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.

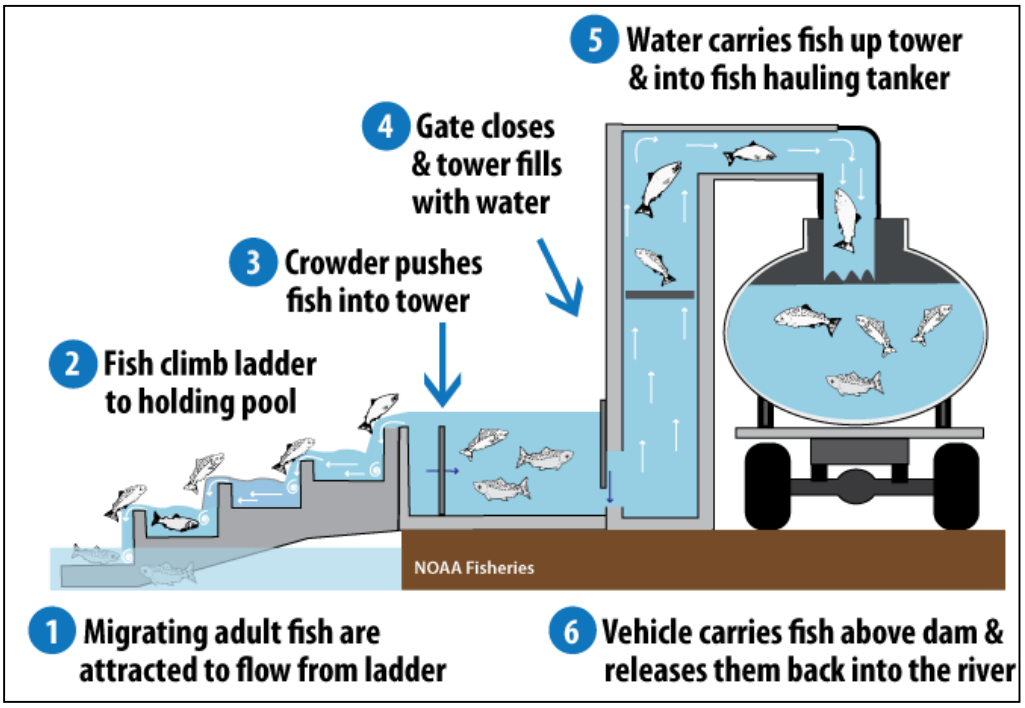
Water agencies are concerned that reintroduction of salmon into the upper Mokelumne watershed could increase their regulatory exposure. They are also concerned that such reintroduction might require changes in temperature or flow requirements that may reduce the availability of water for consumptive 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

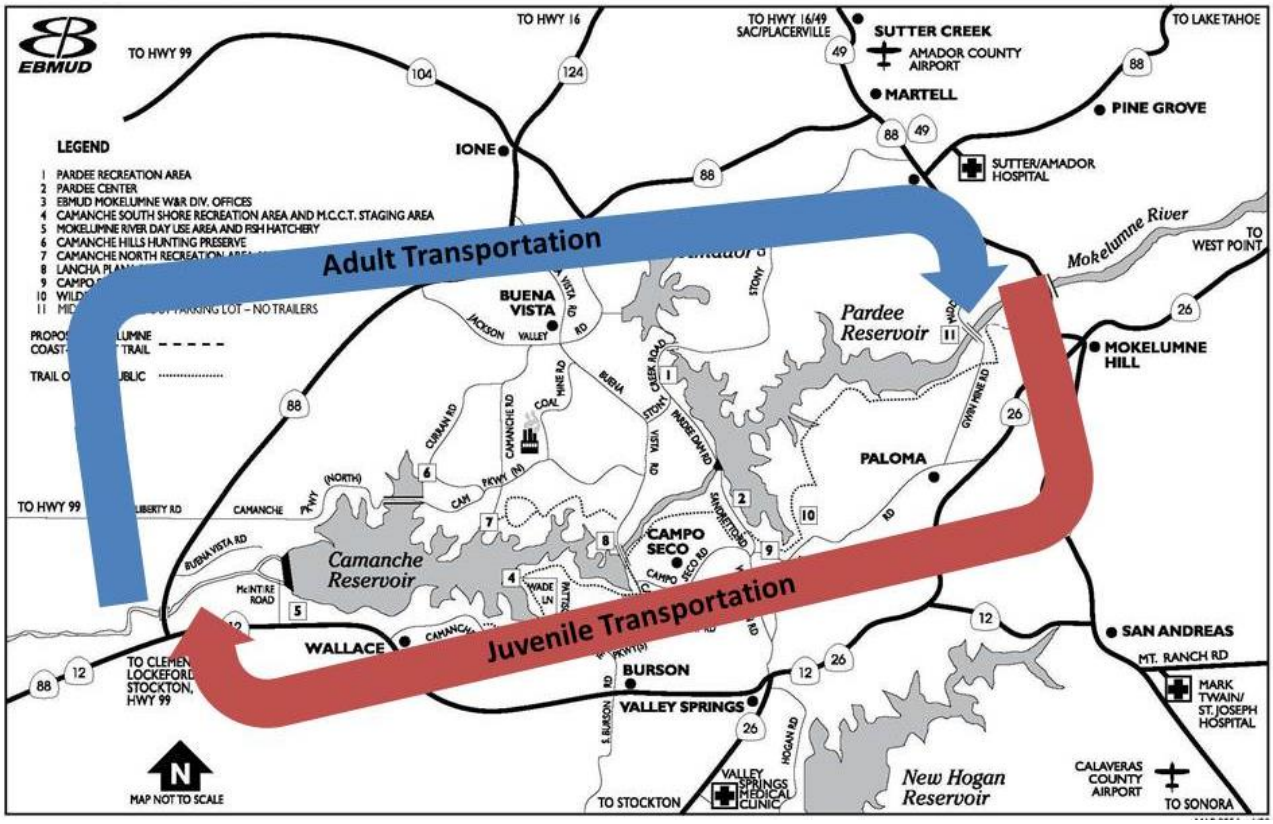
- Economic
- Legal
- Recreation

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

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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

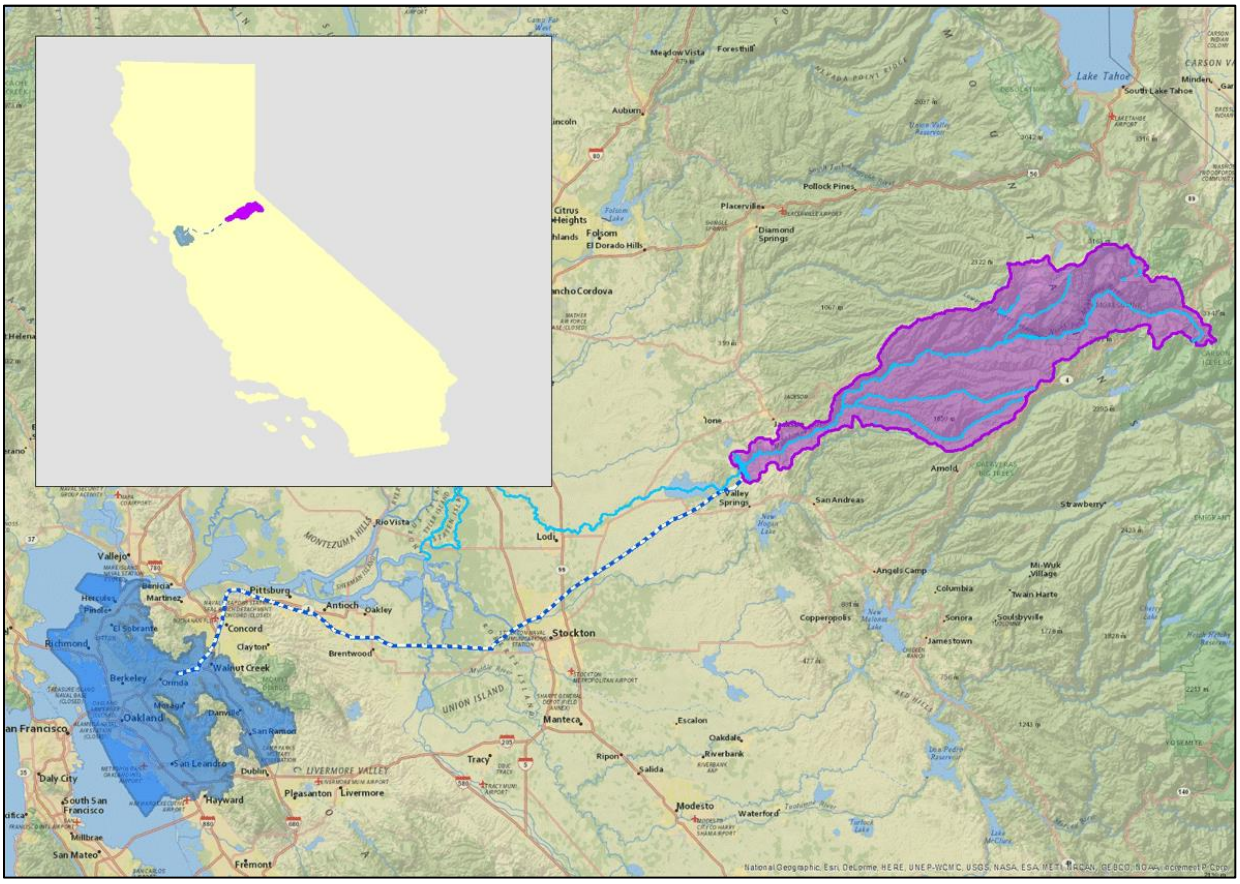
Project Description

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.

Field Assessments

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).

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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 $1/10^{th}$ 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.

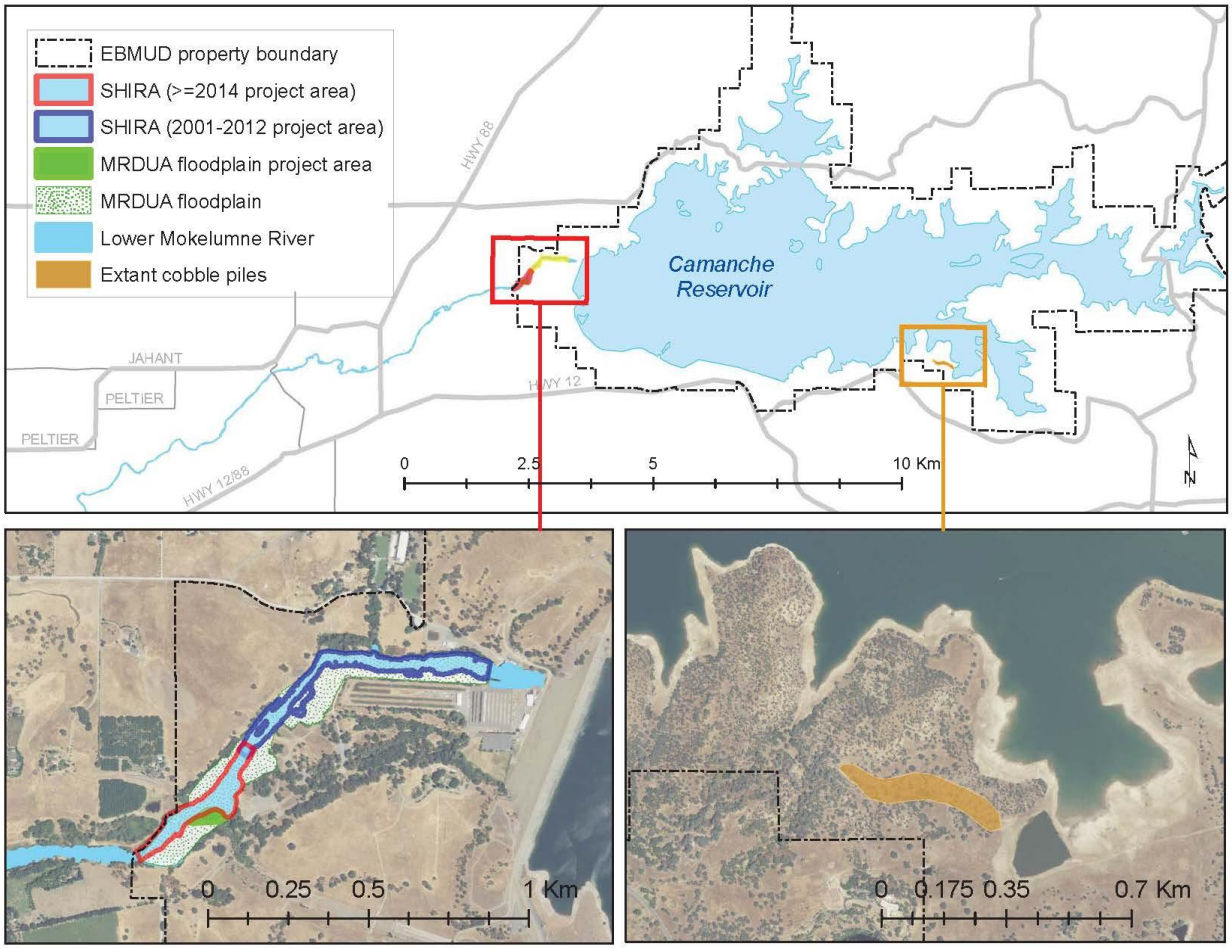
Information from EBMUD suggests that approximately 5,500 cubic yards of material would be excavated and screened. Of this material, approximately 2,500 cubic yards of gravel would be placed and recontoured and 3,000 cubic yards of dredged spoil materials would be placed and recontoured to create a habitat 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.

