

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE LAKE ARROWHEAD COMMUNITY SERVICES DISTRICT
AND
THE ARROWHEAD LAKE ASSOCIATION
AND
THE BUREAU OF RECLAMATION
FOR THE

**S&T 7100 EVALUATION OF APPROACHES TO DETERMINE MIXING AND
ASSIMILATION OF REUSE EFFLUENT PROJECT**

THIS MEMORANDUM OF UNDERSTANDING (MOU) for the S&T 7100 Evaluation of Approaches to Determine Mixing and Assimilation of Reuse Effluent Project (Project) is made and entered into this 2nd day of January, 2019, by the Lake Arrowhead Community Services District, hereinafter referred to as “**District**” and The Arrowhead Lake Association, hereinafter referred to as “**Association**” and The United States Department of the Interior, Bureau of Reclamation, hereinafter referred to as “**Reclamation**”, and collectively referred to as “**Partners**”.

1. PURPOSE AND BENEFIT

The Partners agree to work collaboratively to perform the S&T 7100 Evaluation of Approaches to Determine Mixing and Assimilation of Reuse Effluent project. The purpose of this study is to investigate the best modeling approach to simulate mixing and assimilation of reuse effluent, given a wide range of site specific reservoir conditions and a wide range of available modeling approaches. Reclamation will work with the University of Nevada, Las Vegas (UNLV) to complete research required for this project, which includes data collection from Lake Arrowhead.

This research benefits the public at large as it will propose further research to enhance the understanding at all levels of government of how recycled water can be integrated into existing potable water supplies. This research seeks to optimize water supply by proposing modeling of recycled water in existing reservoirs.

The California State Water Quality Control Board has recently developed regulations on Surface Water Augmentation, so some agencies may be interested in developing models to predict how contaminants will move through reservoirs and how they can estimate residence time. They will need models to show how the discharges will be diluted in the reservoirs.

Results from the research at Lake Arrowhead will be used to develop a manual to guide agencies in hydrodynamic modeling and mixing for reservoirs where re-use effluent is

being considered, which will help gain further understanding of reuse effluent concentration at existing or proposed potable water intakes. This project is anticipated to address the following question as it relates to other reservoirs for which mixing of reuse effluent is being considered:

In the event that reuse water will be discharged into a reservoir to help meet water supply needs, what is the most appropriate and verifiable modeling approach that can be used to determine environmental impacts and ultimately to set a limit, if any, on the amount of reuse water that could be discharged to the reservoir?

2. BACKGROUND

Lake Arrowhead Dam and reservoir were originally conceived as a project to supply irrigation water to the lowlands of the San Bernardino Valley. In 1891, the Arrowhead Reservoir Company was formed and commenced construction of the Little Bear Dam at the east end of Little Bear Valley, approximately 80 miles east of Los Angeles. The Arrowhead Reservoir and Power Company took over in 1905 with the goal of generating hydropower from the project. This company completed construction of the 200-foot-high, 720-foot-long semi-hydraulic earth fill dam in 1921 and filled to capacity in 1923 creating the original Lake Arrowhead reservoir.

The Lake Arrowhead Community Services District (District) was created under the State of California's Community Services District Law in 1978 for the purpose of purchasing the privately-owned water system serving the Arrowhead community. The District expanded several times between 1978 and 1983 resulting in an expanded District boundary as it exists today.

Lake Arrowhead is owned and operated by the Arrowhead Lake Association (Association), a community corporation organized on July 2, 1974, for the specific purpose of providing nonprofit recreational facilities and activities on and around Lake Arrowhead, exclusively for the use and enjoyment of roughly 10,000 owners of residential property in Arrowhead Woods. The Association maintains relationships with Lake Arrowhead Community Services District, The State of California, San Bernardino County and other local business establishments.

3. AUTHORITY

This agreement is intended to facilitate cooperative efforts for research conducted by Reclamation and UNLV on Lake Arrowhead as part of the S&T 7100 Evaluation of Approaches to Determine Mixing and Assimilation of Reuse Effluent project. Reclamation's authorities to enter into this agreement are as follows:

SEC. 9509. Research Agreement Authority.

The Secretary may enter into contracts, grants, or cooperative agreements, for periods not to exceed 5 years, to carry out research within the Bureau of Reclamation.

