BUREAU OF RECLAMATION
LOWER COLORADO BASIN REGION
CATEGORICAL EXCLUSION CHECKLIST

CATEGORICAL EXCLUSION NUMBER: CEC-LC-19-01
WBS OR KEY WOID: SNT 7100
DATE: 10/01/2018

PROJECT NAME: Lake Arrowhead Tracer Study

PROJECT DESCRIPTION:

In 2017, The Bureau of Reclamation (Reclamation) entered into a cooperative agreement (# R17AC00041) with the University of Nevada, Las Vegas (UNLV) for a Science and Technology Program titled, *Evaluation of Approaches to Determine Mixing and Assimilation of Reuse Effluent.* The program proposes using two environmentally safe tracers to investigate the pattern and intensity of mixing in Lake Arrowhead, CA for potential use of recycled water for surface water supply augmentation. Tracer study results will be used to calibrate a three-dimensional hydrodynamic computer model that will be used to simulate dilution and assimilation of a hypothetical recycled water influent into Lake Arrowhead (Attachment A).

During 2017 and 2018, the study focused on research regarding water quality, bathymetry, hydrodynamics, and reservoir operating conditions of Lake Arrowhead. Research also focused on literature reviews, agency coordination, and model selection. UNLV now proposes injecting U.S. Environmental Protection Agency approved Rhodamine WT (RWT), a fluorescent dye tracer, and sucralose, an artificial sweetener also used as a tracer, into the lake. The dye and sucralose would be injected into the lake using either a tank-based injection system or a tank-less injection system, the latter would also include an intake component to mix lake water with the dye before injecting it into the lake.

Findings obtained from the combined tracer studies and computer simulations will be used as a basis for preparation of a guidance manual to support future studies of potential use of recycled water for surface water supply augmentation that can improve communities' drought resilience.

Continued under "Remarks"

EXCLUSION CATEGORY:
516 Departmental Manual 14.5
Categorical Exclusions - (A) 3. Research activities, such as nondestructive data collection and analysis, monitoring, modeling, laboratory testing, calibration, and testing of instruments or procedures and nonmanipulative field studies.

EVALUATION OF CRITERIA FOR CATEGORICAL EXCLUSION

1. This action or group of actions would have significant effect on the quality of the human environment. (40 CFR 1502.3) No_X_ Uncertain__ Yes___.

2.	This action or group of actions would have highly controversial environmental effects or involve unresolved conflicts concerning alternative uses of available resources. (NEPA Section 102(2)(E) and 43 CFR 46.215 (c))	No_X_Uncertain__Yes___.
3.	This action would have significant impacts on public health and safety. (43 CFR 46.215 (a))	No_X_Uncertain__Yes___.
4.	This action would have significant impacts on such natural resources and unique geographic characteristics as historic or cultural resources; park, recreation or refuge lands; wilderness areas; wild or scenic rivers; national natural landmarks; sole or principal drinking water aquifers; prime farmlands; wetlands (EO 11990); floodplains (EO 11988); national monuments; migratory birds; and other ecologically significant or critical areas. (43 CFR 46.215 (b))	No_X_Uncertain__Yes___.
5.	The action would have highly uncertain and potentially significant environmental effects or involve unique or unknown environmental risks. (43 CFR 46.215 (d))	No_X_Uncertain__Yes___.
6.	This action would establish a precedent for future action or represent a decision in principle about the future actions with potentially significant environmental effects. (43 CFR 46.215 (e))	No_X_Uncertain__Yes___.
7.	This action would have a direct relationship to other actions with individually insignificant but cumulatively significant environmental effects. (43 CFR 46.215 (f))	No_X_Uncertain__Yes___.
8.	This action would have significant impacts on properties listed or eligible for listing on the National Register of Historic Places as determined by Reclamation. (43 CFR 46.215 (g))	No_X_Uncertain__Yes___.
9.	This action would have significant impacts on species listed or proposed to be listed, on the List of Threatened or Endangered Species or have significant impacts on designated Critical Habitat for these species. (43 CFR 46.215 (h))	No_X_Uncertain__Yes___.
10.	This action would violate Federal, State, local, or tribal law or requirements imposed for protection of the environment. (43 CFR 46.215 (i))	No_X_Uncertain__Yes___.