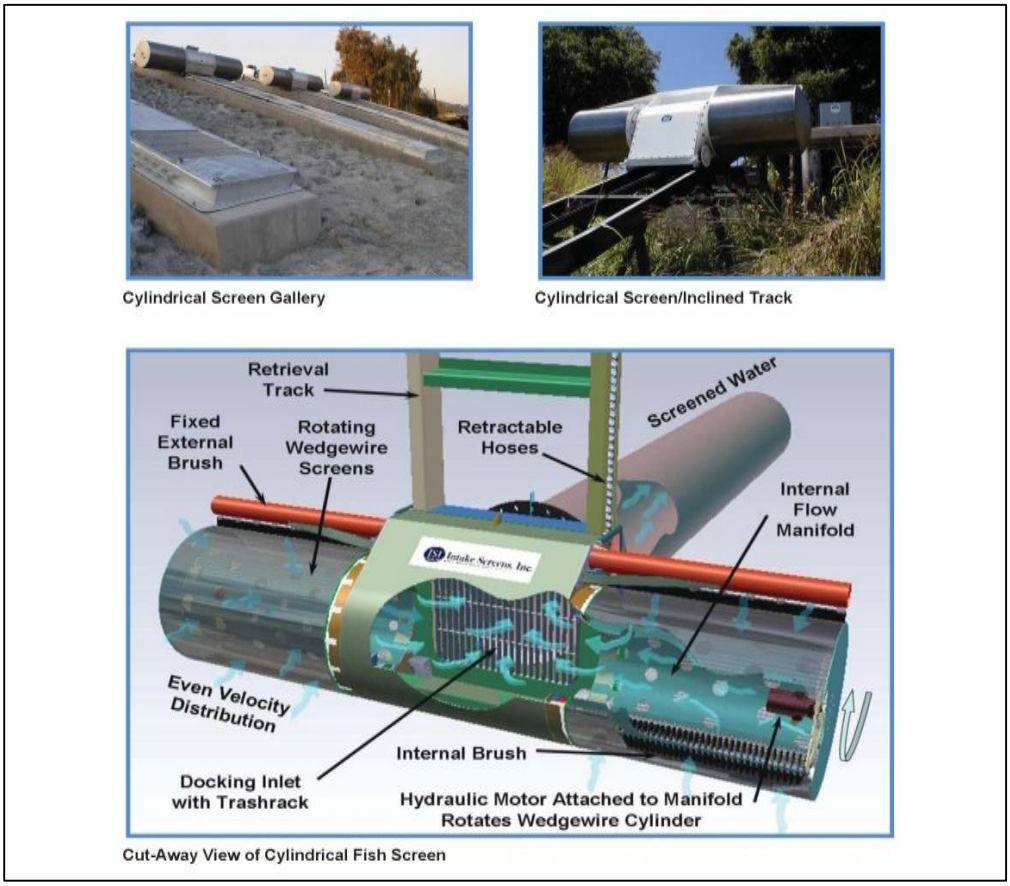
The Fish Screens for Riparian Diversions in the Lower Mokelumne River Project will develop and implement a program to identify and prioritize riparian diversions on the lower Mokelumne River for installation of new fish screens. This includes conducting a diversion assessment and establishing screening 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



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

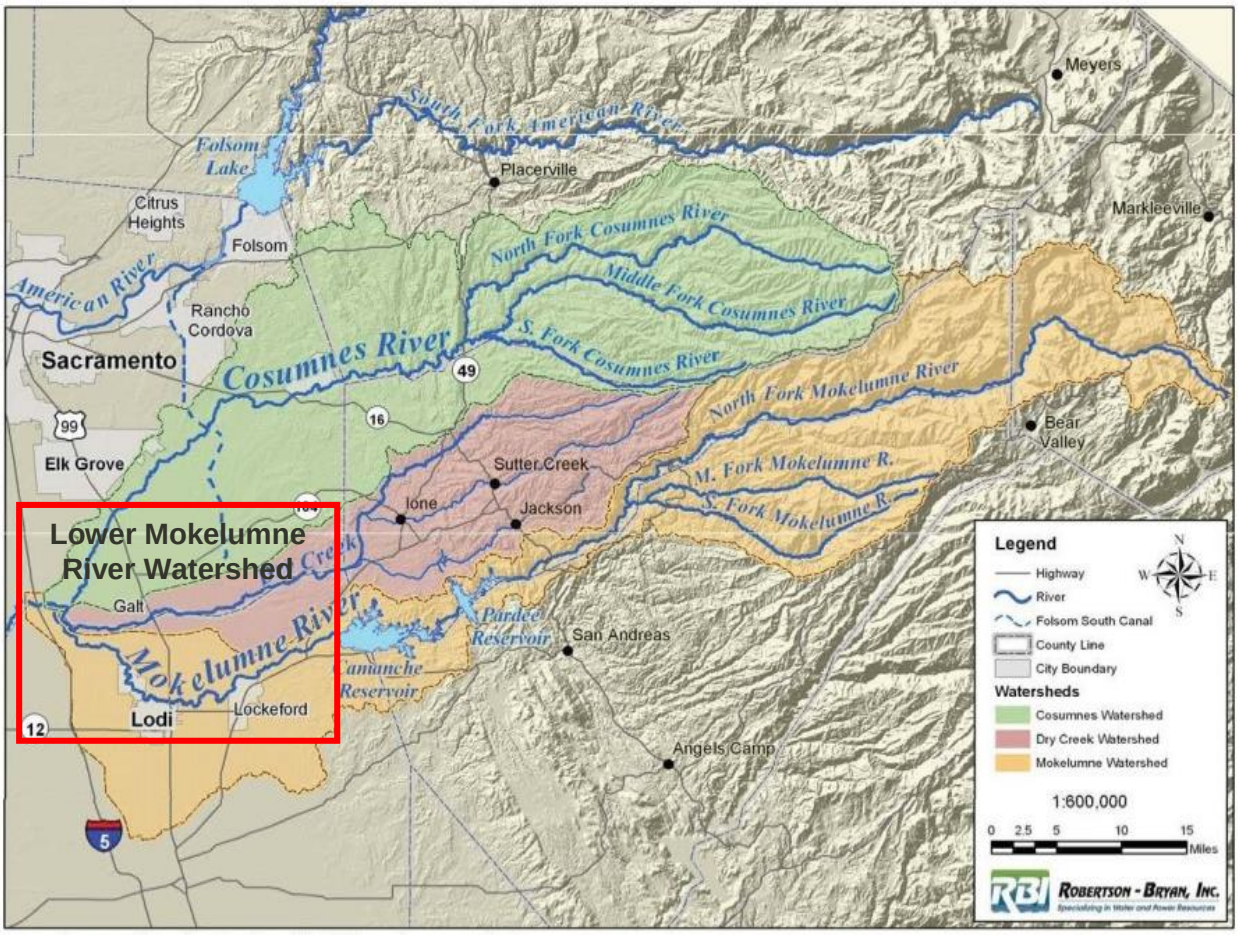
Project Description

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

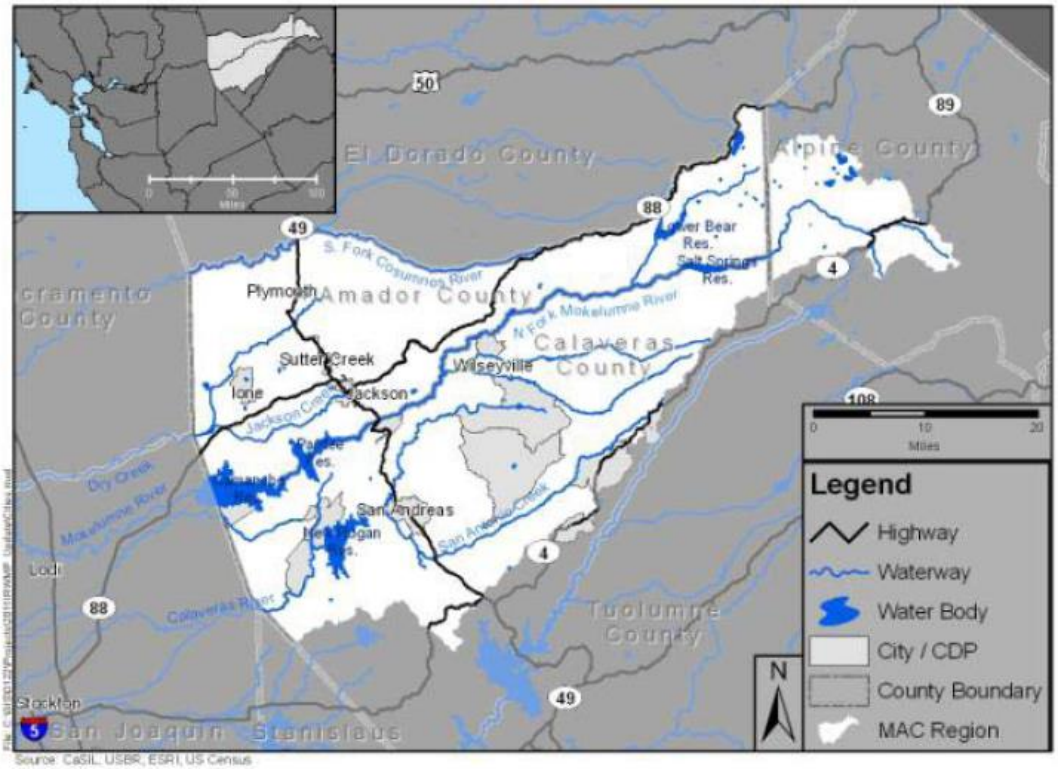
Project Description

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

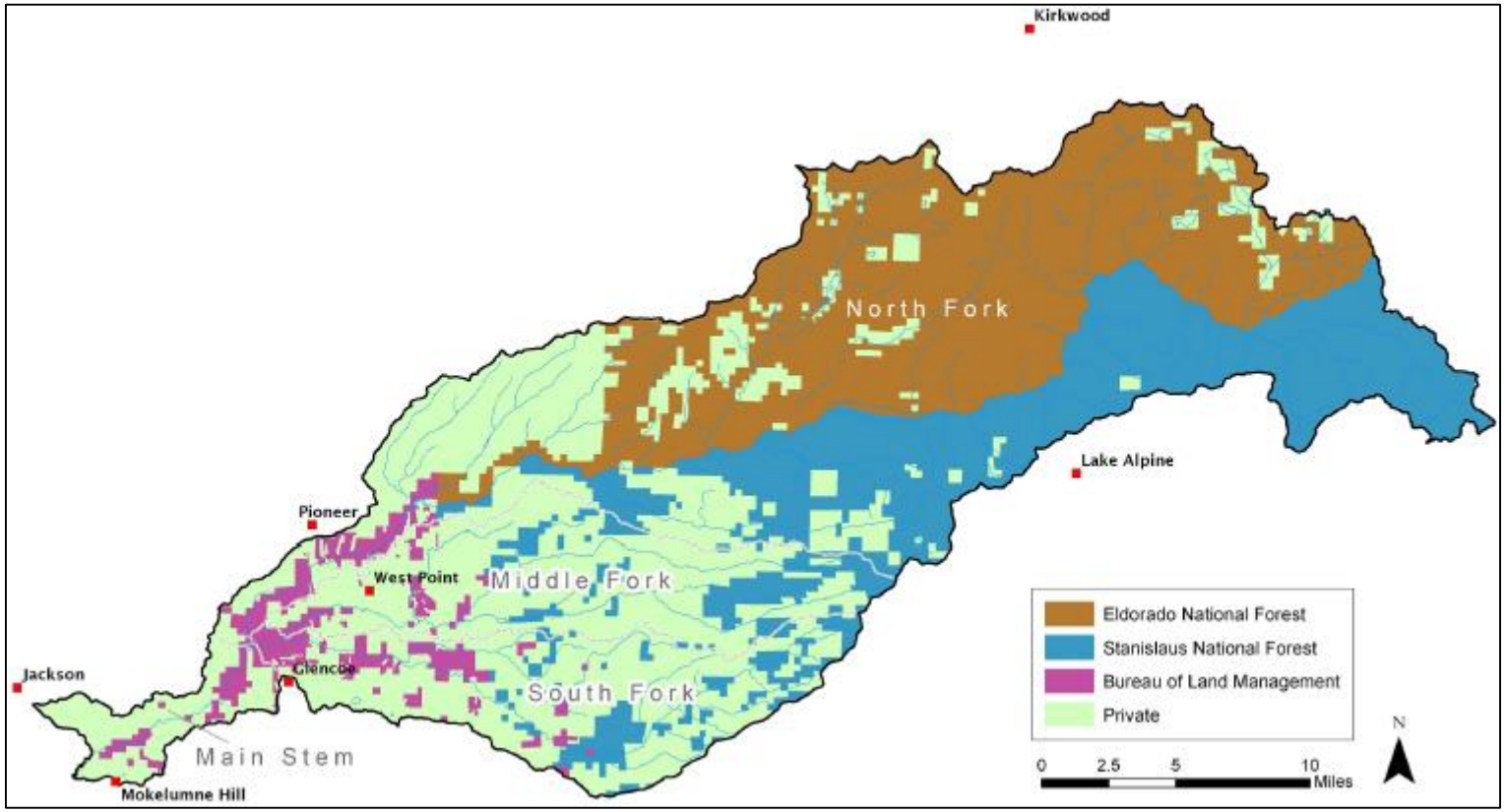
The first step in mapping is to acquire suitable aerial photographs and maps and to travel roads and trails and locate and record data on each erosion site that has or is delivering sediment to the River or tributaries using GPS data recorders. The data will be converted to GIS layers data to create 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

