



Executive Summary

Zone 3 of San Luis Obispo County's Flood Control and Water Conservation District (District) is committed to providing a high quality water supply to its customers. As part of its on-going resources management program, the District authorized Black & Veatch to conduct an audit of Lopez Water Treatment Plant (WTP) to evaluate the existing system and to recommended future improvements. This Audit Report presents the results of an extensive evaluation of current and future state and federal regulations as well as a detailed audit of the existing WTP. The report also develops recommendations for improvements to existing facilities and identifies a recommended treatment strategy to ensure that the WTP continues to provide a safe and reliable water supply.

Project Background And Scope

Lopez WTP has provided treated water to approximately 45,000 customers in the southern portion of San Luis Obispo County for more than 30 years. Portions of the WTP are nearing the end of their useful life. In addition, modifications/additions to treatment processes are required to ensure that the WTP achieves compliance with a wide range of new and proposed state and federal regulations. Structural integrity during a seismic event is also a concern.

Specific tasks undertaken as part of the project and described in this report include: regulatory evaluation, water quality evaluation, treatment strategy alternatives development, pilot studies, and facilities improvements recommendations. In addition to the discussion in the main body of the report, this document contains 18 appendices providing more detailed information.

The findings and recommendations in this report were developed in close coordination with District staff. The project included four workshops with District staff and Zone 3 representatives to develop water quality objectives, screen potential water treatment alternatives, and identify improvements to existing facilities to meet reliability, safety, and other objectives. As the project evolved, the potential for receiving funding from the State Revolving Fund (SRF) was explored, and representatives from the Department of Health Services (DHS) participated in one of the project workshops to give timely feedback and advice.

Regulatory Compliance Evaluation

Black & Veatch evaluated 14 current and proposed future regulations to determine their potential impact on the WTP. The existing WTP is not capable of sustained regulatory compliance without improvement. Table ES-1 presents the five regulations that have the greatest potential impact on the WTP. Table ES-2 presents the treatment plant optimization goals developed by District staff as a



guide to the consultant team in conducting the remaining portions of the audit evaluation.

Table ES-1: Summary of Regulations of Concern

Regulation	Key Provisions	Compliance Issue for Lopez Water Treatment Plant
Interim Enhanced Surface Water Treatment Rule (IESWTR)	Establishes <i>Cryptosporidium</i> removal requirements, turbidity monitoring provisions.	WTP upgrades will be required to meet treated water turbidity requirements.
Stage 2 – Disinfectants/Disinfection Byproducts Rule (D/DBPR)	Lowers Maximum Contaminant Levels (MCLs) for total trihalomethanes (TTHM), total haloacetic acids (HAAs), bromate, and chlorite.	Treatment modifications will be required to meet the Stage 2 D/DBPR. Current THM levels periodically exceed Stage 1 MCLs. Precursor removal will be required long-term if chlorine used as the primary disinfectant.
Long-Term 1 ESWTR	Establishes treatment techniques for <i>Cryptosporidium</i> , requires enhanced filtration.	It is likely that a profile of microbial inactivation levels will need to be developed.
Filter Backwash Rule	Establishes requirements for recycle streams and self-assessment.	Recycling backwash prior to pretreatment should be continued.
Microbial/Disinfection Byproducts Stage 2 M/DBP Agreement in Principle	Establishes requirements for the control of microbial pathogens and disinfectants/disinfection byproducts (D/DBPs) in drinking water.	Selection of an alternative disinfectant to chlorine will be required to achieve protozoan level inactivation and removal. Other potential tools include watershed controls, optimized pre-treatment, and/or membrane treatment for filtration.
MTBE	Establishes maximum concentration for MTBE.	Limiting use of two-cycle engines and/or fuel with MTBE added may be required on the reservoir.