11. This action will adversely affect Indian Trust Assets (ITA). (S.O. 3175) — No_X_ Uncertain__ Yes___.

12. This action would have a disproportionately high and adverse effect on low income or minority populations. (43 CFR 46.215 (j)) — No_X_ Uncertain__ Yes___.

13. This action would limit access to and ceremonial use of Indian sacred sites on Federal lands by Indian religious practitioners or significantly adversely affect the physical integrity of such sacred sites (EO 13007). (43 CFR 46.215 (k)) — No_X_ Uncertain__ Yes___.

14. This action would contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area or result in actions that may promote the introduction, growth, or expansion of the range of such species (Federal Noxious Weed Control Act and EO 13112). (43 CFR 46.215 (l)) — No_X_ Uncertain__ Yes___.

NEPA Documentation:

Categorical Exclusion	_X_
EA	__
EIS	__

REMARKS:
The National Pollutant Discharge Elimination System (NPDES) permit program is delegated to the California Regional Water Quality Boards (CRWQB). Discharge reporting waivers for RWT and sucralose have been submitted to the CRWQB and are awaiting approval.

There will be no effect on proposed, Threatened or Endangered Species. There is no designated Critical Habitat in the project area.

The proposed action has been reviewed for possible effects to Indian Trust Assets (ITAs). ITAs have not been identified in the project area; so no impact to ITAs is anticipated.

The study proposes to use two environmentally safe tracers to investigate the pattern and intensity of water mixing. The undertaking has no potential to affect historic properties (NOPE) and meets NOPE Category 23: Monitoring of facilities, biota, or environmental condition where no ground or other physical disturbance occurs.

ENVIRONMENTAL COMMITTMENTS:

General
All Federal, State, and local required permits shall be obtained prior to the start of the project.

A NPDES Permit or reporting waiver shall be obtained from the appropriate CRWQB before the tracer study can proceed.

Biological

All project equipment that is used in water bodies, rivers or streams, or that mixes water from these sources shall be decontaminated prior to and after use to prevent the spread of Aquatic Invasive Species. Refer to decontamination protocols located in *Recommended Protocols and Standards for Watercraft Interception Programs for Dreissenid Mussels in the Western United States.* This document can be found at: http://www.psmfc.org/program/prog-4?pid=17

To prevent the spread of noxious and invasive weeds, equipment used for this project shall be thoroughly cleaned prior to entering the project site. The cleaning process will ensure that all dirt and debris that may harbor noxious or invasive weeds seeds are removed and disposed of at an appropriate facility. Reclamation's *Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species: 2012 Edition* should be referenced for inspection and cleaning activities. The manual can be found at: http://www.usbr.gov/mussels/prevention/docs/EquipmentInspectionandCleaningManual2012.pdf

If biological issues or questions arise prior to or during project implementation contact Reclamation's Biological Services Coordinator at 702-293-8130.

Hazardous Materials

If there are any spills of a hazardous material during the tracer study contact the Lower Colorado Basin Region Hazardous Materials Coordinator at 702-293-8130 so that the appropriate notification can be made and cleanup procedures are followed.

Cultural

In the event of an unanticipated discovery, all operations in the area of the discovery will cease and a Reclamation archaeologist contacted at 702-293-8130. "Discovery" means the encounter of any previously unidentified or incorrectly identified cultural resource including, but not limited to, archaeological deposits, human remains, or places reported to be associated with Native American religious beliefs and practices.