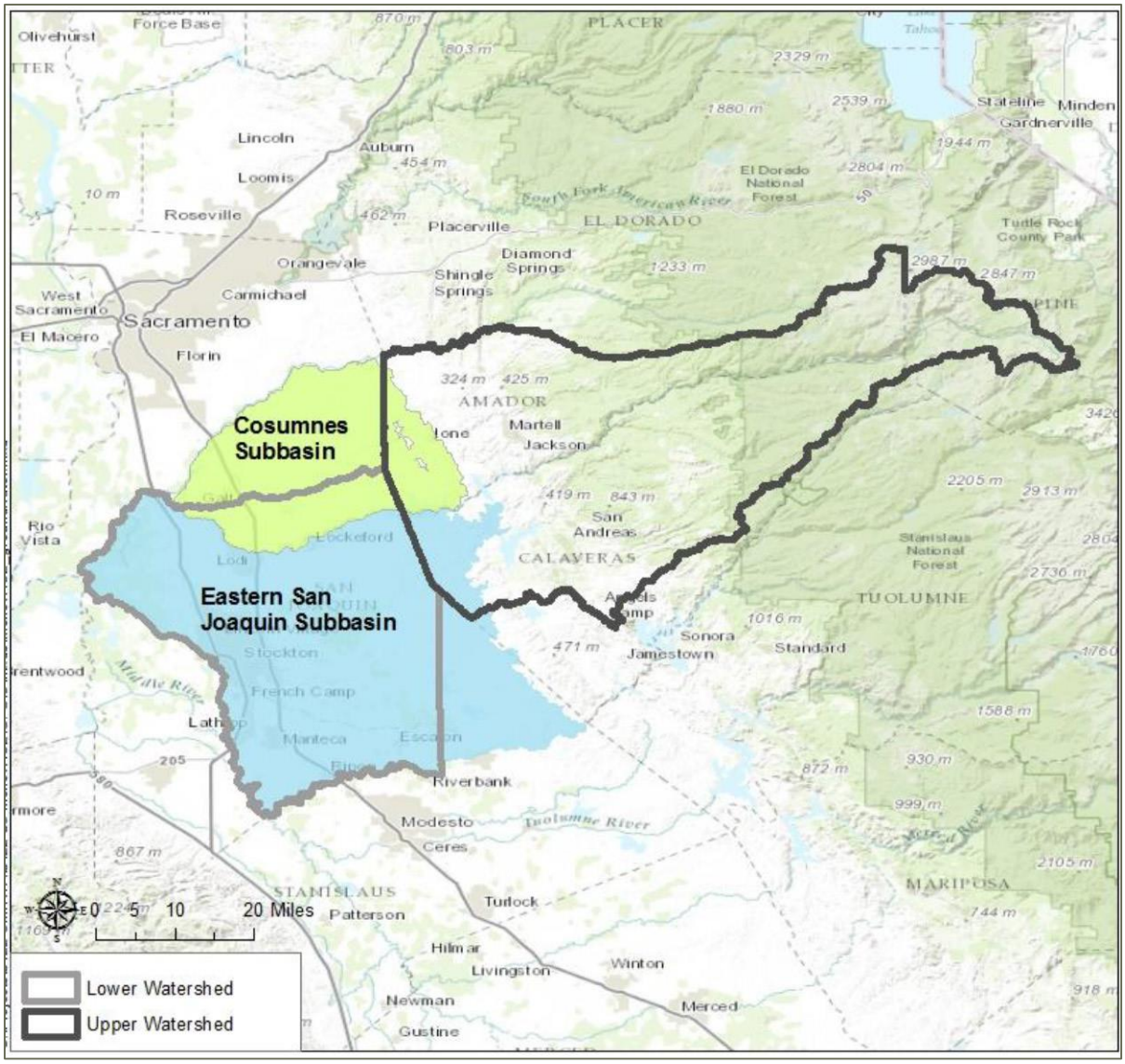
Surface Water

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

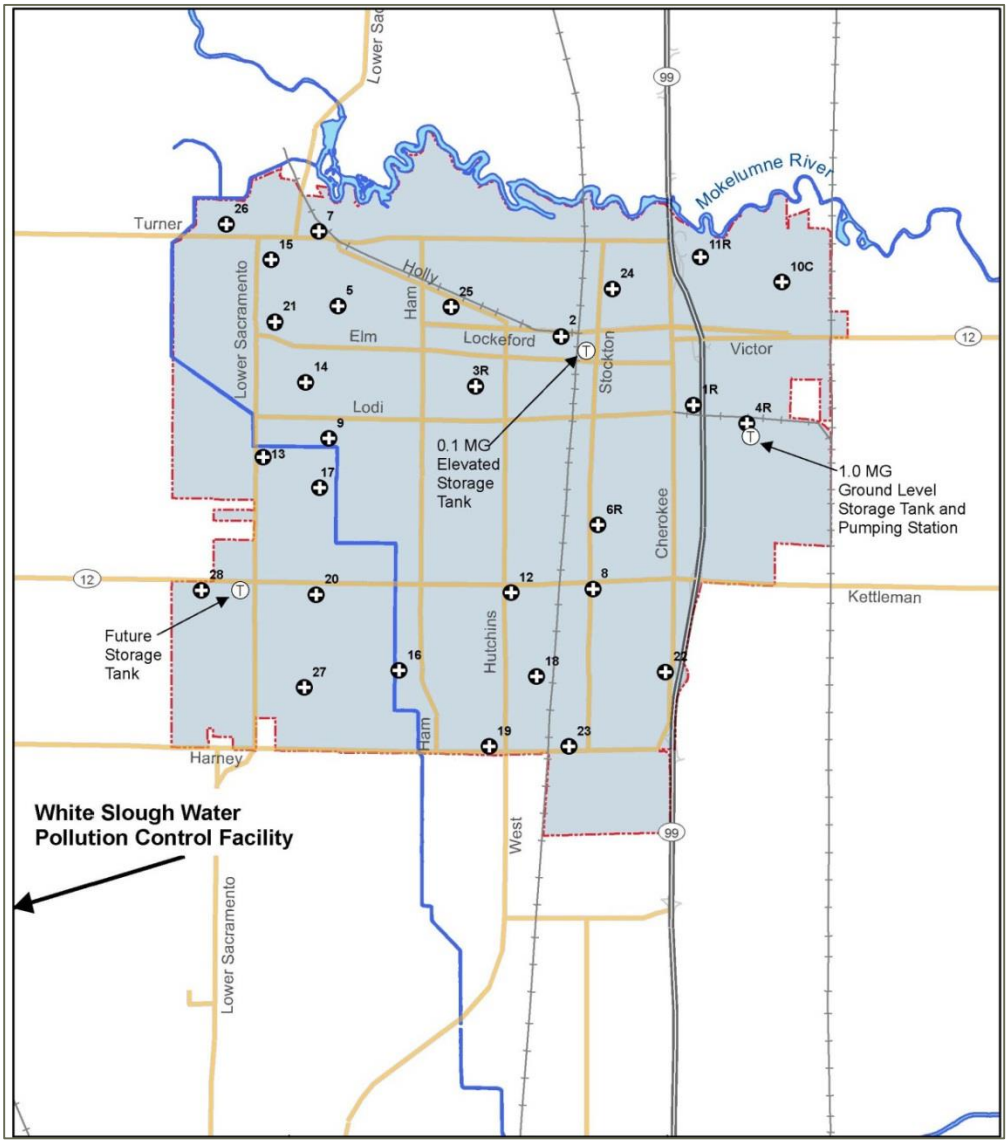
The City of Lodi overlies the Eastern San Joaquin Subbasin of the San Joaquin Valley Groundwater Basin (**Figure 1**). As shown in **Table 1**, groundwater is the primary water supply source for the city, which pumps approximately 15,000 AFY from 26 wells located throughout the city. Up until 2006, when 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

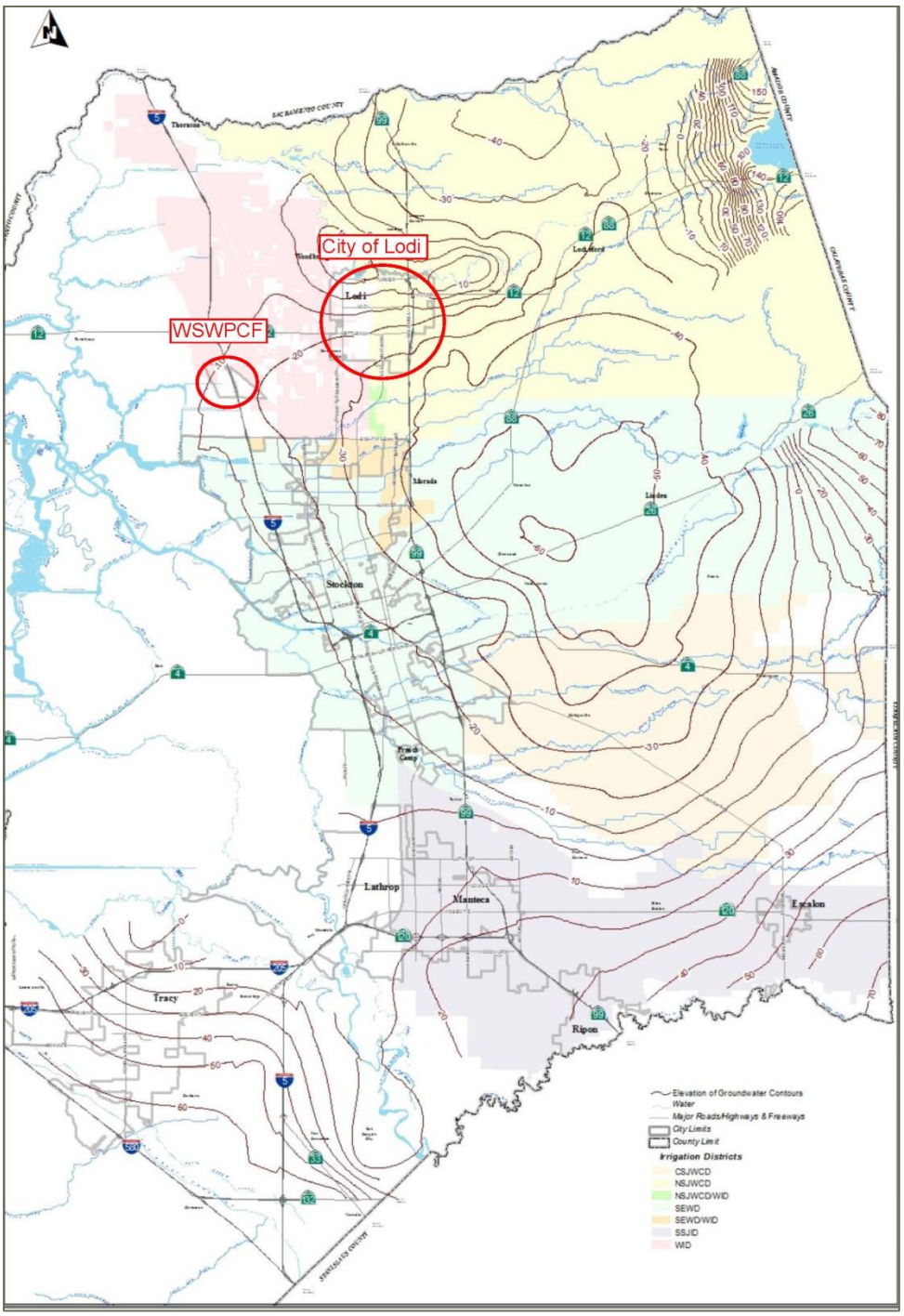
The Municipal Recycled Wastewater Recharge Program will investigate the potential for using treated, disinfected wastewater to recharge groundwater aquifers in the valley, either directly or indirectly through in-lieu use of the recycled water. This project includes two

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

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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

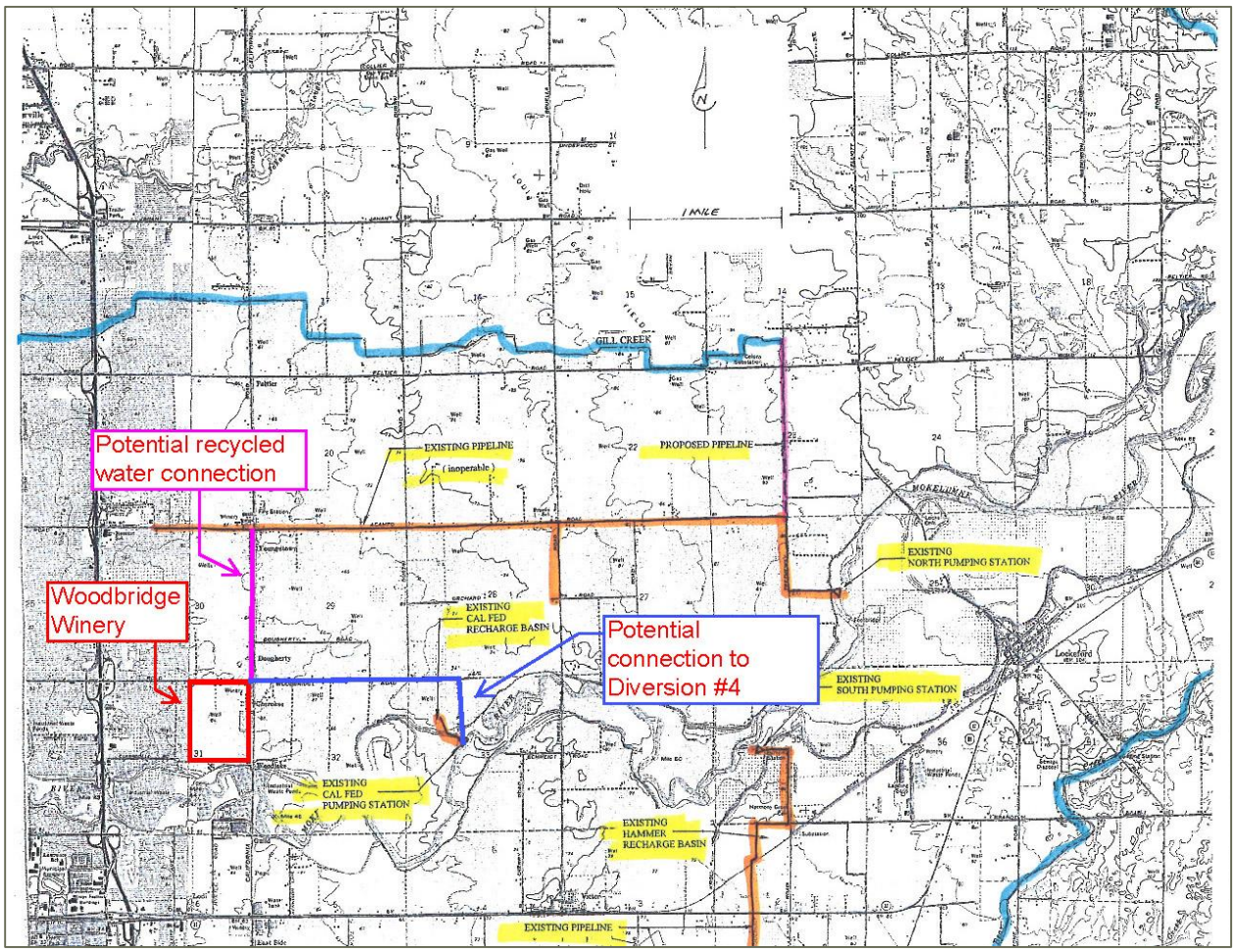
to intentionally over-irrigate their crops, which would provide groundwater recharge. Implementing this project would require connecting the NSJWCD's non-potable water conveyance system to Woodbridge Winery's treated wastewater system, and connecting the NSJWCD's 4th diversion point from the Mokelumne 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.
- **Total Project Cost: $16,160,000**

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

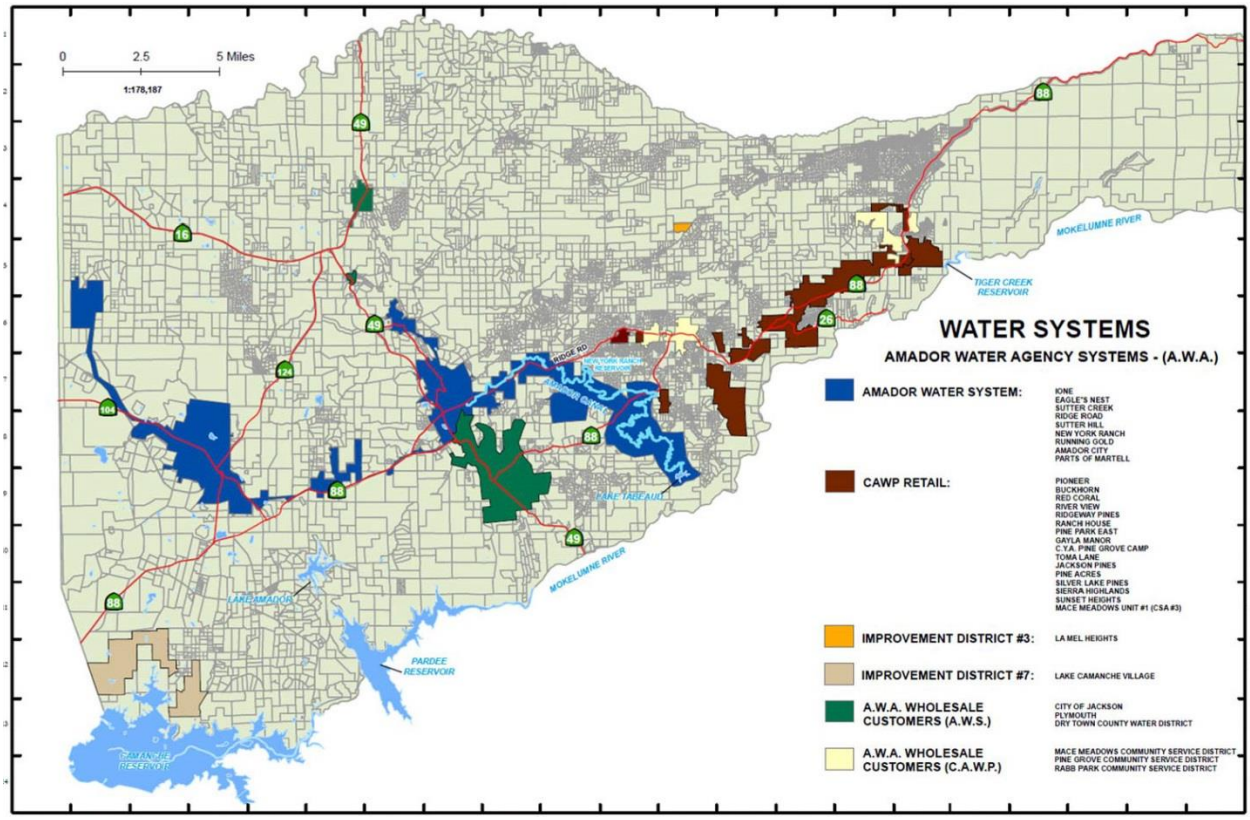
AWA owns and operates three treatment plants, two for the AWS system and one for the CAWP system. These facilities are presented in **Table 2**.