Table ES-2: Treatment Plant Optimization Goals

Parameter	DHS Requirement	Optimization Goal
Sedimentation/Clarification Basin Effluent	1 to 2 NTU	0.5 to 1 NTU
Combined Filter Effluent	0.3 NTU*	0.05 NTU
Reclaimed Backwash Water Effluent	Less than 2.0 NTU	Less than 2.0 NTU
After Filter Backwash/Filter-to-Waste	Less than 0.3 NTU	Less than 0.15 NTU
Manganese in Filter Effluent	0.03 mg/L	0.01 mg/L
Disinfection Byproducts		
• THMs	0.08 mg/L	0.04 mg/L
• HAAs	0.06 mg/L	0.03 mg/L

* The *Cryptosporidium* Action Plan (CAP) reduces this value to 0.1 NTU



Water Quality Evaluation

Black & Veatch performed an evaluation to characterize the raw water quality of Lopez Lake, assessed the treatment performance of the existing system, and performed initial jar testing of water drawn from the lake. Water quality at different intakes and the terminal reservoir were reviewed to assess treatability and compliance with existing and future regulations and to help with process selection and resource operation.

Review of water quality at the WTP indicates upgrades are needed in order to comply with current and future regulations; raw water for the Lopez WTP is very difficult to treat due to numerous characteristics as described in this document. (Combined filter effluent turbidity at the WTP exceeded the *Cryptosporidium* Action Plan (CAP) goal of 0.1 nephelometric turbidity units (NTU) 21% of the time during 2000.) Black & Veatch identified options for which the WTP could meet these requirements:

- TOC removal optimization, use of chlorine dioxide as a pre-oxidant, or installation of an organics removal process in order to comply with Stage 1 and Stage 2 D/DBP Rule.
- Optimization of turbidity removal, use of ozone, ultraviolet light (UV), or membranes, or establishment of source controls at Lake Lopez to comply with the Long-Term 2 Enhanced Surface Water Treatment Rule.
- Optimization of or upgrade to pretreatment, improvement of or upgrade to filter operation, or use of source controls at the Lake or Terminal Reservoir in order to comply with the *Cryptosporidium* Action Plan.

Water Treatment Strategies

From the review of the water quality data and the assessment of regulatory impacts, it was determined that the pretreatment and filtration portions of the existing WTP need to be updated, repaired, and/or replaced. Through a preliminary evaluation by Black & Veatch and through two subsequent screening workshops with the District and its Technical Advisory Committee (TAC), several alternative treatment strategies were developed. These are summarized in Table ES-3.

Table ES-3: Alternative Treatment Strategies Summary

Alternative	Description	Comments
1	Enhance Existing Pre-Treatment	Base Alternative. Not recommended due to inability to achieve long-term regulatory compliance.



Alternative	Description	Comments
2	Upgrade Existing Pre-Treatment and Conventional Filters	Sedimentation does not cope well with algae; lower quality and reliability.
3	Upgrade Existing Pre-Treatment and New Membrane Filters	Membranes increase quality, but also increase life cycle costs.
4	Upgrade with New Ballasted Flocculation/Sedimentation Pretreatment and Conventional Filters	Reliability and operation may be difficult since ballasted flocculation can be pH-sensitive.
5	Upgrade with New Ballasted Flocculation/Sedimentation Pretreatment and Membrane Filters	Reliability and operation may be difficult since ballasted flocculation can be pH-sensitive.
6	Upgrade with New Pre-Treatment, dissolved air flotation (DAF), and Conventional Filters	DAF is more reliable for algae treatment and therefore provides better quality. It is also relatively easy to operate. However, the District would require a variance to meet the CAP and would therefore not be eligible for SRF.
7	Upgrade with New Pre-Treatment, DAF, and Membrane Filters	Membranes will provide better quality than Alternative 6; however lifecycle costs will be higher. Membranes also will meet CAP provision for SRF qualifications.
8	Upgrade Using a Chemical Softening Process and Conventional Filters	Softening is expensive, labor-intensive, and does not cope well with algae.
9	Upgrade with Partial Softening with Nanofiltration and Conventional Filters	Softening is expensive, labor-intensive, and does not cope well with algae.

