LIMNOLOGY AND RESERVOIR DETENTION STUDY OF SAN VICENTE RESERVOIR

INTRODUCTION AND CONTENTS

San Vicente Reservoir (SVR) is located near Lakeside, California, and is used as a source of drinking water supply by the City of San Diego (City), its owner and operator. The reservoir currently has a capacity of about 90,000 acre-feet. It is undergoing an expansion that will raise the dam 117 feet and increase the reservoir's storage capacity to 247,000 acre-feet at the spillway level. The City is considering an option to augment the SVR supply by bringing advanced treated recycled water (*i.e*., purified water) from an advanced water purification facility to SVR. This would be an Indirect Potable Reuse / Reservoir Augmentation (IPR/RA) project. The purified water would be blended with other water in the reservoir. The current project – the Water Purification Demonstration Project (Demonstration Project) – will not actually put any purified water into the reservoir; rather it will study and model the reservoir augmentation process.

A component of the Demonstration Project is the Limnology and Reservoir Detention Study of San Vicente Reservoir (Limnology Study). For the Limnology Study, Flow Science Incorporated (FSI) has employed a numerical three-dimensional water quality model that is used to evaluate hydrodynamic and water quality effects of using purified water to augment SVR. The Limnology Study consists of four technical memoranda or TMs:

- TM #1 – calibration of the model
  (*Reservoir Augmentation Demonstration Project: Limnology and Reservoir Detention Study of San Vicente Reservoir - Calibration of the Water Quality Model, May 1, 2012*)
- TM #2 – hydrodynamic modeling
  (*Water Purification Demonstration Project: Limnology and Reservoir Detention Study of San Vicente Reservoir - Hydrodynamic Modeling Study, May 1, 2012*)
- TM #3 – nutrients and algae modeling results
  (*Water Purification Demonstration Project: Limnology and Reservoir Detention Study of San Vicente Reservoir – Nutrient and Algae Modeling Results, May 1, 2012*)
- TM #4 – proposed water quality monitoring plan
  (*San Vicente Reservoir Proposed Water Quality Monitoring Program, July 10, 2012*)

Flow Science Incorporated (FSI) began by developing [i.e., customizing or tailoring] the three-dimensional water model to conditions at SVR. The model was calibrated using measured data from SVR. After the model was developed its results were compared to existing field data. The results of this analysis were documented in a Technical Memorandum (TM #1) submitted to the City in 2010 and finalized in May 2012 (FSI, 2012a). TM #1 has been peer-reviewed by the National Water Research Institute Independent Advisory Panel (IAP) that was assembled for the review of the City's Demonstration Project. After implementing suggestions proposed by the IAP, the model was deemed by IAP to be "an effective and robust tool, for 1) simulating

thermoclines and hydrodynamics of the San Vicente Reservoir; 2) assessing biological water quality for nutrients; 3) assessing options for the purified water inlet location" (NWRI, 2010).

Upon completion of the SVR model calibration and validation, FSI conducted simulations of purified water delivery to the expanded SVR under various projected future operating conditions using the calibrated and validated model. The simulation results and findings are presented in two separate Technical Memorandums. TM #2 summarizes the hydrodynamic aspects of the modeling results, focusing on density stratification, mixing, and dilution in the reservoir. TM #2 was submitted to the City on November 28, 2011 and finalized in May 2012 (FSI, 2012b). TM #3 focuses on the water quality aspects of the modeling results and findings, with emphasis on nutrients (phosphorus and nitrogen), dissolved oxygen (DO), and algal productivity, and was submitted to the City on February 24, 2012 and finalized in May 2012 (FSI, 2012c). Both TM#2 and TM#3 have been peer-reviewed by the IAP (NWRI, 2012 a, b).

If SVR is augmented by purified water in the future, the three-dimensional model developed for the Limnology Study is expected to provide a tool for evaluating various reservoir management options, assessing residence time and dilution of the purified water within SVR, determining optimal reservoir operations for maximizing water quality, and minimizing any potential short-circuiting between the inlet and outlet. It is expected that the model will be updated on a yearly basis using new data collected each year. In order to update the model and maintain it as a tool for assessing reservoir water quality and operations, data collection in the reservoir, as well as its inflows and outflows, will be needed. TM #4 provides an outline of a reservoir monitoring plan to obtain these necessary data and was submitted to the City on June 21, 2012 and finalized in July 2012 (FSI, 2012d). Another goal of the monitoring plan is to identify monitoring efforts that may be needed to enhance water treatability and address future water quality regulatory issues.

REFERENCES

Flow Science Incorporated (2012a). "Reservoir Augmentation Demonstration Project: Limnology and Reservoir Detention Study of San Vicente Reservoir – Calibration of the Water Quality Model", FSI Project V094005, Pasadena, CA.

Flow Science Incorporated (2012b). "Water Purification Demonstration Project: Limnology and Reservoir Detention Study of San Vicente Reservoir – Hydrodynamic Modeling Study", FSI Project V094005, Pasadena, CA.

Flow Science Incorporated (2012c). "Water Purification Demonstration Project: Limnology and Reservoir Detention Study of San Vicente Reservoir – Nutrient and Algae Modeling Results", FSI Project V094005, Pasadena, CA.

Flow Science Incorporated (2012d). “San Vicente Reservoir Proposed Water Quality Monitoring Plan”, FSI Project V094005, Pasadena, CA.

National Water Research Institute (2010). “Findings and Recommendations of the Limnology and Reservoir Subcommittee Meeting for the Reservoir Augmentation Demonstration Project’s ‘Limnology and Reservoir Detention Study of the San Vicente Reservoir’ ” Memorandum from NWRI Independent Advisory Panel for the City of San Diego’s Indirect Potable Reuse/Reservoir Augmentation Demonstration Project, June 7, 2010.

National Water Research Institute (2012a). “Findings and Recommendations of the Limnology and Reservoir Subcommittee Meeting for the Reservoir Augmentation Demonstration Project’s ‘Limnology and Reservoir Detention Study of the San Vicente Reservoir’ ” Memorandum from NWRI Independent Advisory Panel for the City of San Diego’s Indirect Potable Reuse/Reservoir Augmentation Demonstration Project, February 22, 2012.

National Water Research Institute (2012b). “Findings and Recommendations of the Limnology and Reservoir Subcommittee Meeting for the Reservoir Augmentation Demonstration Project’s ‘Limnology and Reservoir Detention Study of the San Vicente Reservoir’ ” Memorandum from NWRI Independent Advisory Panel for the City of San Diego’s Indirect Potable Reuse/Reservoir Augmentation Demonstration Project, April 24, 2012.