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

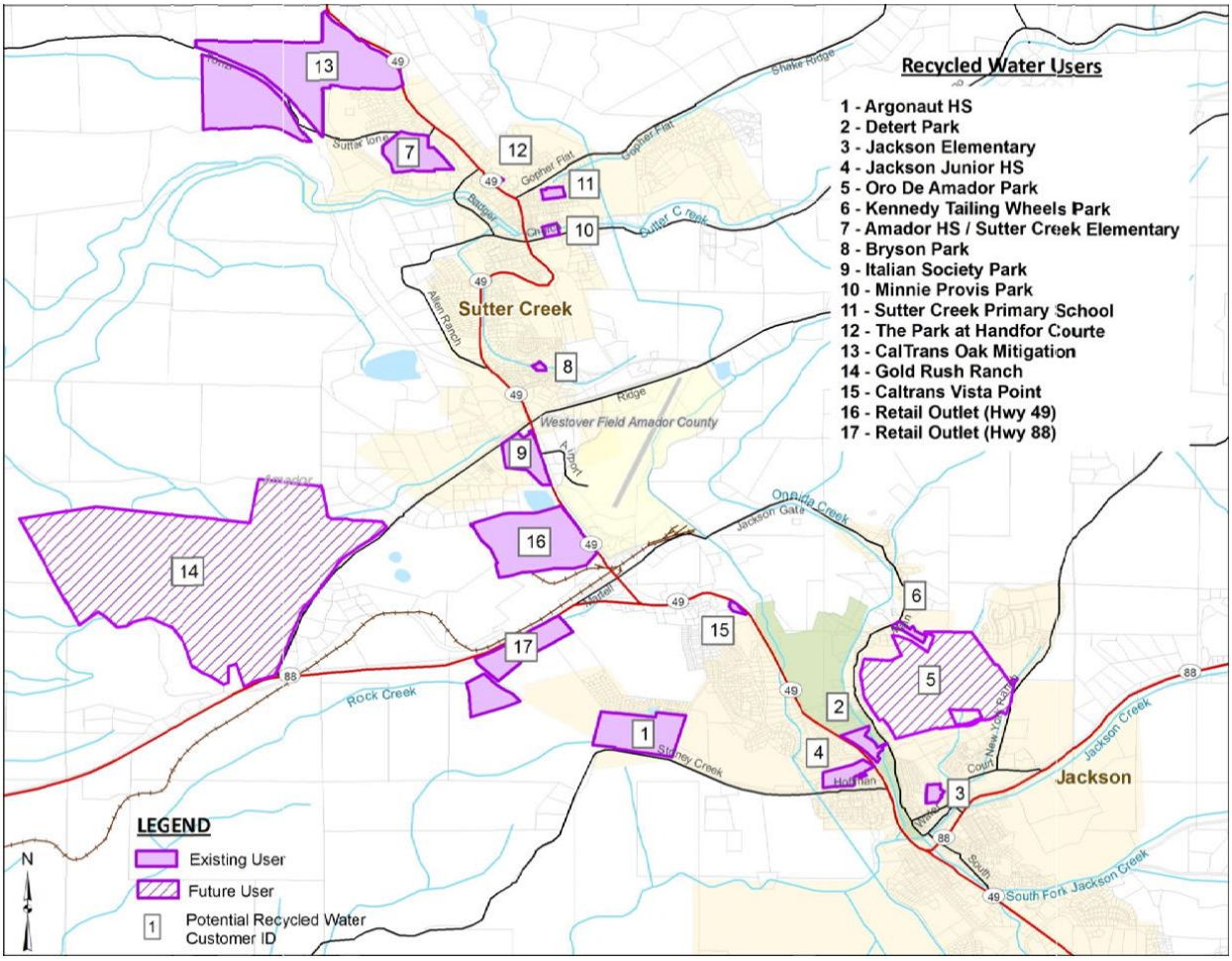
Project Description

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**.

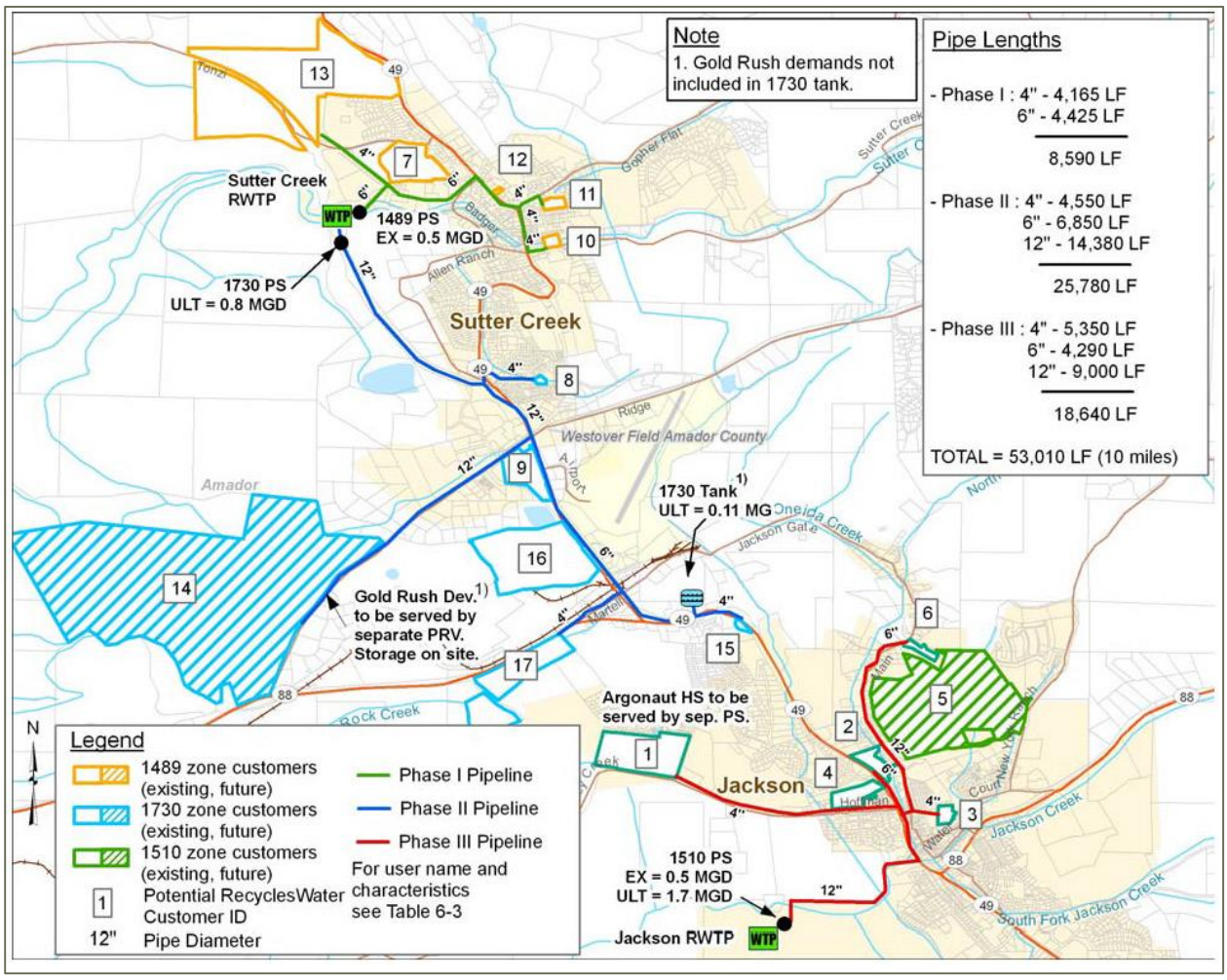
Table 3: Project Wastewater Flows within the Project Area

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

- **Total Project Costs: $21,750,000**

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.

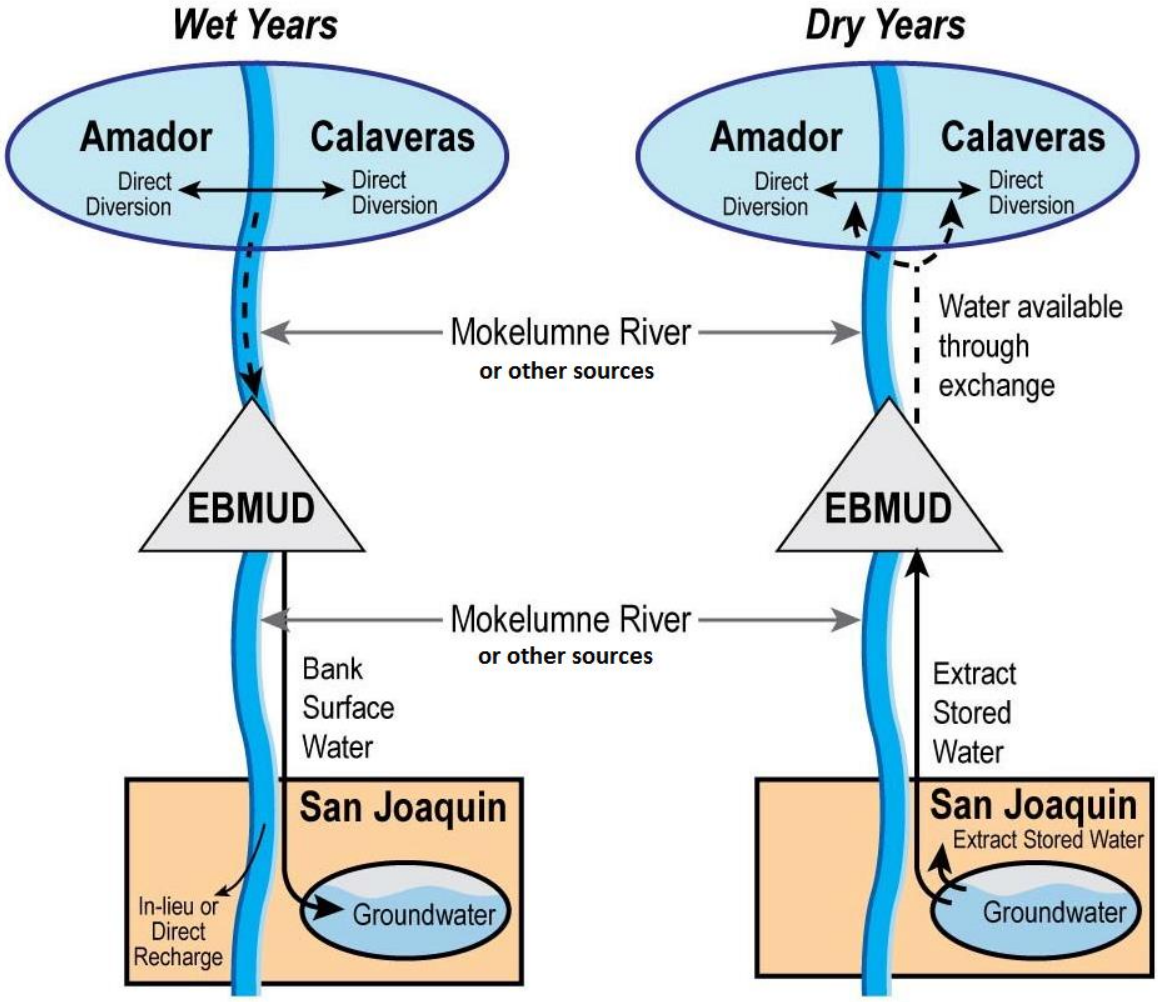
The study will include analysis of various opportunities, impacts and constraints that may affect project implementation through new and evolving legislation, water supply sources, project concepts and design, governance and stakeholder engagement. Operational flexibility is currently maximized by including 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