Preparer's Name and Title: _____ Date: 10/22/18.
Environmental Protection Assistant

Concurrence with Item 5 & 10: _____ Date: 10/22/18.
Hazardous Materials Specialist

Concurrence with Item 4, 9 & 14: _____ Date: 10/23/18
Biological Services Coordinator, Compliance

Concurrence with Item 8 & 13: _____ Date: 10/23/2018.
(required) Cultural Resources Management Professional

Concurrence with Item 11: _____ Date: 10/23/2018
(required) Designated Indian Trust Asset (ITA) Coordinator,
Area Manager, or Office Director

Approved By: _____ Date: 10/23/2018.
Environmental Compliance Group Manager, LC-2600

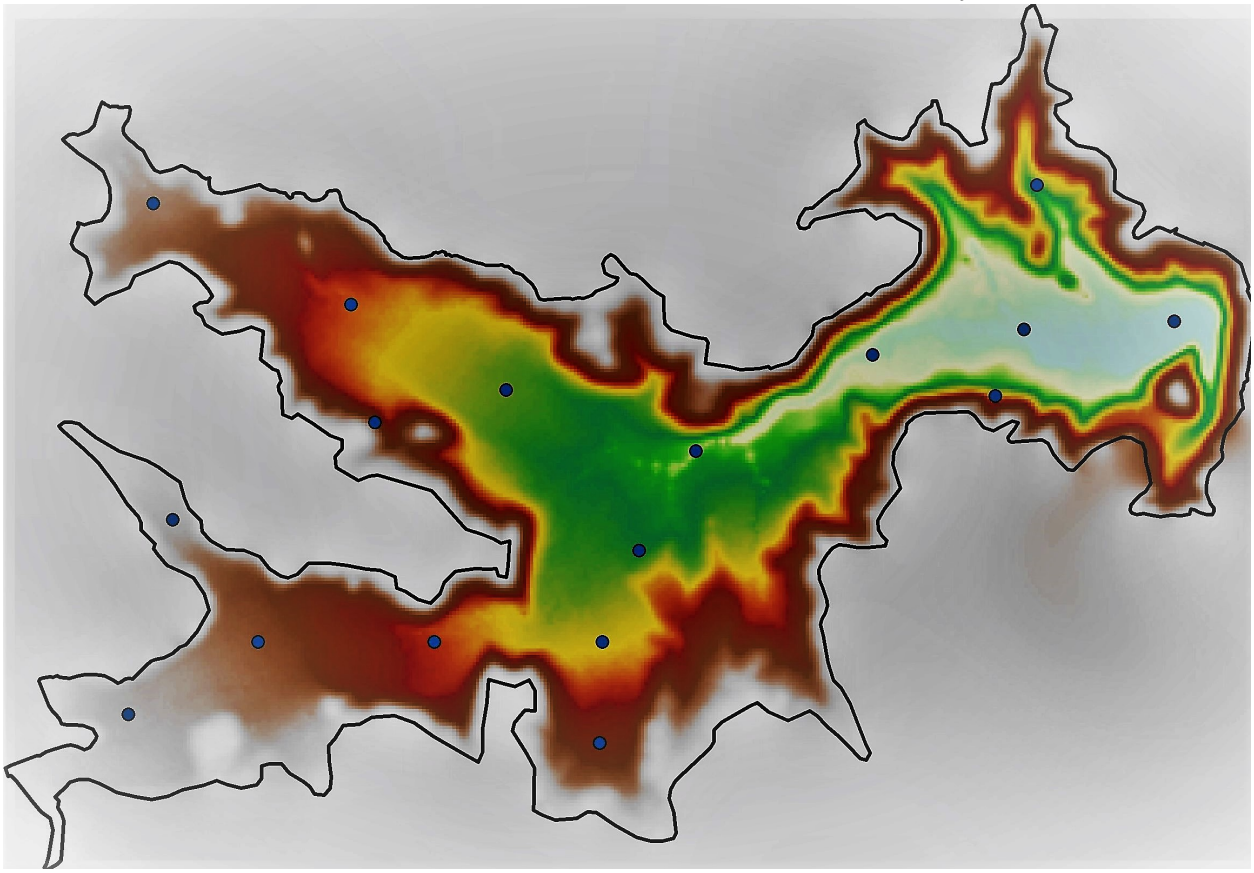
Attachment A

CEC LC-19-01

Introduction and Background - Needs and Benefits, Public Interest and Risk

Proposed Lake Arrowhead Tracer Study

Figure A. Color-coded contour map of Lake Arrowhead's bathymetry. Blue dots show proposed Rhodamine WT and sucralose tracer sampling locations. Depth color codes: Light green: > 100 feet. Green: 80-100 feet. Yellow: 60-80 feet. Red: 40-60 feet. Maroon: 20-40 feet. Grey: < 20 feet



1.1 About Lake Arrowhead

Lake Arrowhead reservoir (Figure 1A and 1B) was created by clearing Little Bear Valley and building a semi-hydraulic fill dam to impound inflows from Little Bear Creek. Stream inflows from Little Bear Creek and the subsequently completed Grass Valley Tunnel are ephemeral, primarily occurring winter rainfall and occasionally from spring snowmelt. The spillway is not at the dam but at Willow Creek on the north shore of the lake. According to the 2008 US Bureau of Reclamation Bathymetry survey[1], the reservoir, when full, has a storage capacity of 46,855 acre-feet and a surface area of 767 acres at a water surface elevation of 5,106.7 feet (ALA datum of 1917). The maximum depth of the lake is in excess of 150 feet. It has over 2,500 recreational boating docks on its 14 miles of shoreline. The lake's maximum width is 1.5 miles and length from east to west is about 2.2 miles.

