

Section G: Summary and Conclusions

In an average year, approximately 85 to 90 percent of the City of San Diego's water supplies are imported water (City of San Diego, 2011a). Imported water reliability issues, coupled with recurring droughts in the San Diego region, have placed considerable strain on the City's ability to meet water demands. The City has taken a variety of actions to maximize water resources and improve water supply reliability, including moving forward with a three-phased Water Reuse Program designed to maximize the use of recycled water throughout the City. The Water Reuse Program is an integral component of the City's plan to improve water supply reliability by developing local, drought-tolerant water supplies.

The City's 2006 Water Reuse Study (Phase 1 of the Water Reuse Program) included a comprehensive evaluation of all viable options to maximize the use of recycled water produced by the City's two water reclamation plants. Based on this study, a stakeholder group determined that the preferred option for maximizing use of the City's recycled water supply would be to augment existing supplies in the City's San Vicente Reservoir with purified water (reservoir augmentation at San Vicente Reservoir).

The City recently completed Phase 2 of the Water Reuse Program, the Water Purification Demonstration Project. This three-year project assessed the feasibility of supplementing San Diego's San Vicente Reservoir with purified water produced at an advanced water purification facility located at North City. The Demonstration Project involved constructing and operating a small-scale advanced water purification facility, studying San Vicente Reservoir, implementing a public outreach and education program, coordinating with regulatory agencies, and developing conceptual design criteria and costs for a full-scale AWP facility and purified water conveyance facilities. The concept of using purified water to augment San Vicente Reservoir has been determined to be feasible, and the Mayor and City Council may consider implementing a full-scale reservoir augmentation project at San Vicente Reservoir, which would be Phase 3 of the Water Reuse Program.

The Demonstration Project consisted of the following components:

1. Convene an Independent Advisory Panel
2. Design, install, and operate a demonstration-scale advanced water purification facility at the North City Water Reclamation Plant
3. Conduct a study of San Vicente Reservoir to establish residence time and water quality parameters and conditions of purified water in the reservoir
4. Perform an energy and economic analysis

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5. Define the state's regulatory requirements for a full-scale reservoir augmentation project at San Vicente Reservoir
 6. Perform a pipeline alignment study
 7. Conduct a public outreach and education program

The Demonstration Project generated a significant body of data related to the expected performance of a full-scale reservoir augmentation project at San Vicente Reservoir. Each Demonstration Project component was designed to generate evidence and findings to assess the feasibility of such a project. Each of these components is summarized below.

- **Component: Convene an Independent Advisory Panel.** An IAP organized and managed by NWRI was convened in 2009 to oversee the Demonstration Project. The IAP consisted of ten academics and professionals with extensive expertise in the science of water reuse, including water and wastewater technology, public health, epidemiology, toxicology, water quality, environmental science, limnology, public utilities, and industry regulations. The IAP unanimously concluded that the project will "...be a landmark development in the acceptance and furtherance of indirect potable reuse and will contribute to the City of San Diego's water portfolio. The proposed project will supplement existing sources and provide a greater degree of independence, thus improving the reliability of the existing water supply." The IAP findings can be found in Appendix F.
- **Component: Design, construct, and operate a demonstration-scale advanced water purification facility at the North City Water Reclamation Plant.** The AWP Facility was designed, installed, operated, and tested between 2010 and 2012. The ability to produce purified water meeting all regulatory standards was evaluated by performing water quality testing on 12 months of purified water samples produced by the AWP Facility. The AWP Facility produced purified water that reliably met applicable water quality standards, and on-line monitoring confirmed the continuous acceptable performance of water purification technologies. Although the testing period is complete, the AWP Facility has continued to operate for public tours and to gather additional equipment performance data.
- **Component: Conduct a study of San Vicente Reservoir to establish residence time and water quality effects of purified water in the reservoir.** A detailed study of San Vicente Reservoir was conducted to establish residence time and water quality effects of purified water in the reservoir. Blending, retention time, and water quality in the reservoir were evaluated by using a robust computer model. The model was set up and applied by an expert team and validated by the IAP. It was



