated by the MOU in Section 5.1

3.2 A withdrawing Partner remains obligated for reimbursement of its share of costs to be paid pursuant to any agreements executed prior to that Partner's withdrawal from participation.

SECTION 4:
MISCELLANEOUS

4.1 Abbreviations, capitalized words and phrases used in this supplement shall have the same meaning as in the MOU.

4.2 All terms of the MOU remain unchanged, except, as supplemented herein.

4.3 This Second Supplement may be executed in any number of counterparts, each of which shall be deemed original, but all of which, when taken together, shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

CITY OF COACHELLA/ COACHELLA WATER AUTHORITY

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COACHELLA VALLEY WATER DISTRICT

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DESERT WATER AGENCY

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CITY OF INDIO/INDIO WATER AUTHORITY

Debra L Kaye

MISSION SPRINGS WATER DISTRICT

CITY OF INDIO/INDIO WATER AUTHORITY

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MISSION SPRINGS WATER DISTRICT

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FOURTH SUPPLEMENT TO
MEMORANDUM OF UNDERSTANDING
among
CITY OF COACHELLA/COACHELLA WATER AUTHORITY, COACHELLA VALLEY WATER DISTRICT, DESERT WATER AGENCY, CITY OF INDIO/INDIO WATER AUTHORITY, and MISSION SPRINGS WATER DISTRICT
for
DEVELOPMENT OF AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN

This FOURTH SUPPLEMENT dated February 22, 2013, is entered into among the City Of Coachella/Coachella Water Authority, Coachella Valley Water District, Desert Water Agency, City Of Indio/Indio Water Authority, and Mission Springs Water District (collectively known as Partners) for the purpose of coordinating water resources planning activities undertaken by the water agencies.

WHEREAS, each Partner is a party to a Memorandum of Understanding (MOU) for Development of an Integrated Regional Water Management Plan (IRWMP) dated September 9, 2008; and

WHEREAS, each Partner is a party to a first Supplement to that MOU for the purpose of retaining a consultant to assist in preparing an IRWMP dated April 29, 2010; and

WHEREAS, Each Partner is a party to the second Supplement to that MOU for the purpose of retaining consultants and entering into grant funding contracts with the Department of Water Resources (State) for Proposition 84, Chapter 2 as follows:

A. Agreement Number 4600009468, for Disadvantaged Communities Outreach (DAC Grant), in the amount of $500,000.
B. Agreement Number 4600009342, for updating the existing IRWMP (Planning Grant), in the amount of $1,000,000.

WHEREAS, each Partner is a party to the third Supplement to the MOU for the purpose of entering into grant funding contracts with the Department of Water Resources (State) for Proposition 84, Chapter 2, Agreement Number 4600009560, for an IRWM Implementation Grant (Implementation Grant) in the amount of $4,000,000, and for the purpose of designating the Coachella Valley Water District (CVWD) as administrating agency of the Implementation Grant as directed by the Partners.

WHEREAS, The Partners wish to supplement the MOU for the purpose of retaining a consultant for ***Subtask 9.1: Outreach*** of the Implementation Grant.

NOW, THEREFORE, it is mutually understood and agreed as follows:

SECTION 1:
AGREEMENTS

1.1 The consultant's scope of work, fees and contract terms shall be approved by the Partners.
1.2 CVWD shall retain the consultant selected by the Partners and administer the consultant agreement as directed by the Partners

SECTION 2:
REGIONAL WATER CONSERVATION PROGRAM
INVOICING AND PAYMENT

2.1 The Regional Water Conservation Program equally benefits each of the five Partners, and the procedures agreed to for invoicing and payment established in the Third Supplement to the MOU shall be followed.
2.2 CVWD will establish an escrow account, and upon signing this fourth amendment, each Partner will deposit $10,000 into that account for a total balance of $50,000 to ensure that outstanding invoices can be paid if the state fails to provide reimbursements.
2.3 CVWD will receive invoices from the consultant on a monthly basis and will pay invoices from the escrow account.
2.4 No less than quarterly, CVWD will invoice the State. CVWD will deposit funds received from the State into the escrow account for payment of consultant invoices.
2.5 If the escrow account balance drops to zero, the Partners will postpone grant work until state reimbursements are received.
2.6 CVWD will not be responsible for making payments, which are neither backed by reimbursements from the State, nor by funds in the escrow account.
2.7 Upon completion of *Subtask 9.1: Outreach*, the funds remaining in the escrow account will be distributed equally to the Partners.
2.8 The sole purpose of this escrow account is for paying consultant invoices for *Subtask 9.1: Outreach.* The funds may not be used for any other purpose without consensus of the Partners.

3.2 A withdrawing Partner remains obligated for reimbursement of its share of costs to be paid pursuant to any agreements executed prior to that Partner's withdrawal from participation.

SECTION 4:
MISCELLANEOUS

4.1 Abbreviations, capitalized words and phrases used in this supplement shall have the same meaning as in the MOU.
4.2 All terms of the MOU remain unchanged, except, as supplemented herein.
4.3 This Supplement may be executed in any number of counterparts, each of which shall be deemed original, but all of which, when taken together, shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

CITY OF COACHELLA/ COACHELLA WATER AUTHORITY

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COACHELLA VALLEY WATER DISTRICT

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DESERT WATER AGENCY

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3.2 A withdrawing Partner remains obligated for reimbursement of its share of costs to be paid pursuant to any agreements executed prior to that Partner's withdrawal from participation.

SECTION 4:
MISCELLANEOUS

4.1 Abbreviations, capitalized words and phrases used in this supplement shall have the same meaning as in the MOU.
4.2 All terms of the MOU remain unchanged, except, as supplemented herein.
4.3 This Second Supplement may be executed in any number of counterparts, each of which shall be deemed original, but all of which, when taken together, shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

CITY OF COACHELLA/ COACHELLA WATER AUTHORITY

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COACHELLA VALLEY WATER DISTRICT

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DESERT WATER AGENCY

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SECTION 3:
PARTICIPATION

3.1 Each Partner retains the right to withdraw its participation in the MOU as stipulated by the MOU in Section 5.1

3.2 A withdrawing Partner remains obligated for reimbursement of its share of costs to be paid pursuant to any agreements executed prior to that Partner's withdrawal from participation.

SECTION 4:
MISCELLANEOUS

4.1 Abbreviations, capitalized words and phrases used in this supplement shall have the same meaning as in the MOU.

4.2 All terms of the MOU remain unchanged, except, as supplemented herein.

4.3 This Fourth Supplement may be executed in any number of counterparts, each of which shall be deemed original, but all of which, when taken together, shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Partners have executed this Supplement as of the day and year indicated on the first page of this MOU.

CITY OF COACHELLA/ COACHELLA WATER AUTHORITY

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COACHELLA VALLEY WATER DISTRICT

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DESERT WATER AGENCY

David K. Luker

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CITY OF INDIO/INDIO WATER AUTHORITY

Debra Kaye
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MISSION SPRINGS WATER DISTRICT

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CITY OF INDIO/INDIO WATER AUTHORITY

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MISSION SPRINGS WATER DISTRICT

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MEMORANDUM OF UNDERSTANDING
BETWEEN CITY OF SAN DIEGO
COUNTY OF SAN DIEGO, and SAN DIEGO COUNTY WATER AUTHORITY
for the
INTEGRATED REGIONAL WATER MANAGEMENT PROGRAM
For Fiscal Years 2012-2016

This Memorandum of Understanding (MOU) between the San Diego County Water Authority (Water Authority); the City of San Diego, a municipal agency (City); and the County of San Diego, a political subdivision of the State of California (County), sets forth the respective roles of Water Authority, City and County in regard to the Integrated Regional Water Management (IRWM) Plan and Program. Water Authority, City and County are sometimes referred to in this MOU collectively as the "Parties" and individually as "Party."

This MOU replaces the Memorandum of Understanding (March 25, 2009), as amended, between City, County, and Water Authority for Fiscal Years 2009-2013 for the IRWM Grant Program.

RECITALS:

1. The California Legislature enacted SBX2 1 (Perata, Chapter 1 Statutes of 2008), the Integrated Regional Water Management Planning Act, which repealed and re-enacted Part 2.2 of Division 6 of the Water Code relating to integrated regional water management plans. SBX2 1 provides that a regional water management group may prepare and adopt an integrated regional water management (IRWM) plan.

2. In November 2002, Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act, authorized the Legislature to appropriate funding for competitive grants for IRWM projects.

3. In November 2006, Proposition 84, the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Act, authorized the Legislature to appropriate funding for competitive grants for IRWM projects.

4. The intent of the IRWM Grant Program (Program) established in accordance with Proposition 50 and SBX2 1, is to encourage integrated regional strategies for management of water resources and to provide funding, through competitive grants, for projects that protect communities from drought, protect and improve water quality, promote environmental stewardship, and improve local water security by reducing dependence on imported water.

5. To qualify as a regional water management group (RWMG) and comply with the Program Guidelines (Guidelines) established under Proposition 50 and SBX2 1, at least three agencies must participate in the group; two of the agencies must have statutory authority over

water management that may include water supply, water quality, flood control, or stormwater management.

6. In 2005, the Parties established an RWMG that consists of Water Authority, which has statutory authority over water management; City, which has statutory authority over water management, water quality, wastewater, flood management and stormwater; and County, which has statutory authority over water quality, stormwater and flood control in the unincorporated area.

7. The Parties understand that only through a collaborative effort with the many stakeholders involved in water management planning can the IRWM Plan process be successful in the San Diego region.

8 As part of the public outreach and stakeholder involvement effort, the Parties established the Regional Advisory Committee (RAC), which comprises up to 32 representatives appointed by the Parties from the water management areas of water supply, water quality and natural resources/watersheds management; and representatives of businesses, academia and tribes, as well as other interested members of the public. The purpose of the RAC is to make recommendations to the Parties on key issues related to IRWM planning and grant applications.

9. The Parties, acting with positive recommendations from the RAC, completed the first San Diego IRWM Plan (Plan) in 2007. Subsequently, the Parties have received funding for planning and implementation of projects from the California Department of Water Resources (DWR). Additional funding is available to the San Diego IRWM Program from Proposition 84, approved by California voters in 2006.

10. To qualify for Proposition 84 IRWM funding, a planning region must have an IRWM Plan that complies with the requirements of California Water Code Section 83002(b)(3)(B), or must have committed to bringing its plan into compliance within two years of receiving such funding.

11. A Local Project Sponsor (LPS) is a proponent of an individual project that will be funded as part of an IRWM Program grant from the State or other future funding agencies. An LPS may be Water Authority, County, City, a Water Authority member agency, a municipality, a local agency or a non-profit organization.

12. This MOU consists of five major components: general grant obligations, San Diego IRWM Plan update, IRWM grant administration, the role of the RAC, and funding for IRWM Program management.

Now, therefore, in consideration of the above incorporated recitals and mutual obligations of the Parties herein expressed, the Parties agree as follows:

1. General Grant Obligations

a. The Parties are equal partners in the development and submission of IRWM grant applications. All Parties shall provide timely reviews and approvals before grant applications are submitted.

b. Water Authority shall submit the grant applications to the funding agency on behalf of the Parties.

c. To expedite the grant application process, Water Authority shall provide initial funding for a consultant to develop the applications. The total cost of the consultant and applications shall be shared by the parties consistent with Section 5 of this MOU.

d. The funding commitment by the Parties under Section 5 of this MOU assumes that the Parties will continue to pay or provide in-kind services as allowed for the entire cost of grant applications for the IRWM Program. As part of the IRWM Plan Update described in Section 2 of this MOU, the Parties agree to study the concept of obtaining funding from other sources to fully or partially defray the cost of grant applications.

e. Water Authority shall be responsible for administering funding for projects that are receiving IRWM Program grant funding with respect to submitting invoices and quarterly reports to the funding agency, distributing funding to LPS, and processing contract amendments as applicable.

f. The Parties shall share equally in any and all contractual liability, regardless of nature or type, which arises out of or results from a LPS's performance of services under its agreement with the Water Authority. The Parties shall share equally in any of the default provisions listed in the grant agreements received by the Parties. The Water Authority also agrees to pursue contractual remedies.

g. Each Party shall procure and maintain during the period of this MOU insurance from insurance companies admitted to do business in the State of California or shall self-insure to cover any contractual liability resulting from the conditions referenced in Section 1f.

2. San Diego IRWM Plan Update

a. The Parties are equal partners in the update of the Plan. Water Authority shall contract with a consultant to update the Plan in compliance with the Guidelines and schedule established by DWR, and submit the updated Plan to DWR.

b. The update of the Plan shall be contingent upon receipt of grant funding for this purpose.

3. IRWM Grant Contracts Administration

a. The Water Authority shall administer and manage IRWM grant agreements, administer the LPS contracts, develop and maintain a reporting and invoicing program, and communicate project and agreement progress to the RWMG, RAC, and the funding agency.

b. An LPS that has satisfied all invoicing requirements for a grant shall invoice the Water Authority, which shall in turn invoice the funding agency. The Water Authority shall, within 45 days of receipt of funds from the funding agency, disburse the funds to the LPS.

c. The Water Authority shall appropriate a percentage of the grant money allocated to each LPS project to fund administration of the IRWM grants. The Parties shall agree mutually to the percentage of the grant money that is to be appropriated for this purpose. To the extent that costs exceed the amount in this fund, and that the Parties mutually agree to the additional cost, the Parties shall equally share the additional costs in accordance with Section 5a.

d. Where a labor compliance requirement has been established by the granting agency, Authority shall report to the granting agency the compliance status of LPS, as reported by LPS, with applicable public works laws.

4. Role of Regional Advisory Committee (RAC)

The RAC shall be considered the project advisory committee. The Parties are committed to a cooperative relationship with the RAC and will incorporate the RAC's consensus recommendations in documents prepared for presentations to the Parties' governing bodies. The Parties' governing bodies will give primary consideration to the recommendations of the RAC as part of any decision related to the following:

a. Adoption of updates to the IRWM Plan for the San Diego Region.

b. Criteria for prioritizing projects to be submitted for IRWM grant programs.

c. Reevaluation of all projects submitted for grant funding if a funding agency funds the Program at a level lower than the requested grant amount and does not provide direction on which projects to fund. Parties shall fund the projects based on consultation with the RAC and the criteria for project prioritization (Section 4b).

d. Approval and submittal of grant applications.

e. Transition of responsibility for implementation of the IRWM Plan to a new institutional structure.