The alternatives were evaluated against seven criteria: public acceptance, capital cost, life cycle costs, reliability, ease of operation, quality, and ability to qualify for the SRF program. Following the first screening workshop, Alternatives 7 and 8 were further evaluated against 12 factors: staffing, regulatory requirements, public acceptance, pipeline deposition, treatment process reliability, safety, and five cost components.

Conventional filtration (without softening) is not compliant with the CAP and therefore would not be eligible for the SRF. Therefore, after the second screening process, it was determined that Alternative 7 would best meet the District's goals.



Pilot Testing

In September and October 2001, Black & Veatch conducted a pilot testing program at the Lopez WTP using a pilot trailer containing a DAF system and two dual media filters. The pilot testing demonstrated that DAF is an effective pretreatment process for particle and algae removal. However, because of the presence of submicron particles, which are very difficult to coagulate, filter performance did not meet the requirements of the *Cryptosporidium* Action Plan. Analysis of particle sizes demonstrated that post-treatment particles are not in the *Cryptosporidium* size-range. Therefore, the District would have been able to obtain a waiver from DHS, but would not have been eligible for the SRF program. Pilot testing results were incorporated into the final treatment process recommendation discussed above.

Facilities Improvements

The Audit developed an extensive plan of prioritized facility improvements, which are detailed in Chapter 6 and Appendices E and I of this Audit Report. These improvements include:

1. General Improvements. Implement a wide range of plantwide improvements related to piping, protective coatings, seismic integrity, Americans with Disability Act (ADA) compliance, electrical and instrumentation system upgrades, including SCADA, and other measures.
2. Lopez Lake. Implement minor modifications at the Inlet Tower (Outlet Works improvements are being constructed under a separate contract.)
3. Raw Water Pipeline. Undertake piping and valving repairs to increase reliability.
4. Terminal Reservoir. Implement structural and operational improvements to ensure the facility's continued useful life.
5. Hydroelectric Facility. Consider taking the facility out of service or implement a program of structural and electrical repairs.
6. Raw Water Influent Vault. Provide confined space equipment and training and implement minor structural and electrical improvements.
7. Pretreatment. Provide pretreatment upstream of membrane filtration to improve dissolved contaminant removal. **Ultimate pretreatment to be chosen during design and pilot tested with selected membrane process.**



8. Filtration. Replace the existing filter units with membrane units. Use an evaluated bid process for selection of the appropriate membrane system supplier (MSS).
9. Bypass Vault. Install a static mixer and leak proof access hatches and implement confined space measures.
10. Clearwater Reservoir. Replace hypalon cover and implement structural and seismic improvements.
11. Ammonia Station. Provide chemical storage with secondary containment, redundancy for ammonia pumping, and new flow controls for ammonia.
12. Finished Water Meter Vault. Provide a second manhole and replace the motor.
13. Domestic Water Tank. Recoat the exterior and implement structural improvements.
14. Wash Water Tank. Recoat the interior and implement structural improvements.
15. Sludge Pump Room. Replace electrical panel and implement other electrical system improvements.
16. Administration Building. Repair or replace roof, modify (expand) building, and implement structural and electrical improvements.
17. Chemical Building. Upgrade the building to comply with new regulations and best management practices. Implement structural improvements. Update or replace electrical system equipment in the Electric Room, Basement, and other locations.
18. Residuals Handling. Clean and upgrade the existing sludge ponds.
19. Chemical Feed System. Modify existing chemical feed systems for the WTP upgrade. Implement improvements required for code compliance.
20. WTP Staffing. Retain current staffing approach.

Total construction cost for these upgrades is currently estimated at **\$14,359,055**. After including additional operations and maintenance costs, the annual cost for treating each acre-foot of water using the recommended alternative is estimated to be **\$255**.