Attachment 4. BUDGET

South Orange County Wastewater Authority

Coastal Treatment Plant Water and Energy Efficiency Project

Work Plan Task No.	Line Item	Requested Grant Funding	Cost Share	Total
1	SOCWA Personnel Services			
	Design Phase	$ 16,414	$ 8,586	$ 25,000
	Bid Phase	$ 1,641	$ 859	$ 2,500
	Construction	$ 29,544	$ 15,456	$ 45,000
	Startup	$ 3,283	$ 1,717	$ 5,000
	Project Closeout	$ 1,576	$ 824	$ 2,400
	Grantee Expenses			
	Mileage	$ 181	$ 94	$ 275
	Office Supplies	$ 328	$ 172	$ 500
	Reproduction	$ 328	$ 172	$ 500
	Equipment less than $5,000	$ 131	$ 69	$ 200
	Equipment over $5,000	$ -	$ -	$ -
2	Land/Easement Acquisition	$ -	$ -	$ -
	Professional and Consulting Services			
3	Planning / Pre-Design Engineering	$ 16,414	$ 8,586	$ 25,000
3	Engineering Design	$ 108,330	$ 56,670	$ 165,000
3	Bid Phase Services	$ 4,596	$ 2,404	$ 7,000
3	Construction Management	$ 68,937	$ 36,063	$ 105,000
3	Project Closeout	$ 4,596	$ 2,404	$ 7,000
4	Environmental Compliance	$ 3,283	$ 1,717	$ 5,000
5	Permitting	$ -	$ -	$ -
6	Proposal Monitoring Plan	$ 6,565	$ 3,435	$ 10,000
7	Construction / Implementation Costs	$ 983,854	$ 514,681	$ 1,498,534
	TOTAL	$ 1,250,000	$ 653,909	$ 1,903,909

Attachment 4 – Budget

Coastal Treatment Plant Water and Energy Efficiency Project

Attachment 4 presents the Budget estimate for the South Orange County Wastewater Authority (SOCWA) Coastal Treatment Plant (CTP) Water and Energy Efficiency Project and explains how it was developed. Supporting documentation necessary to substantiate work already completed includes the following appendices to Attachment 4:

Appendix 4-A *CTP Aeration Upgrades DWR Grant Application Study, estimated capital cost* (December 2014)

Budget Format:

The budget for the Coastal Treatment Plant (CTP) Water and Energy Efficiency Project is presented in the recommended format described in the DWR 2014 Water-Energy Grant Program Guidelines and Proposal Solicitation Package. The breakdown of tasks shown in the budget is based on the CTP Project Work Plan contained in Attachment 3.

Budget Breakdown:

The estimated Project cost shows a breakdown of tasks, activities, cost categories and unit prices and quantities (where applicable). The budget table shows estimated costs for each of the Work Plan tasks. The basis for each of the budget items is described below.

Budget for Task 1: Direct Project Administration and Reporting:

SOCWA staff will manage all aspects of the CTP Water and Energy Efficiency Project and be responsible all administration and reporting. The budget shows estimated SOCWA personnel costs for Task 1 based on approximately 5 percent of the total project costs per the Program Guidelines and Proposal Solicitation Package. An estimate of the hours of effort and costs for SOCWA personnel is presented.

Budget for Task 2: Easement(s):

The budget for land/easement acquisition is zero. No land purchases or easements are required for the CTP Water and Energy Efficiency Project. The Project will be located at the Coastal Treatment Plant site, which is owned by SOCWA.

Budget for Task 3. Project Evaluation/Design/Engineering

SOCWA completed the pre-design analysis of the aeration blower capacity for the CTP Water and Energy Efficiency Project in December 2014 and the budget reflects those actual engineering consultant costs.

The cost for the final design is estimated based on typical ranges for professional engineering services for similar projects.

Budget for Task 4: Environmental Documentation:

The budget for environmental compliance documentation includes estimated costs for preparation of an Initial Study and Mitigated Negative Declaration (MND) for the CTP Project.

Budget for Task 5: Permitting:

The CTP Water and Energy Efficiency Project will require no new permits. Accordingly, the budget for this task is zero.

Budget for Task 6: Proposal Monitoring Plan:

The budget shows the estimated costs for preparation of the monitoring plan to record and report the progress made on the performance measures to DWR as required by the terms of the Program Guidelines and Proposal Solicitation Package for grantees and the grant agreement.

Budget for Task 7: Project Construction/Implementation:

The cost for construction of the CTP Water and Energy Efficiency Project that is shown in the budget is based on the pre-design study (Appendix 4-A) that analyzed aeration blower capacity alternatives and recommended implementation of the apparent best and most cost-effective option. As such, the construction budget is a planning-level cost that will be refined as the final design stage is completed. SOCWA will advertise the CTP Project for competitive bids from contractors.

SOUTH ORANGE COUNTY WASTEWATER AUTHORITY

COASTAL TREATMENT PLANT AERATION UPGRADES

DWR GRANT APPLICATION

December 2014

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SOUTH ORANGE COUNTY WASTEWATER AUTHORITY

COASTAL TREATMENT PLANT AERATION UPGRADES

DWR GRANT APPLICATION

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1.0 INTRODUCTION

The Coastal Treatment Plant (CTP) is a conventional primary/secondary wastewater treatment plant. During the summer months, most of the secondary effluent is treated further with filters and disinfected to meet Title 22 requirements for unrestricted, recycled water use.

