Rancho Murieta Wastewater Reclamation Plant

Operational Audit

for

Rancho Murieta Community Services District

Rancho Murieta, California

April 2008

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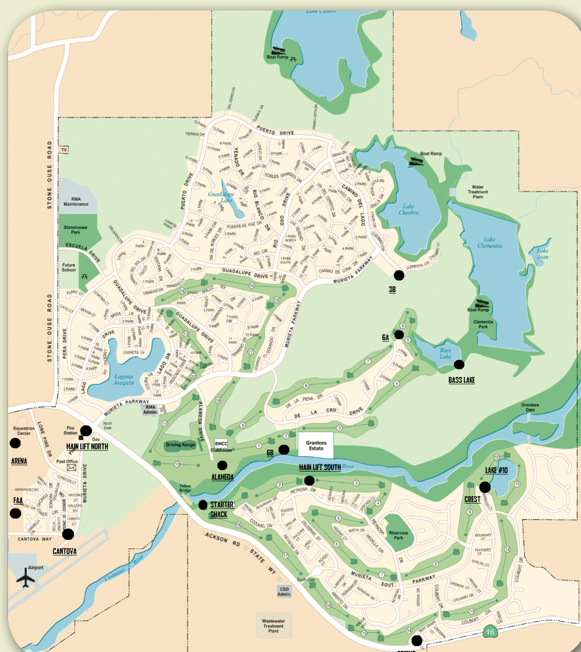

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1. EXECUTIVE SUMMARY

This Operational Audit Report is one of the items committed to by Rancho Murieta Community Services District (RMCDS) as a result of a Notice of Violation from the Sacramento Valley Regional Water Quality Control Board on June 21, 2007. While the Notice of Violation dealt with odors from the plant, this report analyzes and makes recommendations on a wide variety of issues related to the operation of the Wastewater Reclamation Plant (WWRP). Analyses were completed based on interviews with plant staff, a review of procedural documents and policies, and a review of plant operating data.

Recommendations include:

1. Investigate ways to improve employee morale, provide training, and develop standard protocols to aid operators in efficient operation of the processes. Consider increased staffing, at least until improvements can be made.

2. Focus on repairing various components in the plant that have failed. Making these repairs will have a positive impact on process efficiency and operator workload. Some of them, if not completed, will have significant impacts on operations this summer.

3. Formalize the spare part inventory system at the Wastewater Reclamation Plant.

4. Collect and update the “single-shelf” library of Operation and Maintenance manuals and related system information.

5. Perform jar tests to see if alternative coagulants and/or flocculent aids would be more effective.

6. Continue to make improvements, per the established plan, necessary to control odors coming from the plant. These include installing brush-type aerators, increasing the time of aerator operation, removing sludge from the ponds, and planting air drift barriers.

7. Control odors from lift stations in the collection system, by installing a carbon tower on the main north lift station and small carbon canister units in the remaining, vented, lift stations. Add vents to un-vented stations and rehabilitate concrete.

8. Develop a SCADA master plan. Implement projects, conforming to the master plan, to remotely monitor and control system operation. This could reduce manpower requirements.

9. Continue to remove the accumulated sludge from the pond system, and develop a schedule for maintenance cleaning of the ponds based on an ongoing sampling program.

10. Continue to implement the improvements in the Facility Plan, with the following exceptions:
    - Include a coarse screen in lieu of a fine screen in the headworks
    - Continue to utilize chlorination instead of implementing ultra-violet disinfection
    - Construct additional storage ponds instead of covering the existing storage ponds
    - Utilize additional irrigation for disposal in lieu of establishing a seasonal river discharge

2. INTRODUCTION

On June 21, 2007 Rancho Murieta Community Services District (RMCSD) received a Notice of Violation (NOV) related to odors from the Wastewater Reclamation Plant (WWRP) pond process (See Appendix A). Because of this NOV, the Rancho Murieta Community Services District Board took actions mandated by the NOV and voluntary actions to further resolve the concerns (Appendix B). One of the actions RMCSD committed to was to conduct an audit of the operations of the WWRP. This report contains the results of that audit.

The plant review completed by Psomas and Carollo Engineers consisted of a review of one year of operating data, a review of previous engineering studies, site assessments, and interview of operators on February 6, 2008. This report describes what we expected to see, what we found during the interviews and site inspections, and recommendations on how to make the facility operate better and reduce the potential for future odor from the plant.

3. ASSESSMENTS AND RECOMMENDATIONS

The purpose of this section is to examine the operation of the Rancho Murieta WWRP in terms of the staff and resources available to the staff. An otherwise well designed facility can have treatment problems if it is not operated properly. We believe there are a number of process control issues that lead to the poor plant performance document in the June 2007 NOV.

3.1. Training

Operating wastewater treatment plants is both art and science. It requires that operators are aware of safety issues, how the biological process works, how the physical treatment process works, and have institutional knowledge about what is unique about their facility. Engineers or Lead operators who have already gained experience at the plant normally provide training to the new operators at a facility so they are aware of fundamental operating techniques and unique methods suitable to their specific plant.

At this plant, operational efficiency of the treatment plant is suffering from a lack of process control supervision. The operators are unable to optimize the treatment process on their own because they do not fully understand the operational characteristics of the major process equipment.

There have been several generations of operators responsible for managing the facility since the original startup training was received. It appears that several times since the startup of the facility 25 years ago, there has been a complete turnover of staff. On at least one occasion, the most senior operator had less than one year of experience. The revolving door of staff at the WWRP has meant that all institutional knowledge about the operation of the facility has been lost since the start of the facility. In addition, all but one of the operators we interviewed said they were primarily “water operators.” They are all willing to work at the wastewater facility, but their allegiance is to water operations.

During the interview process, several operators reported that they had been trained on their safety equipment. However, they have not been trained on process control of the facility. ***The RMCSD operators need to be trained to operate the processes at the WWRP as efficiently as possible.*** Training classes should be developed to restore institutional knowledge about the operation of the facility so that there is one process control expert and all operators are qualified to make process control decisions, other than just turning up the chemical. ***Process control spreadsheets on both Dissolved Air Flotation (DAF) and filter operation need to be***

developed so operators know where their process is running and where it has been. A Process Control Specialist employed by the district or a Consulting Engineer can develop process control spreadsheets and the training classes. Training subjects that should be considered for operators are:

- **DAF Operation and Process Control.** This class should review mechanical operation of RMCDS DAF process and include a specific analysis of the operation parameters used at the facility. Part of the class should include developing new operating parameters in terms of source water control, operating set points for the process, and loading rates. The scope of the class should include follow up data analysis to support the operators in analyzing process data to make the process run better.
- **Coagulation Chemistry.** This class, in conjunction with the DAF Operation and Process Control class, should review the affects of Alum addition and the benefits and disadvantages of polymer addition to the process. The class should develop new operating parameters for acid and caustic addition for PH control to ensure effective coagulation allows for a high percent solids removal. Scope of work may be expanded to include testing and process control of other coagulants that may also work well in the DAF process.
- **Chlorination Chemistry and Optimization.** Development of this class needs to include sufficient testing to determine if it is more efficient to operate the facility with free chlorine or combined chlorine for disinfection of the plant effluent. The class should also review plant water balance and a mechanism for determining target water production rates.

The training handouts should include, in abbreviated format, the following information:

- Process capacity
- Equipment capacity, including pump curves
- Dose ranges and expected process response
- Experience curves for chemical process control at this facility

3.2. Staff Allocation

The original O&M manual has a section on WWRP staffing which recommends 2.8 operators (See Appendix C). Since the time this estimate was completed, regulatory requirements have increased, which increases the supervisory effort required at the WWRP. Based on changing regulation and other conditions observed at the facility, we estimate that there is 35 percent more work to be done on an annual basis. Therefore, the plant should now require four (4) O&M staff total, including the working supervisor. These operators would be responsible for operation, maintenance, and trouble shooting of the process. The collection system, water treatment plants, and water distribution system each will have separate staffing requirements. Conditions that contribute to this increase in required staff include:

- Increased regulatory requirements add 10 percent more effort
- Facility equipment is no longer new add 10 percent more effort
- Low moral and new, inexperienced staff adds 15 percent more effort

Additional staff is required at the WWRP at least until some of the problems described in this report are solved and additional improvements are made. Then there may be some opportunities to minimize staffing if the ideas listed below and developed in other parts of this report are implemented.

- Catching up on deferred maintenance and implementing a maintenance management program to increase the relative amount of planned maintenance will save staff time in terms of emergency repairs. See Section 3.4.
- Process control training to show operators how the facility runs in terms of physical and chemical relationships will allow operators to make process control decisions faster. See Section 3.1.
- A well integrated SCADA system and additional instruments on the reclamation process could save staff time by allowing one person to monitor all facilities (water and wastewater) while field operators ensure the plant is running well mechanically. See Section 4.6.1.

If the facility and staff are better trained and have updated procedures, there may be an opportunity to reduce staffing to a minimum of 3.5 for the WWRP (additional staff are required for the collection system and water treatment plant). Expected allocation would be one working supervisor, one operator each on the front and back half of the week, and a part time maintenance person.

3.3. Staff Retention

Operators with experience at the plant can generally troubleshoot issues more quickly and save budget because they “know how to get things done.” When the person with the most experience at a facility has been there less than four (4) years, questions about poor staff retention, and how to maintain this valuable resource, should be examined. In general, operators leave a treatment plant because of poor work environment, their perceived value to the organization is low, lack of opportunities for training and improvement, and finally, below the normal compensation.

During the interview process, we found that the most experienced Lead operator only has four years of experience at the facility. It appears, based on input from all the operators, that there has been a long-term effort to reduce budget expenditures in the water and wastewater departments. The result of this has compounded over the years and caused the following problems:

- Overall, operations staff have poor moral. There is a general feeling that all the work required to get the facility running well is impossible with the available staff. The staff expressed a very professional attitude during the interviews and they intend to complete as much of the deferred maintenance as possible.
- The younger operators are poorly equipped to respond to routine breakages. Only one operator reported having adequate tools to repair minor problems. Other operators are making due. Bringing tools from home to accomplish job tasks is common.

We recommend that RMCSD contact previous operators and interview any future departing operators to determine why they left. A plan for improving operator retention based on information learned from these interviews should be developed.

3.4. Maintenance

Preventive maintenance should be between 70 and 80 percent of the total maintenance completed at the facility for the most efficient operation. Facilities with more reactive maintenance generally spend more time and budget putting out fires than would be required with a managed maintenance program. At smaller facilities, such as RMCSD WWRP, the operators are responsible for a significant amount of maintenance. We would expect operators to have access to a full array of tools required for routine maintenance.

During the interview process we asked operators about maintenance of the facility. The most striking response was the operators indicated between 2 and 10 percent of the maintenance work completed are preventive in nature. This indicates that the plant is "operating the operator" and, with current staffing, the operators will be unable to take control of the facility. A common theme of all the interviews was that there is insufficient time to fix equipment. It appears only the biggest problems get fixed quickly.

The new maintenance management program being developed by the district should be able to support a transition to a well maintained facility, but only if the program is completely developed, and there is an ongoing effort to optimize the maintenance effort. This program should not be made overly complicated.

During our tour of the facility and interviews the following mechanical issues were identified. Two highly motivated operators are keeping "To Do" lists of required repairs. Typically operators would not do this plant management function. They are aware that if some of these components are not repaired this winter, it will be difficult to operate the plant during reclamation season. All of these components should be repaired as quickly as possible, however some prioritization will be necessary.

- Chemical building floor drains are plugged. Calling Rotor Rooter is already noted on one of the operators' "To Do" lists. Note that it is possible that the drains from this building are corroded and collapsed and Rotor Rooter will not be able to clear the blockage.
- Pond 5 Effluent weir is not level. The discharge weir is pitched to the East side. This causes uneven distribution of flow through the pond and short-circuiting. Modifying the installation of the weir is the most cost effective method to repair this process.
- Pond 5 effluent weir expansion joint has a significant leak letting water into the process. The source of the water should be investigated to determine if the perched groundwater is from the pond processes or another source.
- One of the chlorine contact basin (CCB) underdrain flushing valves has been broken for several years. The drain provides an easy method for cleaning the CCB to eliminate problems with disinfection due to solids accumulation. This valve should be repaired before the irrigation season.
- Pressurization valve on the East DAF is disassembled. The valve appeared to be in decent working order, but may require the services of a startup technician to get proper adjustment so the process can maintain the 90 psi target and good air saturation. During impromptu training, the operators agreed that it would be good to repaint the valve. To be done correctly, the valve painting should be done by a painting shop. If the valve does not get painted, the corrosion products should not be scraped off as this will exacerbate the corrosion. This is a high corrosion area in a DAF and the valve will eventually need to be painted or replaced.

- Filter media level is uneven between filters. While the imbalance was not severe, it could be valuable to understand why there are different elevations of media. Scraping off the top three-inch layer of media and replacing with new media is already noted on one of the operators' "To Do" lists. This is an excellent method for maintaining a well operating filter.
- It appears the filter box was prepared for new paint, but that painting was not completed. Paint maintenance is the most important way to preserve the value of steel process tanks by minimizing corrosion.
- Existing Acid system is out of service. During the last reclamation season it appears that the process water pH rose above the Alum operating range, making the coagulation process ineffective. Sulfuric acid is the most common chemical used for pH adjustment. This is a dangerous chemical and health and safety training must be completed before it is brought on site. While repairing the acid system is shown on one of the operators' "To Do" lists, we recommend that the startup of the Sulfuric Acid system be a planned event including pressure testing and evaluation of all existing facility components. The operators are too rushed to provide the thorough facility review required before startup of this chemical.
- Chlorine diffuser in the DAF inlet wet well broke last year during the reclamation season causing an uneven distribution of chlorine between the two pumps. Proper oxidation of algae with chlorine is an important part of algae coagulation. This should have been repaired shortly after the break was identified to save operator time. The repair is currently shown on one of the operators' "To Do" lists. This repair will require a confined space entry to complete. This repair must be completed before reclamation season restarts.
- Anchor the chlorine contact pipe (CCCP) in the equalization basin with stainless steel straps is shown on one of the operators "To Do" lists. Care should be taken to ensure that the bottom of the equalization basin is not damaged during this repair. Bolts that are too long or spaced too far apart may result in damage to the basin.
- Annual contract repair work shown on one of the operators' "To Do" lists includes: calibration on influent and effluent flow meters, clean and repair worn parts on Micro 2000 Cl_2 analyzers, and contract maintenance of chlorination equipment. All of these tasks are required for permit or safety reasons.
- DAF annual repair work shown on one of the operators "To Do" lists includes rubber skirt adjustment, lubrication, and PM maintenance of the Dezurik valves. Completion of these preventive maintenance tasks will improve the reliability of the treatment process.
- Annual repair work on Filters shown on one of the operators' "To Do" lists includes checking filter float switches, solenoids, and air control valves, Kaiser air compressor inspection and service. Completion of this preventive maintenance will improve the reliability of the treatment process.
- Ordering parts and kits to finish rebuilding the third alum pump is shown on one of the operators' "To Do" lists. Completion of this preventive maintenance will improve the reliability of the treatment process.
- Repair of the east DAF process water pipe was shown on one of the operators' "To Do" lists.

