PARADISE IRRIGATION DISTRICT

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Memorandum

Date: **June 13, 2012**

From: **Jim Passanisi, Water Treatment Plant Superintendent**
Bill Taylor, Treatment Maintenance Supervisor

To: **George Barber, General Manager**

Re: **NPDES Permit Compliance: Treatment Plant Alternatives**

Overview

The District currently operates under a National Pollutant Discharge Elimination System Permit (NPDES) issued May 10, 2010 by the Central Valley Regional Water Quality Control Board (CVRWQCB). The purpose of the permit is to regulate discharges from the District's pond system (located north and above the plant site) into the Magalia Reservoir, a California Waterway. The permit is scheduled for renewal in May 2015.

The pond system receives process water from the treatment plant, which is about 8% percent of the total water treated at the plant. The process water includes about 87% washwater from the plant clarifiers, about 12% filter back wash water, and about 1% of water from the laboratory sinks and other plant instrumentation.

The 2010 permit includes interim limits and problematic final limits for two contaminates of concern namely, aluminum (Al) and dichlorobromomethane (DCBM). In May 2010 a Time Scheduled Order (TSO) was issued to the District regarding the level of DCBM discharged to the reservoir that requires more stringent discharge limits for this chemical.

The NPDES discharge interim and final limits in micrograms per liter (ug/l) include the following:

	Interim Limits	Final Limits	Current Detection
	Max. Daily	Max. Daily / Avg. Monthly	Max. Daily
Aluminum	704	123 / 77.2	90 - 960
Dichlorobromomethane	3	1.12 / 0.56	0.8 - 2.2

The monthly average sampling results during the last two years for aluminum and DCBM were 265 ug/l and 1.6 ug/l, respectively. This year we have met the interim limits, but were unable to meet the final limits.

The NPDES permit also required completion of other studies that include the following:

1. Site Specific Study for Salinity/Electrical Conductivity (EC). The purpose of this study is to evaluate the appropriate levels of salinity and EC to protect the beneficial uses of the receiving water relative to agriculture. The District hired a consultant to conduct the study, which is on track to complete it by dates set forth in the permit. Cost: $18,000.

2. Groundwater Feasibility Study. The purpose is to focus on the logistics of installing monitoring wells associated with Magalia Reservoir. This permit condition was informally waived based on the District's intent to proceed with Process Water Recycling Project. If the District does not move forward with the project, then this condition will be required. Estimated cost $20,000.

3. Effluent and Receiving Water Characterization Study. The purpose is to ensure there is adequate information available for the RWQCB regarding priority pollutants and other constituents of concern for the next permit renewal. This study is ongoing and the costs are included in the routine monthly and quarterly sampling.

When the permit is renewed in 2015 staff expects there may be other conditions placed on the District relative to sampling for additional pollutants and other studies.

Current Planning

The tentative plan to comply with the NPDES permit and TSO, yet to be approved by the District's Board of Directors, is to eliminate discharge to Magalia Reservoir by treating and recycling all process water back to the headworks of the Plant for potable use. As such, the District entered into a contract with LEE & RO, Inc., water and wastewater engineers of Sacramento, CA to assist in selecting a recycle treatment process and complete design. On May 30, 2012 staff met with LEE & RO engineers to discuss alternatives. The estimated project timeline is to obtain Board authorization to begin construction in 2013.

Source of Contaminants of Concern

The source water does not contain detectible levels of the two contaminants of concern. The treated water is in compliance with the California Department of Public Health primary and secondary contaminant levels and the public health goals. The treated water does not contain any aluminum, but does contain a small amount of DCBM.

The chemicals are generated within the treatment plant as part of the coagulation and disinfection processes, which are in the process washwater. The treatment plant as designed and operated does not have the capability to meet the RWQCB limits in the process water and include the following:

1. The source of the aluminum comes from the coagulants we use (i.e. aluminum sulfate [alum] and aluminum chlorhydrate). These chemicals are commonly used in water treatment and are very effective at coagulating particles.

2. The source of the dichlorobromomethane is the plant's chlorine gas disinfection process. This chemical is in the group commonly referred to as trihalomethanes. It is normally generated in treatment plants that use chlorine as a disinfectant.

Alternatives to Reduce Contaminants

If the District is unable to move forward with the recycle project it would need to retrofit the plant with equipment and change current operations to comply with the NPDES permit and TSO. This memo provides information regarding the alternatives to reduce and/or eliminate the contaminants of concern and include the following categories:

1. Evaluate coagulation process alternatives and cost to use a non-aluminum based chemical to eliminate aluminum in the process water.

2. Evaluate disinfection process alternatives and cost to lower DCBM in the process water.

Aluminum (Al)

The coagulation process has been optimized over many years of operation. In order to eliminate aluminum in the pond discharge, the operation of the process would need to change substantially.