[1] USBR, 2009. *Lake Arrowhead 2008 Reservoir Survey.* Technical Report No. SRH-2009-9 https://doi.org/https://www.usbr.gov/tsc/techreferences/reservoir/Lake Arrowhead 2009 Report.pdf

The lake serves as a water supply only for the community of Arrowhead Woods, with a 2010 census population of 12,424. The reservoir also provides recreational boating, swimming and fishing access. The lake is privately owned, and managed by the Arrowhead Lake Association (ALA). Water supply and treatment, along with sewage collection and treatment, are provided by the Lake Arrowhead Community Services District (LACSD). Sewage collection and treatment are provided by LACSD to the communities of Arrowhead Woods, Blue Jay, Cedar Glen, Skyforeest, Rim Forest, Deer Lodge Park and Arrowhead Villas.

The lake's water inflows are primarily from direct precipitation and streamflow. Net outflows are primarily from evaporation and withdrawal for potable water use from two intakes, one located on the south shore of North Bay, the Bernina intake, and one located on the south shore of Emerald Bay the Cedar Glen intake. In above average precipitation years, outflows will occur over the Willow Creek spillway. In drought years, the lake level may never reach the spillway. As of June 27, 2018, the lake level was 7.0 feet below the spillway elevation.

A prolonged trend of decreasing precipitation has prompted the community to begin evaluation of alternative sources of water supply to augment the lake level. LACSD can utilize groundwater from a couple of wells and purchase water from the Crestline Lake Arrowhead Water Agency (CLAWA). A third option would be to return wastewater effluent treated to near-potable standards, called recycled water, to the reservoir for additional residence time, a process called indirect potable reuse through surface water augmentation. It is the purpose of this request for a waiver of discharge reporting requirements to conduct a tracer study to evaluate the transport and mixing of tracer compounds over time so that mixing processes in the lake can be better understood and incorporated into a three-dimensional hydrodynamic model.