The secondary process is activated sludge. There are two process trains constructed at different times. They are referred to as the East and West Plants. These process trains include both aeration basins and secondary clarifiers.

Activated sludge is an aerobic biological process that requires dissolved oxygen (DO). Centrifugal blowers compress atmospheric air and process piping delivers the air to the bottom of the basin through membrane diffusers. The diffusers have very small openings that produce small bubbles. Oxygen is transferred to the liquid, referred to as mixed liquor, as the bubbles travel to the surface.

The centrifugal blowers are the largest user of electrical power at the CTP. Potable water is also consumed to cool the speed-increaser gears. The blowers are multi-stage centrifugal blowers. This is an older technology with limitations with respect to matching the amount of airflow to the DO requirements of the process. This results in wasting air and electricity during the night and early morning hours when the wastewater flow is reduced. This mismatch can lead to poorer effluent quality that is difficult to filter to Title 22 standards. There are newer technologies that better match the range of demands, have a higher mechanical efficiency, and do not require cooling water.

With these limitations, coupled with the need to produce recycled water, the South Orange County Wastewater Authority (SOCWA) hired Carollo Engineers, Inc. (Carollo) to evaluate options to upgrade the existing system. The 2008 report, *Aeration Blower Capacity Study*, analyzed the air demands with respect to average, diurnal, and peak periods. For these airflows, two newer technologies were compared to the existing centrifugal blowers with respect to water use, power consumption, ability to match airflow to the process needs, and better effluent quality. The report recommended replacing the three centrifugal blowers with four turbine blowers.

2.0 PURPOSE

SOCWA is applying for a Department of Water Resources (DWR) grant to replace the existing blowers with the turbine blowers. The purpose of this Technical Memorandum (TM) is to update and present the findings of the 2008 report to support the grant application. This TM briefly summarizes the existing facilities and operation. The three main project benefits are presented: 1) elimination of potable water for cooling, 2) reduced power consumption, and 3) reduced greenhouse gas (GHG) production related to electrical power

generation. In addition to these benefits, operational stability will be increased with the new blowers and controls. This is an important factor in producing high-quality secondary effluent that can be filtered to meet Title 22 standards for unrestricted reuse. The construction costs presented in the 2008 report have been updated to today's cost level.

3.0 EXISTING FACILITIES

The features of the existing aeration basins system are presented in Table 1.

Table 1 Existing Aeration Basins Design Criteria[1]
DWR Grant Application
South Orange County Wastewater Authority

Criteria	**Location**		
Aeration Basins	**East Plant**		**West Plant**
Units, basins	3		2
Size (length, width, depth), each	100' x 30' x 15'		100' x 25' x 25'
Aeration System Type	Parkson Diffuser Panels		Parkson Diffuser Panels
Total Panels Installed per Basin (# panels)	22		25
Additional Panel Space per Basin (# panels)	10		2
Panel Coverage (sf/panel)	48		48
Maximum Airflow (scfm/sf panels)	1.2		1.2
Aeration Blowers	**East Blower**	**Standby Blower**	**West Blower**
Type	Centrifugal, 8 Stage	Centrifugal, 11 Stage	Centrifugal, 11 Stage
Nominal Operating Pressure (psi)	9	9, 13	13
Motor Size (hp)	150	150	150
Design Capacity (scfm)	2,500	2,500, 1,700	1,700

Notes:
(1) Sources:
2002 HDR Drawings: Aeration System Upgrades and Plant Improvements
1983 VTN Drawings: Coastal Treatment Plant Construction Drawings

The significant characteristics presented in Table 1 include:

1. The aeration basin depth of the West Plant is 25 feet as compared to 15 feet for the East Plant. The centrifugal blowers have to overcome more static pressure when serving the West Plant. The operating pressure of the East Plant is 9 pounds per square inch (psi) as compared to 13 psi for the West Plant.
2. The third East aeration basin is not equipped with diffusers.
3. The design was based on using one blower for the East Plant, one for the West Plant, and the third acting as a mechanical standby unit for either.
4. To overcome this higher pressure, the blowers serving the West Plant have more stages and operate at a higher speed. A speed increaser gear between the motor and blower is required, and this consumes potable water for cooling.
5. The speed increaser gear reduces the overall mechanical efficiency of the blower system.
6. Centrifugal blower output can be varied by throttling the intake valves. However, the output can only be reduced to about 70 percent of the rated capacity before surge conditions occur. The reduced output is still too great for late-night and early-morning demands, and air and power are wasted. The mechanical efficiency is reduced during turndown operation.
7. With the current number of blowers and their capacity, the third or standby blower should be operated to maintain DO levels during peak demand periods. This results in too much air with respect to the turndown capabilities, and air is wasted.
8. The existing automatic DO controls do not work with the existing blowers. The operations staff adjusts the blower intake valves at night to adjust to the lower DO demands and readjusts the valves in the morning.
9. The lack of DO controls, coupled with the mismatch of blower capacity to air demands, can degrade the secondary effluent. This makes it more difficult to filter the effluent to Title 22 standards for unrestricted reuse.

Turbine blowers have a higher mechanical efficiency and greater turndown capabilities. The turndown capability is approximately 45 percent of the rated capacity. The mechanical efficiency remains constant over the operating range. Various blower technologies are compared with respect to efficiency on Figure 1. The variation of efficiency with output is also shown. Turbine blowers have the highest efficiency and maintain high efficiency over the operating range. The multi-stage blower efficiency is much lower.