5. Funding

a. Funding for FY 2012-2016 shall not exceed $1,470,000. Each Party shall provide an equal share of this funding in an amount not to exceed $490,000. If a Party's contribution was not totally expended in the MOU (March 25, 2009), as amended, that Party shall be credited for the unexpended amount in this MOU.

b. In-kind services provided by the Parties shall be considered in excess of the above funding amounts and are not reimbursable. The Parties' staff shall separately document time spent on in-kind services for IRWM planning, administration and grant applications.

c. The funding commitment described in 5a shall not include expenditures to administer the IRWM Grant Program.

d. Water Authority shall invoice City and County on a quarterly basis along with supporting documentation of expenses. City and County shall remit payment within 60 days of receipt of invoice.

6. Assignment

Parties shall not assign or transfer this MOU or any rights under or interest in this MOU without written consent of all other Parties, which may be withheld for any reason.

7. Defense and Indemnity

Water Authority, City, and County each agree to mutually indemnify, defend at its own expense, including attorneys' fees, and hold each other harmless from and against all claims, costs, penalties, causes of action, demands, losses and liability of any nature whatsoever, including but not limited to liability for bodily injury, sickness, disease or death, property damage (including loss of use) or violation of law, caused by or arising out of or related to any negligent act, error or omission of that party, its officers or employees, or any other agent acting pursuant to its control and performing under this Agreement.

Nothing in the foregoing shall be construed to require any Party to indemnify another for any claim arising from the sole negligence or willful act of the Party to be indemnified.

8. Document Review

Water Authority, City and County each shall make available for inspection to the other Parties, upon reasonable advance notice, all records, books and other documents relating to the Plan and the Program, unless privileged.

9. Term

The term of this MOU shall begin on the date of execution by all Parties and expire on June 30, 2016 expressly contingent upon funding by Water Authority, City and County. The term may be extended by written agreement of all Parties. The Parties shall continue to participate in the planning, development and coordination of the Plan and Grants to the maximum extent possible. The Parties agree to notify one another in the event that their agency's future budget appropriations impact Program funding continuity. If appropriations are different than anticipated, the MOU and Program funding shall be adjusted based on actual funding.

10. Notice

Any notice, payment, credit or instrument required or permitted to be given hereunder will be deemed received upon personal delivery or 24 hours after deposit in any United States mail depository, first class postage prepaid, and addressed to the Party for whom intended as follows:

If to the Water Authority:	San Diego County Water Authority 4677 Overland Avenue San Diego, CA 92123 Attn: Mark Stadler
If to City:	City of San Diego Water Department 600 B Street, Suite 600 San Diego, CA 92101 Attn: Cathy Pieroni
If to County	County of San Diego 5201 Ruffin Road, Suite P San Diego, CA 92123 Attn: Sheri McPherson

Any Party may change such address or contact by notice given to the other Parties as provided herein.

11. Amendments

The MOU may be amended by written agreement of all Parties.

12. Severability

The partial invalidity of one or more parts of this MOU will not affect the intent or validity of this MOU.

13. Governing Law

This MOU shall be deemed a contract under the laws of the State of California and for all purposes shall be interpreted in accordance with such laws. Any action brought shall be in San Diego County, California.

14. Obligations

Nothing in this agreement shall create additional obligations with respect to the Plan or Program.

15. Termination of MOU

This MOU may be terminated by any Party with or without cause 30 days after notice in writing to the other Parties.

16. Signatures

The individuals executing this MOU represent and warrant that they have the legal capacity and authority to do so on behalf of their respective legal entities.

IN WITNESS WHEREOF, the Parties have executed this MOU as of the date below.

San Diego County
Water Authority

By: ______________________
Ken Weinberg
Director of Water Resources

City of San Diego

By: Hildred Pepper Jr
Hildred Pepper Jr.
Purchasing & Contracting
Director

County of San Diego

By: Rich E. Crompton
Richard Crompton, Director
Department of Public Works

By: Bruce Retzger RISKY
Winston F. McColl, Director
Department of Purchasing and Contracting

APPROVED AS TO FORM:

San Diego County
Water Authority

By: [signature]
General Counsel
San Diego County Water Authority

City of San Diego

By: [signature]
Raymond C. Palmucci
Deputy City Attorney

County of San Diego

By: [signature]
James O'Day
County Counsel, Senior Deputy

Date: 9/21/11

MEMORANDUM OF UNDERSTANDING
AMONG CITY OF MODESTO, CITY OF TURLOCK, CITY OF HUGHSON, AND CITY OF CERES
FOR INTEGRATED REGIONAL WATER MANAGEMENT PLANNING

This Memorandum of Understanding (MOU) dated August 23, 2011 is entered among the City of Modesto, City of Turlock, City of Hughson, and City of Ceres (collectively known as the East Stanislaus Regional Water Management Partnership or Partnership) for the purposes of coordinating water resources planning activities undertaken by the cities/water agencies and to establish mutual understandings of cities/water agencies with respect to their joint efforts in developing an Integrated Regional Water Management Plan (IRWMP) that will increase regional coordination, collaboration and communication and help in obtaining funding for water resources-related projects.

WHEREAS, the California Legislature enacted SBX2 1 (Perata, Chapter 1 Statues of 2008), the Integrated Regional Water Management Planning Act, which provides that a regional water management group may prepare and adopt an Integrated Regional Water Management Plan.

WHEREAS, In November 2006, the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Act (Prop 84), authorized Legislature to appropriate funding for competitive grants for projects included in Integrated Regional Water Management Plans.

WHEREAS, the Cities of Ceres, Hughson, Turlock and Modesto adopted and entered into a cost share agreement for the preparation of an Integrated Regional Water Management Plan on June 22, 2010.

WHEREAS, the Partnership has submitted an application for approval of the Integrated Regional Water Management Plan and East Stanislaus Region approval, which includes descriptions of the regional boundary, the Partnership, Committees, and governance structure, among other topics, through the Department of Water Resources (DWR) Region Acceptance Process (RAP).

WHEREAS, the signatories of the MOU anticipate the potential need for future agreements on specific projects or programs and with other affected agencies to further coordinate long-term water resources planning.

WHEREAS, the MOU does not prevent any signatory from pursuing other projects individually and participation in Plan planning is nonbinding, and in no way suggests that an agency's ability to plan and undertake efforts to plan for projects or secure project funding from any source. An agency may withdraw from participation at any time.

Now, therefore, the following is mutually understood and agreed:

1. GOALS

The goals of the Partnership are:

1.1. To develop a comprehensive planning document to facilitate regional cooperation in providing water supply reliability, water recycling, water conservation, water quality improvement, storm water capture and management, flood management, wetlands enhancement and creation, and environmental and habitat protection and improvement.

1.2. To foster coordination, collaboration and communication between Partnership agencies responsible for water-related issues and interested stakeholders, to achieve greater efficiencies, enhance public services, and build public support for vital projects.

1.3. To improve regional competitiveness for State and Federal grant funding.

2. DEFINITIONS

As used in this MOU, the following words and phrases shall have the meanings set forth below unless the context clearly indicates otherwise.

2.1. Integrated Regional Water Management Plan. The Integrated Regional Water Management Plan (IRWMP) envisioned by state legislators and state resource agencies that integrates the projects and management plans of all water-related agencies and stakeholders in a region, in this case the East Stanislaus Region, in order to foster coordination, collaboration and communication among those entities and to assist decision-makers in awarding grants and other funding. The plan will address water supply, water quality, wastewater, stormwater/flood control, watershed planning and habitat protection and restoration.

2.2. Agency. A public entity, be it a special district, city or other governmental entity, responsible for providing one or more services in the areas of water supply, water quality, wastewater, recycled water, water conservation, stormwater/flood control, watershed planning and habitat protection and restoration.

2.3. Service function. A water-related individual service function provided by an agency, i.e. water supply, water quality, wastewater, recycled water, water conservation, stormwater/flood control, watershed planning, and habitat protection and restoration.

2.4. Partnership. The Partnership consists of the member agencies signatory to this MOU.

2.5. Partner: Agencies that have signed this MOU shall individually be referred to as Partner.

2.6. Project. A comprehensive list of resource projects or programs that yield multiple benefits including one or more of the following: water supply reliability, water conservation and water use efficiency; stormwater capture, storage, clean-up, treatment and management; removal of invasive non-native species, the creation and enhancement of wetlands, and the acquisition, protection, and restoration of open space and watershed lands; non-point source pollution reduction, management and monitoring; groundwater recharge and management; contaminant and salt removal through reclamation, desalting, and conveyance of reclaimed water to users; water banking, exchange, reclamation and improvement of water quality; planning and implementation of multipurpose flood management programs; watershed protection and management; drinking water treatment and distribution; ecosystem and fisheries restoration and protection.

2.7. Management plan. An agency's or organization's plan, based in part on the land-use plans within the entity's jurisdiction, that addresses how that entity will provide service in the future in one or more of the following service functions: water supply, water quality, wastewater, recycled water, water conservation, stormwater/flood control, watershed planning or habitat protection and restoration.

2.8. Integration. Assembling into one document the water-related management strategies, projects and plans in the East Stanislaus Region. The first phase would be to identify water management strategies for the region and the priority projects that work together to demonstrate how these strategies work together to provide reliable water supply, protect or improve water quality, provide watershed protection and planning, and provide environmental restoration and protection. Projects and plans would be categorized and opportunities to identify regional benefits of linkages between multiple water management strategies among projects and plans of separate service functions and to see where projects and plans of separate service functions may further interrelate, e.g. wastewater treatment and water recycling or habitat restoration.

3. IRWMP PROJECT PARTICIPANTS

3.1. Public agencies. Public agencies, which have developed projects and management plans, are responsible to their respective electorates, and are devoting staff to the process, will take the lead as the voice in the IRWM planning process as described in "Approach to developing the Plan" below. These public agencies shall be one or more of the Partners of the Partnership.

3.2. Contributing entities. Other entities, such as business and environmental groups, are considered valuable contributors and will continue to be invited and encouraged to participate.

3.3. Regulatory agencies. These agencies, such as the Regional Water Quality Control Board and the Department of Fish and Game, will be invited to participate.

3.4. Stakeholders and disadvantaged communities. The Signatories understand that a collaborative effort with stakeholders and disadvantaged communities, regardless of their ability to contribute financially, is vital to a successful Plan planning process and ultimate preparation of a Plan. The public at large, stakeholders, and disadvantaged communities will be asked to participate in the planning process and will be given opportunities to provide input and comments on the preparation of a Plan.

4. MUTUAL UNDERSTANDINGS

4.1. An IRWM Plan is needed for the following reasons:

> **(a)** To foster increased coordination, collaboration and communication between East Stanislaus Region cities/water agencies and interested stakeholders that may result in more effectively managed resources, cost efficiencies and better service to the public.
>
> **(b)** Some state grants and other funding opportunities require development and implementation of an Integrated Regional Water Management Plan.

4.2. Future cost sharing agreements will be developed among the Partnership members, as needed. Developing an Implementation Grant Funding Application and minor costs of supporting the governance structure are two areas that may require additional funding through this cost sharing agreement.

4.3. The Plan will include, but may not necessarily be limited to, water supply, water quality, wastewater, recycled water, water conservation, stormwater/flood control, watershed planning and habitat protection and restoration. It is acknowledged that the management plans of each individual public agency are based, in part, on the land-use plans within an agency's jurisdiction. Therefore, the resultant Plan will by design have incorporated the land-use plans and assumptions intrinsic to the respective water-related service function.

4.4. The East Stanislaus Region for this MOU is defined as a portion of eastern Stanislaus County that includes the signatories' service areas and is bounded by the Merced River on the South and Stanislaus River on the north. A full description of the regional boundary will be included in the Regional Acceptance Process application which will be submitted to DWR for approval and also as depicted in Exhibit A.

4.5. Approach to developing the Plan:

(a) A reasonable approach towards developing the Plan is to first identify the roles and responsibilities of the representatives and stakeholders involved. The governance structure and public outreach sections of the Regional Acceptance Process application will more thoroughly describe these groups and their roles.

(b) The proposed forum for this regional planning effort is through the creation of the Partnership, Steering Committee, Stakeholder Committee and Stakeholder Subcommittees. Agencies, entities, and the public at large will be invited to participate in the effort. Throughout the Plan planning process, the Partnership will have final decision-making authority.

4.6. Decision-making. Consensus will be sought in the event the need for a decision arises. A governance structure will be developed outlining the decision making process. Any decision being made by the Partnership is done so based on a vote with each member representative in the Partnership receiving one vote and all actions requiring a simple majority vote. The Partners understand unless a vote of its representative is either pre-approved or ratified by the Partner's governing body, namely its city council or board, the effect of the representative's vote does not bind that Partner to the decision. Regional decision-making and management processes may be revised as the Region matures and the IRWM Plan is developed and implemented.

4.7. The Partnership shall consist of one representative and one alternate from each participating Partner in the Partnership. Such representatives shall be a board member, council member, general manager, city manager, or as designated by the member agency's electoral body. In the event that the primary representative is unavailable for a meeting, the alternate shall serve as representative.

4.8. Quorum. Representatives or alternates from a majority of the Partnership members shall constitute a quorum for transacting business, except that less than a quorum may vote to adjourn the meeting or to set a date for the next meeting.

4.9. Approval of the Plan. Plan approval and adoption is anticipated by each Partnership member. Should a Partnership member refuse to adopt the IRWMP, the reasons for refusal should be cited and attempts will be made to reconcile any differences. Should the differences remain irreconcilable, the dissenting member will be asked to withdraw from participation in the Partnership.

4.10. Non-binding nature. This document and participation in this MOU and Plan effort are nonbinding, and in no way suggest that a Partner may not continue its own planning and undertake efforts to secure project funding from any source. A Partner may withdraw from participation at any time.

4.11. Personnel and financial resources. It is expected that the signatories of the MOU will contribute the personnel and financial resources necessary to develop and implement the Plan as determined by subsequent agreements.