4. RESPONSIBILITIES

All work to be performed under this MOU shall be identified in the Statement of Work (Attachment A) agreed to by all parties. The SOW includes the description of tasks to be performed, responsibilities of the parties, a cost estimate, and a schedule.

Each party shall be solely liable for the negligent acts of its own employees. Reclamation is not held liable for the acts of contractors under its sovereign immunity. This would be the same for Financial Assistance.

5. TERMS OF AGREEMENT

This MOU shall remain in full force and effect for a period commencing upon the date of the last signature of the party hereto and extending to, but not exceeding September 30, 2020. This MOU may be modified, in writing, by mutual agreement of the parties. This MOU may be terminated for cause, by any party, 60-days from written notification by the party requesting termination.

6. IT IS MUTUALLY AGREED AND UNDERSTOOD BY AND BETWEEN THE PARTIES THAT:

6.1 This MOU is neither a fiscal nor a funds obligation document. Any endeavor involving reimbursement or contribution of funds between or among the parties to this MOU will be handled in accordance with applicable laws, regulations, and procedures including those for Government procurement and printing. Such endeavors, if any, will be outlined in separate agreements that shall be made in writing by representatives of the parties and shall be independently authorized by appropriate statutory authority. This MOU does not provide such authority, and specifically, this MOU does not establish authority for a noncompetitive award to the parties of any contract or other agreement.

6.2 Nothing in this MOU shall obligate the parties or the United States to any current or future expenditure of resources in the absence or in advance of the availability of appropriations from Congress.

6.3 This MOU in no way restricts the parties from participating in similar activities or arrangements with other public or private agencies, organizations, or individuals.

6.4 No member of, or Delegate to, Congress shall be admitted to any share or part of this MOU, or any benefits that may arise wherefrom; but this provision shall not be construed to extend to the MOU if made with a corporation for its general benefit.

6.5 This MOU in no way grants the parties or any of its members any preferential treatment, exclusive use rights, or other privileges at or on Reclamation facilities, its lands or waters, over and/or above those which are accorded the general public.

6.6 The parties hereto agree to meet as necessary, to discuss all matters relevant to this MOU.

7.0 COORDINATION AND PROGRESS REPORTS

7.1 The need for progress reports, if any, shall be included in the SOW.

7.2 Work performed under this MOU is subject to examination and audit by the State Auditor General, the Federal Inspector General, and each Party for a period of three years after final payment of funds under this MOU.

8.0 KEY PERSONS FOR THIS MOU ARE

8.1 Bureau of Reclamation

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8.2 The Lake Arrowhead Community Services District

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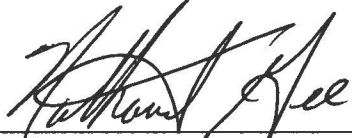
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8.3 The Arrowhead Lake Association

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IN WITNESS WHEREOF, the **Partners** have executed this MOU on the date and the year written below.

**UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
LOWER COLORADO REGION**

By: 
Mr. Nathaniel Gee, Regional Engineer

Date: 1/2/2014

THE LAKE ARROWHEAD COMMUNITY SERVICES DISTRICT

By: 
Mrs. Catherine Cerri, General Manager

Date: 11/14/2018

THE ARROWHEAD LAKE ASSOCIATION

By: 
Mr. Wayne Austin, General Manager

Date: 12/14/18

ATTACHMENT A

Scope of Work

ATTACHMENT A – SCOPE OF WORK

Work will be performed through September 30, 2020. The research is anticipated to answer the following question: *What is the best modeling approach to simulate mixing and assimilation of reuse effluent, given a wide range of site specific reservoir conditions and a wide range of available modeling approaches?* As each respective agency typically has a specific modeling approach and specific needs, this research seeks to support reservoir operational decision making regarding mixing of reuse effluent.

The total cost associated with this project, that is funded by Reclamation, is \$415,500. No direct funding will be provided by the District or Association.

Tasks to be completed for this scope of work are listed below. These tasks will be completed by Reclamation and UNLV, with assistance from the District and Association in the form of access to Lake Arrowhead and knowledge of the site. The District and Association will provide Reclamation and UNLV access to Lake Arrowhead primarily for data collection. Access to the Lake may include use of a boat from the Association or negotiated use of the maintenance barge. Technical group meetings to discuss project progress and data collection will be held monthly in the form of conference calls.