Properly sized, turbine blowers can meet the peak air demands and the late-night/early-morning reduced demands. This has the advantages of higher process stability, less wasted air, lower power consumption, and elimination of the cooling water. These advantages are presented in a subsequent section.

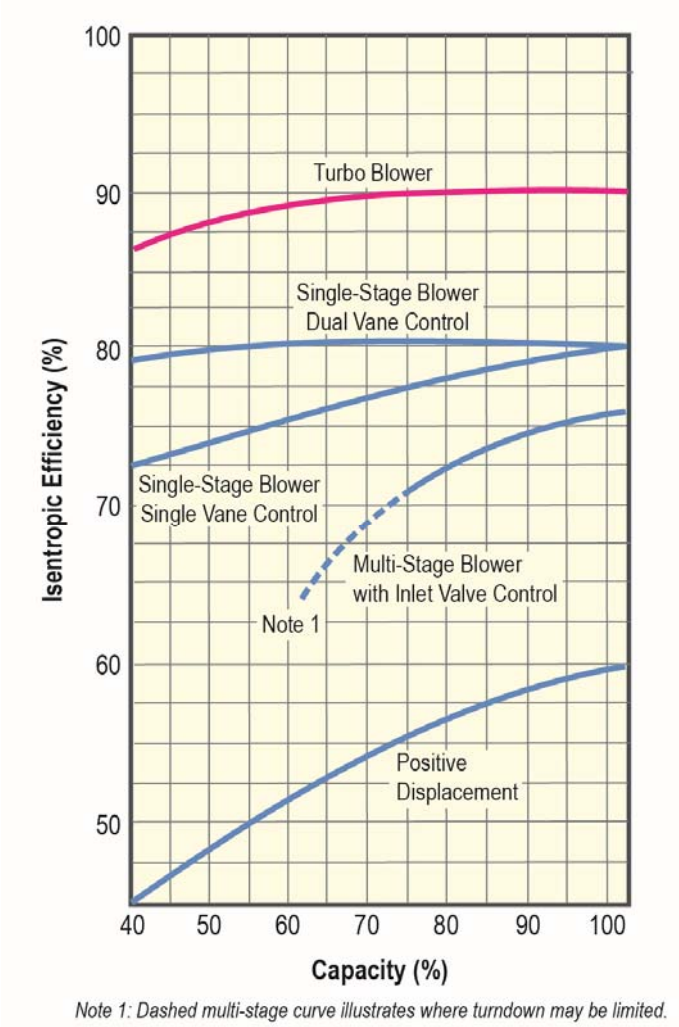

Figure 1 Blower Efficiency Comparison

4.0 EXISTING OPERATION

At current flows, the CTP operates under two scenarios: 1) one East (1E) and two West (2W) aeration basins, or 2) two East (2E) and one West (1W) aeration basins. This means that both the low-speed blower and the high-speed blower must be operated. This section describes the process used to develop the optimal airflows. This information is used to size new blowers and compare the operation to the existing units with respect to potable water use, electrical power consumption, and GHG production related to the electricity.

The proper sizing of aeration blowers considers: 1) the wastewater flow rate, 2) the wastewater strength, and 3) the diffuser efficiency in transferring oxygen into the process. The blowers must also be sized to provide a minimum DO content in the final secondary effluent. This section summarizes these factors from the 2008 report.

4.1 Wastewater Flows

The average wastewater flow to the CTP has remained constant at approximately 3.8 million gallons per day (mgd). The flow varies seasonally, diurnally (over 24 hours), and for peak holiday periods. SOCWA does not foresee changes to the service area, and 3.8 mgd has been used in this evaluation. The flows used in the 2008 report are given in Figure 2. The diurnal variations are shown on Figure 3. The diurnal variations were used to determine the range of airflows required and the power consumption for the existing and proposed blowers.