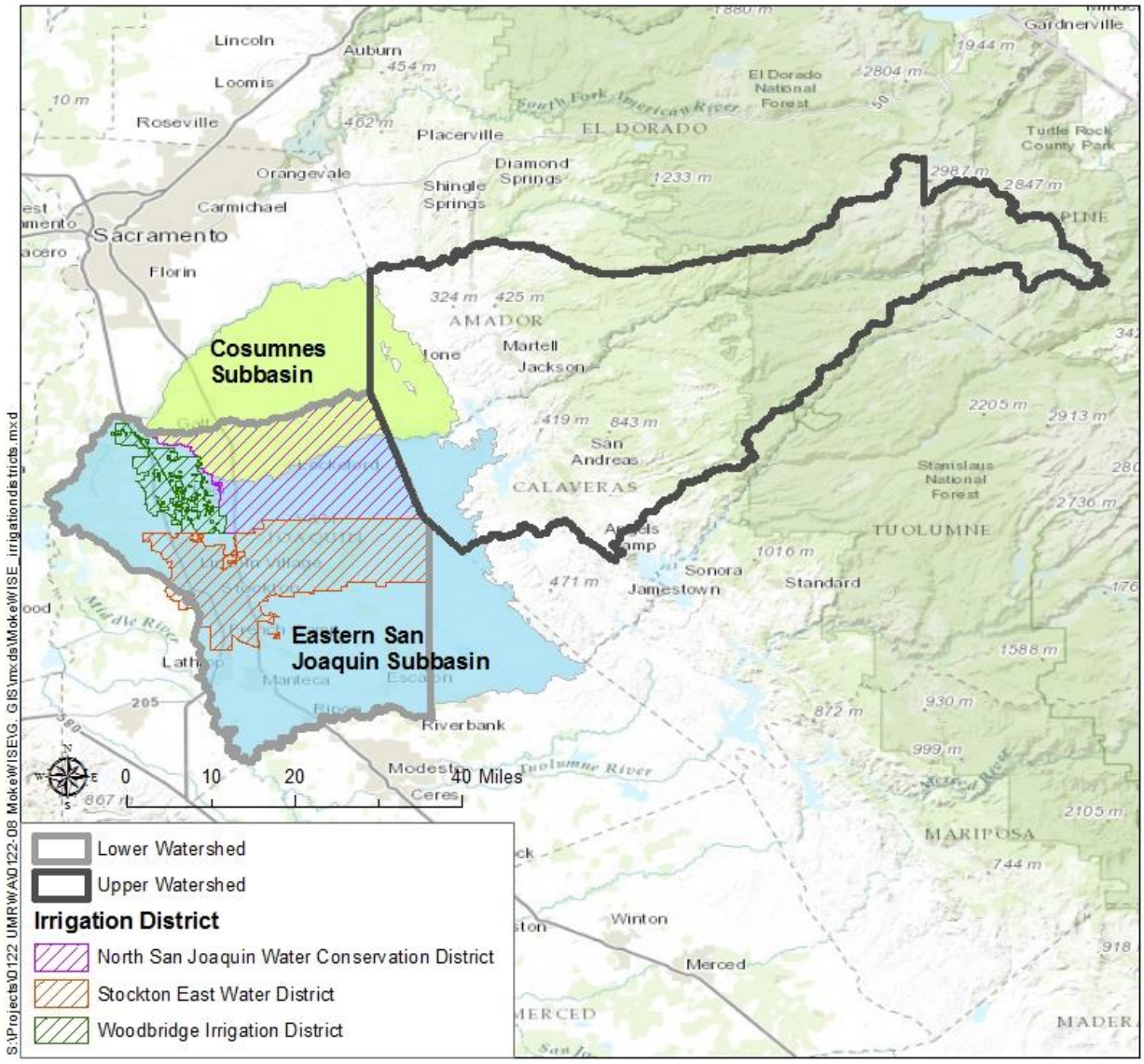
Task 1. Identify Project Study Area

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

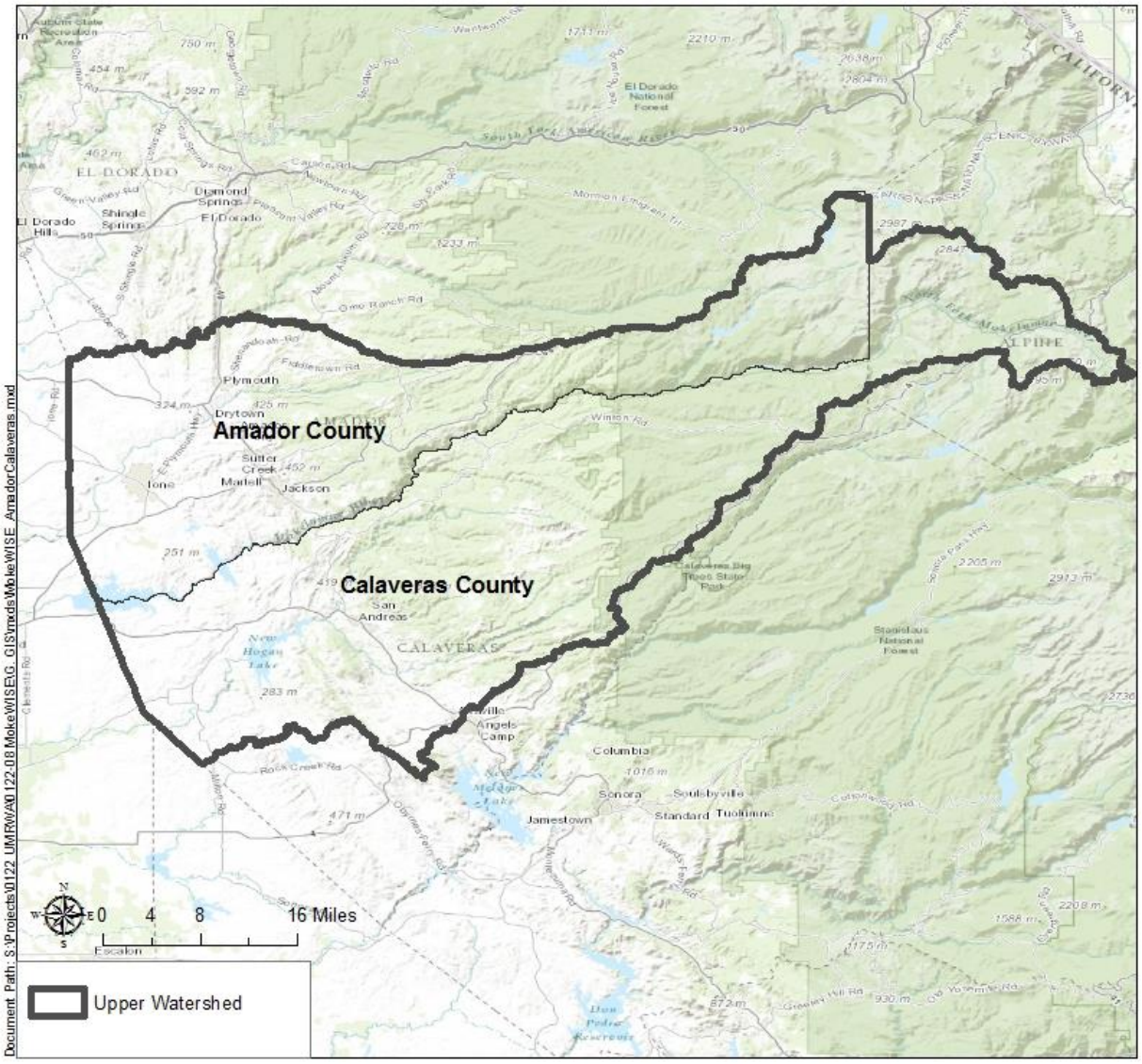
The overall study approach is to characterize the groundwater setting by using watershed water budgets to estimate recharge. Watersheds with streamgaging data would be used. The watershed-scale recharge estimates would be partitioned to smaller geographic scales based on the geographic distribution of 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:

Compile Data. 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.

Estimate Transmissivity. 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.

Characterize Aquifer Physical Properties. 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.

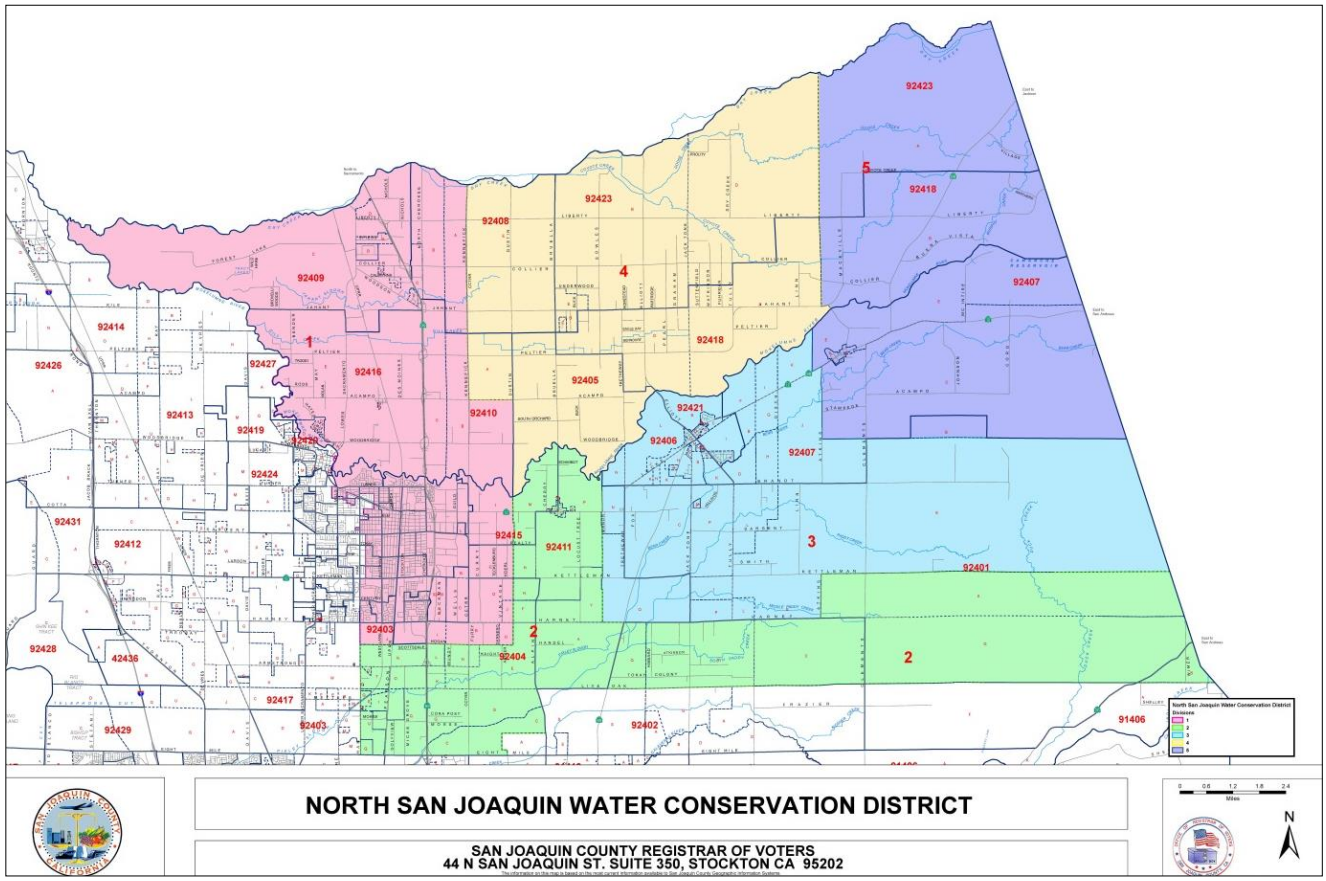
The State Water Resources Control Board approved the NSJWCD water right petitions on March 30, 2015.

Project Information

Project Location

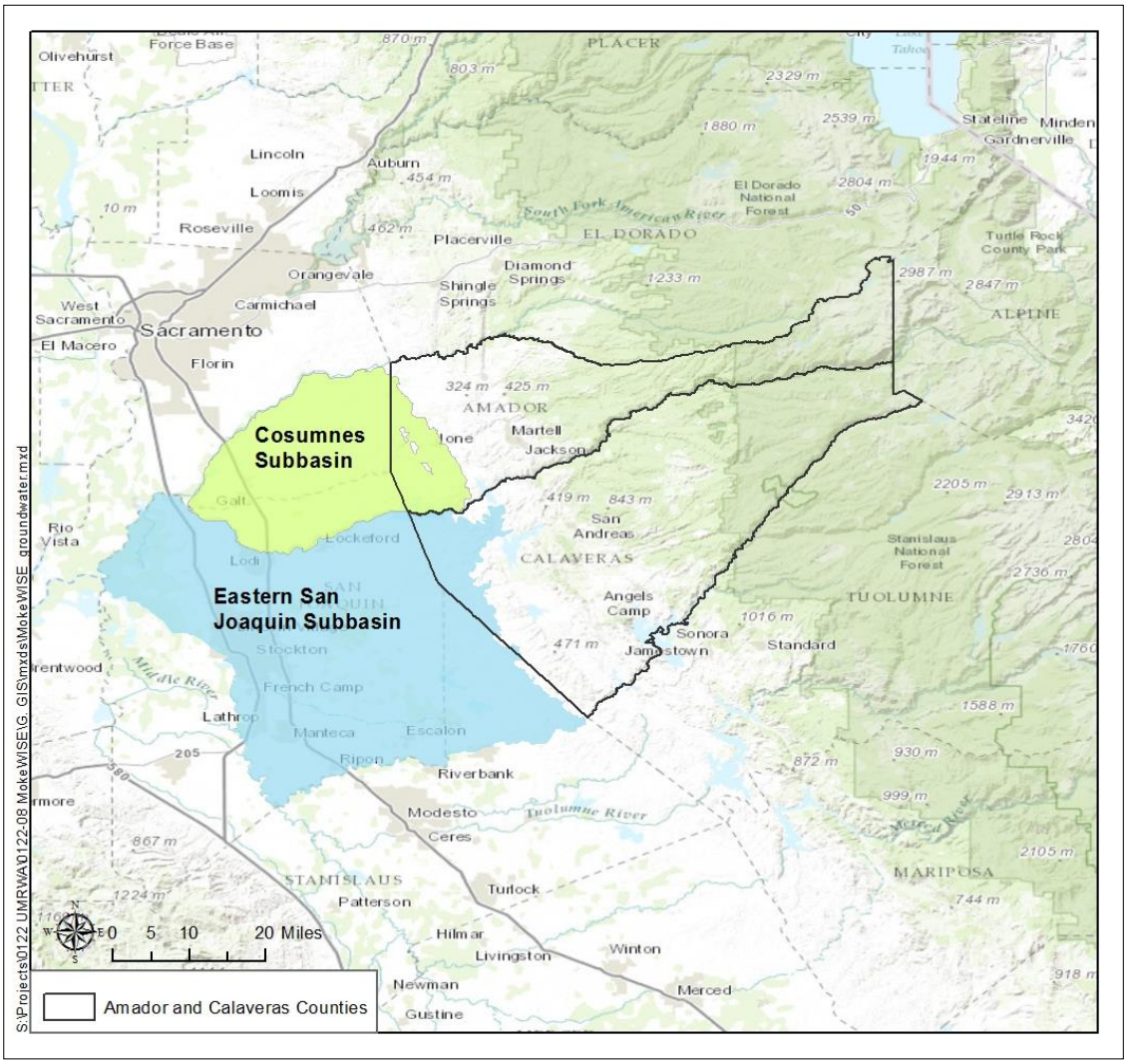
This Project is located within the NSJWCD service area in the lower Mokelumne River watershed. Error! Reference source not found. shows the NSJWCD service area. The lower Mokelumne River watershed is comprised of portions of the Eastern San Joaquin and Cosumnes Subbasins as shown in Error! Reference source not found..