1.2 Summary of proposal

The attached proposal describes the use of US-EPA approved Rhodamine WT (RWT), a fluorescent dye tracer, and sucralose, an artificial sweetener, as two environmentally safe tracers (co-tracers) to investigate the pattern and intensity of mixing in Lake Arrowhead. The work would be carried out as a collaborative effort among UNLV (funded by the US Bureau of Reclamation, USBR), the Arrowhead Lake Association and the Lake Arrowhead Community Services District. If the requested waiver of discharge reporting requirements for use of the tracers is approved, tracer study results will be used to calibrate a three-dimensional hydrodynamic computer model that will be used to simulate dilution and assimilation of a hypothetical recycled water influent into Lake Arrowhead under different weather conditions. Findings obtained from the combined tracer study and computer simulations will be used as a basis for preparation of a USBR-guidance manual for water purveyors to support future studies of potential use of recycled water for surface water supply augmentation that can improve communities' drought resilience.

As this study proposes the use of two different tracers, this waiver of discharge reporting requirements application contains two distinct parts that can be separately reviewed:

- Sections 1 and 2: Request for a waiver for a proposed Rhodamine WT (RWT) tracer study, and
- Sections 3 and 4: Request for a waiver for a proposed sucralose tracer study.

The proposed RWT tracer study can be conducted if the proposed sucralose tracer study is not approved. However, if approved, implementation of sucralose as the second tracer (or co-tracer) depends on approval of the RWT tracer study, because RWT fluorescence will be used to determine where to sample for sucralose.

The proposed use of the two co-tracers will significantly increase the validity of findings, as each tracer result can be compared to the other. In addition, since RWT tracer will slowly photodegrade in well-illuminated surface waters, and sucralose is very stable, cross-validation with sucralose as a non-fluorescent tracer can be used to determine the overall rate of RWT decay in Lake Arrowhead, improving the accuracy of dilution estimates.

After RWT tracer injection, Eureka fluorometric sondes with a resolution of 0.01 parts per billion (ppb) for RWT and a feasible detection limit of 0.01 ppb for RWT, and a combined analysis method of Solid Phase Extraction (SPE) followed by High Pressure Liquid Chromatography-Tandem Mass Spectrometry (HPLC-MS) with a Method Detection Limit (MDL) of 0.005 ppb for sucralose will be used to measure tracer concentrations. Due to the low detection limits of both the RWT sondes and the HPLC-MS methods, very small masses (3.91 kilograms or 8.62 pounds) of each tracer could be released and tracked in the lake. Assuming a full lake level, the final concentration of each tracer when completely mixed with lake water would be 0.067 ppb. These mixed concentrations are factors of several thousand to several million below the tracers' recorded toxicities for aquatic life. The completely mixed RWT concentration is well below the US EPA advisory opinion stating a 10 ppb limit for use as a tracer in the vicinity of drinking water intakes (Turner Designs website, document 998-5104). No adverse effects are expected on either human health or Lake Arrowhead's aquatic life at the proposed concentrations.

In this proposed study, if approved, both tracers would be released simultaneously. The primary tracer in this proposed study is the Rhodamine WT (RWT) dye. If approved, movement and dilution of RWT would be measured in real-time after injection by repeatedly conducting vertical profiles Manta TDX fluorometric sondes at different locations on the lake. For the proposed second tracer, sucralose, 1-liter water samples would be withdrawn from the lake at designated target depths using Van Dorn bottles, and transported to UNLV's environmental engineering laboratory for chemical analysis. Since neither tracer will be visible, identification of sampling locations for the sucralose tracer will rely on the real-time fluorometric readings of the RWT tracer.

If the tracer study is approved, results of these two proposed tracer studies will be used to calibrate a three-dimensional hydrodynamic model that will be used to simulate dilution and assimilation of a hypothetical recycled water influent into Lake Arrowhead under different weather conditions. Findings obtained from the combined tracer studies and computer simulations will be used as a basis for preparation of a guidance manual to support future studies of potential use of recycled water for surface water supply augmentation that can improve communities' drought resilience.