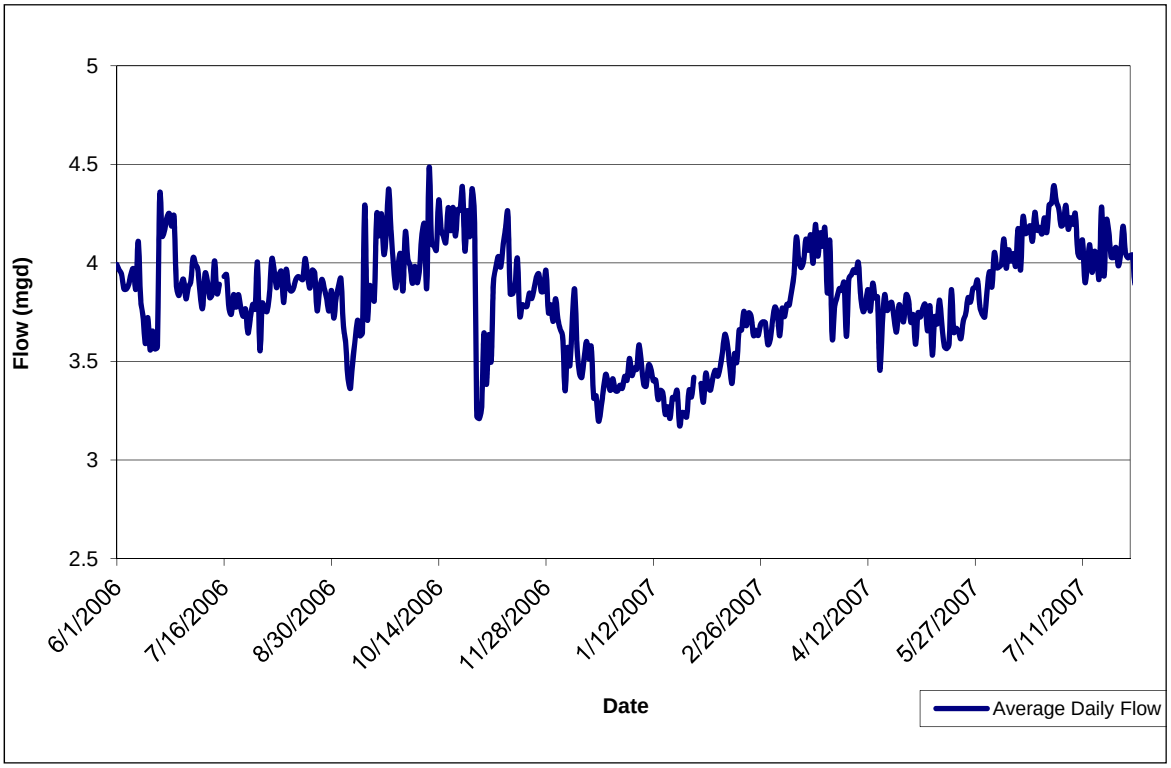

Figure 2 CTP Average Daily Flow

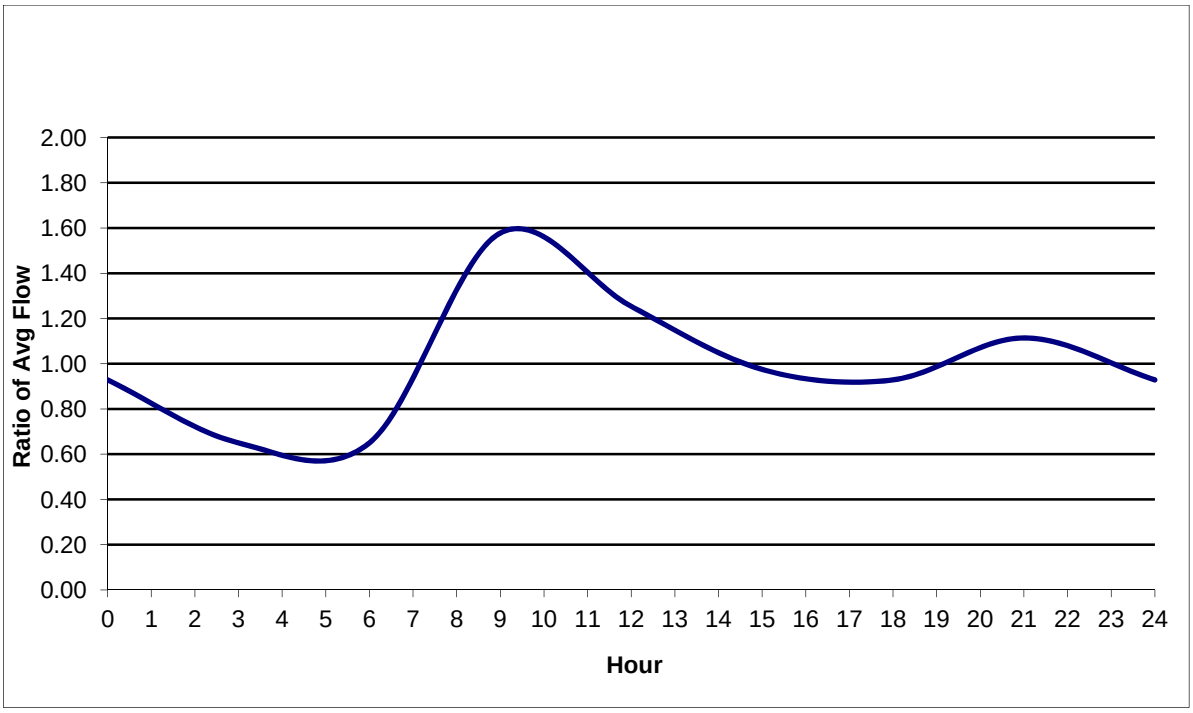

Figure 3 Diurnal Flow Variation

4.2 BOD Loading

The air demands are based on the flow variations presented above at the biological oxygen demand (BOD). The BOD represents the organic matter or wastewater strength that must be converted within the activated sludge process. This section summarizes the average, peak, and diurnal variations in BOD concentration. Combined with the flow variations, the needed oxygen requirements can be calculated.

Influent and primary effluent BOD concentrations were analyzed from January 2002 to June 2007. A portion of the BOD is removed in the primary clarifiers, and the aeration basins treat the primary effluent BOD. The average influent BOD was 289 milligrams per liter (mg/L) with a peak of 544 mg/L. The average primary effluent BOD was 145 mg/L with a peak of 255 mg/L.

4.2.1 CTP Monthly Influent BOD Loading

Influent and primary effluent BOD trends were developed for the period of June 2006 through June 2007. BOD concentrations were taken from monthly wastewater laboratory reports. The BOD data was combined with the average monthly flow to determine loading rates for the plant and the aeration basins. Figure 4 shows the BOD loading trends and average daily influent flow for this year.