Considering the small size of this facility, the list of equipment in need of repair is significant. Much of this work has already been planned for and some of the work may have been completed while this report was being prepared. However, the operators are overloaded so some of this work is likely to be postponed causing more work to be piled up for later years. A worst case scenario of continually deferred maintenance is that a treatment process gets shut down, thereby limiting treatment capacity and causing a water balance problem.

We recommend that plant management continue to concentrate on developing the maintenance management program and on completing this "To Do" list. Once this work list is complete, the facility can be maintained in good condition. The maintenance management program does not need to be overly complicated. Use caution spending budget and time developing features in the program that will not have much benefit at an organization where all operators are familiar with all the mechanical equipment.

3.4.1. Inventory

The current procedure for maintaining a spare parts inventory is very informal. When the operators perceive that the quantity of spare parts is low (rebuild kits, chlorinator supplies, etc), more are ordered. No spare parts list is kept. While the operators seem to know where parts are, there appears to be no centralized or organized location for storage. Inventory for some of the parts is shared with the water treatment plant.

The system for maintaining a spare parts inventory should be more formal. The operators should develop a list of parts and materials that need to be on hand for use. The document should include the quantity required and the designated storage location for each item. While this will be of value to current staff, it will be especially useful for new staff. Developing this list will take at least a year of testing to ensure it includes all the routinely used components. Inventory items should include the following:

- Rebuild kits for items that need periodic maintenance (chlorinators, air-actuated valves, compressors, etc.)
- Long-lead items critical to system operation
- Consumables (lubricants, cleaners, rags, etc) that are constantly in demand

A storage site should be identified for each item and suitable floor area, shelves, or bins provided. While it may not be possible to establish separate inventories for each plant at this time (depending on available space at the water treatment plant), this should be the long-term goal. Round trip travel time to retrieve a part is approximately 30 minutes. Centralized storage, along with the list of parts, should reduce the number of times the 30 minute round trip for parts is made, allowing more time for Operators to perform other important tasks.

While it is frustrating to have to travel to the hardware store for off-the-shelf supplies (nuts, bolts, etc), care must be taken so as not to create more work managing an inventory than the time required to go to the store. One option might be the "buy an extra" method for small parts. When purchasing small parts, the Operator simply buys a small amount of extras to put into the miscellaneous parts bin. With time, organized bins will contain a good assortment of parts, saving trips to the hardware store.

4. PROCESS OPERATION AND CONTROL

The purpose of this section is to examine the operation of the Rancho Murieta Wastewater Treatment Plant from a technical standpoint in terms of water quality. We have reviewed one year of operating data to locate processes that are performing poorly and describe improvements to those processes.

4.1. O&M Manual

The O&M manual should serve as a common reference for mechanical capacity and institutional knowledge from the Engineer to the operator on how the facility should be run. Most of the time O&M Manuals collect dust. However, good manuals are used and must be written so they are useful in urgent situations (i.e. 2 AM when it is raining.) Manuals should include information on maximum hydraulic capacity, maximum and minimum loading, pump curves, alarm responses, etc.

During the investigation and preparation for the operator interviews, we received one electronic copy of a new O&M prepared by Creegan + D'angelo Consulting Engineers of San Jose, California. The manual is updated in terms of the equipment found at the facility and general plus specific equipment capacities. The manual does not provide a lot of process control background information to guide the operators in the proper operation of the process. We also reviewed the original O&M manual developed with the original design in 1982. This manual provides good background on the facility, and some instruction on how to operate the processes in addition to the equipment at the facility. The original O&M manual is out of date in terms of the equipment at the facility. Both manuals should be referenced simultaneously when investigating operational challenges.

Since the O&M manuals are already published, it may not be worth the effort to update them at this time. ***Therefore, we recommend a small single shelf O&M library, similar to what already exists at the wastewater treatment plan.*** The single shelf library should include supplemental reference information as listed above, but not whole submittals. One mechanism for assembling this valuable information is the training classes. Other shelves in the bookcase should include complete technical O&Ms of all equipment to support maintenance activities.

4.2. Chemical Application

The facility was constructed with several chemical processes to support the physical chemical treatment process. The treatment plant currently uses three chemicals. Alum is used for coagulation, chlorine for pre-oxidation of algae and disinfection, and caustic for pH control of the effluent. Use of these chemicals is appropriate, though it appears at times chemical doses were higher than needed. The chemicals planned for the facility and their use are described below.

- **Alum -** The currently used primary coagulant reacts in water to make positively charged gelatinous aluminum hydroxide floc. The floc enmeshes algae solids and air bubbles in the DAF so they can float to the surface for removal from the process. The chemical reaction uses alkalinity and may depress pH. Last year dose ranged between 15 and 104 mg/L. Treating the various forms of algae that can develop in treatment processes does require a wide range of alum doses. Alum is generally effective when the process pH (after chemical addition) is between 6 and 8.5. There are other primary coagulants that could improve process operation.
- **Polymer -** Flocculant aid, if used, will enhance the enmeshment of solids in the DAF process and could improve solids removal. With polymer dose the floc that escapes the DAF will also have a stronger structure ensuring their capture in the upper levels of the filter. Polymer has been successfully tested at the facility several times according to Skip Wright of NTU

Technologies. The disadvantage of polymer is it takes some expertise to use a flocculant aid, and excessive dose could cause high headloss in the filters. A process control expert, Consulting Engineer, and/or good Polymer Representative could all provide the guidance needed to properly dose this useful chemical. After training, the operators can easily control this chemical dose. The existing polymer blend units are not in use and may need some refurbishment prior to use, but this can be done by plant staff if the decision is made to use this chemical.

- **Sulfuric acid -** This strong industrial acid is used for pH control. The system is currently not operable. It would have been useful during June and July 2007 when the DAF pH increased to above optimum. This caused poor solids removal efficiency in the treatment process. Sulfuric acid is a dangerous chemical and health and safety training must be completed before it is brought on site. While repairing the acid system is shown on one of the operators "To Do" lists, we recommend that the startup of the Sulfuric Acid system be a planned event including pressure testing and evaluation of all existing facility components. The operators are too rushed to provide the thorough facility review required before startup of this chemical. Rehabilitation of the acid system may not be required if alum is replaced with another primary coagulant.

- **Caustic -** This strong industrial base is also used for pH control, when an increase is required. The system is currently not operable, but a new temporary tank and metering pump has been located near the Golf Course Irrigation Pump Station. The temporary system has secondary containment and as long as it provides adequate treatment using this system may be easier than rehabilitating the original system.

- **Chlorine -** Gas Chlorine is used to oxidize algae to improve coagulation and as the primary disinfectant. Gas chlorine addition to water tends to decrease pH, which helps keep the process water in the normal operating range for alum. Total plant dose ranged from 5 to 40 mg/L split between the DAF Feed Still Well and the Chlorine Contact Basin. The chlorine system was overused in 2007 indicated by draw of over 400 Lbs/day from the ton cylinder on several occasions. The operator compensated by placing both ton cylinders in service at a time. This is an excellent short-term solution, but it is difficult to always run two cylinders. Some of the extra chlorine draw may have been used for breakpoint chlorination or to deliberately overdose in an effort to reduce DAF process pH to a normal range of alum. If the acid system is not repaired soon, additional chlorine capacity needs to be considered. Transition from the present gas system to sodium hypochlorite should be evaluated as a separate safety and technical issue.

We recommend that the plant conduct Jar testing and consider implementing a different primary coagulant chemical strategy if it is more cost effective. Based on Jar testing if a suitable chemical is located a tote of that chemical can be purchased and tested full scale to make sure it works before converting the contents of the bulk storage tanks. Other chemicals that can sometimes be used in place of alum include Aluminum Chlorohydrate Solution (ACH) and Polyaluminum Chloride (PACl). These chemicals have a wider pH application range. These chemicals should eliminate the need for pH control and rehabilitating the acid system. Plus they will also produce less sludge.

4.3. Odors from Plant

In June 2007, the Sacramento Valley Regional Water Quality Control Board (Regional Board) received several complaints from Rancho Murieta residents about odors coming from the Plant. As a result, the Board issued a Notice of Violation letter on June 19 (See Appendix A) requiring that "… RMCSD must take additional steps to eliminate the odors forthwith."

RMCSD engaged ECO:LOGIC, a consulting engineering firm, to visit the plant, determine the specific causes of the odors, and provide recommendations for their control. The consultant visited the site on June 20 and provided a letter report on June 22 (See Appendix D).

RMCSD incorporated many of the recommendations from the report in their June 27 response to the Regional Board (Appendix B), and at the present time, have implemented several of the "Immediate and Short Term Odor Control Measures" listed. RMCSD is also working on implementation of the "Long-Term Odor Control Measures".

Field observations by ECO:LOGIC are generally in conformance with Psomas/Carollo's understanding of the causes of odors:

- Odors were coming mainly from Pond 1
- Pond 1 was organically overloaded because of not enough oxygen for the organic loading. All available aerators were put back in service.
- There was a significant sludge blanket in Pond 1 which might have contributed to the odor problem
- Floating trash in Pond 1 might have contributed to the odor problem

RMCSD staff should be commended for taking immediate action to correct this problem. By running the existing aerators for longer each day, removing some sludge from Pond 1, installing a brush-type aerator (on a demonstration basis), odors have been controlled.

Psomas/Carollo believes that other actions taken, while not harmful, have not contributed as much to reducing odors:

- Specialized additives, while useful for reviving Pond 1, should not be necessary over time, and
- Adding chlorine to the influent is probably only marginally effective due to the high dosing rate that would be required to reduce odors.

Moving forward, RMCSD should continue to operate the plant and make improvements to insure odor problems do not return:

- Purchase and install brush-aerator(s) in Pond 1 (see section 4.5.1) in addition to the vertical axis aerators that are still required. The brush aerator has been shown to be effective in increasing the dissolved oxygen in the pond while concurrently resisting fouling.
- Continue to operate aerators in Pond 1 full time. This will keep the dissolved oxygen high and reduce the amount of sludge deposited in the pond.
- Remove sludge from the ponds as needed to minimize the sludge blanket as described in Section 4.6.2. The benefits of this include maintaining a larger volume of water in the ponds which increases detention time and treatment efficiency.
- Plant two air drift barriers consisting of rows of trees between the Plant and Highway 16. This will provide some mixing to diffuse "normal" odors coming from the Plant.

- Revise and add to Plant piping to allow recirculation and isolation of ponds.

RMCSD should continue to monitor the operation of the ponds as additional homes are connected to the collection system. At some point, inflows or biological loading could reach the ultimate capacity of the system, especially in Pond 1, requiring alteration and/or expansion of the treatment process.

4.4. Odors from Lift Stations

Odors are generally found in collection systems as a result of hydrogen sulfide generation. On March 4, 2008 a site visit was made to each lift station (See Appendix E for lift station locations). On tour day, the daily high temperature was in the low seventies. The potential for odors increases with the temperature. During our visit, there we no perceptible odors prior to lifting the wet well covers. Once the cover was opened some of the wet wells produced a localized odor. Inlet piping was observed to be under the operating water surface at each of the lift stations, and for the few pipes that entered above the operating water surface, a drop inlet was provided. Drop inlets minimize splashing to prevent off gassing of odors.

A few pump stations were observed to have some corrosion of the cover and brackets. This corrosion was only observed at lift stations that were not vented. All lift stations should be inspected for corrosion and any pump station that is not presently vented should be equipped with a vent, and all materials that show signs of corrosion should be repaired or replaced. Canister carbon filters are recommended on all submersible lift stations. ***Canister carbon filters should be installed on all vented lift stations immediately.***

The main north lift station is a dry pit/wet pit configuration presently equipped with a ventilation system which vents odors approximately ten feet above the surface. Localized odors have been reported. Due to the volume of air that requires scrubbing, a canister carbon filter is not sufficient for this location. ***Carbon towers are available and can be connected to the existing ventilation system.*** A carbon tower will require replacement of the media in three to five years.

4.5. Effluent Quality

For this review, we received operating data on the pond processes from January 2007 to November 2007. We also received operating data for the reclamation plant from March 2007 through September 2007. Two significant events are notable. DAF Influent process water pH was between 8.5 and 10.3 during June and July 2007. Effluent process water pH was between 7.4 and 9.9 and the solids removal efficiency across the DAF was low. High DAF pH most likely caused the on-site reservoirs and golf course irrigation lakes, which are outside of the scope of this investigation, to also have a high pH between 8.5 and 9.75 during June through August 2007.

4.5.1. Pond Processes

According to original design documents, pond process loading is still less than design loading rate. However, the concentration of the wastewater is higher than expected, and the pond process is likely to reach a biological oxygen demand (BOD) treatment limit before the maximum hydraulic treatment capacity. The high total suspended solids (TSS) values contribute to sludge settling in the bottom of the ponds. Table 1 shows the original design loading and the 2007 loading.

Table 1 – Influent Characteristics			
	Design	2007, average	Difference
Flow	1.5	0.5	33%
Average BOD, mg/L	188	215	114%
Average BOD Lbs/day	2350	900	38%
Average TSS, mg/L	233	355	152%
Average TSS Lbs/day	2910	1480	51%

The pond process employed at RMCSD is similar to a dual powered flow through lagoon system (described on page 853 of Wastewater Engineering, G. Tchobanoglous), which consists of a complete mixed (aerated) lagoon followed by several facultative (partially aerated) lagoons. The complete mixed aerated lagoon (Pond 1) should be provided enough mechanical aeration to discourage sludge setting and to allow enough oxygen to grow bacteria to assimilate BOD in the wastewater. Vertical axis surface aerators should be used to provide a significant portion of the mixing energy so the full depth of the pond is kept completely mixed.