1.3 Needs and Benefits

Many communities currently use surface water sources of varying quality to supply their drinking water, including sources that are subject to upstream discharges of treated wastewater. In an era of sustained drought, the need to develop additional sustainable water supplies to address growing populations and declining supplies, combined with recent advances in water reclamation technologies, has motivated

study of recycled water (highly-treated wastewater treatment plant effluent) as a potential resource to augment drinking water supplies (Asano et al., 2007). Currently, in the United States, direct use of recycled water for human consumption is not permitted. However, a growing number of communities are studying potential indirect potable reuse through surface water augmentation, with two-fold protection provided by advanced water reclamation technologies and blending recycled water in a lake or reservoir (Asano et al., 2007). In this context, the lake or reservoir acts as an environmental buffer, allowing the recycled water to undergo additional processes of degradation, dilution, and assimilation (Hawker et al., 2011). Hence, the degree of dilution of the recycled water discharge with the lake or reservoir and travel time to intakes are the two key components of a multiple barrier approach to reduce public health risks (Preston et al., 2014).

The University of Nevada, Las Vegas (UNLV) is conducting an applied research project, funded by the U.S. Bureau of Reclamation, on development of a guidance manual for communities to evaluate and use best-practice approaches to estimate the dilution and travel time of recycled water in lakes and reservoirs. In partnership with the Lake Arrowhead Community Services District (LACSD) and the Arrowhead Lake Association (ALA), this project is using Lake Arrowhead as a case study site to develop the best practice guidelines. The manual includes sections on environmental data collection, lake water quality monitoring, three-dimensional hydrodynamic modeling to simulate mixing and assimilation of recycled water, and the potential use of tracers to validate the hydrodynamic model. An ongoing water quality monitoring program has been initiated in May 2018 to generate input data for the hydrodynamic model by measuring recording and analyzing various properties of the lake. Measured water quality parameters include temperature, conductivity, chlorophyll-a, pH, dissolved oxygen (DO), and photosynthetically active radiation (PAR) versus depth at six locations to determine the intensity of horizontal and vertical mixing that exists in Lake Arrowhead.

This project proposes to use Rhodamine WT (RWT) fluorescent dye and sucralose, an artificial sweetener, as co-tracers to estimate dilution, travel time and mixing intensity in different parts of Lake Arrowhead. Results of this proposed dye tracer study will be used to estimate the magnitudes of both wind-driven mixing and coefficients of eddy diffusion that will serve as inputs to the three-dimensional hydrodynamic model. Subsequently, the calibrated model will be used to accurately determine travel time and simulate dilution of hypothetical recycled water discharges to Lake Arrowhead under representative variations in meteorological conditions.

1.4 Public Interest

This proposed tracer study has the support of the Lake Arrowhead Community Service District (LACSD) and the Arrowhead Lake Association (ALA). The proposed discharge of tracer, and associated waiver of discharge reporting is in the public interest because, if approved, results of the proposed tracer study and associated numerical modeling would be used to prepare a best practice “how to” guidance manual for communities throughout California and the western United States that are interested in conducting water quality studies that would support decisions about augmenting their water supplies and improve their drought resilience. Results of the proposed tracer study could also serve as preparatory material for a future specific indirect potable reuse surface water augmentation study to support improvement of drought resilience for the Lake Arrowhead community.

1.5 Risk

The proposed RWT discharge will use calibrated high resolution (0.01 ppb) fluorometric sondes to assess the movement of low concentrations of Rhodamine WT tracer dye. US EPA's August 2, 1988 letter stated that they did "not anticipate any adverse health effects resulting from the use of Rhodamine WT as a fluorescent tracer in water flow studies when used within the following guidelines:

- A maximum concentration of 100 micrograms/liter Rhodamine WT is recommended for addition to raw water in hydrological studies involving surface and ground waters.
- Dye concentration should be limited to 10 micrograms/liter in raw water when used as a tracer in or around drinking water intakes.
- Concentration in drinking water should not exceed 0.1 micrograms/liter. Studies which result in actual human exposure to the dye via drinking water must be brief and infrequent. This level is not acceptable for chronic human exposure."