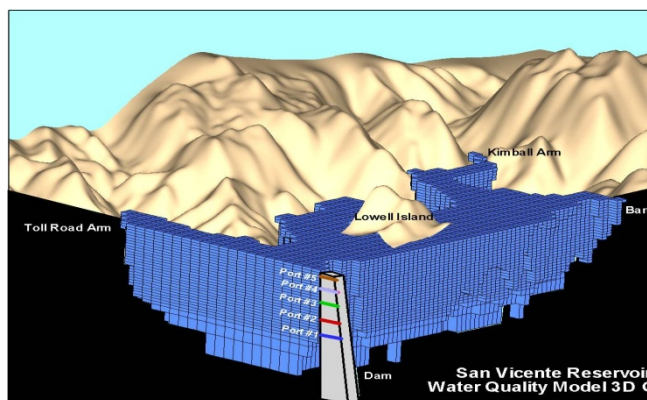
Water quality monitoring showed that purified water met all applicable regulatory standards.

determined that blending and retention of purified water in San Vicente Reservoir would constitute a substantial environmental barrier, sufficient to meet regulatory requirements, and that the addition of purified water would not adversely affect natural reservoir conditions and mixing. The modeling showed that the enlargement of the reservoir will improve nutrient-related water quality issues compared to the historical reservoir, and that adding purified to the enlarged reservoir will not substantially affect these improvements.

- **Component: Perform an energy and economic analysis.** Costs were developed based on concept-level facility plans prepared as part of the Demonstration Project and validated based on existing operating projects. Full-scale project implementation costs were estimated to be \$2,000/AF, with net costs reduced to approximately \$1,000/AF when considering wastewater system avoided costs. A full-scale reservoir augmentation project at San Vicente Reservoir would require approximately the same amount of energy and generate green house gas emissions comparable to imported water, based on an energy analysis conducted as part of the LRWRP.

- **Component: Define the state's regulatory requirements for a full-scale reservoir augmentation project at San Vicente Reservoir.**

Regulators participated in all IAP meetings and working groups addressing all technical aspects of reservoir augmentation conducted throughout the Demonstration Project. This technical background enabled the regulators to establish specific guidelines and regulatory pathways to permitting a reservoir augmentation project at San Vicente Reservoir. A Concept Approval Letter was issued for the project by CDPH, and the Regional Board issued a Resolution of Support for the reservoir augmentation at San Vicente Reservoir, and a Letter of Concurrence confirming the preferred pathway to permit a full-scale project.



The three-dimensional Water Quality Model Output demonstrated that the addition of purified water would improve nutrient-related water quality issues in San Vicente Reservoir.

- **Component: Perform a pipeline alignment study.** In 2012, a conceptual design study was completed to update recommendations for the purified water conveyance system, including potential pipeline alignments and pump station specifications (RMC, 2012). The new conveyance study also comprehensively analyzed conditions that have changed since the Water Repurification Project was completed.
- **Component: Conduct a public outreach and education program.** Comprehensive City-wide outreach enabled key stakeholders and interested members of the public to gain an understanding of how purified water offers a technically feasible and reliable supplemental water supply. Recent survey research showed that when provided with information about

the water purification process, respondents strongly or somewhat favor adding recycled water to the local drinking water supply. Feedback from individuals that toured the AWP Facility showed that providing an opportunity to tour the facility increases understanding about water purification.

Overall, the AWP Project achieved its stated objectives, and demonstrated that water purification technology may be feasibly used to produce water that could be sent to San Vicente Reservoir to be available to drinking water treatment plants for distribution as drinking water.

Table G-1 provides the summaries and findings generated throughout the course of the Demonstration Project.



Targeted presentations proved to be a vital component of the outreach program, increasing the public's understanding about water purification and the Demonstration Project.

Table G - 1: Demonstration Project Findings and Conclusions

Component	Summary	Findings
<p>Convene an Independent Advisory Panel</p>	<p>The IAP provided expert peer review of the technical, scientific, and regulatory aspects of the Demonstration Project. The IAP met ten times over the course of the Demonstration Project.</p>	<p>The IAP found that purified water would meet or exceed all drinking water requirements and provide multiple barriers for public health protection; reservoir modeling verified that the reservoir will provide 100-fold dilution of purified water, CDPH and the Regional Board have indicated support for the project, and City staff has implemented an effective public outreach program.</p> <p>The IAP found the AWP Facility produced water of a higher quality than any source available to the City of San Diego and unanimously concluded that a reservoir augmentation project at San Vicente Reservoir would be a landmark project in the acceptance and furtherance of indirect potable reuse and would improve the reliability of the City of San Diego’s water supply portfolio.</p> <p>See IAP reference letter in Appendix F.</p>
<p>Design, install, and operate a demonstration-scale advanced water purification facility at the North City Water Reclamation Plant</p>	<p>The Demonstration AWP Facility has been in operation since June, 2011. The 12-month testing period took place from August 2011 to July 2012.</p> <p>Comprehensive water quality testing included measurements for 342 constituents and parameters before and after each treatment step, and in the imported aqueduct water. A total of more than 9,000 water quality tests were performed.</p>	<p>Water quality of the purified water was compared to regulatory limits, verifying that purified water met all applicable water quality standards. This comprehensive water quality testing showed that the purified water produced at the AWP Facility is pure, approaching distilled water purity.</p> <p>Continuous and daily monitoring of each water purification process can assure the integrity of each treatment step and that only high quality water is produced.</p>

