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**DATE:** May 22, 2013

**TO:** Honorable Board of Directors  
Sacramento Regional County Sanitation District

**FROM:** Sacramento Regional County Sanitation District

**SUBJECT:** **Treatment Technologies Selection and Costs for the Advanced Wastewater Treatment Plant “EchoWater Project” at the Sacramento Regional Wastewater Treatment Plant**

**RECOMMENDATION:**

It is recommended that your Board receive and file this report on the selection of the major treatment technologies for the Advanced Wastewater Treatment Plant Project - referred to as the “EchoWater Project” at the Sacramento Regional Wastewater Treatment Plant (SRWTP).

**BACKGROUND:**

On December 9, 2010, the Central Valley Regional Water Quality Control Board issued a new discharge permit for the SRWTP which required the construction and operation of several new treatment processes by December 2020. However, due to stays of permit conditions issued by the Sacramento Superior Court and a separate partial settlement agreement, the compliance deadline is now mid-2021 or mid-2023, depending on the treatment process. The more significant permit requirements include: lower discharge limits for ammonia and nitrate, and Title 22 or equivalent reclaimed water treatment standards, requiring filtration and enhanced disinfection processes.

On June 11, 2011, your Board received and filed a presentation on the Advanced Wastewater Treatment Technology Screening which provided information on how the Sacramento Regional County Sanitation District selected the technologies to be pilot tested that had the highest likelihood of meeting the permit requirements. The technologies identified for pilot testing included: biological nutrient removal (BNR) for nitrogen removal, granular media filters (GMF) and membrane filters (MF) for filtration, and ozone, ultraviolet light (UV), and chlorine for disinfection. Ozone was also tested for potential enhancement of filtration performance.

On February 13, 2013, your Board received and filed a letter with preliminary technology selections and cost information for the selected alternatives, based on pilot results to date. Pilot testing at the time indicated that the BNR process worked very well. The pilot study results also appeared favorable for GMF with the added benefit that the technology has a significantly lower cost than MF. Lastly, three (3) disinfection technologies were still under consideration: ultraviolet (UV) light, ozone, and chlorine. At the time, the results indicated that ozone was not as effective as the other technologies, but more time was needed to complete the pilot studies to make a decision on a disinfection technology.

## **DISCUSSION:**

The attached report provides the background and final pilot study results and a business case evaluation (BCE) for the three (3) main technology selections for the Echo Water Project. In addition, updates on the estimated total Echo Water Project costs and schedule are included. Following is a summary of the full treatment process recommendations.

### **Ammonia and Nitrate Removal Technology Selection**

The completed Phase 1 pilot study results confirm preliminary results which are that the biological nutrient removal process works very well and meets the permit requirements for ammonia and nitrate removal, therefore BNR is the selected technology.

### **Filtration Technology Selection**

The completed Phase 1 pilot study results also confirm preliminary results that granular media filtration meets the permit requirements and is the most cost effective option; therefore GMF is the selected technology.

### **Disinfection Technology Selection**

Selection of a disinfection technology is based on technical findings from the completed Phase 1 pilot study which demonstrated performance of the different technologies. This information is then used to perform a BCE that takes into account life cycle costs and non-cost factors to determine the technology that best meets the District's needs. As noted above, the pilot study and BCE evaluated chlorine, ultraviolet light, and ozone disinfection options. In addition, ozone was considered for use upstream of the filters to enhance filter performance.

Key findings of the pilot study are as follows:

- Ultraviolet light functions well as a disinfectant following filtration,
- Chlorine functions well as a disinfectant following filtration,
- Ozone is not an effective disinfectant following filtration, and
- Ozone has a potential role prior to filtration because it can break down certain organic compounds which can then be further reduced as the water passes through filters. This process is not needed to meet the current permit limit but could be added should future permits require it.