4.12. Terms of Office. Each representative and alternate in the Partnership shall serve as long as the Partner's governing body, namely the city council or board of directors, designates that person to serve in that capacity. . If at any time a representative vacancy occurs in the Partnership, a replacement shall be appointed or designated by the Partner within ninety (90) days of the date that such position becomes vacant. The Partner's alternate representative shall fulfill the role of primary representative until a primary representative is designated by the member agency. Alternate representatives to the Partnership shall be empowered to cast votes in the absence of the primary representative or in the event of a conflict of interest that prevents the primary representative from voting subject to this MOU.

4.13. Officers of the Partnership. The Partnership shall elect a Chair and Vice-Chair, and such other officers it deems appropriate. The duties of the Chair and Vice-Chair are as follows:

(a) Chair. The Chair shall direct the preparation of agendas, call meetings of the Partnership to order, and conduct other activities as deemed appropriate by the Partnership.

(b) Vice-Chair. The Vice-Chair shall serve as the Chair in the absence of the Chair. In the event both Chair and Vice-Chair are absent from a meeting, which would otherwise constitute a quorum, and a temporary Chair was not designated by the Chair at the last regular meeting, any Partnership member may call the meeting to order and a temporary chair may be appointed by majority vote to serve until the Chair or Vice-Chair is present.

4.14. Other on-going regional efforts. Development of the Plan is separate from efforts of other organizations to develop water-related plans on a regional basis. As the Plan is developed, work products can be shared with these other organizations.

4.15. Reports and communications. The Steering Committee will regularly report on the progress of the Partnership to the agencies and stakeholders they represent and the associations or organizations to which they belong that are involved in the Plan process.

4.16. Termination. Because the Plan will require periodic review and updating for use into the future, it is envisioned that the joint efforts of those involved will be on-going in maintaining a living document. Thus this document will remain as a reflection of the understandings of the participants when they signed the MOU. As indicated, Partners of the Partnership MOU may terminate their involvement at any time upon thirty (30) days written notice. However, the Partner terminating its involvement in the Partnership shall still be subject to any agreements entered into by the Partner before the effective date of the termination.

4.17. Additional agencies may join the Partnership provided the Partnership receives a written request from the interested agency to join, the Partnership receives a majority vote to approve the new agency's membership and the new agency becomes a signatory to this MOU and any related cost sharing agreements,

4.18. Procedures. The Partnership may adopt bylaws, rules of conduct for meetings, and operating procedures for the Partnership which would be updated from time to time as needed. To facilitate such efforts, the Partnership may adopt the administrative procedures and policies of a Partner.

4.19. Minutes. A secretary or clerk may be appointed by the Partnership to keep and distribute meeting minutes.

5. SIGNATORIES TO THE MEMORANDUM OF UNDERSTANDING

We, the undersigned representatives of our respective agencies, acknowledge the above as our understanding of how the East Stanislaus Integrated Regional Water Management Plan will be developed.

IN WITNESS WHEREOF, the Parties hereto have executed this Memorandum of Understanding as set forth below.

CITY OF MODESTO

Member Agency

By: ______________________

GREG NYHOFF, City Manager

Dated: 8-24-11

ATTEST:

By: ______________________

STEPHANIE LOPEZ, City Clerk
Resolution 2011-359 Aug. 9, 2011

APPROVED AS TO FORM:

By: ______________________

ROLAND R. STEVENS,

Assistant City Attorney

CITY OF TURLOCK

Member Agency

By: Roy W. Wasden

ROY WASDEN, City Manager

Dated: 8/29/11

APPROVED AS TO FORM:

By: ______________________

PHAEDRA NORTON, CITY ATTORNEY

CITY OF CERES

Member Agency

By: Sheila Cumberland for

ART DE WERK, Acting City Manager

Dated: 8-16-11

CITY OF HUGHSON

Member Agency

By: ______________________

BRYAN WHITEMYER, City Manager

Dated: 8-10-11

Exhibit A – East Stanislaus Integrated Regional Water Management Plan Region Map

Appendix Q: IRWM Integration Section

Appendix Q provides the Integrated Regional Water Management Plan Integration section. This section is meant to be included as a stand-alone chapter in the IRWMPs of the MAC and ESJ regions and provides an overview of the MokeWISE outcomes.

Integrated Regional Water Management Plan (IRWM) Integration

for the

MokeWISE Program

1. Introduction

The Mokelumne Watershed Interregional Sustainability Evaluation (MokeWISE) program was developed as a joint effort among the Mokelumne-Amador-Calaveras (MAC) and Eastern San Joaquin (ESJ) Integrated Regional Water Management (IRWM) Regions. As discussed previously, the intent is not to supersede either of the regional plans but to coalesce them into an interregional plan. Portions of this program may be incorporated into the individual regional plans to augment those individual plans. This memorandum summarizes information from the MokeWISE program that could be integrated into the regional plans. Appending this memorandum to the MAC and ESJ IRWM Plans is intended to functionally integrate this program into each respective regional effort. This memorandum addresses the following IRWM sections.

- Stakeholder Involvement – the stakeholder involvement efforts implemented as part of the MokeWISE program and identified in Section 2 are summarized, including the outcomes from the Public and DAC Outreach Implementation effort.
- Coordination – the processes used to coordinate water management of participating local agencies and local stakeholders to avoid conflicts and take advantage of efficiencies, as well as the process of cooperating between adjacent IRWM planning efforts is discussed, along with opportunities for State agency assistance in implementation of the broadly supported projects.
- Governance – the institutional arrangements for implementing MokeWISE, as identified in the implementation section of this document, are described to supplement the Governance sections of the existing plans.
- Region Description – water supply, water quality, and environmental resources information developed through MokeWISE is be summarized to augment the information included in each IRWM Plan.
- Objectives – the Program Objectives developed for the MokeWISE program are summarized to augment the MAC and ESJ Region IRWM Objectives.
- Resource Management Strategies (RMS) – the RMS reflected in the implementation projects are summarized to supplement discussions contained within each existing IRWM Plan.
- Integration – stakeholder integration achieved through MokeWISE is described to supplement integration activities occurring at the regional level through the MAC and ESJ IRWM planning processes.
- Project Review Process – project concept descriptions and scopes of work are provided to allow projects to be prioritized by the MAC and ESJ Region IRWM project review processes.

- Impact and Benefit – impacts and benefits of the implementation projects are provided to supplement the MAC and ESJ IRWM Plan impacts and benefits discussions.
- Plan Performance and Monitoring – a proposed approach for monitoring effectiveness of each project, including performance measures and desired outcomes, is identified to supplement the Plan-level performance and monitoring discussions.
- Data Management – approaches for managing data developed through the MokeWISE program, as well as data generated by implementation and tracking of the implementation projects, is summarized.
- Finance – the approach to funding / financing the implementation projects, as identified in the Implementation Plan, is summarized for inclusion in the respective IRWM Plans.
- Technical Analysis – the technical feasibility analysis of the implementation projects is be summarized.
- Relation to Local Water Planning – the consistency of implementation projects with local water planning is summarized to augment discussions in the MAC and ESJ IRWM Plans.
- Relation to Local Land Use Planning – the consistency of implementation projects with local land use planning is summarized to augment discussions in the MAC and ESJ IRWM Plans.
- Climate Change – potential climate change adaptation and/ or mitigation benefits associated with the MokeWISE program, including estimated greenhouse gas (GHG) emissions impacts, are summarized.

Each topic is discussed in further detail in the following sections.

2. Stakeholder Involvement

The Mokelumne Collaborative Group (MCG) is the stakeholder body that was established to serve as the driving influence in formulating the MokeWISE program. Comprised of organizations with a direct and expressed interest in the Mokelumne River watershed and the MokeWISE program, the MCG provided substantive direction for developing the MokeWISE program. MCG members committed to an intensive work schedule that included monthly group meetings and regular document review for a 22-month period. MCG members included water agencies; non-governmental organizations (NGOs); private entities; resource agencies; and local, state, and federal government agencies. A list of the MCG member agencies can be found in **Appendix A**.

To formalize a public outreach and involvement process, the MCG outlined a Public and Disadvantaged Community Outreach Plan. This Plan describes the strategy that was followed to obtain input from stakeholder interests and the public, referred to as stakeholder tiers. The MCG identified five tiers of stakeholders, each requiring varying levels of public outreach. The five tiers included: Tier 2 stakeholders, interested parties, the general public, disadvantaged communities (DACs), and Native American tribes.

- **Tier 2 stakeholders** included state and federal resource agencies, cities or other organizations that, due to budgetary and/or staffing restrictions, were unable to participate in the MCG. There were 10 Tier 2 stakeholders. While Tier 2 stakeholders had no decision-making authority in the MCG, the MCG solicited feedback received from these stakeholders at various program milestones. There were no comments received from any Tier 2 stakeholders during the MokeWISE process on milestone documents. A Tier 2 stakeholder from the California Department of Fish and Game was part of the Modeling Workgroup and provided insight for the Water Availability Analysis effort (see **Regional Water Supply**).

- **Interested parties** included agencies, organizations and individuals that had registered their interest in the MokeWISE program but were neither members of the MCG nor Tier 2 stakeholders. There were 57 interested party members. During the first public outreach meeting, an interested party member suggested including a slogan for the MokeWISE program. Several slogans were submitted for consideration by students at the Argonaut High School in Jackson, CA. The MCG approved "It's your watershed, your future – your voice matters!" This slogan was included on each subsequent outreach meeting flyer.

- **General public** included residents living in the upper and lower watershed and others with a potential and general interest in the MokeWISE program. At the first outreach meeting, three members of the general public were present; at the second meeting, four members were present; at the third meeting, 12 members were present; and at the fourth meeting, four members were present. Note that these individuals were added to the interested parties list after each meeting. No members of the public attended any of the MCG meetings.

- **Disadvantaged communities** (DACs) were defined consistent with the definition established by the State of California as communities with an annual median household income (MHI) that is less than 80 percent of the statewide MHI. Based on current U.S. Census data, a community with an MHI of $48,706 or less is considered a DAC. DAC participation in the MokeWISE program was achieved at two levels: by MCG members and Tier 2 stakeholders who, in conjunction with their official agency duties, represented DAC communities while developing the various milestone MokeWISE program components; and by conducting some of the planned public workshops in DAC communities. MCG member entities representing DAC communities at MokeWISE meetings included, but were not limited to, Amador County, Calaveras County, City of Lodi, City of Stockton, San Joaquin County, the GBA, and UMRWA.

- **Native American** tribes in the region included the Ione and Jackson Rancheria Native American Bands. Direct outreach was performed to gage the interest of these entities in participating in the program. Given the requirements necessary for MCG participation, the Jackson Rancheria Band opted to participate as Tier 2 stakeholders; no response was received from the Ione Band.

Various outreach methods, including public workshops, press releases, flyers, website postings, and email notifications, were used to inform the stakeholder tiers of the MokeWISE program and progress. Five public workshops were held at strategic points throughout the MokeWISE program. These meetings were held to keep the general public, including DACs, informed of project status and provide a structured opportunity for the public to offer comments, questions, and concerns. All public meetings were held in communities classified as DACs.

Prior to each public outreach meeting, emails were sent to the Tier 2 and Interested Parties lists alerting each stakeholder of the time, date, and location of the public meeting. Press releases were sent to major newspapers within the watershed, as well as posted to the MokeWISE website and given to MCG members for posting. Flyers were also posted to the MokeWISE website and provided to MCG members to send to their constituents. At each of the public meetings, copies of the meeting agenda and PowerPoint slides were provided to attendees. Sign-in sheets were used to collect emails which were then added to the Interested Parties list. Three members of the public attended the first outreach meeting, four new members attended the second meeting, six new members attended the third meeting, no new members attended the fourth meeting, and one new member attended the fifth meeting.

In addition to public meetings, stakeholders were also invited to participate in MCG meetings. Every regularly scheduled MCG meeting was open to the public and included a specified public comment period. This period provided an opportunity for members of the public to speak directly to the MCG and offer comments, questions, suggestions, or other guidance. There were no members of the public that spoke at any of the MCG meetings.

The MokeWISE stakeholder involvement process also provided avenues for stakeholder comment on documents. After documents were approved by the MCG and posted on the MokeWISE website, the public and Tier 2 stakeholders were given the opportunity to respond with comments. Email notifications were sent to both Tier 2 and Interested Parties stakeholders when approved deliverables were posted to the website. Tier 2 stakeholders and Interested Parties were given two weeks to provide comments on milestone MokeWISE documents. There were no comments received from Tier 2 stakeholders or interested party members on milestone documents.

3. Coordination

The institutional arrangements detailed in the Governance section provides the framework for continued coordination between stakeholders in the MAC and ESJ regions. The Implementation Tier, arranged through a memorandum of understanding (MOU) between the Upper Mokelumne River Watershed Authority (UMRWA), the San Joaquin Groundwater Basin Authority (GBA), and other interested entities, is responsible for completing the MokeWISE Implementation Plan projects. A key element of this implementation is coordination with the Stakeholder and Public Involvement Tier. This tier includes interested individuals and / or organizations that would advise the Implementation Tier on implementation efforts, including which projects should apply for various funding opportunities and how to adapt to changing program implementation needs. To support coordination between the Implementation and Stakeholder and Outreach tiers, an annual meeting will be co-hosted by the GBA and UMRWA to discuss project implementation and funding opportunities and strategies. An additional coordination component is coordination with members of the public. Periodic public workshops and discussions will be held to provide status updates and solicit input from the public on the projects being implemented. The institutional structure comprised of the two tiers, provides the framework that allows for and provides opportunities for meaningful input from stakeholders and the public.

4. Governance

To implement projects included in the MokeWISE Implementation Plan, it is necessary to establish an institutional arrangement capable of securing funding, and facilitating and overseeing project implementation. The institutional arrangement must have the following attributes:

1) Legal ability to apply for and accept state and other grant funding
2) Authority and administrative capacity to; enter into contracts, account for receipt and expenditure of funds, and implement water resource projects
3) Commitment to ensure continued opportunities for meaningful input from stakeholders and the public

The MCG determined that the preferred approach would involve two main tiers of responsibility. One tier or group would be responsible for pursuing funding for and facilitating the implementation of projects and programs (implementation tier), and the other tier would be responsible for providing input and serving in an advisory capacity to the implementation tier (stakeholder and public involvement tier).