Figure 1: NSJWCD Service Area



Source: NSJWCD Website

Figure 2: Lower Mokelumne River Watershed and Subbasins

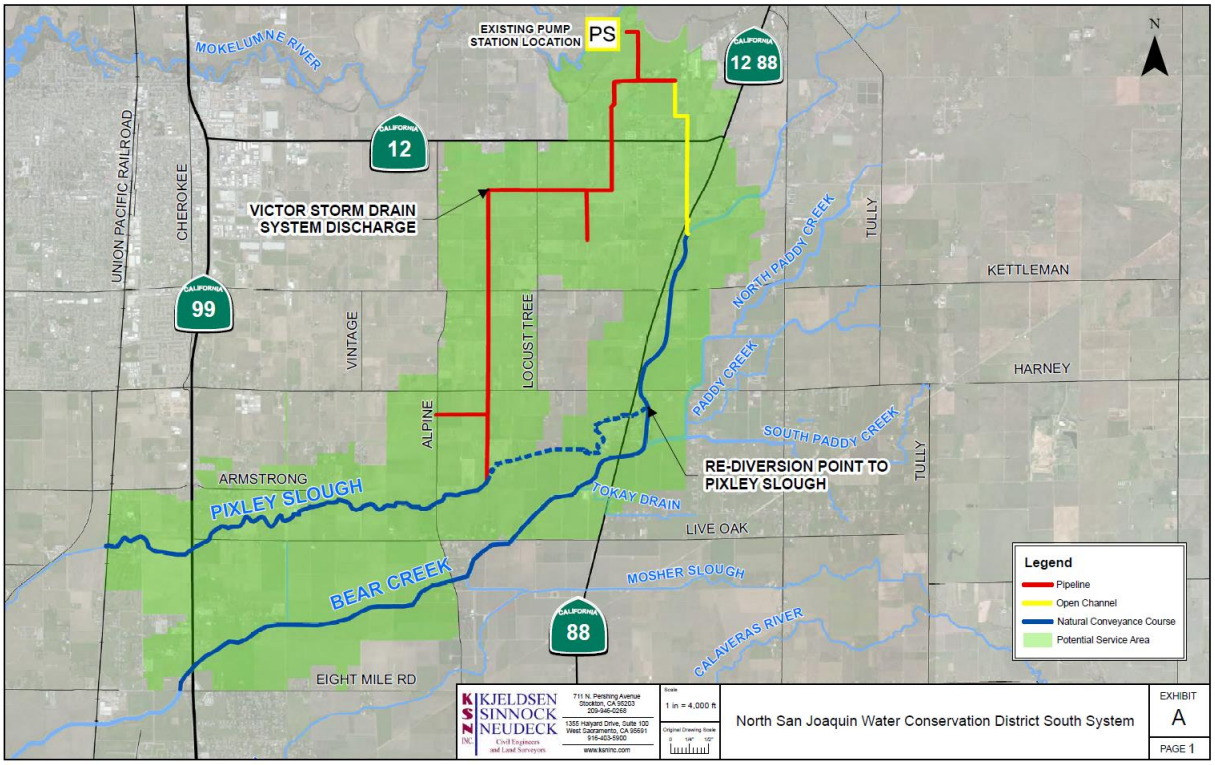


Source: RMC, 2015

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

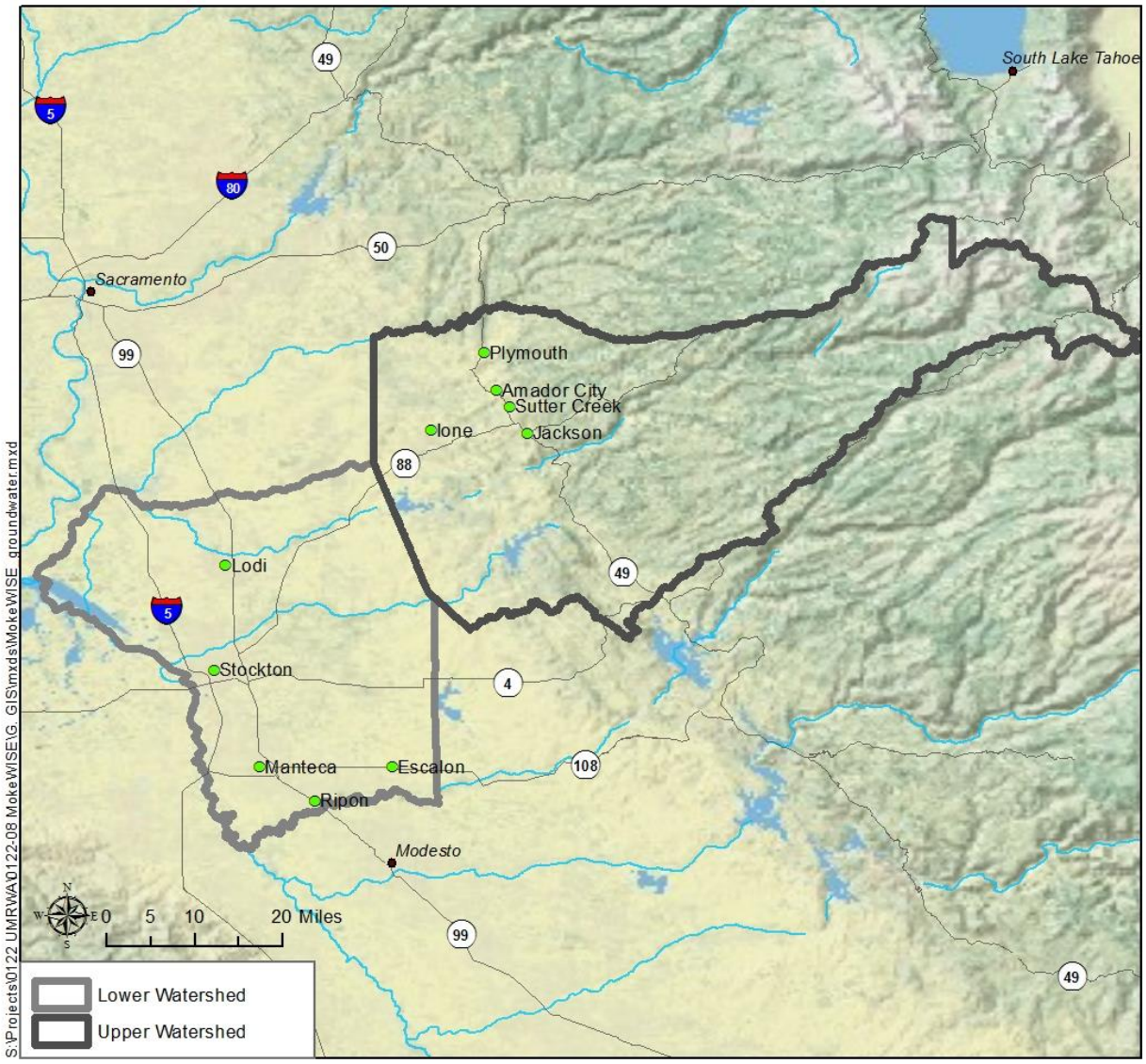
Project Description

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

May 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

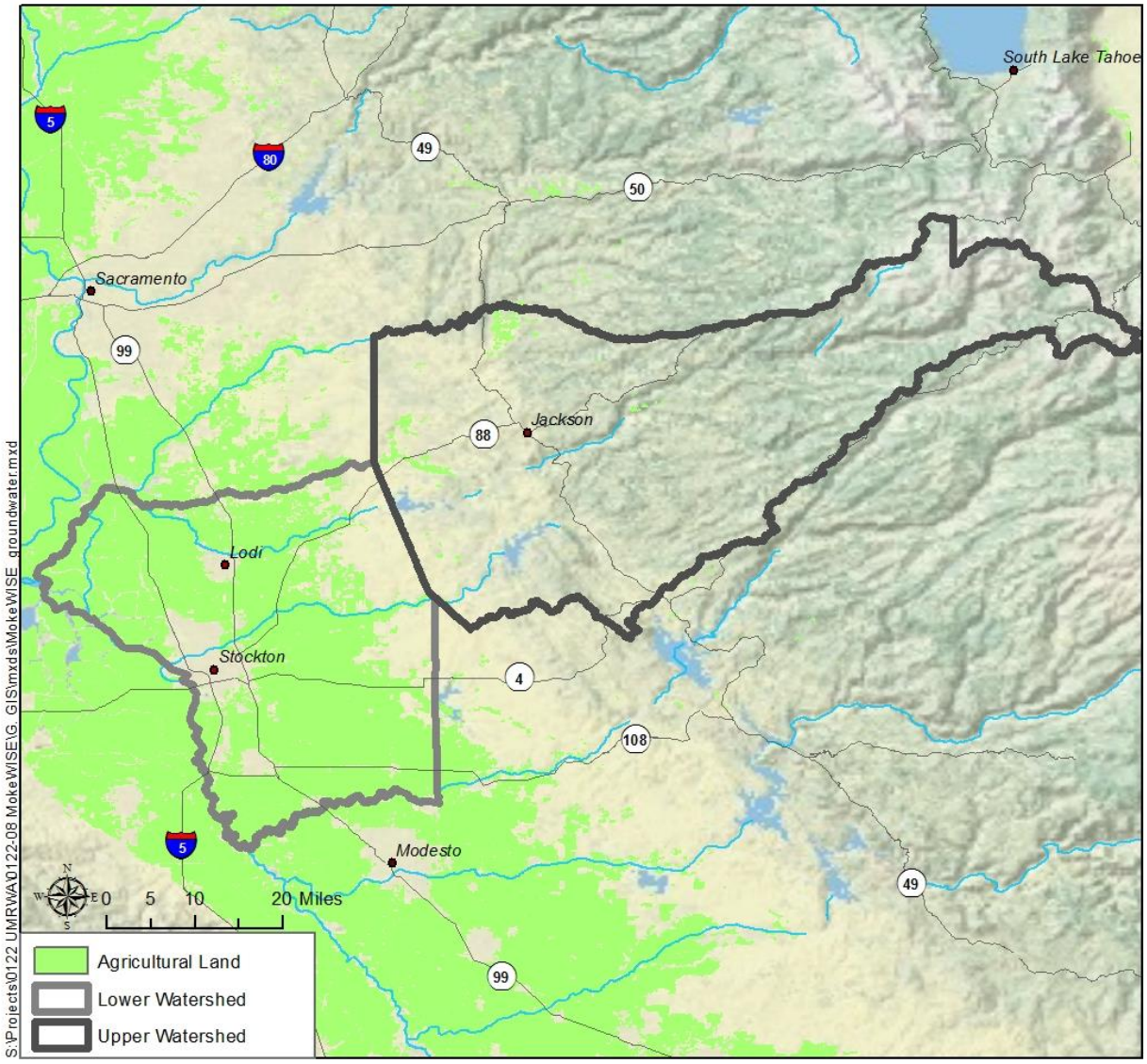
Project Description

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.

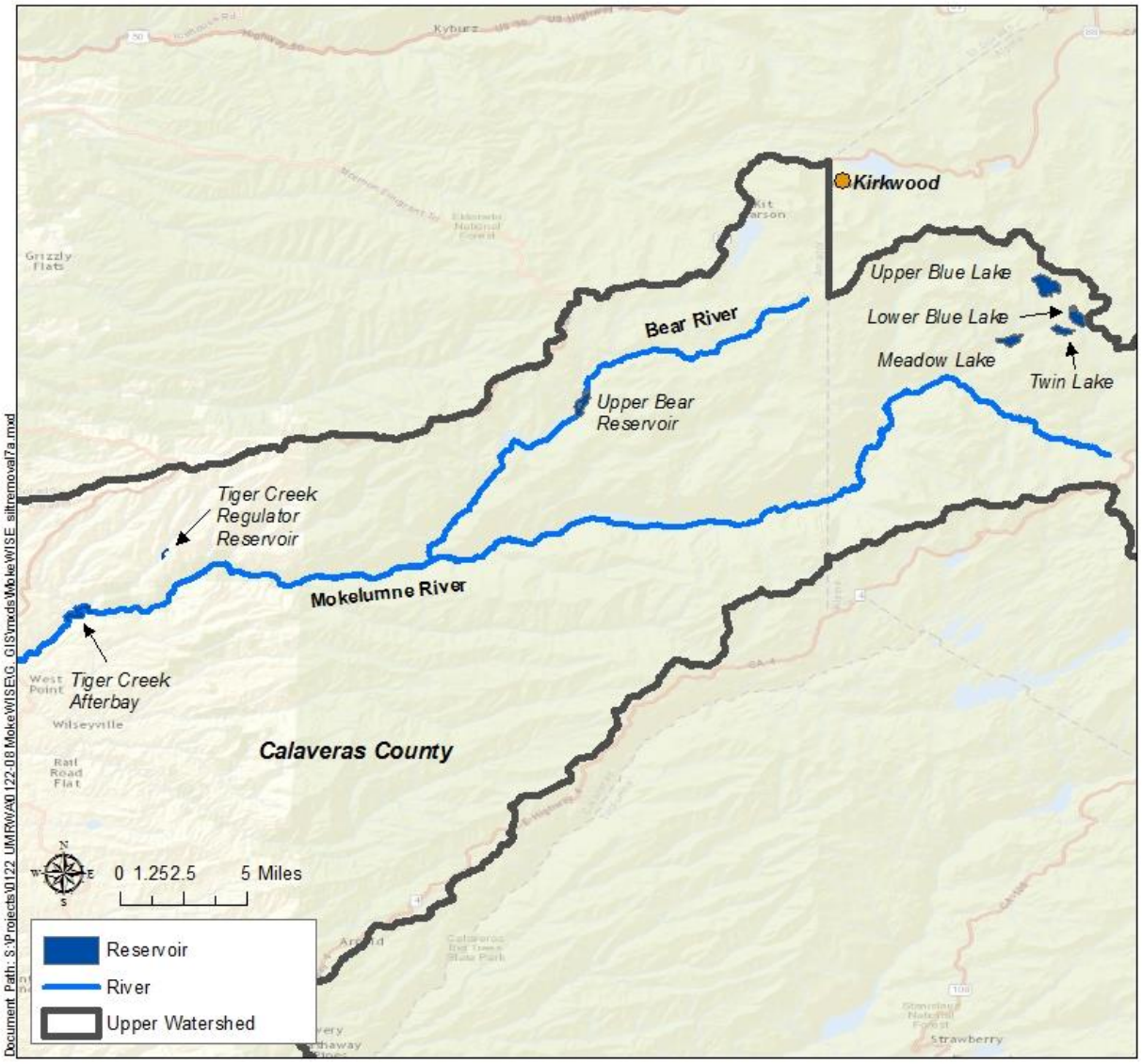
The study will evaluate the cost-benefit ratio of restoring existing reservoirs. It will also evaluate the feasibility and benefits of screening reservoir sediments and using those that fall within a prescribed range for gravel augmentation projects in other areas of the river corridor.

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).

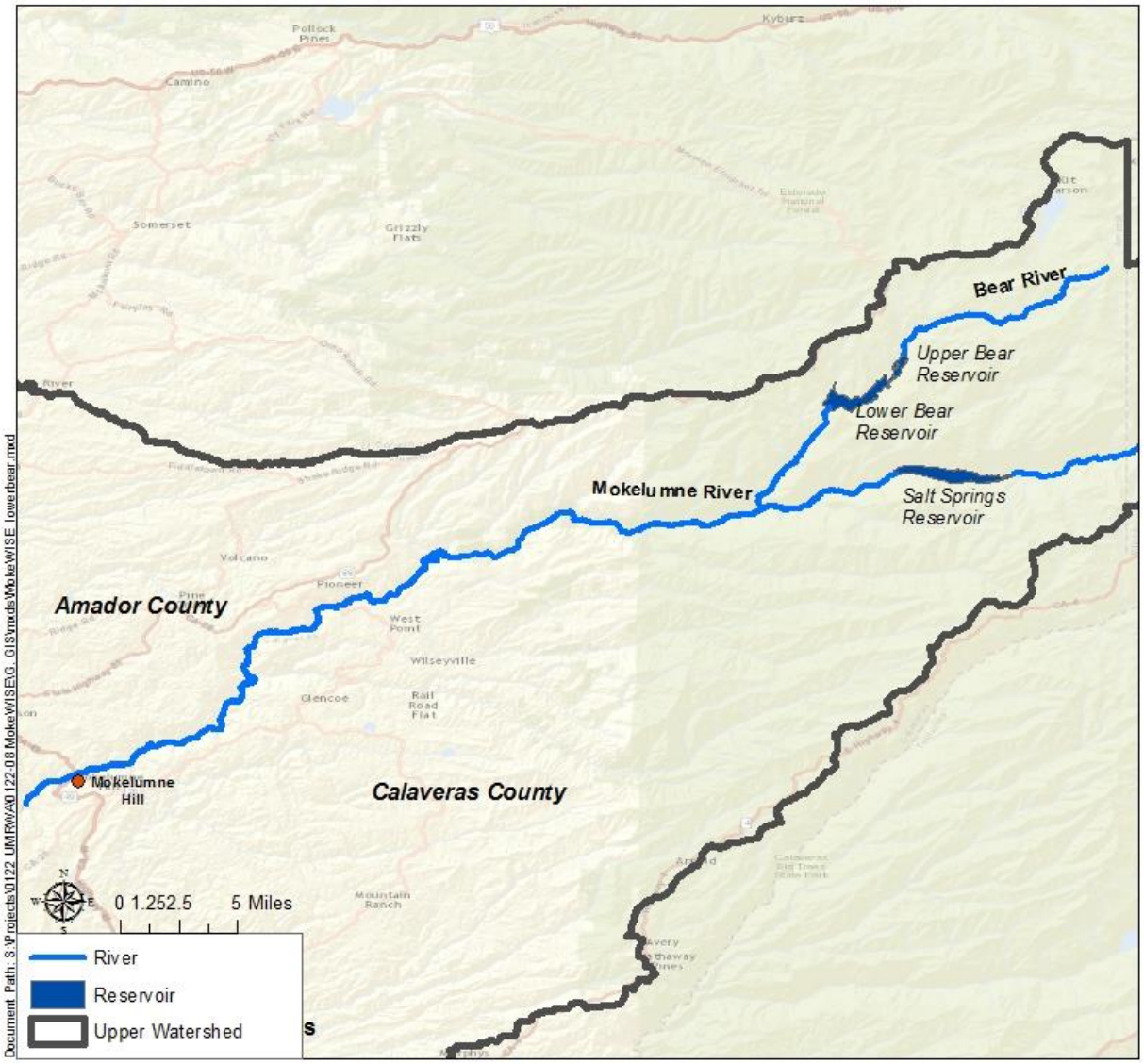
The study will include a consultation process with interested and concerned stakeholders during all phases.