There are two water intakes in Lake Arrowhead, one 2,950 feet and another 4,235 feet from the proposed injection site. The intakes are at a summer 2018 depth of about 71 feet, approximately 21-38 feet deeper into denser waters in the thermocline than the proposed 33-50 foot injection depth in warmer less dense waters.

Preliminary worst-case estimates of travel time, dilution and movement of the dye tracer indicate that, since the tracer will continue to be diluted as it travels in longer indirect paths across the lake and then along the shoreline or follow bathymetry before turning back to the intakes, estimated concentrations of tracer will be in the range of 1.7 to 2.7 ppb at the level of the intakes if, in a worst-case scenario the tracer plume were to approach the drinking water intakes in the first 1.2 to 1.6 days of the study (please see **Appendix 4** of the Rhodamine WT request). Added tracer concentrations would be 0.067 ppb above background values when fully mixed with lake water, if, assuming conservatively, no degradation were to occur. There is no RWT in Lake Arrowhead, but background fluorescence due to algal pigments has been detected at levels as high as 0.05 ppb.

These predicted results show that it is very unlikely that RWT concentrations approaching the 10 ppb limit will occur at the drinking water intakes. In place will be monitoring and notification procedures, along with a plan by LACSD to divert to alternative supplies in the event that the 10 ppb limit is approached. The RWT tracer sections of the waiver request provide detailed information about plans to monitor the drinking water intakes for any increase in RWT that approaches the 10 ppb US EPA advisory limit. shut the intakes, and monitor in the plant for RWT. UNLV conducted an experiment using the standard LACSD 4 mg/L chlorine dose in Lake Arrowhead water and showed that even if the tracer plume with an RWT concentration of 10 ppb were to approach the drinking water intakes, the chlorinated water rapidly reacts with the RWT and the RWT concentration drops to the drinking water US EPA Advisory limit of 0.1 ppb in 8 minutes and to the 0.01 ppb detection limit in 11 minutes (please see **Appendix 5** of the Rhodamine WT waiver request). These reaction times that are far less than the 10-20 hour holding times in LACSD's storage tanks prior to release of treated water to the distribution system

Sucralose is approved by the Food and Drug Administration (FDA) as a safe general-purpose sweetener. Sucralose has been studied extensively, and the FDA reviewed more than 110 safety studies in support of its approval of the use of sucralose as a general-purpose sweetener for food (US FDA, 2018).

Aquatic toxicity of sucralose is much lower than for RWT dye. Ecotoxicological assessments of sucralose using U.S. EPA's Ecological Structure Activity Relationship Model, ECOSAR (USEPA, 2010) suggest that sucralose may cause toxicity to aquatic organisms only at concentrations ≥ 1,123 mg/L (1,123,000 ppb) (Tollefsen et al., 2012). Comparing the toxicity threshold of 1,123,000 ppb to either starting concentrations of 70–100 ppb or to the final mixed concentration of 0.067 ppb that would be used in this tracer study, no adverse effects on aquatic environment in Lake Arrowhead are expected. From a May 11, 2018 sampling, background sucralose concentrations in Lake Arrowhead were found to range from 0.030 to 0.084 ppb.

Detailed descriptions of the proposed tracer addition, monitoring, notification and if needed, spill clean-up procedures are described in the attached requests for permit waivers that can be reviewed separately.

- Sections 1 and 2: Request for a waiver for a proposed Rhodamine WT (RWT) tracer study, and
- Sections 3 and 4: Request for a waiver for a proposed sucralose tracer study.

References

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Preston, A., Hannoun, I.A., List, E.J., Rackley, I., Tietjen, T., 2014. Three-dimensional management model for Lake Mead, Nevada, Part 1: Model calibration and validation. *Lake Reserv. Manag.* 30, 285–302. https://doi.org/10.1080/10402381.2014.927941

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