The facultative lagoons are a layered pond process with anaerobic, facultative, and aerobic processes. The anaerobic process on the bottom is where the sludge settles and undergoes anaerobic digestion. This helps reduce the volume of solids that eventually needs to be removed from the process. The middle layer is facultative where nutrients are absorbed into bacteria responsible for the treatment process. The aerobic process on top is provided with mechanical aeration when necessary to ensure oxygen is available for bacteria consume soluble BOD released from the decomposition of sludge and make sure odorous gases to not escape the treatment process. Brush aerators will work well in facultative ponds because they concentrate the aeration in the top layer of the process. Table 2 describes the typical design values for this type of pond processes.

Table 2 – Pond Aeration Requirements						
	Type	Volume (MG) (1)	Recommended Detention Time (days)	Recommended aeration (HP)	Design Detention Time (days) (1)	Actual aeration (HP) (1)
Pond 1	Complete Mix	2.6	1.5 to 3	78	1.7	35
Pond 2	Facultative	2.6	4.5 to 6 (total)	16	1.7	30
Pond 3	Facultative	5.9		30	3.8	30
Pond 4	Facultative	8.7		43 (2)	5.6	30
Pond 5	Facultative	5.5		27 (2)	3.6	10
(1) Operational data from O&M Manual, assumes no sludge accumulation, 1.55 MGD flow (2) Since the detention time is longer than required less aeration, especially at lower loading rates, may be acceptable.						

During a review of the 2007 pond process operational data we found that the dissolved oxygen (DO) concentration in Pond 1 was generally low. A target DO of 2 mg/L ensures there is adequate oxygen to metabolize BOD. ***This supports the use of additional aeration***

suggested by typical design parameters in Table 2 and the ECO:LOGIC odor control letter (See Appendix D). The recommended horsepower is based on mixing requirements to prevent sludge setting. The number of mixers operating is more a function of required mixing energy than dissolved oxygen. Less operating horsepower may be possible but only after testing to ensure no sludge is settling in the bottom of Pond 1. The mixing requirements should be delivered with a combination of brush aerators and vertical axis aerators.

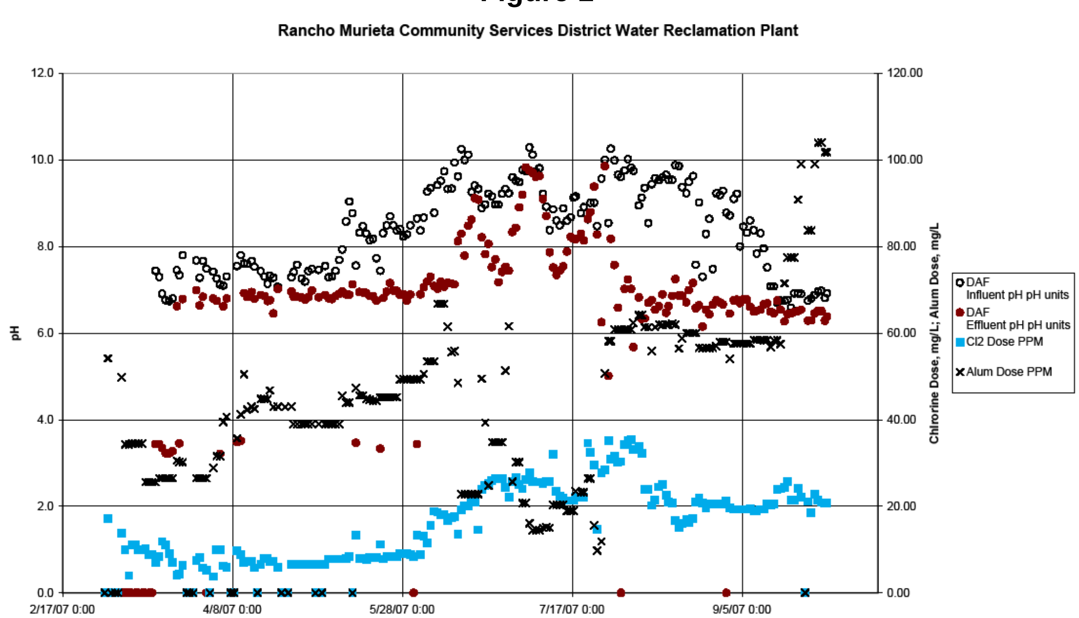
Ponds 2 through 4 had periods of low DO that were erratic and may be the result of intermittent use of aerators. Process pH is within normal ranges. As plant flow continues to increase higher loadings on the ponds will require additional aeration up to the maximum recommended in Table 2.

4.5.2. Water Reclamation Processes

Water reclamation process did not operate well during the middle of 2007. At the beginning of the reclamation season the DAF performed adequately with a 45 percent turbidity reduction and an effluent turbidity normally less than 1.0 NTU. Then at the beginning of June the DAF influent pH began to rise. On June 13 the DAF effluent pH (after chemical addition) jumped from 7.1 to 8.1 and the percent solids removal across the process decreased. Nine days before June 13 average percent reduction in turbidity was 69 percent. Nine days after June 13 average percent reduction in turbidity was two percent. For the next two months effluent turbidity tracked influent turbidity with generally poor removals. Poor solids removal from the DAF process increases loading on the filtration process and over time also increased the filter effluent turbidity. Based on the data received there were no violations, but there were several grab samples above 2 NTU. Title 22 turbidity limit for reclaimed water is 2 NTU for 24 hour average and less than 5 NTU (grab sample).

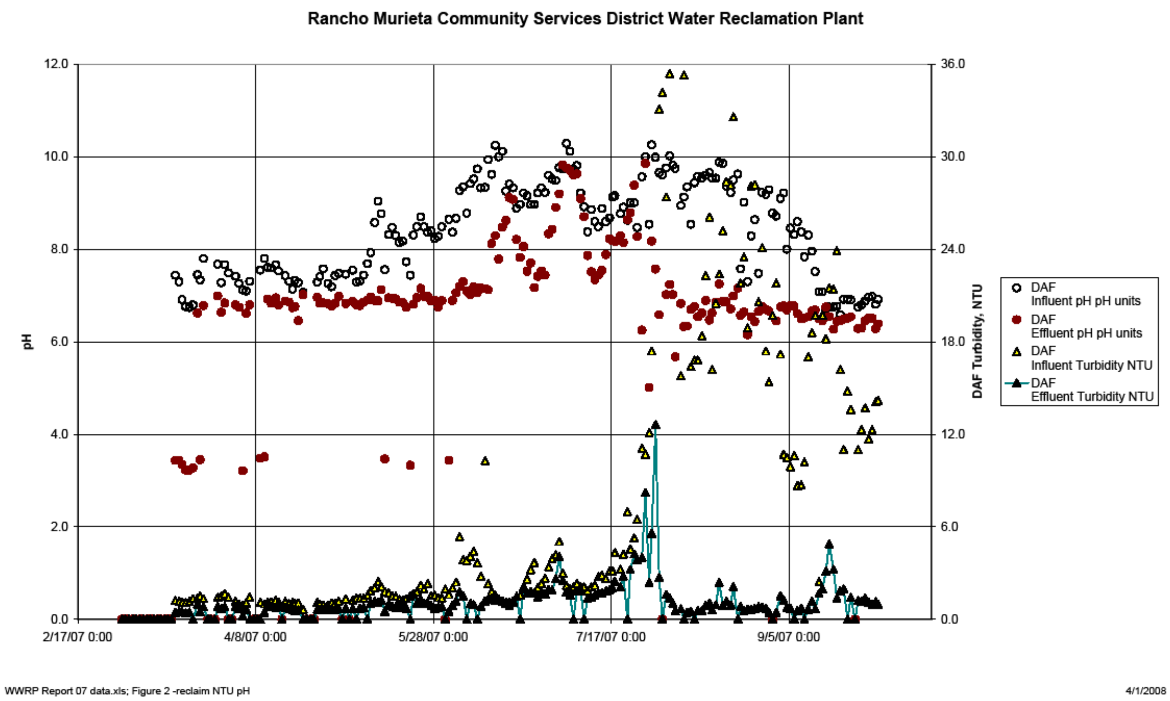
The reason for the process failure is Alum generally has an effective pH range of between 6 and 8.5. Outside of these limits the aluminum dissolves in the process water and will not form the gelatinous floc required for solids removal. DAF effluent pH was recorded above 8.5 over 15 days during June and July. Figure 1 shows the DAF influent and Effluent pH with influent and effluent turbidity.

Figure 1



Between July 26 and July 30 Alum Dose was increased from 12 mg/L to 60 mg/L while chlorine dose was set high and the DAF effluent pH decreased from almost 10 to approximately 7. During the same time period the influent turbidity increased from 12 NTU to over 30 NTU. For the remainder of the summer DAF influent turbidity and pH stayed high, but alum dose was high which maintained the DAF effluent pH around a 7, which is optimum for sweep coagulation. DAF effluent turbidities averaged 1 NTU with removals of 92 percent. Figure 2 shows the DAF influent and effluent pH with alum and chlorine dose in mg/L.

Figure 2



We recommend that a new chemical dose strategy is developed or that the acid system is rehabilitated before the DAF feed pH starts to rise during the 2008 irrigation season. Using artificially high chlorine and alum doses to maintain process pH for effective performance is an expensive way to operate the process.

4.6. Equipment Requirements

The purpose of this section is to examine the available and proposed equipment and review their use and impact on operation of the Rancho Murieta Wastewater Treatment Plant.

4.6.1. SCADA

When we visit wastewater treatment plants we typically expect to find a SCADA system with a graphical interface that allows the operator to monitor instruments that will show process performance characteristics. The SCADA system saves staff time by allowing one operator to monitor the whole process at once, sometimes from a remote location or laptop at home. Most SCADA systems also include a historian that records process variables for trending functions to help operators troubleshoot processes.

The existing plant is monitored and controlled by two sets of control panels and instruments. The first set of control panels is located in the motor control center line-ups for the tertiary pump station. These panels contain two TESCO LIQIV PLCs.

The second set of control panels is vendor provided panels installed to operate the two plant filters. These panels are PLC based, but the operator interface is primarily through hardwired controls mounted on the panel face.

Automation on the plant is limited and there is no plant control network to coordinate the operation between systems. Also, there are no graphical interfaces used on the plant.

Recommendations for plant SCADA improvements are as follows:

1. ***Initiate a system-wide control system SCADA Master Plan***. The operation group's effort is being spread over a number of geographically separated facilities. With the addition of computer based control equipment, remote monitoring and control of these facilities can be cost effectively implemented. It is highly likely that centralized control of the various District facilities could improve the efficiency of the District's operation. For example, reducing sewer lift station site visits will reduce operating costs.
2. ***Install a work station based graphical interface based*** on modern Human Machine Interface (HMI) software such as INVENSYS Wonderware, or GE Intellution iFix. In addition to providing a safer interface to the operation of the plant equipment, this software will provide trending and alarm functions. These additional functions will improve the ability to diagnose process problems. This system should match the water plant's control equipment or comply with SCADA master plan requirements.
3. ***Add a SQL based historian to the HMI recommended above***. This will provide access to historical data from MS Excel, MS Access, and most other software used for report generation.
4. ***Add a telephone alarming software package*** such as SCADAlarm or Win 911 to provided detailed alarm voice and text messages to cell phones and pagers.
5. ***Provide standardized control system equipment.*** In addition to the wastewater treatment plant, the District operates two water treatment plants, remote lift stations, and several remote water sites. For improved maintenance, PLC, communication protocols, and computer control equipment need to be standardized throughout the District's water/wastewater facilities. Fiber optic or radio equipment provided with the SCADA system will allow all facilities to communicate with each other so operators can monitor district equipment from a single location. In addition, the PLCs used should be selected based on the available support. PLCs from vendors such as Allen Bradley and Modicon have effectively supported third party integrators and there are sufficient maintenance and programming resources to support continued operation and expansion of the system.
6. ***Investigate the automation of the chemical feed systems***. In most instances, the automation of chemical addition can reduce operating costs.
7. ***Investigate the benefit of adding additional instrumentation*** for monitoring the water reclamation process. The following instruments could allow for remote monitoring of the facility, automatic shutdown to prevent violations, and with historical trending better understanding and optimization of the treatment process performance. Each instrument also has a control function that could be used for automatic optimization of the treatment process.

   a. **Tertiary Pump Station/DAF influent**

1) Chlorine residual with chlorine dose control to optimize pre-oxidation of algae before coagulation

2) Flow monitoring for flow pacing of chemicals

3) Turbidity meter for alarms and possible automatic control of primary coagulant

4) Streaming current meter for automatic control of primary coagulant

b. **DAF Effluent**

1) Turbidity meter for alarms

2) PH meter for automatic control of acid feed system to ensure treatment process stays in optimum pH range

c. **Filter Effluent/CCB inlet**

1) Turbidity meter for alarms and calculations to ensure filtered effluent stays less than permit limits.

2) Flow monitoring for flow pacing of chlorine

3) Chlorine residual meter for trim of CCB inlet chlorine dose

d. **CCB Outlet**

1) Chlorine residual meter for calculations of CCB CT time (min*mg/L)

4.6.2. Sludge Handling

Aeration Pond 1 should be operated as completely mixed with sufficient energy so sludge is not allowed to settle. Aeration Ponds 2 through 5 are operated as facultative partially mixed ponds. In these ponds, the aeration energy supplied is only sufficient to supply oxygen for biological treatment of the organic matter but not sufficient to maintain the solids in suspension. Therefore, sludge settles in the bottom of the ponds where further anaerobic decomposition of the sludge takes place, typically in a zone of four to five feet below the surface of the ponds. Intermittent removal of sludge from the ponds is required for controlling the volume in the treatment process. If sludge is not removed, the gradual accumulation of solids at the bottom of the ponds will reduce pond volume and release decomposing nutrients back into the process water. Additionally, methane gas and hydrogen sulfide gas are produced during the anaerobic process. Allowing excessive sludge to build up in the bottom of the ponds can result in the release of large quantities of these odorous and explosive gases.

The last time sludge was removed from the ponds was during the summer of 2007. The sludge removal process lasted approximately three weeks. A vactor truck was used to vacuum several truck loads a day of liquid sludge from the periphery of the treatment ponds. The sludge was then hauled to the solar drying beds for drying and eventual removal.