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

David C. Willer, PE Consultant in Water and Power. 1991, revised 2005. *Bear River Water Supply Alternatives for Amador Water Agency and Calaveras County Water District.*

East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April 2012.

RW Beck and Associates. 1994. *Enlarged Lower Bear River Reservoir Water Yield Study*.

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.

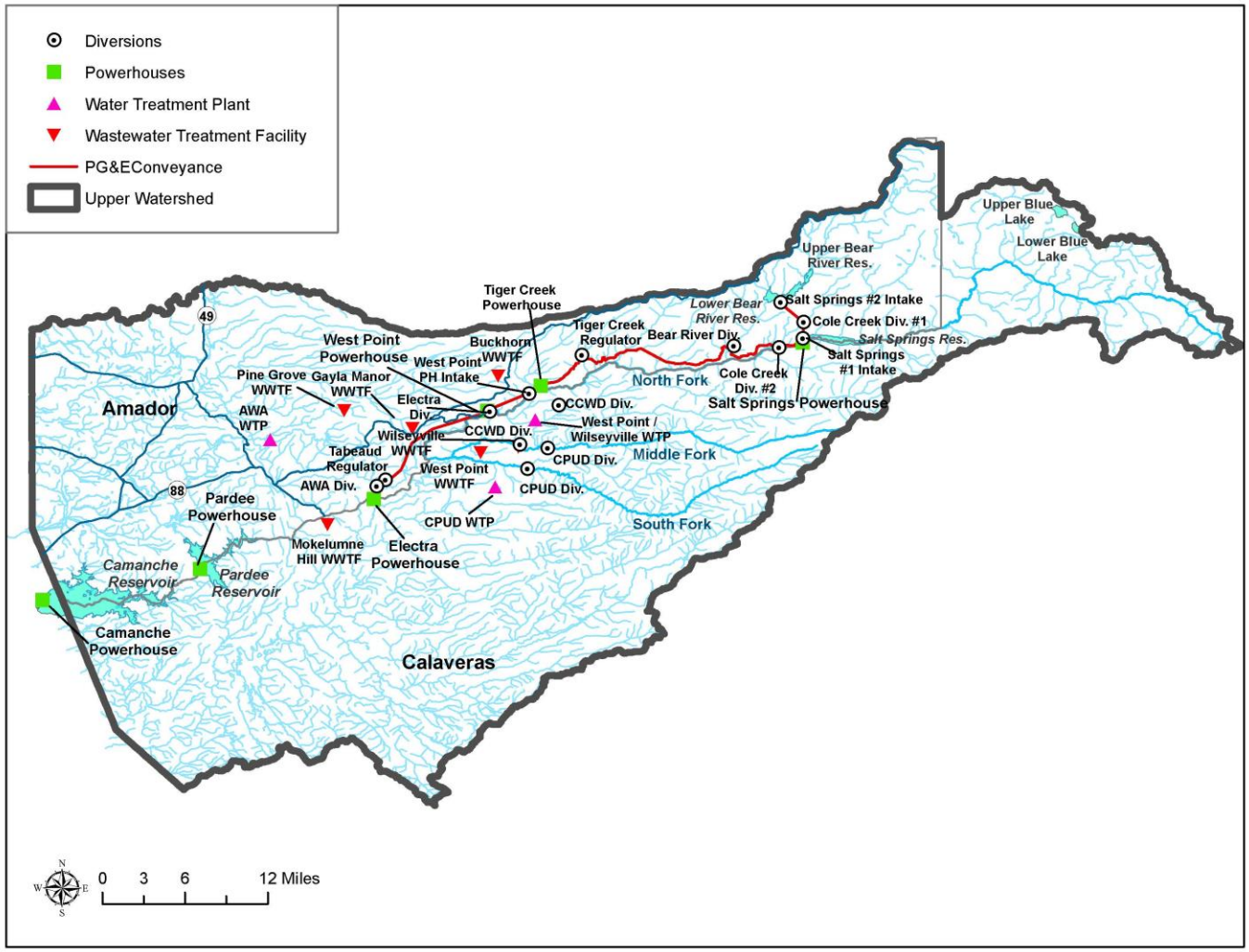
The study will include a consultation process with interested and concerned stakeholders at all stages, from design through approval of results.

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:

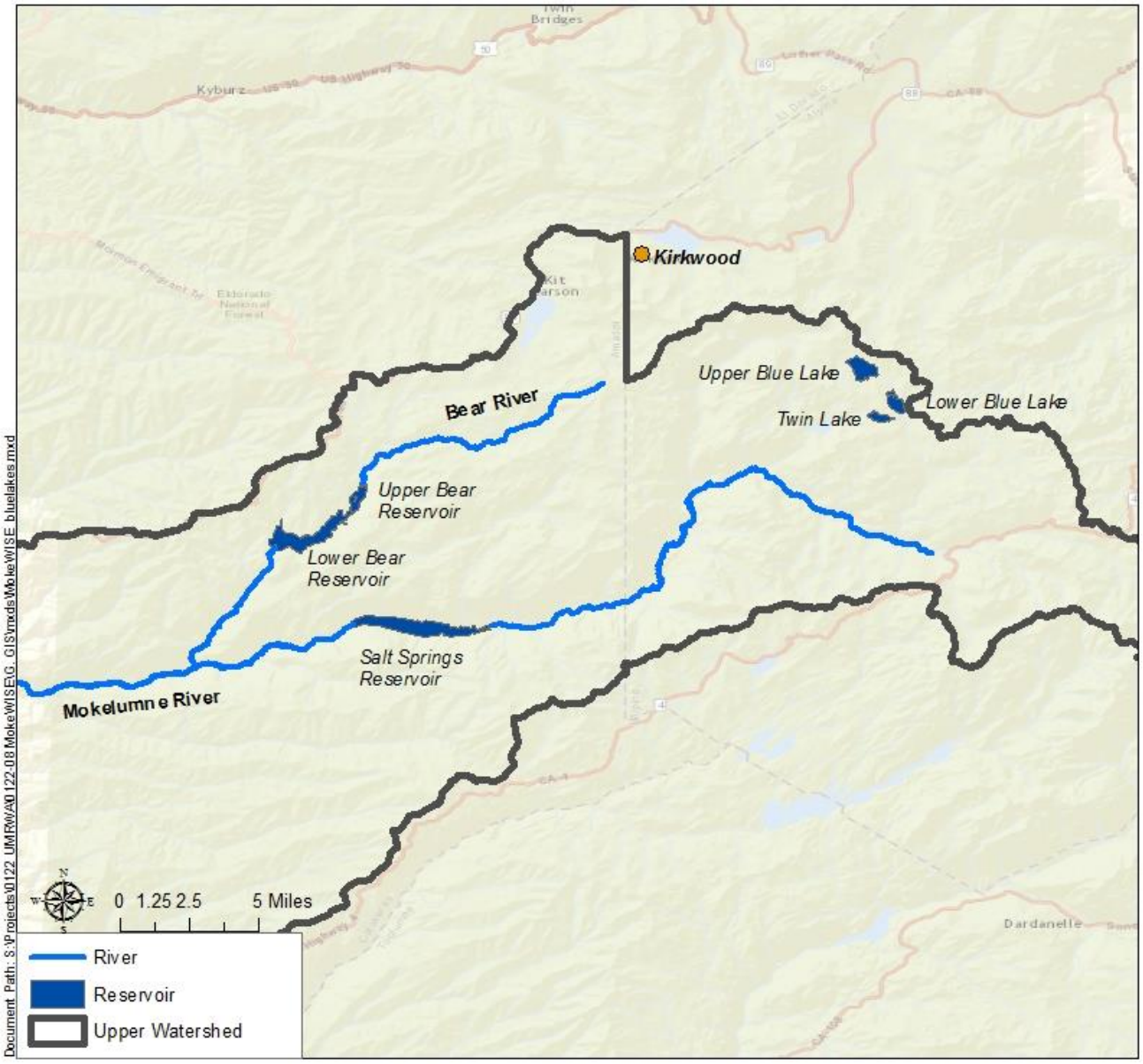
- Review existing engineering, geology, and environmental information on the area and dams;
- Conduct geotechnical field and laboratory investigation and testing to independently determine the safety of these dams during earthquakes and without lowering the water levels during the winter;
- Review the 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.

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[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

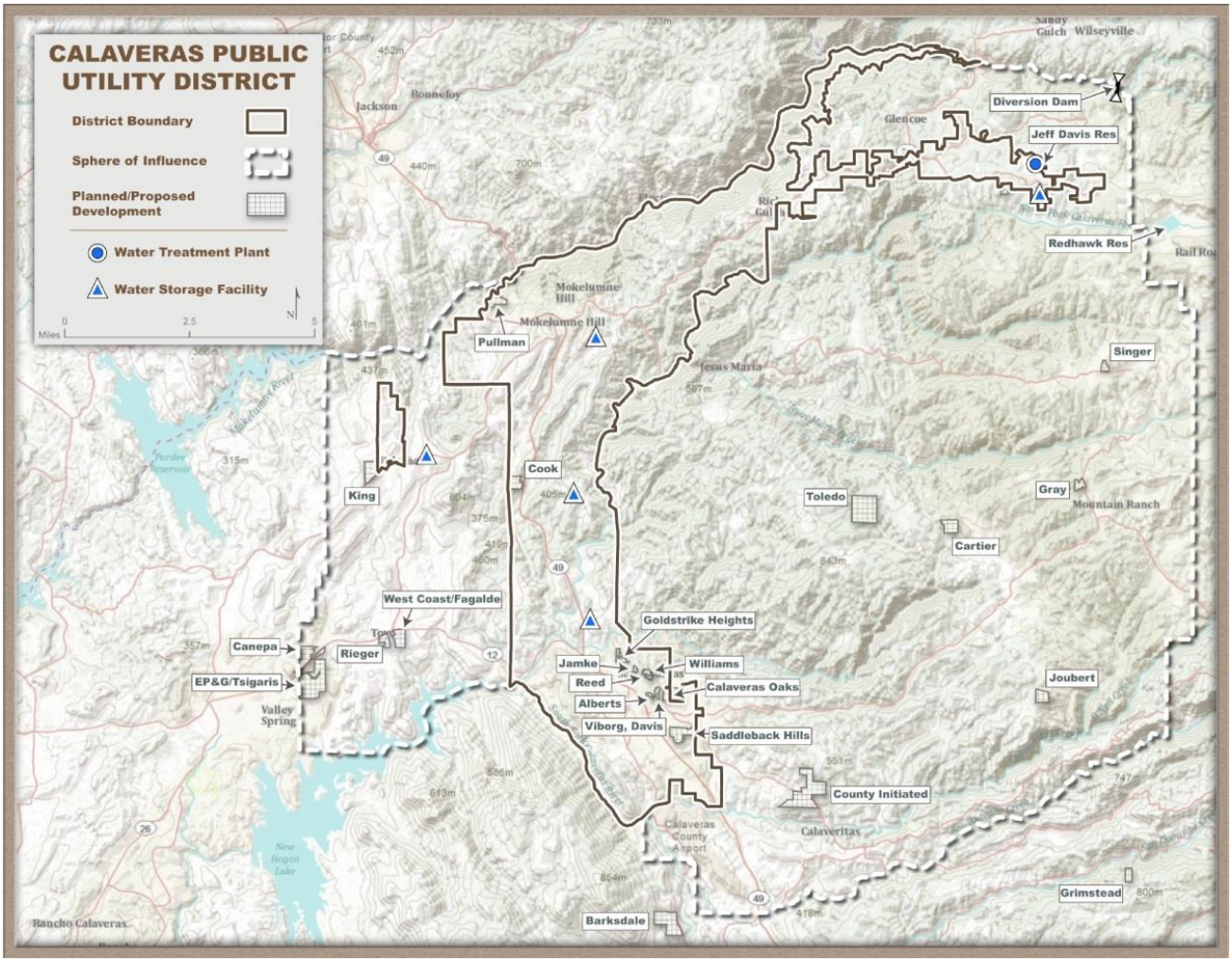
This concept will conduct a study to determine the benefits of replacing all or a portion of the transmission main that conveys treated water from the Jeff Davis Water Treatment Plant (WTP) to Mokelumne Hill, Paloma, and San Andreas. The study will include assessment of areas that are reaching life expectancy, 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

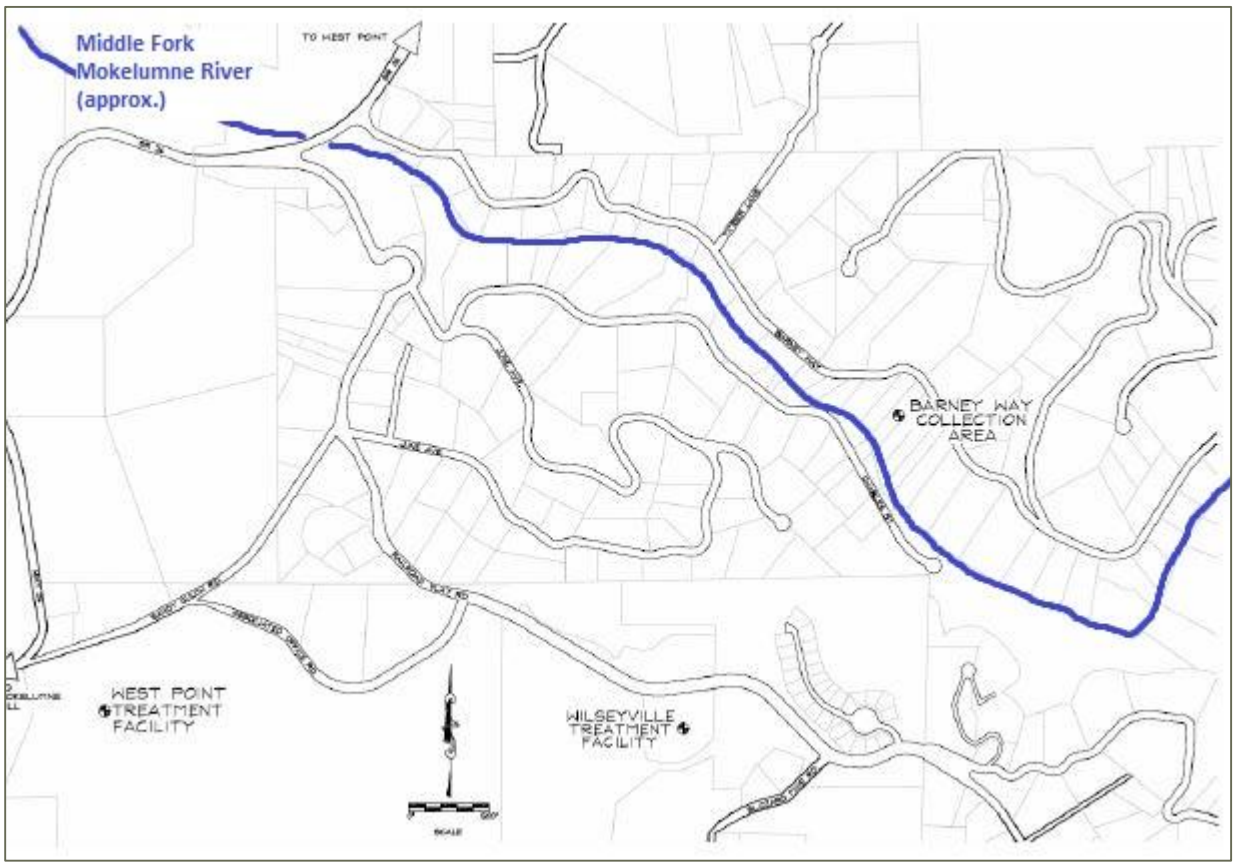
Abstract

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.