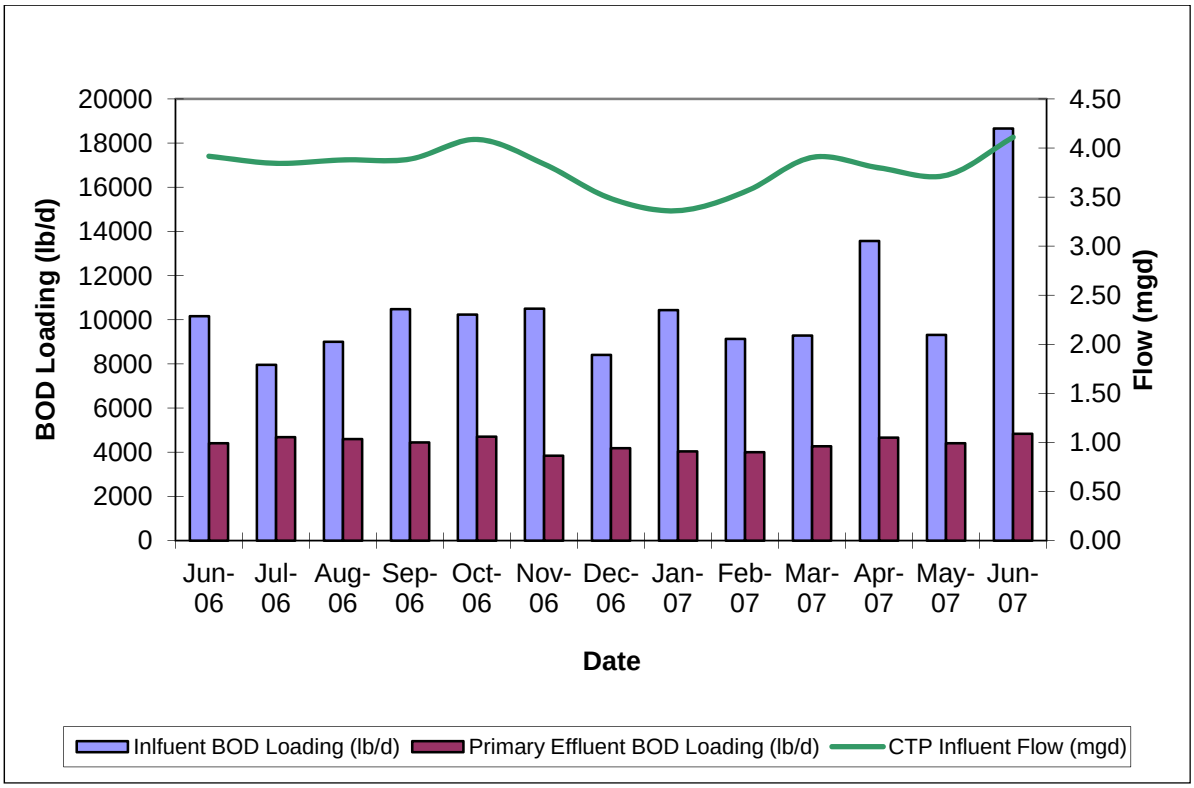

Figure 4 BOD Loading Trends

BOD loading to the plant varies, with the highest loading occurring during the summer months. The average monthly influent BOD loading was 10,550 pounds per day with a maximum monthly loading of 18,660 pounds per day occurring in June 2007. Little variation is seen in the monthly primary effluent BOD loading, indicating consistent removal within the primary clarifiers.

4.2.2 Primary Effluent BOD Loading

A portion of the BOD is removed in the primary clarifiers. The primary effluent BOD represents the strength that the aeration basins must treat. The average daily primary effluent BOD loading is shown on Figure 5. The trend represents an average daily load of 4,360 pounds per day with a peak day of 6,550 pounds per day.