In February 2008, several sludge depth measurements where taken in all the ponds. Ten measurements where taken at various locations in Pond 1 and nine measurements where taken at each of Ponds 2 through 5. Based on these measurements, average sludge depths for each pond were calculated. This sludge survey should be completed once per quarter and records kept for process optimization. The average total solids concentrations were estimated based on solids concentration data from a similar study completed for the City of Stockton. The total solids concentration is generally found to increase with sludge depth since the deeper sludge has had more time to settle and is therefore denser. The solids measurement survey and calculated sludge quantities are summarized in Table 3. Typically, the bottom one foot of sludge cannot be removed effectively. Therefore, the estimate of material to be removed is based on the assumption that solids will only be removed from areas with sludge accumulation deeper than one foot. The total quantity of solids to be removed from Ponds 1 through 5 is estimated to be 385 dry tons.

Table 3 – Sludge Volumes								
Pond	Area (Acres)(1)	Avg. Sludge Depth (ft)(2)	Avg. Total Solids Conc.(4)	Sludge Volume (ft3)	Total Sludge Mass (Dry Tons)	Sludge Volume (% total)(1)	Removable Sludge Volume (ft3) (3)	Removable Sludge Mass (Dry Tons)
1	1.06	3.0	5.4%	140,091	238	41%	93,917	160
2	1.06	1.5	3.3%	67,978	71	19%	21,804	25 (excluded)
3	2.29	1.0	2.3%	96,871	70	12%	0	0
4	2.94	2.3	4.4%	288,149	400	25%	160,083	225
5	2.25	1.0	2.3%	95,288	69	13%	0	0
Total	**9.6**	-		**688,377**	**848**		**275,804**	**385**

(1) Pond Areas and volumes based on O&M prepared by Creegan + D'angelo Consulting Engineers.
(2) Average sludge depth based on 9 measurements for each pond, except Pond 1 which had 10 measurements taken February 2008.
(3) Assumes bottom 1 foot of sludge cannot be removed.
(4) Sludge concentrations based on sludge sample analysis done for City of Stockton with similar operation of lagoons.

Based on the sampling, the volume of Pond 1 is impacted by the 41 percent sludge accumulation. The extra sludge at the bottom reduces treatment volume in the pond and causes more organic waste to flow down stream to other pond processes. Since the average plant flow is currently only 0.5 MGD, the detention time in this pond is adequate even with the high sludge accumulation. However, as plant flows increase, cleaning the pond will be required. If the sludge accumulation is severe enough, rising sludge can contribute to odors and cause spikes in the soluble BOD in the treatment process. The temporary solution to excessive settled sludge is to keep the aerators running so there is adequate DO to oxidize odorous gasses from the decomposing sludge.

Pond 4 also has some sludge accumulation that accounts for 25 percent of the treatment volume. Since Pond 4 is much larger that Pond 1, the mass of sludge in Pond 4 is larger.

Currently the ponds are operating well and ***sludge removal should be scheduled in the next four years***. There are four methods for sludge removal from the ponds. Cost estimates provided are based on very limited testing of the actual material present and 2008 dollars. The values should only be used for establishing an order of magnitude cost for sludge removal project costs. Additional testing to better estimate on site materials and costs will be required when a request for proposal is developed for use by contract dewatering companies. All methods assume tests of the sludge indicate a Class B material with no hazardous characteristics.

- The use of a vactor truck, as was used during the summer of 2007, is probably the least expensive sludge removal method for smaller facilities such as this. Sludge removal with a vactor truck is limited to the length of the hose and how well the hose can be controlled. It is likely that only sludge at the periphery of the ponds can be adequately removed. Costs for this option are unknown, but since the ability to remove sludge is limited, this option is not adequate.

- The second method is to use a small dredge that is pumped to a tanker truck. The truck could haul the liquid sludge off site wet or take it to the on-site sludge drying bed. Assuming the dredge can harvest 3 percent sludge concentration, then cleaning all but the bottom foot would require pumping 1.3 million gallons (MG) from pond 1 and 260 round trips for the truck. Cleaning all but the bottom foot of Pond 4 would require pumping 1.8 MG and 360 round trips for the truck. Both ponds could be cleaned in one season. Costs of a dredge and the person to operate the dredge, truck hauling and disposal would range from $950,000 to $1,230,000, assuming a disposal location is available.
- The third method is a small contract dewatering operation that would use a dredge and mobile centrifuge to dewater the sludge on site. We believe it would be possible to get 18% cake solids. With this assumption, cleaning all but the bottom one foot from Pond 1 would generate 887 wet tons of material and would require 36 trucks to haul the material away. Cost for Pond 1 would range from $210,000 to $270,000. Cleaning all but the bottom one foot from Pond 4 would generate 1,233 wet tons of material and would require 49 trucks to haul the material away. Cost for Pond 4 would range from $300,000 to $390,000. Trucking costs could be minimized by some additional on site solar drying after mechanical dewatering.
- The final option is to bypass a pond and dewater it using temporary pumps and let the sludge solar dry in the pond all summer. Bypassing Pond 1 with most of the aeration capacity would impact treatment capability and could overload the other ponds. Solar drying is more appropriate for Pond 4. Limitations of this option are that only one pond can be cleaned per summer. The advantage is that all of the sludge would be removed, even the bottom one foot. Sludge drying could be “optimized” by using a “brown bear” tractor to turn over the sludge daily to keep wet sludge exposed to the air. If Pond 1 is solar dried then 341 wet tons of material would be hauled off site in 14 trucks. Cost for Pond 1 would range from $135,000 to $175,000. If Pond 4 is solar dried then 571 wet tons of material would be hauled off site in 23 trucks. Cost for Pond 4 would range from $155,000 to $200,000.

We recommend a combination of the second and fourth option in which a dredge would be used to pump the sludge from Pond 1 to Pond 4. Then Pond 4 would be removed from service and solar dried, while Pond 1 is kept in service. The estimated cost for this option is $300,000 to $390,000. Additional sampling needs to be conducted to determine the appropriate solids disposal technique and to verify the quantity of sludge can be dried in one pond during one summer. Continued monitoring of pond sludge level is required because an increase in the mass of the material that must be dried would eliminate the least expensive “dry-in-place” option.

Solar drying sludge into Class B biosolids requires that material remain in the drying beds for 3 months following pond draining. By using the brown bear to facilitate drying in 3 months, the sludge should also comply with the EPA’s Vector Attraction Reduction requirements of 75 percent solids. After achieving the 3 months of solar drying and 75 percent solids, plus any additional regulatory testing, the biosolids can be removed from the pond and hauled directly to a land application site selected by the contract dewatering firm.

5. CAPITAL IMPROVEMENT PROJECTS

Capital Improvement Projects are necessary for improving and expanding treatment facilities, when the cost of the improvement exceeds the O&M budget. It appears that in recent years there have been a couple of quickly developed improvement projects. While these were necessary, rushing the projects often results in added costs.

The "Wastewater Facilities Expansion and Financing Plan" (Facilities Plan) dated July 2007 by HydroScience Engineers, Inc, provided preliminary estimates of the capital costs of alternatives for providing the treatment, storage, and disposal facilities to serve future development at Rancho Murieta. Table 4 at the end of this section, includes a discussion of these alternatives along with updated costs for their implementation. The costs are based upon preliminary layouts of the proposed facilities included in the Facilities Plan and not on specific designs, which would require further engineering effort. Since the new development is anticipated to occur in specified areas in three (3) phases, the improvement projects should also be implemented in phases. Phase 1 is near term, less than five years, with an estimated 700 new wastewater connections to be served by the WWRP. Phase 2 is mid-term, five to ten years, with an estimated 1,000 new connections. Phase 3 is long term, beyond 10 years, with an estimated 600 new connections. The number of new connections is based on the July 2007 estimates in the Facilities Plan. It should be noted that the recent decline in development may push the construction phases out further into the future than what was initially estimated.

5.1. Headworks and Metering Facilities

The proposed headworks facility is recommended in the Facilities Plan for removal of coarse, non-degradable materials from the plant influent water. In recent years, problematic comminutors (grinders) in the collection system have been removed and are being replaced by chopper pumps. Chopper pumps will breakdown large debris in the wastewater, but not to the same extent as comminutors. In this case, the chopper pumps would provide sufficient breakdown of large objects to protect the fine screens.

As an alternative to the fine screen recommended in the Facilities Plan, a coarse screen could be provided:

- Advantages of fine screening upstream of the pond process are:
    - Fine screens will reduce inert plastics as floating scum
    - Vertical axis floating aerators will have much less and maybe no ragging issues
    - No inorganic plastics in sludge during future dewatering projects
- Disadvantages of fine screening over coarse screens are:
    - Increased maintenance of the fine screen and screening washer compactor
    - Channel needs to be much larger for fine screens to pass the same flow due to increased headloss through a fine screen
    - Fine screens have more instrumentation and electronics requiring outside maintenance

Based upon the current borrowed brush aerator performance, it is estimated the time spent operating and maintaining fine screens would be substantially greater than the time spent on downstream operating issues related to ragging. ***A new headworks facility that is equipped with a coarse screen to collect large objects that make their way through the collection***

system and the ability to measure influent flow and provide an influent sampling point is recommended. The proposed Headworks facility will include the following equipment:

- Manual 1-inch (coarse) bar screening in a single channel, with consideration given to adding an auto-cleaning mechanism
- Fiberglass reinforced plastic (FRP) channel covers and odor scrubber to mitigate potential odor problems
- Magnetic flow meter for measuring influent flow to the plant. Currently there is no direct method for measuring influent flow
- An overflow weir will be provided in a bypass channel in case the screens get plugged to let influent flow directly to Pond 1

The headworks and metering facility is recommended for Phase 1. The cost for this facility is based on the preliminary layout provided in the Facilities Plan. A single channel design could accomplish the same design goals for less money. A cost break down per element is provided in Appendix F of this report.

5.2. Disinfection Facilities

The existing WWRP chlorine contact disinfection facility is capable of properly disinfecting a flow of 2.3 MGD. The Facilities Plan estimates a required capacity at build-out for this facility of 3.0 MGD. Expansion of the existing chlorine contact facility is not practical due to its configuration, which utilizes a pipe to achieve the required contact time.

Two alternative technologies for disinfection are discussed in the Facilities Plan, chlorine contact disinfection and ultraviolet (UV) disinfection. UV disinfection would not completely eliminate the need for chlorination in the plant, since chlorine residual would still be required to prevent algal growth in piping for reuse applications such as landscape irrigation. However, the quantity of chlorine required for this purpose would be significantly less than for effluent disinfection.

The capital cost in Table 4 for the chlorine contact basin (CCB) is based on a new serpentine contact basin capable of treating a peak flow of 3 MGD. Basic components of this system include a concrete tank, induction mixers, gates, and weirs.

The capital cost of a 3 MGD UV disinfection facility may vary considerably based on several variables including the transmittance characteristics of the wastewater, type of UV lamp used, and system configuration. Considerable engineering time would be required to determine what type of UV system and configuration would be the most viable based on specific site conditions. The costs included in this report assume a Low Pressure High Output (LPHO) channel mounted system will be used. The transmittance is assumed to be 55 percent since data is not available and this is the lower threshold for a cost-effective UV system.

The new chlorine contact tank disinfection facility is recommended for implementation in Phase 1 so that the treatment capability of the plant can keep up with the demands of new development. Unless river discharge is seriously being considered, an UV disinfection processes probably costs more to build and operate than chlorination systems. Specific design criteria for both needs to be developed to answer this question for certain.

5.3. Increased Storage Capacity

Based on the water balance model conducted for the Facilities Plan, the WWRP will require 204 acre-feet of storage for Phase 2 development and 330 acre-feet of storage for Phase 3 development at build-out. The Facilities Plan suggests that the storage required for Phase 3 can be reduced to 165 acre-feet if the reservoirs are covered and do not receive direct rainfall. However, covering reservoirs of this size with impermeable covers does not appear to be a cost effective solution. Additionally, covering the reservoirs reduces evaporation, thereby reducing storage capacity.

Costs to increase storage capacity include land acquisition, excavation, lining of reservoirs, piping, and pumping. Land acquisition costs are estimated to be $20,000 dollars per acre.

5.4. Increased Disposal Capacity

Several alternatives were presented in the Facilities Plan for increasing the disposal capacity at the WWRP. The following were listed as viable alternatives:

- Spray irrigation on nearby grazing land
- Title 22 (recycled water) landscape irrigation for new development
- Seasonal discharge to the Cosumnes River which would require a NPDES Permit
- A combination of these alternatives

Spray irrigation to nearby grazing lands is the only alternative for disposal that can be implemented in Phase 1. The Facilities Plan recommends that this option be implemented in Phase 1 for all three alternatives since it is the only feasible option for disposing of effluent in the short term.

Beneficial reuse of the WWRP effluent for Title 22 landscape irrigation is an attractive option since it reduces future potable water demands while providing a means for disposing of plant effluent water. Application of this alternative would require a system of storage, transmission, and distribution of recycled water similar to a potable water system. Installation of distribution piping within the individual developments would be the responsibility of the developer. This alternative may not be cost effective for new developments located far from the WWRP but should still be considered because of other benefits listed above.

Obtaining a seasonal discharge permit (NPDES Permit) for discharge to the Cosumnes River would require considerable effort in engineering and environmental studies. The $2.5 million dollar cost estimate for river discharge listed in Table 4 does not appear to include all sufficient design contingencies to accommodate regulatory issues. An anti-degredation analysis, a reasonable potential analysis, and river hydraulic modeling will most likely be required for the NPDES Permit application process. Other permitting requirements may include the following:

- An Environmental Impact Report (EIR) addressing the environmental impacts of construction of a river discharge structure.
- An encroachment permit or temporary construction easement for construction of the pipeline and river discharge structure.
- A Streambed Alteration Permit from the California State Department of Fish and Game.
- A nationwide general permit from the US Army Corps of Engineers for fill associated with construction of the outfall within the Cosumnes River

- State Lands Commission and Reclamation Board Permits

Infrastructure required for this alternative would include an effluent pump station, effluent pipeline, and a river discharge structure. The use of UV disinfection in lieu of chlorination should be seriously considered if there are plans to pursue the river discharge option as the issue of disinfection byproducts from chlorination is becoming an increasing concern.

There is insufficient information is available to update the costs for increased disposal capacity due to the many variables discussed above. The costs presented in Table 4 for disposal alternatives are taken from the Facilities Plan.