Component	Summary	Findings
<p>Perform a study of San Vicente Reservoir to establish residence time and water quality parameters and conditions of purified water in the reservoir</p>	<p>A detailed Limnology and Reservoir Detention Study of San Vicente Reservoir was conducted to establish residence time and water quality effects of purified water in the reservoir.</p> <p>Blending, retention time, and water quality in the reservoir were evaluated by using a three-dimensional hydrodynamic model.</p>	<p>The addition of purified water into San Vicente Reservoir would not affect natural hydrologic characteristics of the reservoir, seasonal stratification, or mixing.</p> <p>Blending and retention of purified water in the reservoir would constitute a substantial environmental barrier, sufficient to meet regulatory requirements.</p> <p>For all anticipated reservoir operating scenarios and purified water release locations, the reservoir would dilute the purified water by at least a factor of 200 to one.</p> <p>The addition of purified water would not substantially affect water quality in San Vicente Reservoir. The dam raise will improve overall water quality and the addition of purified water will not change these improvements.</p>
<p>Perform an energy and economic analysis</p>	<p>Cost were evaluated for a full-scale reservoir augmentation project at San Vicente Reservoir in terms of overall capital and operational and maintenance costs; unit costs, which reflect the capital and O&M costs spread over the project life and presented in terms of cost per AF of water produced.</p>	<p>The estimated capital and annual operational and maintenance costs for a full-scale reservoir augmentation project at San Vicente Reservoir are \$369 million and \$15.5 million per year, respectively.</p> <p>This capital and annual costs for a full-scale project yielded an estimated unit cost of \$2,000/AF. This unit cost is comparable to the \$2,100/AF unit cost estimated in the LRWRP for a full-scale (15 mgd average production) reservoir augmentation project at San Vicente Reservoir.</p>

Component	Summary	Findings
Perform energy and economic analysis, cont'd	As part of the 2012 Long-Range Water Resources Plan, an energy analysis for a reservoir augmentation project at San Vicente Reservoir was performed.	<p>Accounting for wastewater system avoided costs, the estimated net unit cost of a reservoir augmentation project at San Vicente Reservoir is \$1,000/AF, which is comparable to the current imported water cost.</p> <p>A full-scale reservoir augmentation project at San Vicente Reservoir was estimated to require 2,500 kWh/AF of energy and would produce approximately 1.0 metric tons of greenhouse gases/AF.</p> <p>A full-scale project would consume energy and produce green house gas emissions that are equivalent to imported water and less than ocean desalination.</p>
Define the state's regulatory requirements for a full-scale reservoir augmentation project at San Vicente Reservoir	Throughout the Demonstration Project the City engaged separately with the California Department of Public Health and the San Diego Regional Water Quality Control Board. In addition, both agencies actively participated in ten IAP meetings.	The California Department of Public Health issued a concept approval of the City's San Vicente Reservoir Augmentation Project. The San Diego Regional Water Quality Control Board, with concurrence from the United States Environmental Protection Agency issued concept approval as well.
Perform a pipeline alignment study	A conceptual design study was completed to update recommendations for the purified water conveyance system, including potential pipeline alignments and pump station specifications.	<p>The estimated capital and annual operational and maintenance costs for the conveyance system are \$225 million and \$3.4 million, respectively.</p> <p>Updated analysis of the pipeline alignment confirmed that a southerly alignment appears to be the most feasible.</p>

Component	Summary	Findings
Conduct a public outreach and education program	A comprehensive public outreach and education program was conducted throughout the city to educate San Diego's local leaders, stakeholders and residents about the Demonstration Project	<p>Recent research showed that when provided with information about the water purification process, respondents favor use of purified water to supplement local water supply via reservoir augmentation at San Vicente Reservoir.</p> <p>Feedback from individuals that toured the Advanced Water Purification Facility showed that providing an opportunity to tour the facility increases understanding about water purification.</p>