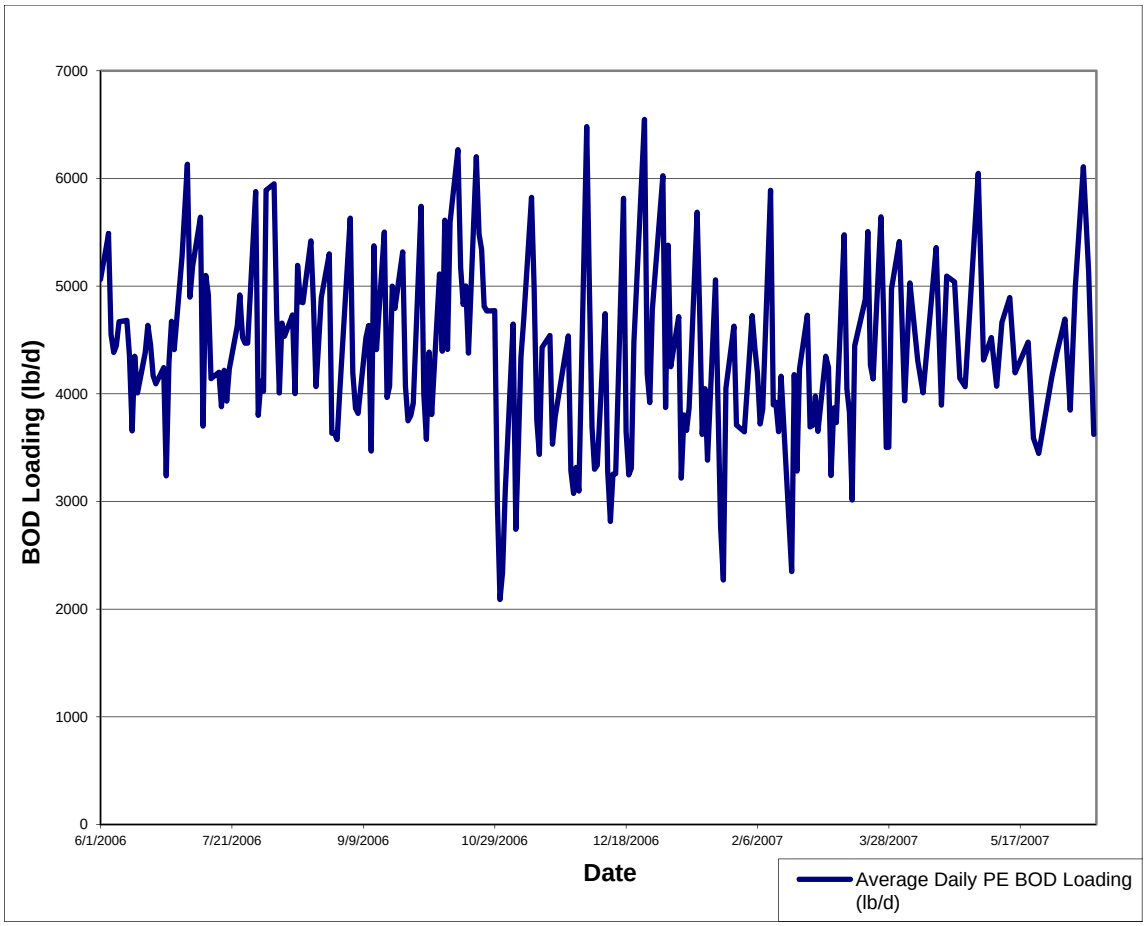

Figure 5 Average Daily Primary Effluent BOD Loading

Moving averages of 7-day and 30-day periods were determined to better represent monthly and weekly loadings. The moving averages, shown on Figure 6, smooth the daily loading data shown in Figure 6 to give a better representation of peak loading periods. These averages express the BOD loading that can be expected over any given continuous 7-day or 30-day period, regardless of specific month and day. The calculated 7-day peak factor is 1.25. The 30-day peak factor is 1.14.