1. **Project Management.** Project Management is necessary to ensure smooth execution of the research proposal deliverable. Reclamation is responsible for project management tasks.
2. **Data Collection.** Gather information about Lake Arrowhead, its outfall and intake design location, and operating conditions. Acquire or generate information required for modeling inputs including the lake's water balance, hydrodynamics, meteorology, energy budget, reservoir operating conditions, and water quality.
3. **Establish the model approximations and simplifications needed.** Define a representative but simplified set of conditions to replicate the Lake Arrowhead's situation, and then determine the spatial mesh and temporal step sizes for a coupled system based on the defined conditions.
4. **Generate input files for each model.** Generate required model input data files for Lake Arrowhead's bathymetry, water quality and hydrodynamic/meteorological, operational conditions.
5. **Couple the models and conduct trial runs.** Create a two-way coupling between the near-field and far-field models and conduct trial runs of the coupled system based on the defined conditions.
6. **Evaluate Trial Runs.** Evaluate results of coupled system and adjust the coupling approach to make sure appropriate coefficients have been adopted and the coupling algorithm can work successfully under different conditions.

7. Conduct full scale modeling runs. Run the coupled system based on the generated/gathered input data from steps 3 through 8 and evaluate the results, looking for stability of model output and soundness of results (e.g. dilutions increasing further from the discharge and estimated travel times are within the expected range) and use the Monte Carlo technique.
8. Conduct spot field measurements to generate validation data. Design and perform field validation experiments using a rapidly measured water quality parameter, such as conductivity/temperature/depth (CTD), (or possibly chlorophyll a, turbidity) measurements in the reservoir.
9. Adjust input data per validation results – Compare the model outputs with obtained data from the field measurements and perform required adjustments to the model. Adjustments might include changes in grid size, variation in estimated turbulent eddy diffusivities, and changes in simplifying assumptions (for example, changing an estimate of three vertical grid cells immediately down-gradient of the discharge to five).
10. Run the model with adjusted data for scenarios observed during the field campaign. Again, use Monte Carlo techniques to generate probability distributions of input variables and probability distributions of dilutions and travel times to the drinking water intake.
11. Conduct additional scenario analysis if needed. After validation of the model, different scenario analyses need to be performed to simulate/evaluate the role of the lake as an environmental buffer to protect public health. Use a Monte Carlo technique for different scenarios.
12. Technical Reporting, Professional Publications and Published reports to include:
 - a. Technical Memorandum, Report, or Manual summarizing findings and recommendations of research in electronic format only.
 - b. Peer Review by Subject matter expert. Subject matter expert to provide ongoing peer review and oversight of research, make recommendations regarding hydrodynamic modeling, and other tasks. Internal peer review by Reclamation's Denver Technical Service Center will be conducted.
 - c. Professional Publications, Publish Reports. Publish studies, reports, and data developed on behalf of, and in close coordination with, local partners, such as the City of San Diego.

These tasks will be completed according to the project schedule, below.

Table 1. S&T 7100 Project Schedule

Projected Completion Date	Milestone and Brief Information
9/30/17	Select model & lake
6/30/20	Evaluate available lake data
12/31/18	Model approximations
12/31/18	Field validation
7/31/18	Met station install
5/10/19	Collect, evaluate data Year 1
9/30/18	Tracer study waiver application & review
9/30/18	Prep tracer study #1
10/15/18	Model input files
11/30/18	Trial model runs
10/27/18	1 st tracer study
12/31/18	Evaluate tracer study results
1/31/19	Model & calibrate 1 st tracer study
2/28/19	2 nd tracer study
4/30/19	Evaluate 2 nd tracer study and recalibrate model
6/30/19	Model scenario analysis
5/10/20	Collect, evaluate data Year 2
8/31/19	Scenario data visualizations
10/31/19	Expert review scenario analysis
1/31/20	Revise scenario analysis
3/1/20	Write 1 st draft technical report
3/31/20	Expert review 1 st draft report
5/15/20	Revise 1 st draft report
6/30/20	Agency S&T review draft final report
7/31/20	UNLV revisions
8/31/20	Expert Review of UNLV revisions
9/30/20	Final revisions submit final report