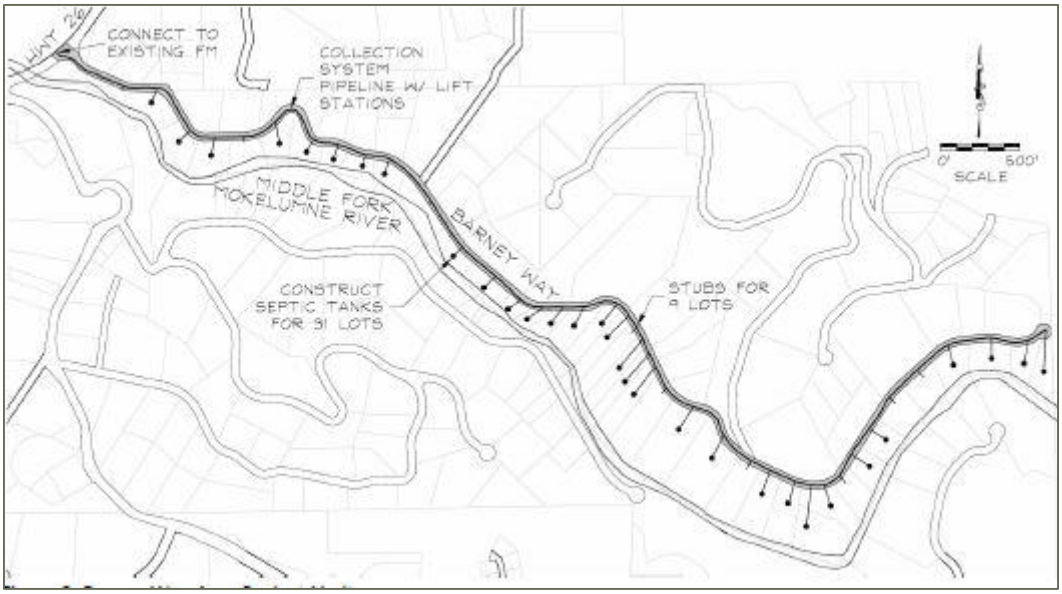
Task 2. Public Outreach

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

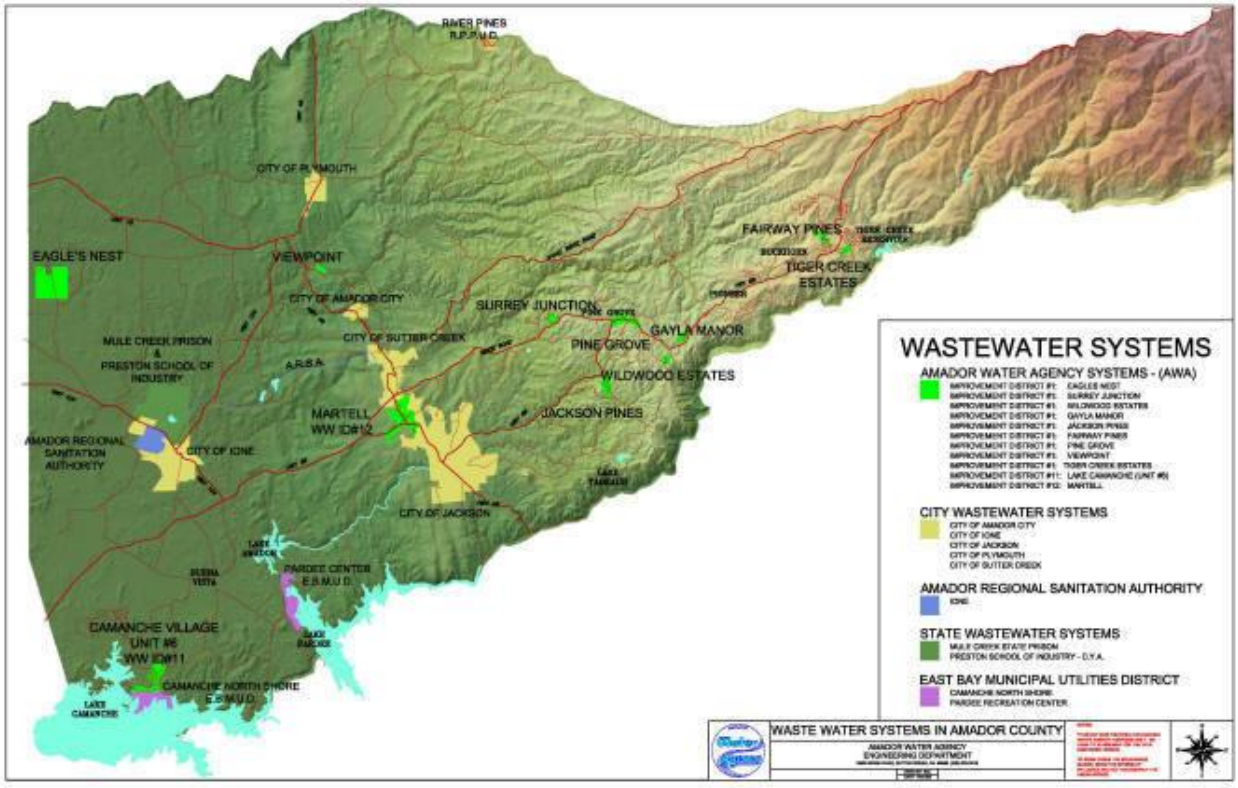
Supply	2010 (AFY)	2015 (AFY)	2020 (AFY)	2025 (AFY)	2030 (AFY)
Surface Water	16,150	17,200	17,200	17,200	17,200
Groundwater	296	369	441	511	581
Recycled Water	0	0	0	0	0
Incidental Transfer to EBMUD*	N/A	N/A	N/A	N/A	N/A
Total	**16,446**	**17,569**	**17,642**	**17,711**	**17,781**

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

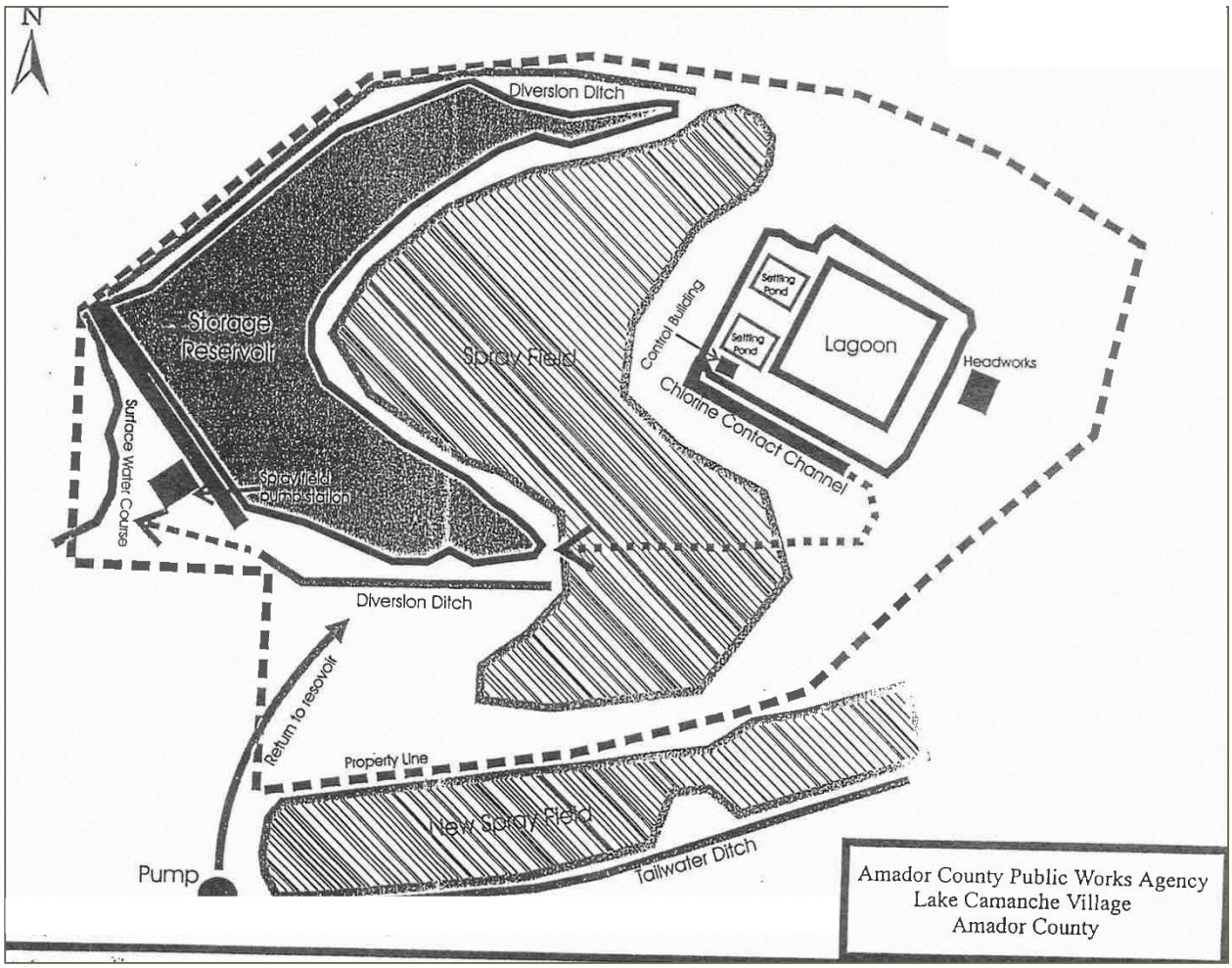


Source: AWA, n.d. (http://www.amadorwater.org/waste_wtr_srv_area.html)

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).

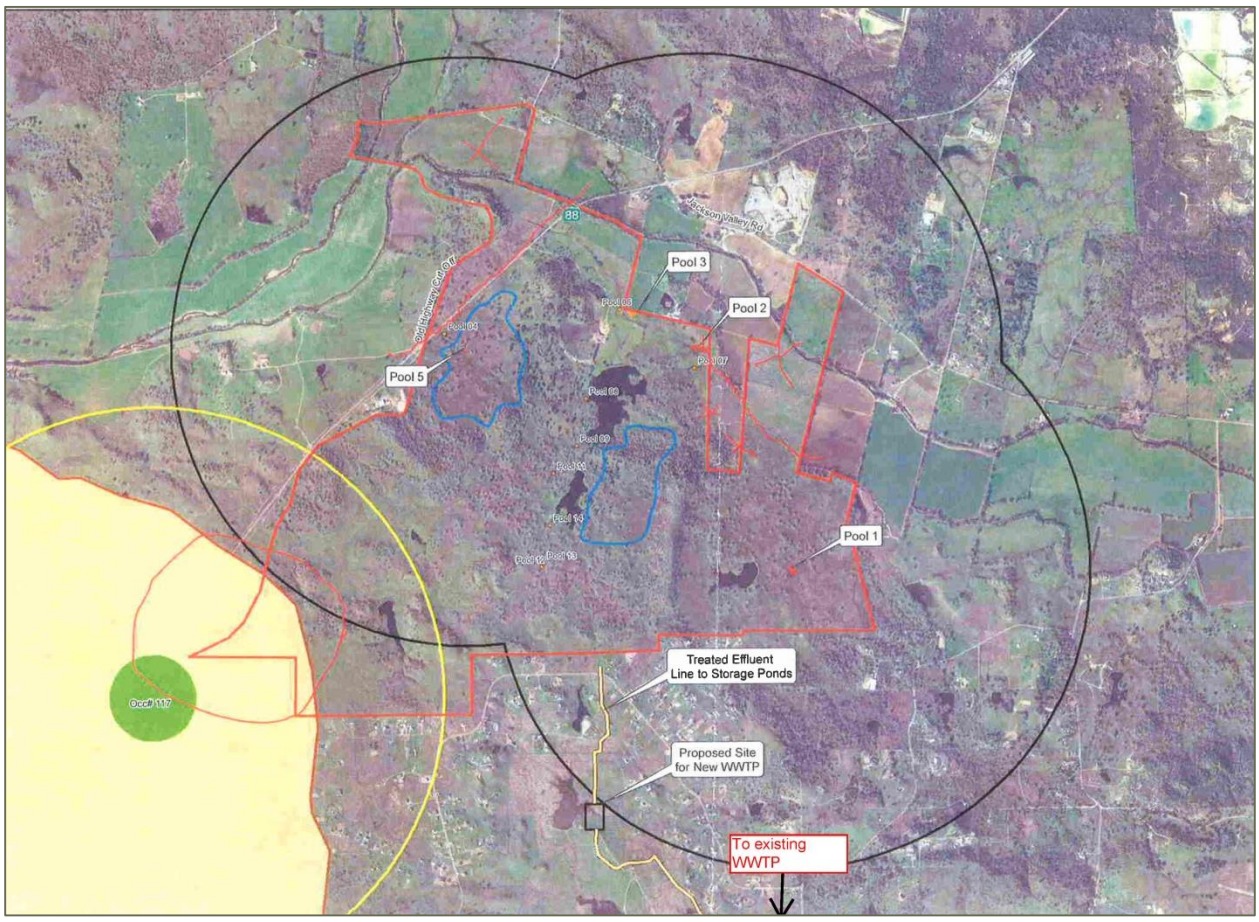
Scope of Work

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.

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