Implementation Tier

The Implementation Tier would be achieved through an MOU between the GBA and UMRWA. The MOU would specify that the GBA and UMRWA would act as the lead agencies for soliciting, securing, and administering funding for projects being implemented in each of their regions, respectively, and for bi-regional projects (**Table 1**). The MOU would specify that project sponsors would be ultimately responsible for implementing their respective projects. Project sponsors and other governmental and non-governmental stakeholders would also be able to sign on to the MOU but would not be required to do so.

If funding were secured by UMRWA or the GBA for a project, a separate contractual agreement would be developed between UMRWA or GBA and the project sponsor, as appropriate, to clearly articulate the funding agreement terms, conditions, and requirements. It should be noted that being included in the MokeWISE Implementation Plan does not mean that a project cannot be initiated by a project sponsor independently from this process. It simply means that the project is a high priority for the region and that the institutional group, charged with implementing MokeWISE, will lead or assist in pursuing funding for the project, as appropriate and in coordination with the project sponsor. Project sponsors should avoid unilaterally modifying projects if they wish to retain the support gained from MCG participants over the 22-month course of the MokeWISE process.

Table 1: Lead Agency Responsible for MokeWISE Implementation Plan Projects

MOKEWISE IMPLEMENTATION PLAN PROJECT	GBA	UMRWA
1a. Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir		✓
1b. High Country Meadow Restoration Program		✓
1c. Mokelumne River Day Use Area Floodplain Habitat Restoration Project		✓
1d. Fish Screens for Riparian Diversions in the Lower Mokelumne River	✓	
1f. Riparian Restoration Program – Below Camanche River	✓	
1g. Mokelumne Water Quality, Soil Erosion & Sedimentation Inventory/ Monitoring		✓
2a. Municipal Recycled Wastewater Recharge Program	✓	
2b.Woodbridge Winery Wastewater Reuse	✓	
2c. Amador County Reuse		✓
4a. Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*	✓	
4b. Amador and Calaveras Counties Hydrologic Assessment*		✓

4d. NSJWCD Infrastructure Improvements	✓	
5a. Regional Urban Water Conservation Program[1]	✓	✓
5b. Regional Agriculture Conservation Program[1,2]	✓	✓
7a. PG&E Storage Recovery*		✓
7b. Raise Lower Bear Feasibility Study*		✓
7d. Re-operation of Existing Storage*		✓
7f. Blue & Twin Lakes Dams Reliability & Replacement Assessment*		✓
8b. Rehabilitation of Transmission Main		✓
8c. Barney Way Septic System Conversion		✓
8d. Camanche Village Recycled Water Project*		✓

* These projects are studies and do not have implementation components.

Stakeholder and Public Involvement Tier

The Stakeholder and Public Involvement Tier would engage at two levels of completing Implementation Plan projects.

[1] UMRWA will be responsible for those projects implemented in the upper watershed and the GBA will be responsible for those projects implemented in the lower watershed.
[2] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix E**.

At the region level, existing stakeholder committees (the Regional Participants Committee in the MAC Region, and the GBA Coordinating Committee in the Eastern San Joaquin Region) would advise the implementation tier on what projects to pursue funding for, changing needs for program implementation, etc.

At the inter-regional level, a MCG legacy stakeholder group will be co-hosted annually by the GBA and UMRWA. This MCG legacy stakeholder group would presumably include current MCG member organizations and potentially other members not currently involved in the process. The legacy stakeholder group would adopt or adapt the MCG's protocols for decision-making and organization, and would meet at least annually to review Implementation Plan progress. Membership in the stakeholder group would be open to organized entities and individual members of the public. As determined appropriate by the MCG legacy stakeholder group, public workshops would be held to provide status updates and solicit input from the public on the projects being implemented, similar to those being held under the current structure.

Additionally, at the project level, projects will each have unique stakeholder processes overseen by project sponsors, with input and/or coordination with stakeholders and other parties interested in that project.

5. Region Description

Watershed Overview

The Mokelumne River drains about 627 square miles in the central Sierra Nevada. Mean precipitation in the watershed during 1981-2001 was 48 inches, with a range of 23-65 inches depending on geographic location (Null and others, 2010). In the Mediterranean-montane climate, most precipitation occurs October through May and generally falls as snow above about 3,000 to 5,000 feet in elevation, depending on temperature. As with all other Sierran watersheds, the flow regime of the Mokelumne River is highly dependent on annual snowpack.

Although the Mokelumne River and its waters provide for consumptive water use, more water is often desired than is available from surface water alone. Agriculture and other developments have come to depend on groundwater as a reliable supplemental water source. Prior to development, groundwater generally infiltrated into the subsurface and moved from uplands areas to lowland areas further downstream. Below Camanche Dam, the Mokelumne River tends to be a losing stream (i.e., one in which surface water infiltrates into the groundwater system through the channel bed rather than groundwater filtering up into the wetted channel).

The Mokelumne River supports a diverse assemblage of resident and migratory fish species. Resident rainbow trout and other native fish inhabit the upper basin watershed. While impoundments such as Camanche and Pardee reservoirs prevent sediment from traveling downstream, they also provide habitat for a number of native and introduced fish species, including largemouth bass that support recreational fisheries. The Mokelumne River downstream of Camanche Dam supports a diverse assemblage of resident and migratory fish species including fall-run Chinook salmon and steelhead, which - prior to construction of the river's dams - continued where they spawned upstream in the upper watershed. Changes in geomorphic function can lead to loss of habitat or populations of fish or amphibians.

More information about Mokelumne River and watershed conditions can be found in the Baseline Environmental Conditions report, included as **Appendix B**.

Regional Water Supply

Estimated quantities of supplies potentially available from groundwater, agricultural drainage water, recycled water, stormwater, conservation, desalination, Mokelumne River, and other surface water are summarized below.

Groundwater

- While currently used in the upper watershed, groundwater is not considered a viable additional source in Amador and Calaveras counties due to low yield, unreliability, age of groundwater, and limited storage opportunities.
- The Eastern San Joaquin Groundwater Basin is considered critically overdrafted.
- Groundwater is not considered a viable additional supply source, although conjunctive use and recharge opportunities may be available.

Agricultural Drainage Water

- While quantities of agricultural drainage water are unknown, it is assumed that they are currently minimal and decreasing due to investments in agricultural irrigation efficiency practices and technologies. As such, this is not considered a viable source.
- Some local, small-scale applications may be viable for capturing agricultural drainage, but it is not expected to provide a viable regional water supply.
- It is generally accepted that there is usually a user that will take agricultural drainage water downstream for use.

Recycled Water

- The total quantity of potentially available recycled water is estimated to be 222,500 acre-feet per year (AFY); however, that amount is reduced to roughly 169,400 AFY after accounting for challenges and constraints associated with the treatment and distribution of recycled water.
- Potential recycled water available in the future within the upper watershed, lower watershed, and East Bay Municipal Utility District (EBMUD) service area is estimated to be 3,489 AFY, 3,050 AFY, and 162,857 AFY, respectively. However, full use of this supply is not currently deemed realistic due to monetary costs associated with required infrastructure, costs associated with coordinating between various agencies, and the level of demand for recycled water.
- Of the up to 169,400 AFY potentially available, an estimated 126,720 AFY of secondary treated and 42,680 AFY of tertiary treated recycled water is available in the future.

Stormwater

- Total potentially available stormwater within the MokeWISE region is between 14,939 AFY and 15,560 AFY. This amount includes the municipal systems in Lodi and Stockton and the residential areas in both the upper and lower watersheds.
- The municipal system in Lodi could potentially yield 3,550 AFY and the system in Stockton could potentially yield 11,370 AFY, totaling 14,920 from municipal systems.
- Residential areas in the MokeWISE region could potentially yield an estimated 20 AFY, with 3 AFY from the upper watershed and 17 AFY from the lower watershed, assuming rainfall capture occurred from April to October. If rainfall capture occurred all year long, the upper watershed could capture 90 AFY and the lower watershed could capture roughly 550 AFY.

Conservation

- Using water savings assumptions from the California Urban Water Conservation Council (CUWCC) and the applicable agencies, the estimated quantity of water that could potentially be available in the future under expanded implementation of BMPs is between 173,000 and 175,000 AFY. This number is assumed to be low, as the savings for several BMPs were unable to be determined due to data gaps.
- Under a theoretical maximum conservation program where agencies could reduce to 85 gallons per capita per day (gpcd), anticipated future savings in 2040 would be roughly 350,000 AFY.
- Agricultural efficiency could potentially conserve roughly 170,000 AFY by 2030.

Desalination

- Groundwater demineralization requires additional withdrawal from the groundwater basin, which could exacerbate the existing overdraft condition.
- While desalination exchange could potentially yield available water in the future, the Bay Area Regional Desalination Project (BARDP) as currently sized is designed to meet the needs of all current partners. Additional partners would require a modification of the design capacity.
- At this time, neither groundwater demineralization nor desalination exchange are considered viable supplies.

Mokelumne River

- The MCG decided to quantify "unallocated water" within the Mokelumne River in lieu of defining "available water," because the definition of "available" is heavily dependent on one's perspective and value assigned to various existing uses. Unallocated water, as it is used within MokeWISE, was defined as that quantity of water in the Mokelumne River that is not diverted pursuant to a riparian, pre-1914 or appropriative water right and that is not explicitly required to be in the river pursuant to a prescribed regulatory requirement.
- Unallocated water was simulated using the Mokelumne-Calaveras Simulation Model (MOCASIM), which simulates in-river flow conditions over the period of record (1953-2010) under specific diversion assumptions representative of the years 2010 and 2040.
- Unallocated water is highly variable based on year type and River location.
- Generally, there is more unallocated water in wetter years than in drier years.
- MokeWISE stakeholders recognize that there are likely to be disagreements about how much unallocated water is "available" for projects, and agreed to look at various definitions of availability in the context of specific projects.
- Modeling indicates that under both 2010 and 2040 baselines, more water is being released at both Joint Settlement Agreement (JSA) compliance points than is required as part of the JSA.

Other Surface Water

- The total estimated quantity of short-term transfers available is 85,325 AFY, while long-term transfers potentially provide an additional 127,261 AFY. However, more information on availability under various seasonal conditions and year types is needed to refine this estimate.

- Other surface water may include unappropriated flood flows or water that may potentially be available under a new flow regime. These quantities, while variable and difficult to determine, may potentially provide additional available water to the MokeWISE program.

More information about water availability within the Mokelumne Watershed can be found in the Water Availability Analysis, which is included as **Appendix C**.

6. Objectives

The MCG established priorities for the MokeWISE program intended to guide development of the MokeWISE program and provide a structure for gauging its success. These priorities developed into the MokeWISE Program Objectives to be Achieved and Consequences to be Avoided ("Program Objectives"). The Program Objectives served as a guide to determine how well the MokeWISE program addressed the priorities and objectives of the MCG. **Table 2** presents the MCG approved MokeWISE Program Objectives to be Achieved and **Table 3** presents the MCG approved MokeWISE Program Consequences to be Avoided which together constitute the Program Objectives. **Appendix D** includes the Program Outcomes and Measures Memorandum with more information.

Table 2: MokeWISE Program Objectives to be Achieved

CATEGORY	OBJECTIVE	SUMMARY
Water Supply	WS-1: Promote demand-side management strategies	The program should promote projects and policies that support demand-side management strategies including conservation, water use efficiency, peak period rationing and leak detection.
	WS-2: Increase supply reliability	The program should result in increased water supply reliability for water purveyors.
	WS-3: Increase amount of stored water	The program should result in an increase in the amount of water stored within the watershed and consider both ground and surface options.
	WS-4: Promote smart, responsible development	The program should promote projects and policies that ensure that the water needs of new development are met while limiting negative externalities and end use harm.
	WS-5: Reduce reliance on groundwater for irrigation	The program should result in a reduced reliance on groundwater for irrigation and explore surface water alternatives.

	WS-6: Promote a long-term groundwater balance	The program should promote projects and policies that seek to contribute to a positive long-term groundwater balance.
	WS-7: Maximize water resource availability for all beneficial uses	The program should promote projects and policies that allocate water to the full spectrum of beneficial uses based on full analysis of all potential sources of supply.
	WS-8: Decrease the need to import water	The program should seek to implement state legislative goals to improve self-sufficiency and reduce the need to import water
Water Demands	WD-9: Review and understand existing agency demand estimates	The MCG should review and come to a common understanding of water demand estimates described in existing planning documents
	WD-10: To identify water demand issues for timely consideration by the water agencies during their next UWMP update.	The program should identify issues and analyses for water agencies to consider as they prepare demand and population estimates.
Water Quality	WQ-11: Protect and improve surface and groundwater quality	The program should result in improved water quality within the watershed for both surface water and groundwater.
	WQ-12: Match delivered water quality to use	The program should try to avoid wasting high quality water on uses that do not need it.
	WQ-13: Use water purification technology as a tool to maximize beneficial uses	The program should seek to implement the state's legislative goals to use water purification technology as a tool to increase the beneficial uses of water.
Recreation	R-14: Increase access for water-based recreation	The program should result in increased access to the Mokelumne River from Highway 12 to the headwaters.
	R-15: Increase angling and other recreational opportunities	The program should result in increased spawning habitat, designating sections of the river for hatchery and wild species, and designating appropriate environmental flows.
	R-16: Increase angling and other recreational opportunities	The program should result in the stocking of hatchery-raised trout in designated areas on the Upper Mokelumne and designating and managing wild trout sections.
	R-17: Increase angling and other recreational opportunities	The program should result in the reintroduction of salmon in the Upper Mokelumne river.
	R-18: Increase angling and other recreational opportunities	The program should result in increased angling, harvesting, and other recreational opportunities.