Table 4 – Costs of Capital Improvements

Cost Element	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost	Build-out Total
Alternative 1				
Storage	$0	$13,000,000	$17,000,000	$30,000,000
Spray Fields [(1)]	$8,500,000	$5,700,000	$3,200,000	$17,400,000
Headworks	$1,100,000	--	--	$1,100,000
Chlorine Disinfection	$3,300,000	--	--	$3,300,000
Alternative 1 Total	**$12,900,000**	**$18,700,000**	**$20,200,000**	**$51,800,000**
Alternative 2				
Storage	$0	$13,000,000	$17,000,000	$30,000,000
Spray Fields [(1)]	$8,500,000	--	--	$8,500,000
Landscape Irrigation [(1)]	--	$9,400,000	$13,600,000	$23,000,000
Headworks	$1,100,000	--	--	$1,100,000
Chlorine Disinfection	$3,300,000	--	--	$3,300,000
Alternative 2 Total	**$12,900,000**	**$22,400,000**	**$30,600,000**	**$65,900,000**
Alternative 3				
Spray Fields [(1)]	$8,500,000	--	--	$8,500,000
River Discharge [(1)]	--	$2,500,000[(2)]	--	$2,500,000
Headworks	$1,100,000	--	--	$1,100,000
UV Disinfection	$4,600,000	--	--	$4,600,000
Alternative 3 Total	**$14,200,000**	**$2,500,000**	**$0**	**$16,700,000**

Notes:
1. Costs taken from Wastewater Facilities Expansion and Financing Plan by HydroScience Engineers, Inc, July 2007
2. This cost may not include sufficient design contingencies to accommodate regulatory issues.

6. SUMMARY OF RECOMMENDATIONS

Table 5 - Recommendations					
Section[1]	**Recommendation**	**Management/Trainer Labor[2]**	**Operator Total Labor[2]**	**Priority[3]**	**Comments**
3.1	Provide training to the operators so that they may operate the processes at the WWRP as efficiently as possible.	960 hours, then 240 hours per year to maintain. Includes other recommendations below	Initial training 80 hours, then optimization program maintenance will require 240 hours per year	High	Optimization program will take less time with SCADA improvements. This includes training, process control spreadsheets, and jar testing as listed below.
3.1	Develop process control spreadsheets on both dissolved air flotation (DAF) and filter operation.	Included with 3.1	Included with 3.1	High	Effort should be concurrent with 3.1.
3.2	Hire additional staff at the WWRP at least until some of the problems described in this report are solved and additional improvements are made.	40 Hours	2080 hours per year	High	Assumes the addition of one FTE.
3.3	Contact previous operators and interview any future departing operators to determine why they left. Develop a plan for improving operator retention based on information learned from these interviews.	40 Hours		Medium	Time to make contacts and develop a retention plan. Salary surveys or benefits comparisons will require additional effort.

Table 5 - Recommendations					
Section[(1)]	Recommendation	Management/Trainer Labor[(2)]	Operator Total Labor[(2)]	Priority[(3)]	Comments
3.4	Plant management should continue to concentrate on developing the maintenance management program.	Complete setup with 520 hours, then 240 hours per year to maintain program	240 hours per year to maintain program	High	Assumes a lump sum effort, then 5 hours a week of program maintenance.
3.4	Plant management should continue to concentrate on completing the "To Do" list.	On-going	On-going	High	The effort required to repair the current plant is difficult to estimate.
3.4.1	Develop a more formal spare parts inventory procedure and implement that procedure.	40 hours, then 12 hours per year to maintain supplies.	24 hours per year to maintain program	Medium	Work on this after the maintenance management program is substantially complete
4.1	Establish a small single shelf O&M library.	Included with 3.1	Included with 3.1	Medium	Should be developed with the training recommended in section 3.1.
4.2	Plant personnel should conduct jar testing and consider implementing a different primary coagulant chemical strategy if it is more cost effective.	Included with 3.1	Included with 3.1	Medium	Included with 3.1.
4.3	RMCSD should continue to operate the plant and make improvement to insure odor problems do not return.				

Table 5 - Recommendations					
Section[(1)]	**Recommendation**	**Management/Trainer Labor[(2)]**	**Operator Total Labor[(2)]**	**Priority[(3)]**	**Comments**
	• Purchase brush-style aerators	80 hours for purchase order and plan for installation.	(4)	High	See section 4.5.1. Excludes effort that may be required to supply additional power.
	• Continuous operation of Pond 1 aerators	Minor	520 hours per year	High	Assumes one 10 hour repair of aerator per week. Recommended Bar screen will substantially reduce this effort after 6 months.
	• Remove sludge as needed	Tracking 30 hours per year, then additional time to set up contract dewatering when required.	Monitoring 60 hours per year.	Medium	See section 4.6.2. During sludge removal project refer to Note 5 below.
	• Plant two air drift barriers	80 hours for purchase order and plan for installation.	(4)	High	Maintaining new tree will require some special irrigation.
	• Modify piping to allow recirculation and isolation of ponds	80 hours for purchase order and plan for installation.	(4)	Medium	Recycle water dilutes the inlet wastewater and spreads treatment among more ponds.
4.4	Install a carbon tower on the main north lift station	80 hours for purchase order and plan for installation.	(4)	High	Pump station site location odor control.
4.4	Install canister carbon filters on all other vented lift stations	80 hours for purchase order and plan for installation.	(4)	High	Pump station site location odor control.

Table 5 - Recommendations					
Section[1]	**Recommendation**	**Management/Trainer Labor[2]**	**Operator Total Labor[2]**	**Priority[3]**	**Comments**
4.5.1	Operate ponds to obtain required dissolved oxygen levels, add aerators if necessary.	Minor		High	Already in progress except for the additional mixing energy needed in Pond 1.
4.5.2	Develop a new chemical dose strategy or rehabilitate the acid system before the DAF feed pH starts to drop during the 2008 irrigation season.	Included with 3.1.	Included with 3.1.	High	Included with 3.1.
4.6.1	Initiate a system-wide SCADA control system master plan.	40 hours to set up and participate in project.	Minor	Medium	Master plan will tell future integrators what equipment to use so eventually the whole district may be monitored from a single location.
4.6.1	Install a standardized control system including graphical interface, SQL based historian, and telephone alarming software package.	(4)	(4)	Medium	Historian allows Operators to do troubleshooting with the SCADA system. Automated compliance reporting is also a possibility.

Table 5 - Recommendations					
Section[1]	**Recommendation**	**Management/Trainer Labor[2]**	**Operator Total Labor[2]**	**Priority[3]**	**Comments**
4.6.1	Investigate the automation of the chemical feed systems.	Included with 4.6.1. above.	Included with 4.6.1. above.	Medium	Allows new SCADA system to control more of the process automatically.
4.6.1	Investigate the benefit of adding additional instrumentation.	Included with 4.6.1. above.	Included with 4.6.1. above.	Medium	Allows new SCADA system to control more of the process automatically and improves troubleshooting ability.
4.6.2	Schedule sludge removal from all ponds in the next four years, utilizing a combination of a small dredge and isolating ponds/solar drying.	(4)	(4)	Medium	Present day cost, future cost may escalate due to inflation and additional sludge accumulation.
5.1	Install a new headworks facility that is equipped with a coarse screen, flowmeter, and sampling point.	(4)	(4)	Medium	Headworks facilities are included in Facilities Plan. This report includes modifications to plan.
5.2	Install a new chlorine contact as needed for increased (future) flows.	(4)	(4)	Low	Chlorination included in Facilities Plan.

Table 5 - Recommendations					
Section[1]	Recommendation	Management/Trainer Labor[2]	Operator Total Labor[2]	Priority[3]	Comments
5.3	Increase storage capacity by building additional storage ponds.	(4)	(4)	Low	Increased storage included in Facilities Plan. Facilities plan recommends these improvements for Phases 2 and 3.
5.4	During Phase 1 of the Facilities Plan, implement spray irrigation to nearby grazing lands to increase disposal capacity.	(4)	(4)	High	Spray field included in Facilities Plan, RMCSD has initiated this work.

(1) See referenced report section for more detailed description.

(2) "Order of magnitude" estimate of in-house staff (person-hours) needed to implement the recommendation.

(3) Priority 1 needs immediate attention (within six months) to prevent plant malfunction, discharge violation, or other imminent impact.
Priority 2 should be done within the next year to improve performance and/or prevent future problems.
Priority 3 is a long-term solution (more than one year) to a current or future issue.

(4) In-house operations and maintenance staff work loads will increase during design and construction of capital improvements projects due to the need to support contractor activities and interruption of the normal work flow caused by construction activities at the plant site.

Appendix A

California Regional Water Quality Control Board
Central Valley Region
Karl E. Longley, ScD, P.E., Chair

Linda S. Adams
Secretary for Environmental Protection

Sacramento Main Office
11020 Sun Center Drive #200, Rancho Cordova, California 95670-6114
Phone (916) 464-3291 • FAX (916) 464-4645
http://www.waterboards.ca.gov/centralvalley

Arnold Schwarzenegger
Governor

19 June 2007

RECEIVED
JUN 21 2007
Rancho Murieta Community Services District

Mr. Edward R. Crouse
Rancho Murieta Community Services District
15160 Jackson Road
Rancho Murieta, CA 95683

NOTICE OF VIOLATION, RANCHO MURIETA COMMUNITY SERVICES DISTRICT, SACRAMENTO COUNTY

On 7 June 2007, Regional Water Board staff began receiving complaints from Rancho Murieta residents regarding offensive odors originating at the Rancho Murieta Community Services District (RMCSD) wastewater treatment facility (WWTF). As of 18 June 2007, we have received eight complaints from five different parties. The complainants report strong very objectionable sewage odors in the evening and morning hours, particularly after a warm day when there is some wind blowing from west to east.

Based on staff's conversations with you and your staff, we understand that RMCSD acknowledges that odors at the WWTF have been a problem for several weeks, and that you believe that accumulated biosolids in the first two aerated ponds are the cause.

On 11 May 2001, the Central Valley Regional Water Board adopted Waste Discharge Requirements (WDRs) Order No. 5-01-124 to regulate the treatment and discharge of wastewater at the RMCSD WWTF. The odors are violations of the following WDRs requirements:

- Discharge Prohibition A.3 states: "*Neither the treatment nor the discharge shall cause a nuisance or condition of pollution as defined by the California Water Code, Section 13050.*"
- Discharge Specification B.4 states: "*Objectionable odors originating at this facility shall not be perceivable beyond the limits of the wastewater treatment and disposal areas.*"

We understand that the following measures have been tried to reduce the odor:

1. Adding chlorine to the influent at the sampling structure for Pond No. 1.
2. Running recycled water through Pond No. 1 to flush out accumulated sludge.
3. Running the aerators at night only.
4. Lowering Pond Nos. 1, 2, and 3 to reduce their exposure to moving air.

5. Bypassing Pond No. 1 to direct influent to Pond No. 2.

We also understand that RMCSD is considering the following additional measures:

1. Isolating Pond No. 1 from Pond No. 2 and pumping accumulated sludge to the drying beds.
2. Purchasing and installing an odor-masking unit.
3. Setting pond aeration times to begin later at night so that evening winds do not carry odors.

Based on the complaints about severe odors over the weekend of 16/17 June 2007, these efforts have not been adequate, and **RMCSD must take additional steps to eliminate the odors forthwith.**

By **25 June 2007 and each subsequent Monday until further notice**, Rancho Murieta Community Services District shall submit a weekly *Odor Monitoring and Odor Control Status Report* that contains daily logs **for each day during the previous week** that document the following:

a. The results of thrice daily odor observations at the predominantly downwind WWTF boundary. Odor observations shall be made before 8:00 a.m., between noon and 2:00 p.m., and after 4:00 p.m. each day. Odors associated with wastewater shall be characterized as slight (barely noticeable or noticeable but sporadic); moderate (noticeably objectionable and relatively constant); or severe (strong, continuous, objectionable odors). Monitoring shall be performed by the same person each day to the maximum practical extent, and shall be performed on weekends and holidays as well as workdays.

b. The results of thrice daily dissolved oxygen monitoring for each wastewater treatment pond. Samples shall be obtained before 8:00 a.m., between noon and 2:00 p.m., and after 4:00 p.m. each day, and shall be representative of wastewater near the surface of the ponds. A hand-held dissolved oxygen meter may be used in accordance with Revised Monitoring and Reporting Program No. 5-01-124.

c. Documentation of all citizen complaints received, including the date, time, nature of the complaint, and complainant's contact information (if available).

d. A description of specific odor control measures implemented and the specific hours that they were implemented. Discuss the effectiveness of the day's odor control efforts in consideration of the weather, odor observations, complaints, and dissolved oxygen readings.

e. A description of all efforts to find and implement a permanent odor control solution.

We recommend that RMCSD reach out to affected community members through public notice and/or a public meeting as soon as possible to explain the cause of the problem and what is being done to eliminate the odors. Based on recent communications with you during which you expressed your commitment to resolving the issue, we hope that further enforcement will not be necessary. If you have any questions, please contact Anne Olson at (916) 464-4740.

Wendy Wyels

WENDY WYELS
Environmental Program Manager

cc: Joyce Horizumi, Sacramento Co. Dept. of Environmental Review and Assessment, Sacramento
Thomas W. Hutchings, Sacramento Co. Planning and Community Development Dept., Sacramento
Sacramento County Environmental Management Department, Sacramento
Paul Siebensohn, Rancho Murieta Wastewater Treatment Facility, Rancho Murieta
Ward Walters, Rancho Murieta Country Club, Rancho Murieta
Roberta Larson, Somach, Simmons & Dunn, Sacramento
Michael Lozeau, Law Office of Michael R. Lozeau, Alameda
Steven Cassidy, Cassidy, Shimko & Dawson, San Francisco
Edward Mevi, Stanton, Kay & Watson, LLP, San Francisco
Christopher Sanders, Ellison, Schneider & Harris, LLP, Sacramento
Robert Cassano, Cassano Kamilos Homes, Gold River
Brad Sample, Rancho Murieta
Donald Sams, Rancho Murieta
Gregory Tenorio, Rancho Murieta
Candy Chand, Rancho Murieta
Deborah Quick, Morgan, Lewis & Bockius LLP, San Francisco
Marcia Oxford, Sutter Creek
Karen Muldoon, RanchoMurieta.com, Rancho Murieta

CIWQS ID Nos. 570396, 570400, 570401, 570403, 570405, and 570406

Appendix B

Rancho Murieta Community Services District
15160 Jackson Road • P.O. Box 1050 • Rancho Murieta, CA 95683 • (916) 354-3700 • Fax (916) 354-2082
Visit our website • www.rmcsd.com

June 27, 2007

Wendy Wyels
Environmental Program Manager
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670-6114

Subject: RMCSD, WDR 5-01-124, Notice of Violation, Dated June 22, 2007

Dear Wendy Wyels:

In response to the NOV request for the District to submit a specific plan of action for removal of sludge and community outreach, the District submits this letter report.