Key non-cost factors in selecting a disinfectant are as follows:

- UV has a very large energy requirement and thus has a big greenhouse gas footprint,
- UV adds heat to the water which may be of regulatory concern,
- The gaseous form of chlorine has significant safety concerns. Many water and wastewater utilities across the United States have converted from gas to liquid chlorine in the last decade, and there continues to be regulatory pressure at the Federal, State and local level to make this change.
- Chlorine adds salts to the water but the treated effluent meets permit requirements, and
- Chlorine creates certain disinfection by-products that are of regulatory concern. However, it appears permit conditions may be adjusted that will allow the continued use of chlorine.

With the elimination of ozone as a disinfection technology, BCEs were conducted for UV and chlorine disinfection options. Given the safety concerns with gaseous chlorine, liquid chlorine (bleach) was also considered in the analyses. Cost comparisons between these disinfection options are presented in the table below.

**Disinfection Alternative Costs**

Disinfection Alternative	Capital Cost	Total Amortized Annual O&M	Net Present Cost
Chlorine Gas	\$92,500,000	\$5,200,000	<b>\$234,800,000</b>
Bulk Liquid Chlorine	\$98,200,000	\$5,500,000	<b>\$251,300,000</b>
Ultraviolet Light	\$252,000,000	\$5,600,000	<b>\$406,600,000</b>

Additional information can be found in Attachment A, Executive Summary for Technology Selection.

Based on cost and non-cost factors, liquid chlorine is the recommended alternative for disinfection. In comparison to UV disinfection, chlorine is significantly less expensive and UV is not needed to meet the permit requirements. When comparing liquid and gaseous chlorine, the cost difference over a 60-year period is about 7%, with liquid chlorine being more expensive. However, the non-cost factors, most notably the safety concerns with the transportation, storage and use of gaseous chlorine make liquid chlorine the preferred option. In summary, liquid chlorine is the recommended disinfection technology. There will be further analysis to explore the early implementation of this project in order to eliminate gaseous chlorine as soon as possible.

**Side Stream Treatment**

An analysis is being conducted to determine the effectiveness of side stream treatment. This involves the preliminary treatment of a few high strength streams produced by plant processes before returning these streams back to the main flow of the plant. The side streams include return flows from the solids storage basins and the Biosolids Recycling Facility which are significant sources of ammonia. Side stream treatment for ammonia would involve construction of a small biological treatment process that would convert ammonia to nitrate. The side stream treatment facility capital and O & M costs could be partially offset by savings on the BNR portion of the main plant. Furthermore, it offers savings in the costs related to the use of chlorine for plant odor control because the nitrate produced by the side stream process will reduce odors in the system.

**Costs for Future Facilities**

The total EchoWater Project costs for the full treatment trains with the most viable disinfection options are as follows:

Treatment Train	Capital Cost	Total Amortized Annual O&M
BNR+GMF+ UV	\$1,673,000,000	\$50,400,000
BNR+ GMF+Liquid Chlorine	\$1,520,000,000	\$50,300,000
BNR+GMF+Gaseous Chlorine	\$1,513,000,000	\$50,000,000

Note: All capital costs include soft costs and escalation to midpoint of construction.

**Summary of Treatment Technology Selection**

Following is a summary of the treatment technology selection for construction of the full scale EchoWater Project.

1. Ammonia/nitrate removal will be accomplished with biological nutrient removal (BNR) process that replaces the existing pure oxygen secondary treatment process.
2. Filtration will be accomplished with granular media filtration technology.
3. Disinfection will be accomplished with liquid chlorine, and the possibility of making the conversion from gas to liquid chlorine an early implementation item will be analyzed.
4. To meet potential future permit requirements, the treatment facilities will accommodate the future installation of ozone upstream of the filters and UV as a final disinfectant.
5. Side stream treatment will continue to be investigated for treatment of high strength ammonia return streams.

### **Future Decisions on Treatment Technology**

The recommended technologies and alternatives will be included in environmental documents (CEQA) which will ultimately be subject to Board approval. Future approvals will also include contracts for design and construction.

### **CONCLUSION:**

It is recommended that the Board receive and file this report on the treatment technology selection for the EchoWater Project.

Respectfully submitted,

APPROVED:

Ruben Robles  
Director of Operations

Stan Dean  
District Engineer

RR:VK/sk

Attachment: Executive Summary for Technology Selection

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