Water Rights	WR-19: Resolve existing water rights conflicts in the watershed	The program should seek to resolve existing water rights protests and to achieve a common understanding of the application of relevant water rights law in the watershed.
Flood Management	F-20: Enhance flood protection and management	The program should result in multi-benefit projects which provide flood protection for residents and businesses within the watershed and enhance ecosystem function.
Data	D-21: Use sound, agreed-upon data to evaluate program alternatives	The program should produce an agreed-upon hydrology dataset and Water Availability Analysis
	D-22: Use sound, agreed-upon data to evaluate program alternatives	Program components should be described with sufficient detail to allow for evaluation.
	D-23: Promote the contribution of sound scientific data to current body of knowledge	The program should generate and promote projects with monitoring and reporting requirements to increase water resources data
Other Human Values	O-24: Increase investment in forest management	The program should promote forest management that reduces the economic impact of wildfires and other natural disasters, particularly on water supply.
	O-25: Maximize socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on disadvantaged communities (DACs)	The program should seek to design projects and policies to improve socio-economic, cultural, recreational, public health, and public safety benefits with a particular emphasis on DACs.
	O-26: Achieve equity	The program should be designed to achieve equity across regions, cultures, incomes, and time,
Environment	E-27: Protect and enhance natural environment	The program should result in the protection and enhancement of the natural environment of the Mokelumne watershed.
	E-28: Protect and enhance natural environment	The program should include support for wild and scenic designation of the Mokelumne River down to the Pardee High Pool.
	E-29: Protect and restore fisheries	The program should protect, restore, and enhance fisheries in the Mokelumne River downstream of Woodbridge Dam.
Agricultural Benefits	A-30: Enhance or maintain the water supply for the beneficial use of agricultural practices	The project should increase the current agricultural water supply.

Collaboration	C-31: Foster long-term regional relationships and avoid unnecessary conflict and litigation	The program should foster long-term regional relationships which will promote continued collaboration on water management issues and reduce unnecessary litigation.
	C-32: Promote broadly-supported outcomes that benefit a wide range of interests	The program should promote projects and policies that support outcomes benefiting a wide range of interests within the watershed.
	C-33: Promote broadly-supported outcomes that benefit a wide range of interests	The program should promote the least controversial projects and policies.
	C-34: Promote broadly-supported outcomes that benefit a wide range of interests	The program should result in agreements that reduce conflict.
	C-35: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	The program should facilitate a common understanding of the requirements contained in all existing licenses, permits, and agreements affecting the Mokelumne River and ensure that MCG proposals will not interfere with their implementation.
	C-36: Develop a program consistent with all existing licenses, permits, and agreements affecting the River	The program should adhere to all CEQA/NEPA regulations.

Table 3: MokeWISE Program Consequences to be Avoided

CATEGORY	CONSEQUENCE TO BE AVOIDED	SUMMARY
Data	CA-37: Avoid basing decisions on incomplete or inaccurate information	The program should avoid decision-making based on incomplete or inaccurate information.
Environment	CA-38: Avoid demand for new or larger on-stream dams	The program should avoid demand for new or larger on-stream dams.
	CA-39: Avoid harmful impacts to fisheries and other wildlife	The program should avoid harming fisheries and other aquatic and terrestrial wildlife.

	CA-40: Avoid conversion of agricultural lands to developed uses	The program should avoid urbanization of agricultural lands.
	CA-41: Avoid shifting environmental impacts from one area to another	The program should avoid shifting environmental impacts from one sensitive area to another.
	CA-42: No diminishment of the benefits of existing in-stream flow	The program should protect against any decrease in benefits to public trust resources of existing in-stream flows.
Collaboration	CA-43: Avoid closing the process to the public	The program should avoid closing the process to the public.
Other Human Values	CA-44: Avoid dependency on potentially unreliable supply	The program should support projects and policies that will prevent downstream users from becoming dependent on unreliable supplies
	CA-45: Minimize adverse socio-economic and public health and safety impacts	The program should promote projects and policies that limit or appropriately mitigate adverse socio-economic and public health and safety impacts.
	CA-46: Avoid end use harm	The program should seek to allocate water in ways that do the least end use harm.
	CA-47: Avoid violating procedural or substantive laws.	The program should commit to completing CEQA/NEPA analysis prior to the agencies adopting and implementing the program.
	CA-48: Avoid interregional inequity	The program should provide parity or equity among the regions.

7. Resource Management Strategies (RMS)

The Prop 84 IRWM Guidelines require consideration of the California Water Plan resource management strategies (RMS) in identifying regional projects and water management approaches. The RMS that would be addressed by the projects included in the MokeWISE Implementation Plan include:

- Agricultural Water Use Efficiency
- Conjunctive Management and Groundwater Storage
- Conveyance – Regional/Local
- Economic Incentives
- Ecosystem Restoration
- Flood Risk Management

- Matching Quality to Use
- Pollution Prevention
- Recharge Area Protection
- Recycled Municipal Water
- Sediment Management
- Surface Storage – Regional/Local
- System Reoperation
- Urban Runoff Management
- Urban Water Use Efficiency
- Water Transfers
- Watershed Management

Table 4 indicates which of the RMS each MokeWISE Implementation Plan project would address.

Table 4: Resource Management Strategies Addressed by the MokeWISE Implementation Plan

PROJECT	RMS IMPLEMENTED
1a. Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir	• Ecosystem Restoration • Water-Dependent Recreation
1b. High Country Meadow Restoration Program	• Ecosystem Restoration • Recharge Area Protection • Watershed Management • Flood Risk Management
1c. Mokelumne River Day Use Area Floodplain Habitat Restoration Project	• Ecosystem Restoration • Recharge Area Protection • Watershed Management • Flood Risk Management
1d. Fish Screens for Riparian Diversions in the Lower Mokelumne River	• Ecosystem Restoration • Watershed Management
1f. Riparian Restoration Program – Below Camanche River	• Ecosystem Restoration • Recharge Area Protection • Watershed Management

PROJECT	RMS IMPLEMENTED
	• Flood Risk Management
1g. Mokelumne Water Quality, Soil Erosion & Sedimentation Inventory/Monitoring	• Sediment Management • Watershed Management
2a. Municipal Recycled Wastewater Recharge Program	• Conjunctive Management and Groundwater Storage • Recycled Municipal Water • Matching Quality to Use • Pollution Prevention
2b.Woodbridge Winery Wastewater Reuse	• Conjunctive Management and Groundwater Storage • Recycled Municipal Water • Matching Quality to Use • Pollution Prevention
2c. Amador County Reuse	• Recycled Municipal Water • Matching Quality to Use • Pollution Prevention
4a. Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*	• Water Transfers • Conjunctive Management and Groundwater Storage • Recharge Area Protection
4b. Amador and Calaveras Counties Hydrologic Assessment*	• Water Transfers • Conjunctive Management and Groundwater Storage • Flood Risk Management
4d. NSJWCD Infrastructure Improvements	• Conveyance – Regional/Local • Conjunctive Management and Groundwater Storage • Recharge Area Protection
5a. Regional Urban Water Conservation Program	• Urban Water Use Efficiency • Matching Quality to Use • Pollution Prevention • Urban Runoff Management

PROJECT	RMS IMPLEMENTED
	• Economic Incentives
5b. Regional Agriculture Conservation Program[3]	• Agricultural Water Use Efficiency
7a. PG&E Storage Recovery*	• System Reoperation • Surface Storage – Regional/Local • Flood Risk Management
7b. Raise Lower Bear Feasibility Study*	• System Reoperation • Water Transfers • Conjunctive Management and Groundwater Storage • Surface Storage – Regional/Local • Watershed Management • Flood Risk Management
7d. Re-operation of Existing Storage*	• System Reoperation • Surface Storage – Regional/Local • Flood Risk Management
7f. Blue & Twin Lakes Dams Reliability & Replacement Assessment*	• Surface Storage – Regional/Local • Flood Risk Management
8b. Rehabilitation of Transmission Main	• Urban Water Use Efficiency • Conveyance – Regional/Local
8c. Barney Way Septic System Conversion	• Pollution Prevention • Recharge Area Protection
8d. Camanche Village Recycled Water Project*	• Recycled Municipal Water • Matching Quality to Use • Pollution Prevention

* These projects are studies and do not have implementation components.

[3] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix E**.

8. Integration

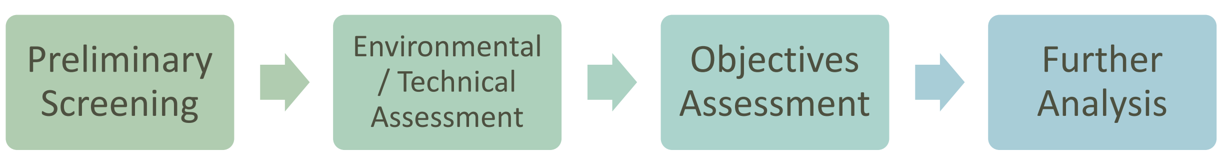
The MokeWISE program allows for maximizing opportunities for integration of water management activities. As shown in Table 3 in the Resources Management Strategies section of this technical memorandum, the MokeWISE Implementation Plan integrates 17 resource management strategies.

In addition, the governance structure, as previously described, fosters integration by allowing a diverse group of stakeholders and interested parties to participate at all levels of the planning process. Cities, water agencies/districts, irrigation districts, wastewater agencies, non-governmental organizations (NGOs), DACs, private corporations, public utility districts, community organizations, watershed stakeholders, and the general public can each play a key role in the planning process, regardless of their ability to contribute to the process financially. With a diverse group of participants in the planning process, different views can be represented and through collaboration, a multi-benefit, implementable program can be prepared.

9. Project Review Process

Each of the projects brainstormed and synthesized by the MCG underwent four assessments (**Figure 1**). The assessment information was ultimately used by the MCG to determine whether or not a specific project concept would be included in the MokeWISE Implementation Plan.

Figure 1: Project Review Process Overview



Preliminary Screening

Project concepts were initially assessed to determine if they were feasible, beneficial, attainable, and compatible. Projects passing all four screens moved forward for further analysis. Those projects that did not were either revised to address the issue and comply with all four screening criteria, or were deemed to have a fatal flaw and were not moved forward.

Environmental / Technical Assessment

Projects passing the preliminary screening were assessed against environmental criteria as well as technical feasibility. This assessment did not result in any projects being removed from the process, but provided the MCG with information about the environmental merits and anticipated technical feasibility of each project. The information provided in this assessment was then incorporated into the third assessment.

Objectives Assessment

The third assessment incorporated the MokeWISE program objectives and consequences to be avoided by assessing the project concepts against the objectives and consequences to be avoided. This assessment was used to determine the degree to which project concepts fulfilled program objectives and avoided negative consequences.

Further Analysis

Following the three assessments, the MCG reviewed each project concept to determine whether it would potentially provide a high value to the region and whether each MCG member could potentially "live with" the project – meaning it may have the potential to be modified to address any apparent issues that might provide a MCG member entity from allowing it to move forward to implementation. At this stage, key study components were added to some projects to get answers to questions affecting support for future project implementation. For each project identified as potentially providing high value to the region and which each MCG member entity could potentially live with, an expanded project description, or preliminary project scope of work / preliminary engineering, was developed. At this stage, stakeholder interests in projects were identified, and key project components, limitations, and disclosures were added to address these stakeholder interests. The scopes of work / preliminary engineering, which will provide information needed for other future review processes, are included in **Appendix E**.

10. Impact and Benefit

Anticipated impacts associated with completing the MokeWISE Implementation Plan include fishery, geomorphic, and cultural impacts. Fishery and geomorphic impacts vary across individual projects, so each project concept was assessed on a scale from 1 to 5, with 1 indicating less potential benefit or greater potential impact and 5 indicating greater potential benefit or less potential impact. This assessment included a narrative explanation of anticipated feasibility, potential geomorphic benefit / impact, and potential fisheries benefit / impact. Anticipated impacts to fisheries include decreases to instream flows which could affect habitat conditions. Anticipated geomorphic impacts include decreased sediment and nutrient mobility due to decreased River flows. **Appendix F** includes the Environmental Assessment of Concepts, which presents the fishery and geomorphic impacts associated with each MokeWISE project concept.

A preliminary cultural assessment performed on three of the projects with well-defined areas indicates that these projects could have cultural impacts. Results of the cultural assessment identify 24 archeological resources within the 8,400 acre search area. The majority of the sites are related to mining activities and associated settlements along the Mokelumne River. Others are food production sites with small habitation areas. CEQA Guidelines require that the significance of potential project impacts to these resources needs to be considered. Public agencies must avoid damaging effects on these cultural resources whenever feasible. If avoidance is not feasible, the significance of the resource shall be evaluated to determine impacts and develop mitigation measures.

Benefits of completing the MokeWISE Implementation Plan would be expected to include:

- Enhanced municipal and industrial water supply
- Enhanced agricultural water supply
- Improved recreation
- Increased hydropower generation
- Increased opportunities for nature tourism
- Reduced energy costs
- Improved flood management
- Local economic benefits
- Environmental enhancement and habitat restoration
- Improved source water quality

Table 5 summarizes the anticipated type and extent of potential project benefits. Additional project information and analysis would be required to determine the extent and magnitude of benefits. Those projects with an asterisk are studies and do not have implementation components. For these projects, the benefits are estimated and assume implementation of study outcomes.