Following the inspection by the staff of the Regional Water Quality Control Board on June 19, 2007, Richard Stowell, PhD, PE, of Eco:Logic Engineering, visited the Reclamation Plant to assist the District in reducing and managing the current nuisance odors. During his visit he looked at the field conditions at the plant, attempted to determine the specific causes of the odor and proposed some initial actions that he felt would help to reduce the odors.

Dr. Stowell's opinion is that the cause of the odors is the low level of dissolved oxygen in Pond 1, when compared to the incoming organic load. While the District initially believed that the amount and level of the sludge was the cause of the nuisance odors, Dr. Stowell does not believe that the odors are related to the amount and level of sludge. The District has consulted with other experts in the area of wastewater treatment plant operations who share Dr. Stowell's opinion that the sludge level is not the source of the problem.

In consultation with Dr. Stowell and with the assistance of our operations staff, the District has prepared the following action plan to reduce odors.

ODOR REDUCTION AND CONTROL

I. Immediate and Short Term Odor Control Measures. The measures identified below are actions and activities that the District has already undertaken, or will undertake within the next few days, to reduce nuisance odors to the level associated with normal pond operations.

A. Operate four of the smaller aerators in Pond 1 to increase and maintain a dissolved oxygen (DO) level well above 1.0 mg/l, and to achieve balance between the dissolved oxygen and the incoming organic load.

Schedule: Currently in process

Cost: Varies, depending on time and length of operation; funding from operating budget.

B. Check for floating scum and debris on Pond 1 several times daily and remove these materials whenever there is any significant accumulation.

Schedule: Currently in process

Cost: Estimated on $1,000/week; funding from operating budget.

C. Contact local representatives of floating brush aerators (not aspirating, propeller-type aerators) and arrange for a field test of a "loaner/ demonstration" unit in Pond 1. This type of aerator may increase the pond surface mixing and assist in the more efficient distribution of incoming raw sewage to the four operating aerators.

Schedule: Contact will occur within the next few days, and the field test will commence as soon as possible, and continue over the next 30-60 days.

Cost: Unknown at this time.

D. Arrange for the application of specialized additives (bacteria, enzymes, etc) that increase biological activity to assist with reducing odor and as an option for a biological process to gradually reduce sludge volume in Pond 1.

Schedule: The first application has been made, with another application to occur on Friday, if determined necessary by the contractor. Future applications will occur as recommended by the contractor.

Cost: Initial application: $5000; monthly maintenance $500/month. Sludge reduction based on volume reduced, estimated at $100-150,000

E. Add chlorine to influent shortly before it enters Pond 1 to reduce the odor in influent wastewater.

Schedule: Chlorine added during the week of June 18, but stopped on June 23rd to avoid killing the specialized additives.

Cost: $2-4000/month

F. Dilute the influent wastewater organic concentration by introducing tertiary effluent into Pond 1 to help move that load into Pond 2 more quickly, if the previous recommended actions do not provide adequate odor control. Influent wastewater load distribution could also be achieved by diverting some of the effluent flow directly into Pond 3.

Schedule: Currently used as needed, depending on odors and weather

Cost: None

G. Recirculate water from pond 2 or 3 to assist in repopulating Pond 1 with algae.

Schedule: Currently used as needed, depending on odors and weather

Cost: None

II. Rapid Response Odor Control Measures – These measures will be implemented should the pond imbalance reoccur and cause abnormal operating pond odors.

A. Contract with consulting engineer(s) and/or WWTP operations expert(s) to review plant operations and provide advice to control odors and /or sludge maintenance.

Schedule: Begin July 1 and continue until Pond 1 odors are under control

Cost: Up to $5000/month, on call retainer for weekly assistance

B. Immediate sludge removal of up to 33% of volume to provide additional water cap and to reduce organic loading should short term odor measures prove unsuccessful. Pump sludge to sludge drying beds. Haul off site when dried as part of normal yearly sludge removal

Schedule: 2-4 weeks following recommendation of rapid response team

Cost: $30-50,000

III. Long-Term Odor Control Measures – These measures will be implemented over time, in addition to the current activities, to further reduce the future possibility of reoccurring abnormal nuisance odors.

A. Removal of sludge from the perimeter of Ponds 1 and 2, as needed.

Schedule: Currently in process for odor control; extended long term use if buildup occurs.

Cost: $5000/week

B. Review and implement updated routine and preventative maintenance practices to prevent sludge buildup in the future.

Schedule: 6 months

Cost: Plan: $20,000; Maintenance: varies/unknown

C. Install at least one brush aerator in Pond I to circulate the contents of the ponds so as to reduce hydraulic short-circuiting and to improve the oxygen transfer efficiency of the existing aerators, if field tests validate ability to produce desired results.

Schedule: 60-90 days

Cost: $20,000 each

D. Install head works to include a fine influent screen with washer and compactor to increase the efficiency and reliability of the existing aerators.

Schedule: Board approval of this work expected in July 2007. Six to nine months for design through construction.

Cost: $300,000

E. Install piping to allow Ponds 1&2 to be taken out of service for maintenance (e.g., sludge removal). As part of this project, the need for an additional pond, additional aeration, and an effluent recirculation system will be considered.

Schedule: 1-2 years or longer

Cost: Unknown

F. In consultation with an arborist, design and plant an air drift barrier between the WWRP ponds and the District offices and consider planting a second barrier between District offices and Highway 16. The barrier will consist of perennial bushy trees of two types: fast growing (usually short-lived) trees to get a barrier in as quickly as possible and long-lived (usually slower growing) trees to act as the long-term barrier over the decades.

Schedule: 6-9 months

Cost: $50,000

G. Conduct audit of operations of the Reclamation Plant to ensure plant, equipment and O&M is in accordance with current industry standards. Schedule: Board approval of this work expected in July 2007. Six to nine months for implementation.

Cost: Unknown at this time

COMMUNITY OUTREACH

This effort involves engaging the community on a variety of ongoing issues within the District, but primarily this effort will involve community outreach concerning the nuisance odors. District's activities will include community updates on the status of our efforts and notice of activities that may cause new resident concerns.

Since receiving the NOV, the District has held two special board meetings and mailed a community letter addressing the nuisance odor.

In the near and long term, the District will employ the following outreach:

1. Weekly updates via postings on Ranchomurieta.com, River Valley Times and the Districts website.
2. Monthly updates during the normal Board meetings
3. Community letters with more background and details on odor issues
4. News releases to RM.com, River Valley Times and District website
5. Special townhall or workshops as needed as we move forward with or odor control measures
6. Emergency Notices on Channel 5
7. Emergency Notices hand delivered
8. Emergency email alerts to concerned residents
9. Re-vamp complaint processing procedures

In closing, the District believes it has developed a comprehensive plan to reduce and control nuisance odors. We will continue to monitor the success of this program, in addition to our other monitoring and reporting requirements.

Sincerely,

Edward R. Crouse
General Manager

Appendix C

F. Operation Help

The reclamation facility was patterned after several operational systems which have years of background data and operational considerations. The operator may elect to contact the following facilities for questions or advice:

- City of Stockton (209) 466-9400
- City of Sunnyvale (408) 738-5666

G. Plant Personnel

Annual manhour requirements for plant operation and maintenance, laboratory control, and supervision were determined from our estimation of operation and maintenance requirements for this treatment facility based upon our experience at other completed treatment plants. Weekly manhours are summarized below. Manpower requirements are computed from manhours on the basis of 1,500 productive hours per year out of 2,080 hours. This assumes an average of 6-1/2 hours of productive work per man per day, plus vacations, sick leave and holidays.

TABLE 3

ESTIMATED WEEKLY MANHOURS REQUIRED FOR
RECLAMATION FACILITY OPERATION

Category	Weekly Estimated Manhours
1) Supervisory and Report	5
2) Yard Work and Collection	8
3) Clerical	2
4) Plant Facilites	
A) Laboratory	20
B) Aeration Lagoons	5
C) Reservoir Operation	5
D) Dissolved Air Floatation (DAF)	5
E) Filtration	5
F) Chlorination	2.5
G) Chemical Treatment	5
H) Sludge Drying Beds	10
I) Pump Maintenance	7.5
Total Plant Facilities Manhours	80/week
	4,160 per year

The total annual estimated productive manhours of 4,160 (as shown in Table 3) represents a need of 5,800 manhours or 2.8 operators. This method of determining staffing is not absolute; however, it does indicate the need for two full time operators and perhaps a part time assistant. Many factors can affect these estimated manhours. Table 4 illustrates some of these factors.

TABLE 4

FACTORS AFFECTING MANHOURS

Factors	Effect on Manhours
Level of Treatment	Above secondary - increase
Morale	High - decrease
Climate	Cold winters - increase
Equipment Age	New - no adjustment Old - increase
Plant Layout	Compact - decrease

Because of these variables, the need for the 2.5 operators will have to be verified in the field. Initially, it is recommended that 2 full time operators with lab experience be employed. Several months of operation will determine the exact level of staffing required.

The chief plant operator should be responsible for day-to-day operations and should be informed on all developments effecting plant performance. The other operators should be trained in all aspects of plant operation and maintenance (including lab work), to be capable of properly running the plant when the chief operator is ill or on vacation.

Collection system and heavy maintenance work will be performed by the maintenance crews as needed.

Recent reports from EPA and in the wastewater treatment literature have emphasized that negligent and improper operation of wastewater treatment plants is frequently the cause behind failures to meet effluent discharge requirements. Therefore, it is of paramount importance that the plant operation and maintenance personnel be properly trained and perform their work conscientiously for the plant to meet its pollution control goals.

Subchapter 14, Chapter 3, Title 23 of the California Administrative Code classifies the wastewater reclamation facility as a Class II plant. This means that the chief plant operator must possess a minimum Class II certification from the State of California as a wastewater treatment plant operator.

It is recommended that during the full capacity summer months, the plant be manned seven days a week. Twenty-four hour staffing is not mandatory; however, some level of O & M (four to eight hours per day) will be necessary throughout this high use time period.

Appendix D

ECO:LOGIC

Consulting Engineers

June 22, 2007

Mr. Edward Crouse
Rancho Murieta Community Services District
15160 Jackson Road
Rancho Murieta, CA 95683

Subject: WWRP Odors

Dear Mr. Crouse,

Per your request, I visited the Rancho Murieta Community Services District Wastewater Reclamation Plant (WWRP) shortly after dawn on 20 June 2007 to (1) look at field conditions at the WWRP, (2) try to determine the specific cause(s) of the odors, and (3) make recommendations regarding reducing the odors based on field observations, information made available to me by your staff on this date, and my 30 years of experience with ponds.

Field Observations

Odors

There was no perceptible significant odor at dawn on 20 June until I approached with about 50 feet of Aeration Pond No. 1 (Pond 1). There was a mild, but significant odor of relative fresh raw sewage downwind from the one aerator (of four) in the pond that was operating. There was a more pronounced odor immediately downwind of floating scum and debris that had accumulated in one corner of the pond, reportedly over the course of one week since this pond's surface was last cleaned of all floating materials.

There was no detectable odor downwind from aerators operating in Ponds 2 and 3. There was no material scum or debris accumulated in either of these ponds. These observations are in concert with District beliefs that Pond 1 is the primary sources of nuisance odors.

3875 Atherton Road ▪ Rocklin, California 95765 ▪ Phone (916) 773-8100 ▪ Fax (916) 773-8448

Pond Color

The Pond 1 color was "raw sewage brown" indicating that algae are not present in the pond in significant numbers. Therefore, there is no significant oxygen produced in Pond 1 during the day. The absence of algae in Pond 1 is probably a result of chronic low oxygen conditions, short hydraulic residence time, and water turbidity. The Pond 1 color and scum are typical of organically overloaded ponds (insufficient oxygen) I have seen over the years.

Pond 2 had a light green color indicating that algae and photosynthesis are present, and more importantly that organic loading conditions in Pond 2 are not so excessive as to exclude algal life as appears to be the case in Pond 1. However, the color of Pond 2 is not strong, which suggests that condition are not ideal for algae and that this pond may become odorous under protracted hot weather.

Pond 3 had a very healthy green color, and I would not expect any significant odor from Pond 3 as currently operated. As with any pond treatment plant, operation of aerators is important to facilitate an aerobic (non-malodorous) succession of seasonal algae populations in even healthy ponds like Pond 3. The major seasonal algal succession with highest odor risk typically occurs in late summer to early autumn.

Sludge Operations

Several feet of settled sludge are reported to be in Ponds 1 and 2. A sludge blanket was not visible during my visit, even in the corners of these ponds. Significant rising sludge was not evident in any of the ponds. Small amounts of rising sludge and scum were evident in Pond 1, which contribute to the organic load on the water column in this pond. As wastewater temperatures increase, rising sludge is more likely to be a problem and would place a greater organic load on these ponds.

Gas bubbles were evident in Ponds 1 and 2, providing evidence of significant decay/digestion of the settled sludge in these ponds. This also means that there is some release of settled sludge organics back into the water column.

Aerator Operation

Aerators were operating in Ponds 1, 2, and 3 at the time of my arrival. Only one of four aerators was operating in Pond 1, reportedly to minimize odor release from wastewater in the pond, and to minimize disturbance/scour of the settled sludge and associated organic load and potential for odors.

Aerators reportedly are not operated during the day when photosynthesis by algae (that should thrive in these ponds) should provide the needed oxygen. During my visit, the aerators in Pond 1 automatically turned themselves off via a timer control system.

Staff reported that they rotate the operation of the four aerators in Pond 1; thus, scour of sludge from running more than one aerator at a time should be relatively minor, e.g., three days of accumulation since the aerator was last operated in the 4-unit, 4-day rotation. Accordingly, we turned on two more aerators in Pond 1 and noticed no significant increase in odors and no indication of significant sludge scour.

Staff reported that the buildup of rags on the aerators was a severe problem. As an example, an aerator can plug with rags after only one day of operation since being cleaned.

Cause of Significant Odors

The apparent cause of significant/nuisance odors at the WWRP is organic overload of Pond 1 relative to the amount of oxygen being input into Pond 1. Algae-related odors do not appear to be an issue at this time through there is the potential for algae-related odors in the late summer to autumn period. The sources of the organic load on Pond 1 are a combination of (1) incoming raw wastewater and (2) leakage of settled sludge organics back into the water column as a result of the natural digestion of the settled sludge in Pond 1. The relative deficiency in oxygen input into Pond 1 is a combination of 1) little photosynthetic oxygen generation during the day (because few algae are surviving under Pond 1 environmental conditions, and 2) no operation of aerators during the day based on believes that:

- Algae should be producing the needed oxygen.
- Operating aerators risks stripping odors from influent wastewater.
- Operating aerators risks scour of settled sludge (and releasing odors) and suspending more bacteria and organics in the water column thereby increasing the Pond 1 organic load above and beyond the increased oxygen transfer benefit of operating the aerator(s), i.e., a net increase in odors resulting from increased use of aerators.