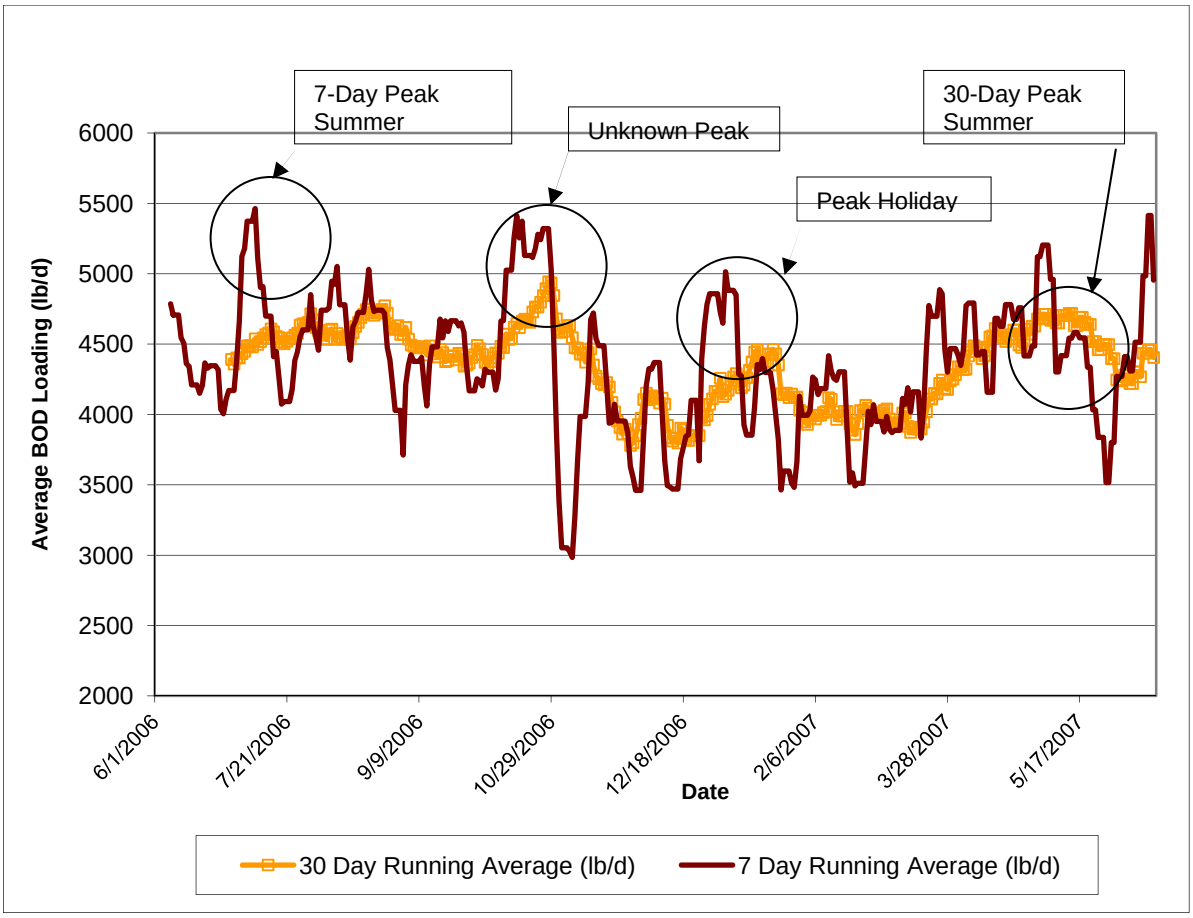

Figure 6 Primary Effluent BOD Loading Moving Averages

4.2.3 Holiday BOD Loading

BOD testing was performed on July 4, 2007, to determine the peak-hour load. The reported average daily flow was combined with the diurnal curve to produce hourly flows and loading rates for the CTP and the aeration basins. The hourly trend is shown in Figure 7. The trend represents a peak-hour factor of 1.4 for the primary effluent BOD loading.

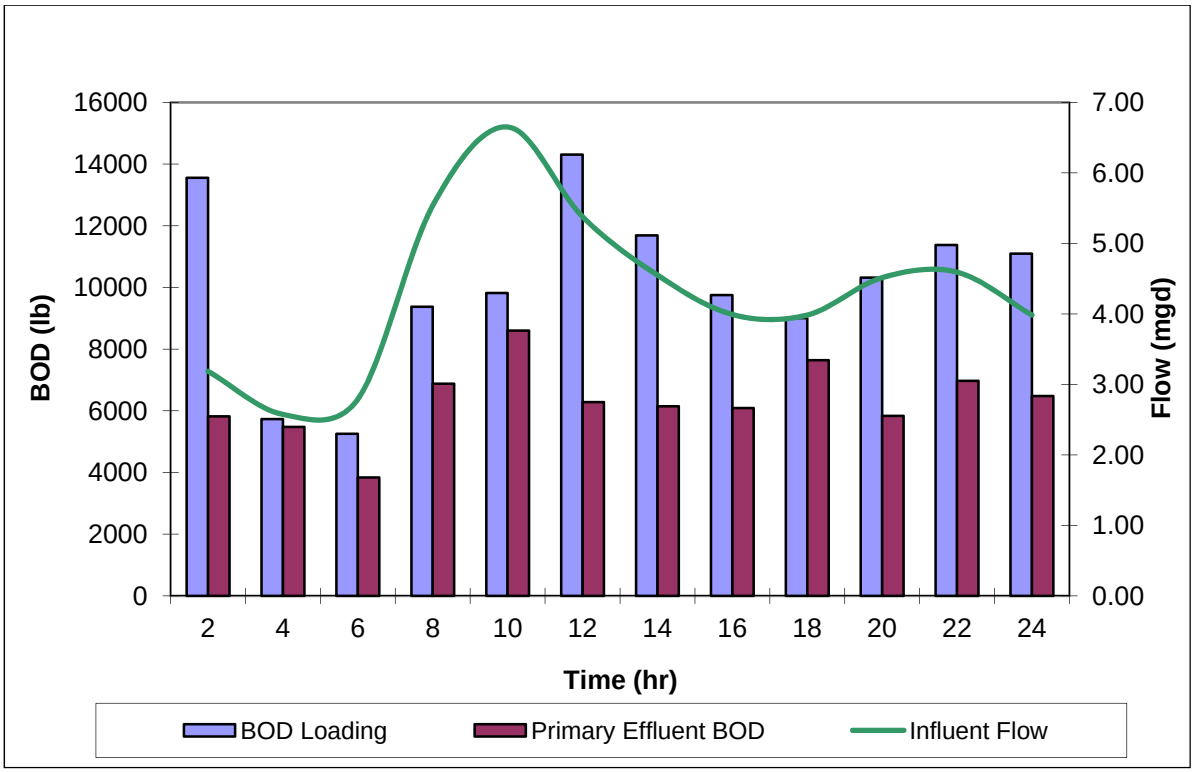

Figure 7 July 4, 2007, Trends

4.3 Loading Summary

The flows and BOD loads used in the analysis are presented in Table 1.

Table 1 Flow and Loading Summary
DWR Grant Application
South Orange County Wastewater Authority

Design Criteria	Design Value
Existing Average Daily Flow (mgd)	3.8
Peak-Hour Flow Factor (4-hour average)	1.45
Minimum Hour Flow Factor (4-hour average)	0.7
Peak-Day Loading Factor (7-day moving average)	1.25
Minimum Day Loading Factor (7-day moving average)	0.7
Average Influent BOD (mg/L)	140
Average Daily BOD Loading at 3.8 mgd (lb/day)	4,437
Peak Daily BOD Loading (lb/day)	6,650
Average Effluent BOD (mg/L)	17
Average Nitrate (mg/L)	5
Return Activated Sludge Recycle Rate (%)	50%

4.4 Diffuser Transfer Efficiency

The diffuser transfer efficiency, along with the BOD loading, is used to calculate the air demands. The existing transfer efficiency was calculated using wastewater flow, BOD, and airflow records. These records were available from the laboratory and the Supervisory Control and Data Acquisition (SCADA) system.