Table 5: Potential MokeWISE Project Benefits

PROJECT	MUNICIPAL AND INDUSTRIAL WATER SUPPLY	AGRICULTURAL WATER SUPPLY	RECREATION	HYDROPOWER	NATURE TOURISM	ENERGY COST	FLOOD MGMT	ECONOMIC BENEFITS	ENVIRONMENTAL ENHANCEMENT AND HABITAT RESTORATION	IMPROVED SOURCE WATER QUALITY
1a Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir			✓		✓			✓	✓	
	The project would provide recreation benefits by increasing angling opportunities in the upper watershed. This could also create additional nature tourism opportunities. Increased tourism could provide economic benefits. The project will contribute to increased fish habitat in the upper watershed.									
1b High Country Meadow Restoration Program	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	The project would provide water supply benefits to municipal and agricultural customers by mitigating flood flows and increasing the portion of flood water able to be stored for later use. Increasing water in the system could provide hydropower benefits, which could lead to reduced energy costs. Reducing flood peaks could provide flood management benefits. Creation of new meadows could increase recreation and nature tourism opportunities. Increased tourism could provide economic benefits. The project would enhance the environment and habitat in the upper watershed by creating/restoring meadows. Water quality could be enhanced by greater natural filtration.									
1c Mokelumne River Day Use Area Floodplain Habitat Restoration Project			✓		✓		✓	✓	✓	✓
	The project would restore floodplain downstream of Camanche Reservoir, thereby mitigating flood flows. Reducing flood peaks could provide flood management benefits. Creation of new meadows could increase recreation and nature tourism opportunities. Increased tourism could provide economic benefits. The project would enhance the environment and habitat in the upper watershed by restoring the floodplain. Water quality could be enhanced by greater natural filtration.									
1d Fish Screens for Riparian Diversions in the Lower Mokelumne	✓	✓	✓		✓			✓	✓	
	The project would increase supply reliability by assuring diverters that their use of the diversion would not be restricted due to potential impacts to fish. Implementing fish screens on currently unscreened lower Mokelumne River diversions would reduce entrapment and entrainment, leading to enhanced fish populations and associated recreation and nature tourism benefits. Increased tourism could provide economic benefits. By reducing entrapment and entrainment issues, the project would provide enhanced fish habitat.									
1f Riparian Restoration Program – Below Camanche	✓	✓	✓		✓		✓	✓	✓	✓
	The project provide groundwater recharge opportunities which would help water supply for municipal, industrial, and agricultural uses. The project would restore riparian habitat downstream of Camanche Reservoir, providing environmental restoration and potential flood management benefits. This could result in enhanced recreational opportunities associated with improved habitat and environmental conditions, and an associated increase in nature tourism. Increased tourism could provide economic benefits. Water quality could be enhanced by greater natural filtration.									
1g Mokelumne Water Quality, Soil Erosion, & Sedimentation Inventory/Monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	The project would improve water quality by addressing erosion and reduce sediment loading to the Mokelumne River. This could provide supply, flood management, and hydropower benefits by reducing reservoir siltation and reducing cost of filtering water for domestic use. Hydropower benefits could in turn lead to reduced energy costs. Improved water quality resulting from reduced sediment loading could result in improved habitat and associated nature tourism, as well as related recreational opportunities. Increased tourism could provide economic benefits.									
2a Municipal Recycled Wastewater Recharge Program	✓	✓						✓		✓
	Using recycled water provides a supply benefit by increasing overall supply availability. Recycled water can help reduce utility rates, which would provide an economic benefit. The project improves water quality by recharging the groundwater basin, which would dilute harmful constituents.									
2b Constellation Winery Wastewater Reuse	✓	✓						✓	✓	✓
	Using recycled water provides a supply benefit by increasing overall supply availability. If recycled water use offsets Mokelumne River supplies, leaving additional supply in the river, the project could provide a recreational benefit associated with improving instream habitat. Increased recreation can provide an economic benefit. If the project reduces withdrawals from the Mokelumne River, there would be an environmental impact associated with greater instream flows. Greater instream flows would provide a water quality benefit.									
	✓	✓		✓		✓		✓		✓

PROJECT	MUNICIPAL AND INDUSTRIAL WATER SUPPLY	AGRICULTURAL WATER SUPPLY	RECREATION	HYDROPOWER	NATURE TOURISM	ENERGY COST	FLOOD MGMT	ECONOMIC BENEFITS	ENVIRONMENTAL ENHANCEMENT AND HABITAT RESTORATION	IMPROVED SOURCE WATER QUALITY
2c Amador County Regional Reuse	Using recycled water in the upper watershed provides a supply benefit by increasing overall supply availability and could provide hydropower benefits if the recycled water supply is used in lieu of Mokelumne River supply. If there is a hydropower benefit, this could result in reduced energy costs. Reduced energy costs can provide an economic benefit. If the project reduces withdrawals from the Mokelumne River, there could be a water quality benefit to the River associated with greater instream flows.									
4a Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*	✓	✓	✓				✓	✓	✓	✓
	Implementing groundwater recharge could provide a supply benefit by increasing overall ability to store available supplies for use when needed. Having improved supply reliability provides a recreation benefit (and associated economic benefit) by potentially leaving additional supply in the Mokelumne River when being conveyed for groundwater storage. Increased groundwater levels can result in enhanced environmental conditions, which generates a recreation and nature tourism benefit. Managing flood flows for recharge could provide a flood management benefit. If the project reduces withdrawals from the Mokelumne River during certain year types, there could be a water quality benefit to the River associated with greater instream flows.									
4b Amador and Calaveras Counties Hydrologic Assessment*	✓	✓	✓					✓	✓	✓
	Completing the hydrologic assessment could enable expanded groundwater use and/or groundwater banking in the upper watershed. Implementing groundwater recharge could provide a supply benefit by increasing overall ability to store available supplies for use when needed. Having improved supply reliability provides a recreation benefit (and associated economic benefit) by potentially leaving additional supply in the Mokelumne River when being conveyed for groundwater storage. Increased groundwater levels can result in enhanced environmental conditions, which generates a recreation and nature tourism benefit. If the project reduces withdrawals from the Mokelumne River during certain year types, there could be a water quality benefit to the River associated with greater instream flows.									
4d NSJWCD Infrastructure Improvements		✓						✓		✓
	The project would enable NSJWCD to use surface water in lieu of groundwater when it is available. This could provide a supply benefit by increasing overall ability offset groundwater pumping, which has associated economic benefits of reduced pumping. Increased groundwater levels can dilute constituents, which can result in increased water quality.									
5a Regional Urban Water Conservation Program	✓			✓	✓	✓		✓	✓	✓
	Conserving water can reduce withdrawals from the Mokelumne River, providing a supply benefit by increasing overall supply availability and a potential hydropower benefit by reducing withdrawals from the Mokelumne River. If there is a hydropower benefit, this could result in reduced energy costs. Reducing River withdrawals could result in improved water quality associated with increased in stream flow and associated environmental and habitat improvement. Improved habitat could provide an increase in nature tourism and associated economic benefit.									
5b Regional Agriculture Conservation Program[4]		✓		✓	✓	✓		✓	✓	✓
	Conserving water can reduce withdrawals from the Mokelumne River, providing a supply benefit by increasing overall supply availability and a potential hydropower benefit by reducing withdrawals from the Mokelumne River. If there is a hydropower benefit, this could result in reduced energy costs. Reducing River withdrawals could result in improved water quality associated with increased in stream flow and associated environmental and habitat improvement. Improved habitat could provide an increase in nature tourism and associated economic benefit.									

[4] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix E.**

PROJECT	MUNICIPAL AND INDUSTRIAL WATER SUPPLY	AGRICULTURAL WATER SUPPLY	RECREATION	HYDROPOWER	NATURE TOURISM	ENERGY COST	FLOOD MGMT	ECONOMIC BENEFITS	ENVIRONMENTAL ENHANCEMENT AND HABITAT RESTORATION	IMPROVED SOURCE WATER QUALITY
7a PG&E Storage Recovery*	✓	✓		✓	✓	✓	✓	✓	✓	
	Increasing existing storage by desilting reservoirs would provide a supply benefit by increasing available storage. Capturing additional supply could provide increased instream flows for fisheries and environmental purposes when needed. Improved environmental conditions could result in increased nature tourism. Ability to capture and manage flood flows would be enhanced with greater storage capability. In addition, hydropower operations could be enhanced, resulting in a potential decrease in energy costs, which could yield economic benefits.									
7b Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Increasing existing storage by raising Lower Bear Reservoir could provide a supply benefit by increasing available storage. Capturing additional supply could provide a recreational benefit by providing increased instream flows for fisheries and environmental purposes when needed. Improved environmental conditions could result in increased nature tourism. Increased instream flows could provide enhanced recreational opportunities and associated economic benefits. Ability to capture and manage flood flows would be enhanced with greater storage capability. In addition, hydropower operations could be enhanced, resulting in a potential decrease in energy costs.									
7d Re-operation of Existing Storage*	✓	✓		✓	✓	✓	✓	✓	✓	
	Optimizing existing storage through reoperation of existing reservoirs could provide a supply benefit by increasing/optimizing available storage capacity. Capturing additional supply could provide a recreational benefit by providing increased instream flows for fisheries and environmental purposes when needed. Improved environmental conditions could result in increased nature tourism. Increased instream flows could provide enhanced recreational opportunities and associated economic benefits. Ability to capture and manage flood flows would be enhanced with greater storage capability. In addition, hydropower operations could be enhanced, resulting in a potential decrease in energy costs.									
7f Blue and Twin Lakes Dams Reliability and Replacement Assessment*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	This project would reduce the possible earthquake risk associated with one or more of these dams and allow carryover storage, increasing supply reliability and available storage for the entire Mokelumne River system. This could provide a supply benefit by increasing available storage capacity. Capturing additional supply could increase instream flows for fisheries and environmental purposes when needed. Improved environmental conditions could result in increased nature tourism, recreation, and associated economic benefits. Ability to capture and manage flood flows would be enhanced with greater storage capability. In addition, hydropower operations could be enhanced, resulting in a potential decrease in energy costs.									
8b Rehab of Transmission Main	✓	✓		✓	✓	✓		✓	✓	✓
	Rehab of this transmission main would provide a water conservation benefit. Conserving water can reduce withdrawals from the Mokelumne River, providing a supply benefit by increasing overall supply availability and a potential hydropower benefit by reducing withdrawals from the Mokelumne River. If there is a hydropower benefit, this could result in reduced energy costs. Reducing River withdrawals could result in improved water quality associated with increased in stream flow and associated environmental and habitat improvement. Improved habitat could provide greater recreational opportunities and an increase in nature tourism and associated economic benefit.									
8c Barney Way Septic System Conversion					✓			✓	✓	✓
	Reducing pollution to the Mokelumne River associated with failing onsite septic systems could provide a water quality benefit, which could in turn provide environmental and habitat improvements. These improvements could generate increased recreational and nature tourism opportunities and an associated economic benefit.									
8d Lake Camanche Village Recycled Water Project*	✓	✓		✓	✓	✓		✓	✓	✓
	Using recycled water in the upper watershed provides a supply benefit by increasing overall supply availability and could provide hydropower benefits if the recycled water supply is used in lieu of Mokelumne River supply. If there is a hydropower benefit, this could result in reduced energy costs. If the recycled water offsets Mokelumne River supplies, leaving additional supply in the river, the project could increase recreation and provide an economic benefit. If the project reduces withdrawals from the Mokelumne River, there could be a water quality benefit to the River associated with greater instream flows.									

* These projects are studies and do not have implementation components.

11. Plan Performance and Monitoring

The intent of the Plan Performance and Monitoring section is to confirm that the MokeWISE Implementation Plan projects are making progress toward meeting the MokeWISE program objectives, is implementing projects as identified in the program, and is ensuring that each implementation project is monitored to comply with all applicable rules, laws, and permit requirements.

Tracking and Reporting Program Performance

A Performance Review will be conducted, at a minimum, every three years (or as deemed appropriate by the implementation governance structure) to evaluate progress made toward achieving program objectives. The Performance Review will be administered by the Implementation Tier and vetted thorough the existing regional stakeholder committees or through the legacy MCG stakeholder group, or both.

Two tables will be generated with each Performance Review: one that addresses the extent to which the objectives have been met, and one that describes progress made in implementing the Implementation Plan projects. The first table, which will be entitled 'Progress Toward Achieving Objectives', will report the performance measure data collected for the projects being implemented.

The second table, which will be entitled "Status of Project Implementation" will list all of the Implementation Plan projects, their implementation status, and funding source. Projects that have been fully implemented will be highlighted separately.

Templates of these tables are provided below (**Table 6** and **Table 7**).

Table 6: Example Reporting Template: Progress toward Achieving Objectives

OBJECTIVE	PERFORMANCE MEASURES	MONITORING/REPORTING RESULT
Objective 1	Performance Measure 1	Reporting Result

Table 7: Example Reporting Template: Status of Project Implementation

	SPONSOR	PROJECT	STATUS OF PROJECT IMPLEMENTATION
1	Sponsor Name	Project Name	Project Status

Project-Specific Data Collection and Monitoring Plans

Sponsors of projects implemented as part of the MokeWISE Implementation Plan will be required to develop project-specific monitoring plans prior to or in conjunction with project implementation. Project sponsors will be responsible for collecting the data consistent with MokeWISE requirements for compatibility with statewide databases (refer to data management section below), performing the monitoring activities, validating the data for compatibility with statewide databases, and reporting to UMRWA, the GBA, and appropriate state databases. For projects that receive implementation grant funding from the California Department of Water Resources (DWR), UMRWA or the GBA will act as the overseeing entity (consistent with the governance approach described previously), ensuring that each project sponsor prepares its project-specific monitoring plan(s) and implements the plan(s) accordingly. Monitoring plans will include schedules with an estimated timeline of monitoring activities, which will be used as a guideline for overall program implementation. Data collected and analyses performed as part of the performance monitoring plans will be reported to UMRWA or the GBA and appropriate statewide databases on a quarterly basis, along with required documentation and an evaluation of project performance. This will help ensure that implemented projects fulfill the program objectives as originally intended.

Project-specific monitoring plan requirements will vary based on the type of project being implemented. All projects must adhere to appropriate State guidelines for monitoring, depending upon the type of data being collected, in order to be implemented through the IRWM Plan. These include:

- Projects that involve surface water quality must meet the criteria for and be compatible with the Surface Water Ambient Monitoring Program (SWAMP, http://www.waterboards.ca.gov/water_issues/programs/swamp/tools.shtml).
- All projects that involve groundwater quality must meet the criteria for and be compatible with the Groundwater Ambient Monitoring and Assessment Program (GAMA, http://www.waterboards.ca.gov/gama/).