Recommendations Regarding Near-Term and Long Term Odor Control

Based on my field observation in the morning of 20 June 2007, and based on my experiences with ponds, I recommend the following near-term and long-term odor control measures.

I. Near-Term Odor Control Measures.

A. Operate all four of the smaller aerators in Pond 1 continuously or as required to maintain adequate DO levels. We did not see sludge on 20 June while operating 3 of the 4 aerators concurrently. Sludge scour may begin with protracted hot weather. If that occurs, it was going to occur anyway, and in a less controlled, more malodorous manner. I see nothing to lose with operating all four aerators based on conditions observed on 20 June. Operating the aerators, now, should reduce the severity of any rising sludge event that may occur with hot weather. Do not refloat and restart the large aerator that normally floats in the center of Pond

1. This aerator would probably strip incoming wastewater odors, scour sludge, and suspended bacteria creating oxygen demand.

B. Remove the floating scum and debris from Pond 1 and continue to remove these materials whenever they accumulate in significantly odorous amounts.

C. Contact local representatives of floating brush aerators (not aspirating, propeller-type aerators) to determine if they have a "Loaner/ demonstration" unit that you could use on the level of Pond 1 to get some pond surface mixing and therefore distribution of the incoming raw sewage to the four operating aerators. Installing this unit in Pond 1 has to be done carefully. Brush immersion in the wastewater may need to increase from 0 inches to the design immersion over the course of several days to avoid a massive episodic odor release. Field observations need to govern bringing a floating brush aerator into full operation in Pond 1.

D. Contact local representatives of specialized additives (bacteria, enzymes, etc) that can assist with reducing odor, such as by facilitating conservation of odorous sulfide into non-odorous elemental sulfur. Such products have been used with some success, most recently in Ione.

E. Rent a "wind machine," i.e., an air mixing device as used by agriculture to reduce crop freezing by moving the air. All of the foregoing measures should reduce odors possibly to a level that is less than significant. However, considering the sludge in the ponds, the hot weather coming, the proximity of homes, and the tendency for air to drift along the ground from the WWRP to the homes with little dilution, it is prudent to have a means to both break up the air drift phenomenon and dilute the air leaving the WWRP site. This can be accomplished with an agricultural wind machine.

F. I do not recommend use of a masking agent, unless requested by a majority of the people impacted by the odors. The masking agents have their own odor issues and only treat the symptoms.

G. Diluting the influent wastewater organic concentration down by the introducing tertiary effluent into Pond 1 was tried in the past. That was probably not successful because it does not reduce the organic loads on Pond 1, but just moved that load into Pond 2 more quickly. I do not recommend this action at this time. Influent wastewater load distribution could be achieved by diverting some of the influent flow directly into Pond 2, or as has been done in the past, Pond 2 contents can be diverted back into Pond 1, although it is expected that this method would not be as directly beneficial.

H. It may be possibly to reduce the odor in influent wastewater by adding chlorine to it shortly before it enters Pond 1, and/or by altering the pump operation to maximize scour velocity in the influent forcemain.

II. Long-Term Odor Control Measures

A. Remove the sludge from Ponds 1 and 2, as needed, and implement maintenance practices that will prevent an excess buildup in the future.

B. Install at least one brush aerator in each of the treatment ponds to gently mix the contents of the ponds so as to reduce hydraulic short-circuiting and to improve the oxygen transfer efficiency of the existing aerators. Conduct field tests to determine if this equipment will yield the desired result.

C. Install a fine influent screen with an excellent washer/ compactor system to get the rags out of the wastewater. Ragging is reducing the efficiency and reliability of the existing aerators.

D. Install piping to allow any treatment pond to be taken out of service for maintenance (e.g., sludge removal). As part of this project, the need for additional aeration, a pond, and an effluent recirculation system should be assessed so that taking a pond out of service does not leave the WWRP operations staff with inadequate facilities to do their job reliably.

E. Plant an air drift barrier between the WWRP ponds and the District offices. A second barrier between District offices and Highway 16 may also be appropriate and aesthetic. The barrier should consist of perennial bushy trees of two types: fast growing (usually short-lived) trees to get a barrier in as quickly as possible and long-lived (usually slower growing) trees to act as the long-term barrier over the decades. Neither of the barriers should allow direct line of sight to the WWRP. Such lines of sight are where WWRP air may tend to drift through on warm summer evenings.

F. Undertake odor control operational procedures for the influent force main.

G. Permanent installation of wind machines should be considered. All sewage and its treatment processes have some smell. A wind machine can force dilution of that smell rather than relying on nature to do that service for you.

In closing, I considered there to be nothing fundamentally wrong with the WWRP. Aerated pond treatment can be more reliable and less odorous than activated sludge as long as nutrient removal is not as effluent limitation, and if an acceptable means for regular removal of sludge from the ponds can be developed. Nutrient removal should not become an effluent limitation as long as the effluent continues to be reclaimed on the golf course, which needs nutrients. An acceptable means for regular sludge removal is a more challenging question. Settled sludge is always malodorous. Options for addressing sludge include:

- Install a primary clarifier, aerobic digester, and mechanical sludge dewatering process to get the sludge out before pond treatment.
- Purchase a sludge suction dredge that could regularly (e.g., each March/ April, weather permitting) pump settled sludge to either the existing sludge drying beds, more remote lined sludge drying beds, or a new mechanical dewatering process.

- Use of the specialized bacteria and enzymes may reduce sludge quantities and its odor potential. This possibility should be investigated as part of the near-term use of these products.

I don't think emptying these ponds and allowing the sludge to air dry, crack, and be removed in place will be satisfactory to the nearby residents.

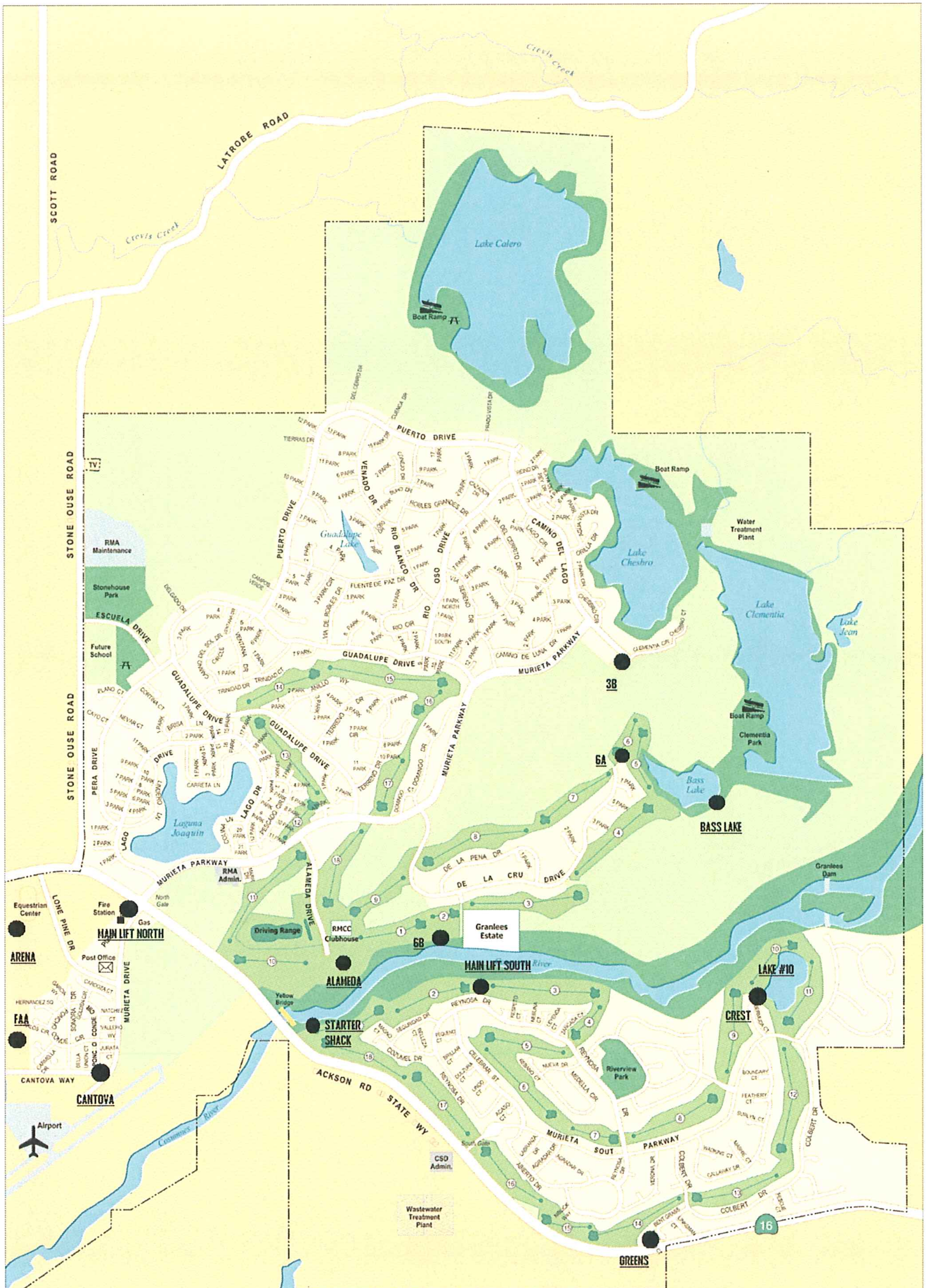
These are my thoughts on the matter. Please feel free to call if you have any questions, or if ECO:LOGIC Engineering can be of any further service to the District.

Sincerely,
ECO:LOGIC Engineering

Harold Wellborn

for Richard E. Stowell, PhD, PE

Appendix E



LATROBE ROAD
SCOTT ROAD
STONEHOUSE ROAD
Clevis Creek
Lake Calero
Boat Ramp
PUERTO DRIVE
Guadalupe Lake
RIO BLANCO DR
RIO OSO DRIVE
VENADO DR
CAMINO DEL LAGO
GUADALUPE DRIVE
MURIETA PARKWAY
Lake Chesbro
Lake Clementia
Lake Jean
Water Treatment Plant
Boat Ramp
Clementia Park
Bass Lake
Granlees Dam
RMA Maintenance
Stonehouse Park
ESCUELA DRIVE
Future School
PERA DRIVE
Laguna Joaquin
LAGO DR
RMA Admin.
North Gate
ALAMEDA DRIVE
DE LA PENA DR
DE LA CRU DRIVE
Driving Range
RMCC Clubhouse
Granlees Estate
River
Equestrian Center
Fire Station
Gas
LONE PINE DR
Post Office
MURIETA DRIVE
CANTOVA WAY
Airport
Cosumnes River
Yellow Bridge
JACKSON RD STATE WY
CSD Admin.
South Gate
Wastewater Treatment Plant
Riverview Park
REYNOSA DR
MURIETA SOUTH PARKWAY
COLBERT DR
16
Arkansas Creek
3B
6A
BASS LAKE
MAIN LIFT NORTH
ARENA
6B
ALAMEDA
MAIN LIFT SOUTH
STARTER SHACK
FAA
CANTOVA
LAKE #10
CREST
GREENS
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Appendix F

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PROJECT : RANCHO MURIETA EXPANSION
JOB # : 7950A.00
LOCATION : (Rancho Murieta, CA Zip Code)
ELEMENT : HEADWORKS AND METERING FACILITY

DATE : February 28, 2008
BY : CMF/RLG
REVIEWED BY: 0

SPEC. NO.	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
DIVISION 2	SITEWORK					
02300	Earthwork					
	Excavation	329	CY	$10.97	$3,603.74	
	Offhall	17	CY	$27.92	$470	
	Backfill	352	CY	$17.25	$6,080	
	Aggregate Base Course		CY	$58.30	$0	
	SUBTOTAL SITEWORK					$10,154
DIVISION 3	CONCRETE					
	8" Slab on grade	7	CY	$458.34	$2,979	
	8" Slab on grade forms	70	LF	$5.60	$392	
	12" Slab on grade	3	CY	$390.07	$975	
	12" Slab on grade forms	33	LF	$10.01	$330	
	21" Slab on grade	2	CY	$356.38	$690	
	21" Slab on grade forms	25	LF	$18.05	$445	
	30" Slab on grade	22	CY	$329.30	$7,135	
	30" Slab on grade forms	70	LF	$29.64	$2,075	
	12" Straight wall to 8'	16	CY	$1,487.76	$23,828	
	36" Straight wall to 8'	8	CY	$877.53	$6,923	
	4" Curb	0	CY	$475.25	$18	
	12" Elevated Slab	1	CY	$621.59	$622	
	SUBTOTAL CONCRETE					$46,412
DIVISION 5	METALS					
	Aluminum handrail	69	LF	$81.02	$5,590	
	Aluminum stairs	7	RS	$554.31	$3,880	
	Bollards	9	EA	$100.00	$900	
	Manual Bar Screen	1	EA	$23,100.00	$23,100	
	SUBTOTAL METALS					$33,470
DIVISION 6	WOODS AND PLASTICS					
	Fiberglass Effluent weir	7	LF	$44.17	$309	
	Screening bin	1	EA	$1,000.00	$1,000	
	FRP Covers	239	SF	$52.81	$12,596	
	SUBTOTAL WOODS AND PLASTICS					$12,596
DIVISION 11	EQUIPMENT					
	Portable Davit Crane	1	EA	$7,440.40	$7,440	
	Aluminum Stop Plate	1	EA	$3,850.00	$3,850	
	Air Scrubber or BioFilter	95	CFM	$78.30	$7,470	
	SUBTOTAL EQUIPMENT					$18,760
DIVISION 15	MECHANICAL					
	18" Plug Valve	3	EA	$7,125.77	$21,377	
	12" FLG CLDI PIPE IN BLDG	14	LF	$159.80	$2,237	
	12" x 4" WYE	1	EA	$2,006.29	$2,006	
	18" FLG CLDI PIPE IN BLDG	36	LF	$263.21	$9,476	
	18" 90° 125# CLDI FXF ELL	4	EA	$4,286.25	$17,145	
	18" 90° 125# CLDI FXF BASE ELL	1	EA	$4,952.79	$4,953	
	18" 45° CLDI ELL	2	EA	$3,573.45	$114,388	
	18" CLDI TEE	2	EA	$6,365.18	$12,730	
	18"X12" 125# CLDI FXF ECCENTRIC RDCR	2	EA	$4,107.22	$8,214	
	2" Vent Pipe (Galv. STL)	3	LF	$19.07	$57	
	Pipe Supports	8	EA	$55	$440	
	Wall Thimble 12"	1	EA	$2,237.13	$2,237	
	Wall Thimble 18"	2	EA	$6,223.87	$12,448	
	2" PVC	35	LF	$10.91	$376	
	2" Backflow Preventer	1	EA	$2,200.00	$2,200	
	SUBTOTAL MECHANICAL					$210,286
DIVISION 16	ELECTRICAL	30%			$68,714	
						$68,714
DIVISION 17	INSTRUMENTATION					
	12" Mag Flow Meter	1	EA	$6,194.86	$6,195	
	SUBTOTAL INSTRUMENTATION					$6,195
	TOTAL HEADWORKS DIRECT COST					$406,587
	CONTINGENCY				30.0%	$121,976
	SUBTOTAL					$528,563
	GENERAL CONTRACTOR OVERHEAD, PROFIT & RISK				15.0%	$79,284
	SUBTOTAL					$607,848
	ESCALATION TO MID-POINT (ASSUME I=5% AND 2012 MID-POINT)				27.6%	$167,937
	SUBTOTAL					$775,785
	SALES TAX (Based on CA)				7.3%	$56,244
	SUBTOTAL					$832,029
	BID MARKET ALLOWANCE				10.0%	$83,203
	TOTAL ESTIMATED CONSTRUCTION COST					$915,232
	ENGINEERING, LEGAL & ADMIN. FEES				10.0%	$91,523
	OWNER'S RESERVE FOR CHANGE ORDERS				5.0%	$45,762
	TOTAL ESTIMATED PROJECT COST					$1,052,517