Substitution of our aluminum-based coagulants with ferric chloride (iron-based) is an option. The cost for this chemical would be about twice as much as what we spend now. Iron, like aluminum may also be a problem for the RWQCB in future permits. Switching to ferric chloride may result in unforeseen operational issues that include an increase in concrete corrosion rates and less effective coagulation.

Dichlorobromomethane (DCBM)

In order to reduce the level of DCBM in the pond discharge, the existing disinfection process would need to change substantially. The use of chorine would be minimized as much as possible. Chlorine will still be required to meet the CDPH disinfection regulation relative to a chlorine residual in the distribution system. Chlorine gas is currently operating well at the plant and is inexpensive compared to other disinfection systems. However, a new chlorine leak scrubber is needed once the decision is made to move forward with the new process water recycle project.

The plant operates best with pre-chlorination ahead of the clarifiers and filters, and chlorine has been shown to improve the coagulation process. It is possible to meet the CDPH disinfection regulations by moving the chlorine injection point downstream to the inlet of the Treated Water Storage Tank. Experience has shown that post-chlorination

would not provide the same level of operational confidence we currently appreciate, but would tend to reduce the level of DCBM in the process water. It is unknown if the reduction would be consistently below the NPDES limitation. Changing the point of injection would adversely affect the coagulation process.

Two processes that may be used in conjunction with chlorination for disinfection are ultraviolet light (UV) and ozonation. Both process are very effective at killing bacteria and viruses, reducing chlorine demand and would replace the plant's pre-chlorination process:

1. Ozone equipment generally consists of a liquid oxygen tank, two air vaporizers, two ozone generators, and two side-stream injection systems with a pipeline flash reactor, electrical and controls. The capital cost is estimated at $1.5 million. The estimated annual operation and maintenance costs are $60,000. Ozone systems are sold by proprietary vendors so costs for parts and repairs can be high. Ozone can generate bromate and other hydrocarbons similar to trihalomethanes, which may also be a concern for the RWQCB.

2. UV equipment generally consists of reactor vessels, UV ballasts and lamps, control and instrumentation. O&M costs include semiannual replacement of medium pressure lamps, quarterly calibration of sensors, spare parts, cleaning chemicals, monthly cleaning for systems without automatic cleaning. The capital cost is estimated at $2.0 million. O&M for UV disinfection is 40 - 80% less expensive than ozone. The estimated annual operation and maintenance costs are $30,000 and can vary significantly.

Conclusions

Compliance with the 2015 permit is expected to result in significant additional costs. Continuing under the NPDES permit can be expected to result in increasingly stringent permit conditions and ongoing costs. The annual cost to maintain the permit is currently about $20,000. The cost for the Salinity/EC study is $18,000. The cost for the Groundwater Monitoring Feasibility Study is estimated at $20,000.

The planning concerns cited below support staff’s recommendation to replace the existing ponds and sludge drying facilities, and discontinue the discharge of process water to Magalia Reservoir and include the following:

1. About eight percent of the raw water that is used as process water is diverted to Magalia Reservoir. This amount of water is currently unusable until Magalia Reservoir becomes the primary source of raw water for the treatment plant again.

2. The current coagulation process is working well and has been optimized over many years of operations. Adjusting this process could reduce PID's treated water quality and reduces the operator’s ability to detect minor variations in plant operation that affect treatment performance.

3. The chemical cost to switch to ferric chloride is twice as much as the current cost with the aluminum-based coagulants. Additional costs will likely be associated with coagulation optimization and other potential operational problems.

4. Changing to non-aluminum based coagulant such as ferric chloride is likely to impact the concrete structures, potentially raising maintenance costs.

5. Ferric chloride may have similar consequences as the aluminum based coagulants regarding the generation of a contaminant of concern (i.e. iron) that the RWQCB may want to regulate.

6. Future permits are expected to have additional conditions that are more stringent and costly, such as additional studies and sampling requirements.

7. Future permit is expected to require a costly capital and O&M groundwater monitoring well system. The final plan will be based on the Feasibility Study. The estimated cost is $200,000 for wells and $15,000 in annual monitoring costs.

8. The estimated capital and O&M costs for UV disinfection are $2 M and $30,000, respectively. Chlorination will still be required.

9. The estimated capital and O&M costs for Ozone disinfection are $1.5 M and $60,000, respectively. Chlorination will still be required.

10. Regardless of the modifications in the disinfection system, chlorine will still need to be added. The potential to generate DCBM may still be an issue, particularly if the limits under the NPDES permit are reduced in the future.

11. Preliminary cost estimates from LEE & RO to replace the existing ponds and sludge drying facilities range from $2 to $4 million. Ongoing operating costs are expected to be lower than the costs to operate the alternative treatment systems described above.