- All projects that involve wetland restoration must meet the criteria for and be compatible with the State Wetland and Riparian Area Monitoring Plan (WRAMP, http://www.waterboards.ca.gov/mywaterquality/monitoring_council/wetland_workgroup/docs/2010/tenetsprogram.pdf)

All project-specific monitoring plans must include the following:

1. A table describing what is being monitored for the project (e.g. water quality, water depth, flood frequency), and effects the project may have on habitat or particular species (before and after construction).
2. Measures to remedy or react to problems encountered during monitoring.
3. Location of monitoring.
4. Monitoring frequency.
5. Monitoring protocols/methodologies and quality assurance and quality control (QA/QC) procedures, including who will perform the monitoring.
6. A description of how those monitoring protocols / methodologies and QA / QC procedures are consistent with requirements for applicable statewide databases including SWAMP, GAMA, and WRAMP)
7. An identified data management system (DMS) that will be used or procedures to keep track of what is monitored.
8. Procedures and a schedule for incorporating collected data into statewide database(s).
9. Procedures and a schedule for reporting to UMRWA confirmation of data submittal to appropriate statewide database(s).
10. Procedures to ensure the monitoring schedule is maintained and that adequate funding is available to maintain monitoring of the project throughout the scheduled monitoring timeframe

The project sponsor will be responsible for completed data collection in accordance with the approved project-specific monitoring plan, which will clearly identify monitoring and analytical techniques and QA/QC procedures to be implemented, and will describe how those techniques are compatible with the requirements of appropriate statewide database(s). The individual project sponsor will be responsible for reviewing the data collection and QA/QC protocols to validate that data was collected in accordance with

QA/QC procedures required as part of the project monitoring program. In addition, project sponsors will be responsible for "spot-checking" all data for accuracy at the time of entry to the database to identify any apparent errors. Once data collection and QA/QC has been complete in accordance with provisions of the approved project-specific monitoring plan, the project sponsor will submit the compatible data to the appropriate statewide database, as well as to UMRWA or the GBA for inclusion in the respective IRWM Regions' DMS. The project sponsor will also provide UMRWA or the GBA with confirmation that the data has been submitted to the appropriate statewide database.

UMRWA and the GBA will each maintain the centralized DMS as discussed in their respective IRWM Plans. The data will be maintained by UMRWA and the GBA and copies of all data will be available to stakeholders and members of the public on request. Data management is discussed in greater detail in the following section.

Using the Information Collected

The Performance Review process will include an adaptive management component which will allow UMRWA, the GBA, and the legacy MCG to respond to lessons learned from analyzing collected performance measure and project monitoring data. With this information, UMRWA, the GBA, and the legacy MCG may consider modifying program implementation.

Local agencies implementing projects as part of the MokeWISE Implementation Plan will monitor for the parameters identified in order to identify when their projects may not be fulfilling their objectives. This information will be fed back into the project's decision-making structure to adapt the project to better meet its overall objectives. Only by consistent monitoring and analysis can projects successfully achieve their objectives. Monitoring will also provide a clear reporting mechanism for the public, decision-makers, and regional planners to determine the planned versus actual value of the project. The results of project-specific monitoring efforts will be utilized to identify areas where implementation may need to be modified to best achieve objectives moving forward.

For those Implementation Plan projects that may be implemented independently from the MokeWISE program, project sponsors will be encouraged to prepare and administer project-specific monitoring plans that are generally consistent with the monitoring plans described above. During the Performance Review, UMRWA and the GBA will assess the extent to which the program objectives have been met, based on the projects and programs completed throughout the Regions. In this way, progress made toward achieving MokeWISE program objectives by projects implemented outside of the MokeWISE program will be assimilated into the Plan Performance Review, though specific monitoring data may not be made available by project sponsors to the centralized DMS.

12. Data Management

The Data Management section is intended to ensure the efficient use of available data, describe stakeholder access to data, and ensure the data generated by implementation activities can be integrated into existing State databases.

Data Collection Techniques

Data associated with the design and implementation of Implementation Plan projects will depend upon project type, but may include streamflow, surface water deliveries, groundwater elevations, groundwater pumping, precipitation, water demand, locations and sizes of water-related facilities, political and agency boundaries, land use, contaminant plume location and extent, water quality data, locations of sensitive habitats and species, and hydrogeologic and hydrologic data. These data will be collected from various federal, state, and local sources. Data may also be developed by project sponsors using numerical models such as HEC, H2ONet, and various hydraulic and hydrologic models.

Data collected in conjunction with completing the Implementation Plan will vary based on the type and scope of each individual project. These data will include, at a minimum, data relevant to surface water, groundwater, water quality, stormwater, and ecosystem restoration. **Table 8** indicates the types of data to be collected for the various project types.

Table 8: Data to be Collected through MokeWISE Project Implementation

	PROJECT TYPE					
DATA TYPE	**Water Supply**	**Recycled Water**	**Water Quality**	**Stormwater and Flood Management**	**Ecosystem Restoration**	**Groundwater Management**
Stream & River Flows	X		X		X	
Stream & River Water Quality	X	X	X	X	X	
Locations of Sensitive Habitats & Species			X		X	
Surface Water Deliveries	X		X			X
Groundwater Pumping	X		X			X
Hydrogeologic						X
Precipitation	X		X	X		X
Water Demand	X	X				X
Water Related Facilities	X	X	X	X		X
Political and Agency Boundaries	X	X	X	X	X	X
Land Use	X	X	X	X	X	X
Contaminant Plume Locations and Extents	X		X			X

As described in the Plan Performance and Monitoring section, project sponsors implementing projects through the MokeWISE Implementation Plan will be required to prepare project-specific monitoring plans that adhere to the data collection techniques and procedures established by the following statewide programs. This will ensure compatibility of data among projects, as well as compatibility with relevant statewide databases.

SWAMP: Typical data collection techniques for surface waters include both field measurements and laboratory analysis. Field measurements are either collected using meters or field kits for a common list of constituents including but not limited to: water temperature, pH, conductivity, dissolved oxygen and turbidity. For an example of a field data sheet and complete list of SWAMP-required fields go to: http://swamp.mpsl.mlml.calstate.edu/wp-content/uploads/2009/04/swamp_sop_field_measures_water_sediment_collection_v1_0.pdf.

There is a large list of possible constituents that are measured in surface waters that require laboratory analysis. Typical laboratory analysis includes fecal indicator bacteria, metals, nutrients, persistent organic pollutants, and turbidity. SWAMP provides guidance on methods and quality assurance. This guidance can be found at:

http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/qaprp082209.pdf.

Biological monitoring is helpful for determining the health of a system and whether it is able to sustain a diverse community of benthic macro invertebrates. Standard operating procedures for determining a stream's physical/habitat condition and benthic invertebrate assemblages can be found at:

http://swamp.mpsl.mlml.calstate.edu/wp-content/uploads/2009/04/swamp_sop_bioassessment_collection_020107.pdf.

Projects collecting surface water data will be required to adhere to the SWAMP data collection protocols.

GAMA: The GAMA Priority Basin Project is grouped into 35 groundwater basin groups called "study units." Each study unit is sampled for common contaminants regulated by the California Department of Public Health (CDPH), and also for unregulated chemicals. Testing for these chemicals—usually at detection levels well below those achieved by most laboratories—will help public and private groundwater users to manage this resource. Results from the Northern San Joaquin study unit, which includes the western-most portion of the MAC Region (Amador and Calaveras Counties), can be found at http://pubs.usgs.gov/fs/2011/3089/. Some of the chemical constituents that are sampled by the GAMA Priority Basin Project include:

- Low-level volatile organic compounds (VOCs)
- Low-level pesticides
- Stable isotopes of oxygen, hydrogen, and carbon

- Emerging contaminants (pharmaceuticals, perchlorate, chromium VI, and other chemicals)
- Trace metals (arsenic, selenium, lead, and other metals)
- Radon, radium, and gross alpha/beta radioactivity
- General ions (calcium, magnesium, fluoride)
- Nutrients, including nitrate, and phosphates
- Bacteria: total and fecal coliform bacteria

Projects collecting groundwater data will be required to adhere to GAMA data collection protocols.

WRAMP: The WRAMP is intended to track trends in wetland extent and condition to determine the performance of wetland, stream, and riparian protection programs in California. The program defines standardized assessment methods and data management with the goal of minimizing new costs and maximizing public access to assessment information. Additional information on the WRAMP program can be found at the following location http://www.waterboards.ca.gov/mywaterquality/monitoring_council/wetland_workgroup/docs/2010/tenetsprogram.pdf

All projects that involve wetland restoration must meet the criteria for and be compatible with the State Wetland and Riparian Area Monitoring Plan.

As described previously, individual project sponsors will be responsible for collecting data in accordance with the approved project-specific monitoring plan, which will clearly identify monitoring and analytical techniques and QA/QC procedures to be implemented, and will describe how those techniques are compatible with the requirements of appropriate statewide database(s). The individual project sponsor will be responsible for reviewing the data collection and QA/QC protocols to validate that data was collected in accordance with QA/QC procedures required as part of the project monitoring program. In addition, project sponsors will be responsible for "spot-checking" all data for accuracy at the time of entry to the database to identify any apparent errors. Once data collection and QA/QC has been complete in accordance with provisions of the approved project-specific monitoring plan, the project sponsor will submit the compatible data to the appropriate statewide database, as well as to UMRWA and the GBA for inclusion in the respective Regions' centralized data management systems (DMS). The project sponsor will also provide UMRWA and the GBA with confirmation that the data has been submitted to the appropriate statewide database.

Data dissemination will be accomplished through the existing MAC and ESJ IRWM processes.

13. Finance

Conceptual-level estimates of capital and operations and maintenance costs were developed for the projects included in the MokeWISE Implementation Plan. These costs, together, are expected to total more than $100,000,000. In many cases, these costs reflect only the cost to complete the planning or feasibility study; as such, the actual cost to implement all of the identified projects and therefore realize all of the potential program benefits would be significantly greater than this estimate. As a result, it is expected that a high degree of outside funding will be necessary to implement the projects included in the MokeWISE Implementation Plan.

At the State level, the November 2014 passage of Proposition 1 will result in an influx in State funding to support much-needed water projects statewide. Proposition 1 authorizes $7.54B for implementation of water projects, including $7.12B in new funds, combined with $420M repurposed from existing bonds (84, 50, 13, 204, 44, and 1E). The $7.54 B in funding is allocated to the following general project categories:

- Storage: $2,700 M
- Statewide Flood Management: $395 M
- Watershed Protection / Ecosystems: $1,495 M
- Groundwater Sustainability: $900 M
- Water Recycling: $725 M
- Safe Drinking Water: $520 M
- Regional Water Reliability: $810 M

These categories cover the full range of projects types represented in the MokeWISE Implementation Plan, and the funds could potentially offset a significant portion of the cost to implement the recommended projects.

Based on the Proposition 1 funding schedule and identification of potentially-eligible MokeWISE project types, it is recommended that the GBA and UMRWA, review and track development of each proposal solicitation process. Upon Prop 1 program guidelines being published, UMRWA and the GBA should consult with project sponsors to determine which, if any, projects may be eligible, to what extent the projects may be competitive, whether local march funds are available, and what funding is available to pay the costs for completing the identified grant applications. Based on this assessment, UMRWA and the

GBA should determine whether to pursue funding from each solicitation for upper and / or lower watershed MokeWISE projects, respectively.

Table 9 summarizes the anticipated capital and operations and maintenance costs for each MokeWISE Implementation Plan project and identifies whether existing revenue sources may be available to offset a portion of the project cost. In addition, this table identifies which Proposition 1 program or programs should be evaluated for their ability to provide additional potential funding for each project.

Table 9: Estimated MokeWISE Implementation Plan Project Costs and Potential Funding Sources

				Potential Proposition 1 Funding Opportunities															
Project	General Project Type	Estimated Project Cost	Potential for Water / Wastewater Rate Funding?	SWRCB - Small Community Wastewater	SWRCB - Clean, Safe and Reliable Drinking Water	San Joaquin River Conservancy – SJR Conservancy Multi-Benefit Watershed Protection and Restoration	Sierra Nevada Conservancy - Sierra Nevada Watershed Improvement Program	Sacramento-San Joaquin Delta Conservancy - Proposition 1 Grant Program	Wildlife Conservation Board - Stream Flow Enhancement Program	Natural Resources Agency - Watershed and Urban River Enhancements Program	Dept. of Fish and Wildlife - Watershed Restoration and Delta Water Quality and Ecosystem Restoration Grant Programs	Dept of Water Resources - Integrated Regional Water Management	Dept of Water Resources - Water Use and Efficiency Grants, Round 1 - Urban and Ag	SWRCB - Stormwater	Water Commission - Water Storage Investment Program	SWRCB - Water Recycling	SWRCB - Groundwater Sustainability	DWR - Groundwater Plans and Project Grant Program - Phase 1	DWR and Central Valley Flood Protection Board - Flood Management
1a Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir	Ecosystem / Habitat Protection	$180,000 (includes $80,000 for planning and $100,000 for implementation)	N			✓	✓	✓	✓	✓	✓	✓							
1b High Country Meadow Restoration Program	Ecosystem / Habitat Protection	$40,000 for assessment plus $10,000 per acre restored	N			✓	✓	✓	✓	✓	✓	✓							
1c Mokelumne River Day Use Area Floodplain Habitat Restoration Project	Ecosystem / Habitat Protection	$150,000 (including $111,000 for implementation and 30% contingency)	Y			✓	✓	✓	✓	✓	✓	✓							
1d Fish Screens for Riparian Diversions in the Lower Mokelumne	Ecosystem / Habitat Protection	$300,000 for the preliminary assessment and prioritization plus $10,000 per cfs of diversions screened	N			✓	✓	✓	✓	✓	✓	✓							
1f Riparian Restoration Program – Below Camanche	Ecosystem / Habitat Protection	$10,000 for ranking and evaluation of proposed restoration sites plus $8,000 per acre restored	N			✓	✓	✓	✓	✓	✓	✓							✓
1g Mokelumne Water Quality, Soil Erosion, & Sedimentation Inventory/Monitoring	Ecosystem / Habitat Protection	$1,080,000 for planning, inventory, mapping, assessment of erosion-sedimentation reduction options, prioritization, stakeholder coordination, publishing the results, and outreach	N			✓	✓	✓	✓	✓	✓	✓							✓
2a Municipal Recycled Wastewater Recharge Program	Recycled Water	$150,000 for the feasibility study and $15 million for implementation	Y		✓							✓				✓			
2b Constellation Winery Wastewater Reuse	Recycled Water	$35,000 for the conceptual design report, $100,000 for securing the Waste Discharge Report permit, $25,000 for securing funding, and $16 million for construction	Y	✓	✓							✓				✓			

Project	General Project Type	Estimated Project Cost	Potential for Water / Wastewater Rate Funding?	Potential Proposition 1 Funding Opportunities															
				SWRCB - Small Community Wastewater	SWRCB - Clean, Safe and Reliable Drinking Water	San Joaquin River Conservancy – SJR Conservancy Multi-Benefit Watershed Protection and Restoration	Sierra Nevada Conservancy - Sierra Nevada Watershed Improvement Program	Sacramento-San Joaquin Delta Conservancy - Proposition 1 Grant Program	Wildlife Conservation Board - Stream Flow Enhancement Program	Natural Resources Agency - Watershed and Urban River Enhancements Program	Dept. of Fish and Wildlife - Watershed Restoration and Delta Water Quality and Ecosystem Restoration Grant Programs	Dept of Water Resources - Integrated Regional Water Management	Dept of Water Resources - Water Use and Efficiency Grants, Round 1 - Urban and Ag	SWRCB - Stormwater	Water Commission - Water Storage Investment Program	SWRCB - Water Recycling	SWRCB - Groundwater Sustainability	DWR - Groundwater Plans and Project Grant Program - Phase 1	DWR and Central Valley Flood Protection Board - Flood Management
2c Amador County Regional Reuse	Recycled Water	$400,000 for the refinement study and $21.35 million for implementation	Y	✓	✓							✓				✓			
4a Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*	Groundwater	$3,605,000 for study	Y		✓							✓		✓	✓		✓	✓	✓
4b Amador and Calaveras Counties Hydrologic Assessment*	Groundwater	$600,000 for study	Y		✓							✓			✓		✓	✓	
4d NSJWCD Infrastructure Improvements	Groundwater	$20,000,000 for implementation	Y		✓							✓					✓	✓	✓
5a Regional Urban Water Conservation Program	Water Conservation	$80,000 (includes $60,000 for planning and $20,000 to prepare materials for a funding application)	Y		✓							✓	✓						
5b Regional Agriculture Conservation Program[5]	Water Conservation	$100,000 (includes $80,000 for planning and $20,000 to prepare materials for a funding application)	Y		✓							✓	✓						
7a PG&E Storage Recovery*	Storage	$350,000 for study preparation	Y		✓							✓			✓				
7b Raise Lower Bear Reservoir Feasibility Update and Preliminary Engineering*	Storage	$750,000 for study preparation	Y		✓							✓			✓				
7d Re-operation of Existing Storage*	Storage	$750,000 for study preparation	Y		✓							✓			✓				

[5] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix E**.