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PROJECT : RANCHO MURIETA EXPANSION
JOB # : 7950A.00
LOCATION : (Rancho Murieta, CA Zip Code)
ELEMENT : UV DISINFECTION

DATE : February 28, 2008
BY : CMF/RLG
REVIEWED BY: 0

SPEC. NO.	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
DIVISION 2	SITEWORK					
02300	Earthwork					
	Excavation	296	CY	$10.97	$3,249.30	
	Offhall	228	CY	$27.92	$6,352	
	Backfill	190	CY	$17.25	$3,284	
	Aggregate Base Course	122	CY	$58.30	$7,089	
	SUBTOTAL SITEWORK					$19,974
DIVISION 3	CONCRETE					
	4" Slab on grade	1	CY	$475.25	$250	
	4" Slab on grade forms	34	LF	$4.06	$140	
	8" Slab on grade	4	CY	$458.34	$2,020	
	8" Slab on grade forms	109	LF	$5.60	$611	
	12" Slab on grade	11	CY	$390.07	$4,298	
	12" Slab on grade forms	99	LF	$10.01	$991	
	12" Straight wall to 8'	15	CY	$1,487.76	$22,675	
	8" x 12" Footing	3	CY	$1,011.97	$2,549	
	Class C Fill	8	CY	$196.81	$1,537	
	SUBTOTAL CONCRETE					$35,069
DIVISION 5	METALS					
	Metal Building	147	SF	$61.60	$9,055	
	Aluminum channel cover	110	SF	$41.25	$4,548	
	SUBTOTAL METALS					$13,603
DIVISION 6	WOODS AND PLASTICS					
	Finger Overflow Weir	15	LF	$19.81	$297	
	SUBTOTAL WOODS AND PLASTICS					$297
DIVISION 11	EQUIPMENT					
	Portable Davit Crane	1	EA	$7,440.40	$7,440	
	Duplex Air Compressor	1	EA	$3,281.96	$3,282	
	Trojan UV3000Plus with Hereaus Lamp (LPHO)	1	EA	$1,271,953.00	$1,271,953	
	SUBTOTAL EQUIPMENT					$1,282,675
DIVISION 15	MECHANICAL					
	16" DI Pipe	100	LF	$236.68	$23,668	
	16" Wall Thimble	2	EA	$4,350.51	$8,701	
	2" PVC	76	LF	$19.07	$1,450	
	SUBTOTAL MECHANICAL					$33,819
DIVISION 16	ELECTRICAL	30%			$394,948	
	SUBTOTAL ELECTRICAL					$394,948
DIVISION 17	INSTRUMENTATION					
	Ultrasonic Level Sensor	1	EA	$5,500.00	$5,500	
	Transmittance Monitor	1	EA	$5,500.00	$5,500	
	SUBTOTAL INSTRUMENTATION					$11,000
	TOTAL UV					$1,791,386
	CONTINGENCY				30.0%	$537,416
	SUBTOTAL					$2,328,802
	GENERAL CONTRACTOR OVERHEAD, PROFIT & RISK				15.0%	$349,320
	SUBTOTAL					$2,678,123
	ESCALATION TO MID-POINT (ASSUME I=5% AND 2012 MID-POINT)				27.6%	$739,916
	SUBTOTAL					$3,418,039
	SALES TAX (Based on CA)				7.3%	$247,808
	SUBTOTAL					$3,665,846
	BID MARKET ALLOWANCE				10.0%	$366,585
	TOTAL ESTIMATED CONSTRUCTION COST					$4,032,431
	ENGINEERING, LEGAL & ADMIN. FEES				10.0%	$403,243
	OWNER'S RESERVE FOR CHANGE ORDERS				5.0%	$201,622
	TOTAL ESTIMATED PROJECT COST					$4,637,296

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PROJECT : RANCHO MURIETA EXPANSION
JOB # : 7950A.00
LOCATION : (Rancho Murieta, CA Zip Code)
ELEMENT : CHLORINE CONTACT BASIN

DATE : February 28, 2008
BY : CMF/RLG
REVIEWED BY: 0

SPEC. NO.	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
DIVISION 2	SITEWORK					
	EXCAVATION	3097	CY	$6.72	$20,814.19	
	OFFHAUL	2982	CY	$3.54	$10,561.46	
	NATIVE BACKFILL	894	CY	$17.25	$15,424.55	
	AGGREGATE BASE COURSE STR BACKFILL	282	CY	$58.30	$16,444.57	
	SUBTOTAL SITEWORK					$63,245
DIVISION 3	CONCRETE					
	FLAT NON-FORMED S.O.G., 18"	247	CY	$356.38	$87,986	
	18" EDGE FORMS, SLAB ON GRADE, ADD	290	LF	$18.05	$5,234	
	8" WALLS - BAFFLE WALLS	336	CY	$1,746.92	$586,965	
	12" WALLS	158	CY	$1,287.69	$203,742	
	18" WALLS	216	CY	$1,038.65	$224,349	
	SUBTOTAL CONCRETE					$1,108,276
DIVISION 6	WOODS AND PLASTICS					
	EFFLUENT WEIR	7	LF	$44.17	$309	
	SUBTOTAL WOODS AND PLASTICS					$309
DIVISION 11	EQUIPMENT					
	CHEMICAL INDUCTION MIXING SYSTEM	1	EA	$34,170.07	$34,170	
	24" STAINLESS STEEL SLIDE GATE	1	EA	$12,764.58	$12,765	
	SUBTOTAL EQUIPMENT					$46,935
DIVISION 15	MECHANICAL					
	24" CL 52 CLDI MJ PIPE IN OPEN TRENCH	100	LF	$134.98	$13,498	
	24" WALL THIMBLE	2	EA	$6,223.87	$12,448	
	6" CL 52 CLDI MJ PIPE IN OPEN TRENCH	100	LF	$47.32	$4,732	
	6" MUD VALVE	1	EA	$736.50	$737	
	2" PVC	100	LF	$10.91	$1,091	
	SUBTOTAL MECHANICAL					$32,506
DIVISION 16	ELECTRICAL	30%			$23,832	
	SUBTOTAL ELECTRICAL					$23,832
DIVISION 17	INSTRUMENTATION					
	ULTRASONIC LEVEL SENSOR	1	EA	$5,500.00	$5,500	
	CHLORINE/BISULFITE RESIDUAL ANALYZERS	2	EA	$5,000.00	$10,000	
	SUBTOTAL INSTRUMENTATION					$15,500
	TOTAL CCB					$1,290,603
	CONTINGENCY				30.0%	$387,181
	SUBTOTAL					$1,677,783
	GENERAL CONTRACTOR OVERHEAD, PROFIT & RISK				15.0%	$251,668
	SUBTOTAL					$1,929,451
	ESCALATION TO MID-POINT (ASSUME I=5% AND 2012 MID-POINT)				27.6%	$533,072
	SUBTOTAL					$2,462,523
	SALES TAX (Based on CA)				7.3%	$178,533
	SUBTOTAL					$2,641,056
	BID MARKET ALLOWANCE				10.0%	$264,106
	TOTAL ESTIMATED CONSTRUCTION COST					$2,905,161
	ENGINEERING, LEGAL & ADMIN. FEES				10.0%	$290,516
	OWNER'S RESERVE FOR CHANGE ORDERS				5.0%	$145,258
	TOTAL ESTIMATED PROJECT COST					$3,340,935

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PROJECT : RANCHO MURIETA EXPANSION
JOB # : 7950A.00
LOCATION : (Rancho Murieta, CA Zip Code)
ELEMENT : RESERVOIR - PHASE 2

DATE : February 28, 2008
BY : CMF/RLG
REVIEWED BY: 0

SPEC. NO.	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
DIVISION 2	**SITEWORK**					
	Reservoir Excavation 334 Acre-feet	269,500	CY	$6.72	$1,811,310	
	Haul-off site = Excavation + Fluff	325,260	CY	$3.54	$1,152,071	
	Trenching	5,167	CY	$10.97	$56,661	
	Unconfined Backfill	3,617	CY	$17.25	$62,390	
	Confined Trench Backfill - ABC	1,550	CY	$58.30	$90,365	
	Reservoir Lining - Hypalon - assume Reservoir 30' Deep	252,997	SF	$1.23	$311,693	
	SUBTOTAL SITEWORK					**$3,484,489**
DIVISION 11	**EQUIPMENT**					
	Pump Stations - Assume 1 MGD Capacity	1	EA	$500,000.00	$500,000	
	SUBTOTAL EQUIPMENT					**$500,000**
DIVISION 15	**MECHANICAL**					
	8" EFF DIP - Based on Hydroscience Rpt Figure 4-5	2500	LF	$52	$129,195	
	8" Return DIP - Based on Hydroscience Rpt Figure 4-5	2150	LF	$52	$111,108	
	SUBTOTAL MECHANICAL					**$240,303**
DIVISION 16	**ELECTRICAL**	30%			$150,000	
						$150,000
	TOTAL RESERVOIR DIRECT COST					**$4,374,791**
	CONTINGENCY				30.0%	$1,312,437
	SUBTOTAL					**$5,687,229**
	GENERAL CONTRACTOR OVERHEAD, PROFIT & RISK				15.0%	$853,084
	SUBTOTAL					**$6,540,313**
	ESCALATION TO MID-POINT (ASSUME I=5% AND 2015 MID-POINT)				47.7%	$3,122,708
	SUBTOTAL					**$9,663,021**
	SALES TAX (Based on CA)				7.3%	$700,569
	SUBTOTAL					**$10,363,590**
	BID MARKET ALLOWANCE				10.0%	$1,036,359
	TOTAL ESTIMATED CONSTRUCTION COST					**$11,399,949**
	ENGINEERING, LEGAL & ADMIN. FEES				10.0%	$1,139,995
	OWNER'S RESERVE FOR CHANGE ORDERS				5.0%	$569,997
	TOTAL ESTIMATED PROJECT COST					**$13,109,942**

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PROJECT : RANCHO MURIETA EXPANSION
JOB # : 7950A.00
LOCATION : (Rancho Murieta, CA Zip Code)
ELEMENT : RESERVOIR - PHASE 3

DATE : February 28, 2008
BY : CMF/RLG
REVIEWED BY: 0

SPEC. NO.	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
DIVISION 2	SITEWORK					
	Reservoir Excavation 334 Acre-feet	269,500	CY	$6.72	$1,811,310	
	Haul-off site = Excavation + Fluff	325,260	CY	$3.54	$1,152,071	
	Trenching	5,167	CY	$10.97	$56,661	
	Unconfined Backfill	3,617	CY	$17.25	$62,390	
	Confined Trench Backfill - ABC	1,550	CY	$58.30	$90,365	
	Reservoir Lining - Hypalon - assume Reservoir 30' Deep	252,997	SF	$1.23	$311,693	
	SUBTOTAL SITEWORK					$3,484,489
DIVISION 11	EQUIPMENT					
	Pump Stations - Assume 1 MGD Capacity	1	EA	$500,000.00	$500,000	
	SUBTOTAL EQUIPMENT					$500,000
DIVISION 15	MECHANICAL					
	8" EFF DIP - Based on Hydroscience Rpt Figure 4-5	2500	LF	$52	$129,195	
	8" Return DIP - Based on Hydroscience Rpt Figure 4-5	2150	LF	$52	$111,108	
	SUBTOTAL MECHANICAL					$240,303
DIVISION 16	ELECTRICAL	30%			$150,000	
						$150,000
	TOTAL RESERVOIR DIRECT COST					$4,374,791
	CONTINGENCY				30.0%	$1,312,437
	SUBTOTAL					$5,687,229
	GENERAL CONTRACTOR OVERHEAD, PROFIT & RISK				15.0%	$853,084
	SUBTOTAL					$6,540,313
	ESCALATION TO MID-POINT (ASSUME I=5% AND 2020 MID-POINT)				88.6%	$5,792,423
	SUBTOTAL					$12,332,736
	SALES TAX (Based on CA)				7.3%	$894,123
	SUBTOTAL					$13,226,859
	BID MARKET ALLOWANCE				10.0%	$1,322,686
	PURCHASE 10 ACRES @ $20,000 PER ACRE					$200,000
	TOTAL ESTIMATED CONSTRUCTION COST					$14,749,545
	ENGINEERING, LEGAL & ADMIN. FEES				10.0%	$1,474,955
	OWNER'S RESERVE FOR CHANGE ORDERS				5.0%	$737,477
	TOTAL ESTIMATED PROJECT COST					$16,961,977

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