Project	General Project Type	Estimated Project Cost	Potential for Water / Wastewater Rate Funding?	Potential Proposition 1 Funding Opportunities															
				SWRCB - Small Community Wastewater	SWRCB - Clean, Safe and Reliable Drinking Water	San Joaquin River Conservancy – SJR Conservancy Multi-Benefit Watershed Protection and Restoration	Sierra Nevada Conservancy - Sierra Nevada Watershed Improvement Program	Sacramento-San Joaquin Delta Conservancy - Proposition 1 Grant Program	Wildlife Conservation Board - Stream Flow Enhancement Program	Natural Resources Agency - Watershed and Urban River Enhancements Program	Dept. of Fish and Wildlife - Watershed Restoration and Delta Water Quality and Ecosystem Restoration Grant Programs	Dept of Water Resources - Integrated Regional Water Management	Dept of Water Resources - Water Use and Efficiency Grants, Round 1 - Urban and Ag	SWRCB - Stormwater	Water Commission - Water Storage Investment Program	SWRCB - Water Recycling	SWRCB - Groundwater Sustainability	DWR - Groundwater Plans and Project Grant Program - Phase 1	DWR and Central Valley Flood Protection Board - Flood Management
7f Blue and Twin Lakes Dams Reliability and Replacement Assessment*	Storage	$2,500,000 for study preparation	Y		✓							✓			✓				
8b Rehab of Transmission Main	Water Conservation	$1.03 million (includes $30,000 for the study and $1 million for implementation)	Y									✓	✓						
8c Barney Way Septic System Conversion	Ecosystem / Habitat Protection	$4.3 million (includes planning, engineering, construction, and a 10% contingency)	N	✓	✓	✓	✓	✓	✓	✓	✓	✓							
8d Lake Camanche Village Recycled Water Project*	Recycled Water	$150,000 for study completion	Y	✓	✓							✓				✓			

* These projects are studies and do not have implementation components.

14. Technical Analysis

Proposed implementation projects were assessed for their technical feasibility at two points in the MokeWISE program. The preliminary screening step identified in the Project Review Process Table 1 included a "feasible" screen. This screen included using engineering judgment to determine whether a project was likely to be found technically feasible.

In addition, projects that moved beyond the initial screen underwent a second screen to assess anticipated environmental benefits / impacts and technical feasibility. The results of this assessment are provided in **Appendix F**.

Finally, projects included in the implementation plan underwent "preliminary engineering." Because the projects were primarily conceptual in nature, this preliminary engineering consisted primarily of expanded and enhanced project descriptions and scopes of work. These scopes often included completing more detailed technical analyses to identify the parameters within which the projects will meet the MokeWISE objectives of being economically, socially, and environmentally acceptable. Examples of reference projects that demonstrate technical feasibility were provided and referenced in these expanded project write-ups. The scopes of work / preliminary engineering can be found in **Appendix E**.

15. Relation to Local Water Planning

The projects identified for implementation in the MokeWISE Implementation Plan are consistent with and based upon local water planning documents. The Implementation Plan projects were developed and analyzed using information contained in published local water planning documents such as urban water management plans, as well as the MAC and ESJ Region IRWM Plans, which are also based upon local planning documents. The MokeWISE program coalesces and builds upon local and regional water planning information at an interregional level; it does not supersede local or regional water planning documentation.

Referenced local water planning documents that serve as the basis for the data, analyses, and projects in the MokeWISE program can be found in **Appendix G**.

16. Relation to Local Land Use Planning

The projects identified for implementation in the MokeWISE Implementation Plan are consistent with and based upon local land use planning documents. The Implementation Plan projects were developed and analyzed using information contained in published local land use planning documents, such as adopted general plans, as well as the MAC and ESJ Region

IRWM Plans, which are also based upon local planning documents. The MokeWISE program coalesces and builds upon local and regional land use planning information at an interregional level; it does not supersede local or regional land use planning documentation.

The MokeWISE process acknowledged the benefits that could be achieved through better coordination among water utilities and local land use planning agencies. Policy 9a, Land Use Coordination, was drafted and approved to start improving this coordination.

Referenced local land use planning documents that serve as the basis for the data, analyses, and projects in the MokeWISE program can be found in **Appendix H**.

17. Climate Change

The State of California, along with scientific organizations, including the International Panel on Climate Change (IPCC), have documented changes in both global and local climate over the past 100 years and anticipate even more changes in air temperature, precipitation, and mean sea levels in the coming decades. In California, warming temperatures are expected to raise the snowfall elevation, causing more winter precipitation in the Sierra Nevada to occur as rainfall. As a result of these changes, several million acre-feet of natural snowpack storage could be lost annually, reducing available water supply. In addition, the increasing severity of storms and increased runoff could overwhelm existing reservoir flood protection capacity and increase flood risks downstream. Rising sea levels may increase the scope of saltwater intrusion challenges in the Delta.

Planning for these changes is necessary in order to ensure a reliable water supply, maintain water quality, protect against flooding, and protect and restore ecosystems and habitat. Climate change will likely affect the upper and lower watersheds differently. As such, a review of climate change information developed by the MAC and ESJ IRWM Regions and related subsequent publications was conducted to determine how climate change may impact the upper and lower watersheds. Climate change adaptation and/or mitigation benefits associated with projects included in the MokeWISE Implementation Plan are shown in **Table 10**.

Table 10: Potential Climate Change Benefits of the MokeWISE Implementation Plan

MOKEWISE PROJECT	RELATED CLIMATE CHANGE VULNERABILITIES	ADAPTATION STRATEGIES IMPLEMENTED	GREENHOUSE GAS MITIGATION EFFECTS
1a. Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir	• Impacted ecosystem and habitat	• Ecosystem Restoration • Water-Dependent Recreation • Flood Risk Management	• None
1b. High Country Meadow Restoration Program	• Degraded surface water and groundwater quality Impacted ecosystems and habitat	• Ecosystem Restoration • Recharge Area Protection • Watershed Management • Flood Risk Management	• Carbon Sequestration
1c. Mokelumne River Day Use Area Floodplain Habitat Restoration Project	• Increased flooding • Impacted ecosystem and habitat	• Ecosystem Restoration • Recharge Area Protection • Watershed Management • Flood Risk Management	• Carbon Sequestration
1d. Fish Screens for Riparian Diversions in the Lower Mokelumne River	• Impacted ecosystems and habitat	• Watershed Management	• None
1f. Riparian Restoration Program – Below Camanche River	• Degraded surface water and groundwater quality Increased flooding • Impacted ecosystems and habitat	• Ecosystem Restoration • Recharge Area Protection • Watershed Management • Flood Risk Management	• Carbon Sequestration
1g. Mokelumne Water Quality, Soil Erosion & Sedimentation Inventory/ Monitoring	• Decreased surface water quality	• Sediment Management • Watershed Management	• None
2a. Municipal Recycled Wastewater Recharge Program	• Decreased water supply / Water table decline • Degraded surface water and groundwater quality	• Conjunctive Management and Groundwater Storage • Recycled Municipal Water • Matching Quality to Use	• Energy Efficiency • Emissions Reduction

MOKEWISE PROJECT	RELATED CLIMATE CHANGE VULNERABILITIES	ADAPTATION STRATEGIES IMPLEMENTED	GREENHOUSE GAS MITIGATION EFFECTS
		• Pollution Prevention	
2b.Woodbridge Winery Wastewater Reuse	• Decreased water supply • Degraded surface water and groundwater quality	• Conjunctive Management and Groundwater Storage • Recycled Municipal Water • Matching Quality to Use • Pollution Prevention	• Energy Efficiency • Emissions Reduction
2c. Amador County Reuse	• Decreased water supply • Degraded surface water and groundwater quality	• Recycled Municipal Water • Matching Quality to Use • Pollution Prevention	• Energy Efficiency • Emissions Reduction
4a. Groundwater Banking Evaluation within the Eastern San Joaquin Groundwater Basin*	• Decreased water supply / Water table decline • Degraded surface water and groundwater quality	• Water Transfers • Conjunctive Management and Groundwater Storage	• Energy Efficiency • Emissions Reduction
4b. Amador and Calaveras Counties Hydrologic Assessment*	• Decreased water supply / Water table decline • Degraded surface and groundwater quality	• Water Transfers • Conjunctive Management and Groundwater Storage • Flood Risk Management	• Energy Efficiency • Emissions Reduction
4d. NSJWCD Infrastructure Improvements	• Decreased water supply / Decreased water supply / Water table decline	• Conveyance – Regional/Local	• Energy Efficiency • Emissions Reduction

MOKEWISE PROJECT	RELATED CLIMATE CHANGE VULNERABILITIES	ADAPTATION STRATEGIES IMPLEMENTED	GREENHOUSE GAS MITIGATION EFFECTS
5a. Regional Urban Water Conservation Program	• Increased domestic / urban and commercial, industrial and institutional (CII) demands • Degraded surface water and groundwater quality	• Urban Water Use Efficiency • Matching Quality to Use • Pollution Prevention • Urban Runoff Management • Economic Incentives	• Energy Efficiency • Emissions Reduction
5b. Regional Agriculture Conservation Program[6]	• Increased agricultural demands • Degraded surface water and groundwater quality	• Agricultural Water Use Efficiency	• Energy Efficiency • Emissions Reduction • Carbon Sequestration
7a. PG&E Storage Recovery*	• Decreased water supply • Increased seasonal flooding	• Surface Storage – Regional/Local • Flood Risk Management	• Energy Efficiency • Emissions Reduction
7b. Raise Lower Bear Feasibility Study*	• Decreased water supply • Increased seasonal flooding	• System Reoperation • Water Transfers • Conjunctive Management and Groundwater Storage • Surface Storage – Regional/Local • Watershed Management • Flood Risk Management	• Energy Efficiency • Emissions Reduction • Carbon Sequestration
7d. Re-operation of Existing Storage*	• Increased seasonal flooding • Reduced hydropower generation	• System Reoperation	• Energy Efficiency

[6] This project was identified as having outstanding concerns. These concerns have been characterized and appended to the project scope, which is included in **Appendix E**.

MOKEWISE PROJECT	RELATED CLIMATE CHANGE VULNERABILITIES	ADAPTATION STRATEGIES IMPLEMENTED	GREENHOUSE GAS MITIGATION EFFECTS
		• Surface Storage – Regional/Local • Flood Risk Management	• Emissions Reduction
7f. Blue & Twin Lakes Dams Reliability & Replacement Assessment*	• Decreased Water Supply • Increased Seasonal Floods	• Local/Regional Surface Storage	• Energy Efficiency • Emissions Reduction
8b. Rehabilitation of Transmission Main	• Decreased water supply	• Urban Water Use Efficiency • Conveyance – Regional/Local	• Energy Efficiency • Emissions Reduction
8c. Barney Way Septic System Conversion	• Decreased water supply • Degraded surface water and groundwater quality	• Pollution Prevention • Recharge Area Protection	• None
8d. Camanche Village Recycled Water Project*	• Decreased water supply • Degraded surface water and groundwater quality	• Recycled Municipal Water • Matching Quality to Use • Pollution Prevention	• Energy Efficiency • Emissions Reduction

* These projects are studies and do not have implementation components.

Appendices

- A: MCG Member List
- B: Baseline Environmental Conditions Technical Memorandum
- C: Water Availability Analysis
- D: Program Outcomes and Measures Memorandum
- E: MCG Approved Scopes of Work / Preliminary Engineering
- F: Environmental Assessment
- G: Local Water Planning References
- H: Local Land Use Planning References

Appendix A: Mokelumne Collaborative Group (MCG) Member List

Please reference Appendix A in Draft Final Plan.

Appendix B: Environmental Conditions Overview Technical Memorandum

Please reference Appendix F in Draft Final Plan.

Appendix C: Water Availability Analysis

Please reference Appendix G in Draft Final Plan.

Appendix D: Program Outcomes and Measures Memorandum

Please reference Appendix E in Draft Final Plan.

Appendix E: Scopes of Work / Preliminary Engineering

Please reference Appendix N in Draft Final Plan.

Appendix F: Environmental Assessment of Concepts

Please reference Appendix L in Draft Final Plan.

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