The oxygen transfer efficiency (OTE) was calculated from the following formula:

Air Required (scfm) = Q * BOD * 8.343 * f / (OTE * 1440 * 0.075 * 0.232)

Where

Q = Average Daily Flow (mgd)
BOD = BOD Concentration (mg/L)
8.343 = Conversion Factor [(lb/d)/(mgd/mg/L)]
f = BOD Utilization Factor = 1.03 (lb O_2/lb BOD)
OTE = Oxygen Transfer Efficiency calculated from existing SCADA data
1440 = Conversion Factor (min/day)
0.075 = Specific Weight of Water @ 14.7 psi, 68 degrees F and 36% Humidity
0.232 = Weight of Oxygen in Air (lb O_2/lb air).

In calculating the OTE, primary effluent flows were split between the East and West Plants proportionate to the operating aeration basin volume. It was assumed that flows split equally within each plant when more than one basin was operated in that plant. The resulting transfer efficiencies are reported in Table 2.

Table 2 Calculated Oxygen Transfer Efficiency
DWR Grant Application
South Orange County Wastewater Authority

Basin Configuration	West Plant OTE (%)	East Plant OTE (%)
2W + 1E	10.29 %	9.28 %
2E + 1W	9.20 %	9.90 %

4.5 Airflows

The optimum airflows were then calculated using the wastewater flows, BOD loadings, and diffuser transfer efficiencies. An allowance is also needed to provide a stable effluent DO concentration of 2 mg/L and for mixing.

Air requirements for the target effluent DO concentration where calculated using the following equation:

Air Required (scfm) = Q * (1 + RR) * Effluent DO * 8.343 / (OTE * 1440 * 0.075 * 0.232)

Where

Q = Average Daily Flow (mgd)
RR = Recycle Rate assumed to be 50 percent
8.343 = Conversion Factor [(lb/d)/(mgd/mg/L)]
Effluent DO = Target Effluent DO Concentration = 2 mg/L
OTE = Oxygen Transfer Efficiency calculated from existing SCADA data
1440 = Conversion Factor (min/day)
0.075 = Specific Weight of Water @ 14.7 psi, 68 degrees F and 36% Humidity
0.232 = Weight of Oxygen in Air (lb O_2/lb air)

Mixing requirements for each basin were calculated assuming 0.12 standard cubic feet per minute (scfm) per square foot of basin area. Each West aeration basin requires 300 scfm (100-ft x 25-ft x 0.12 scfm/sf). Each East aeration basin requires 360 scfm (100-ft x 30-ft x 0.12 scfm/sf). The mixing airflow is compared to the process airflow, and the greater applies.

The resulting airflows are reported in Table 3. They are given for the existing combination of East and West aeration basins needed to treat the wastewater flow.

Table 3 Airflows
DWR Grant Application
South Orange County Wastewater Authority

Basin Configuration	Minimum Loading Air Demand (scfm)	Average Loading Air Demand (scfm)	Maximum Loading Air Demand (scfm)
West Aeration Basins			
2W + 1E	740	1,880	2,350
2E + 1W	460	1,170	1,460
East Aeration Basins			
2W + 1E	300(1)	750	940
2E + 1W	620	1,570	1,960
Total Aeration Basins			
2W + 1E	1,040	2,630	3,290
2E + 1W	1,080	2,740	3,420

Notes:
(1) Minimum mixing requirement of 360 scfm will govern.

The existing East blower capacity is 2,500 scfm. This capacity is capable of meeting the maximum demand, but the minimum blower flow is 1,500 scfm, much greater than the

minimum demand of 1,040 scfm. Air must be wasted late at night and early morning. The West blower capacity is 1,600 scfm, less than the peak demand of 2,350 scfm. The standby blower must be operated for short periods, which is very inefficient.

5.0 RECOMMENDED PROJECT

The recommended project is to install four new turbine blowers, with a capacity of 1,500 scfm at 13 psi (West) and 1,600 scfm at 9 psi (East). Three would be operational with one mechanical standby unit. There would be sufficient capacity to meet the peak demand of 3,420 scfm (2E + 1W). There would be 4,600 scfm available. The turbine blowers are smaller than the centrifugal blowers, and they can be installed on the existing equipment pads. A fourth equipment pad was constructed with the original project. Electrical conduits were also constructed.

The turbine blowers have a lower motor horsepower of 100 hp. The existing electrical system was sized for 150-hp motors, and it is sufficient for this installation. There is space for an additional motor control center in the electrical room.

As stated above, the existing blower output is adjusted manually. The new turbine blowers would be installed with automatic controls that vary the blower output to maintain minimum DO concentrations in the aeration basins. There are existing DO monitors in the basins. There are also automatic valves for controlling the airflow to specific basins and aeration zones. A new programmable logic controller is the only item needed to implement the aeration control system. These controls also increase the power advantage of the recommended system.

6.0 PROJECT BENEFITS

This section summarizes the project benefits.

6.1 Water Savings

The turbine blowers eliminate the need for potable water to cool the existing blower speed-increaser gears. Each speed-increaser consumes 3 gallons per minute (gpm). The estimated water savings with the new blowers is 1,734,000 gallons per year. This is based on one blower operating continuously, and the standby blower operating during peak loading periods.

6.2 Electrical Power Savings

The electrical power consumption was compared between the existing blowers and the recommended turbine blowers. This comparison considered:

1. The plant operates 50 percent of the time using 1E + 2W and 2E + 1W.
2. The diffuser transfer efficiencies presented in Table 2 were used for the specific basins in service.
3. The peak demand occurs 10 percent of the time.

4. The turbine blowers would have automatic DO control. The existing blowers do not have automatic control.
5. The airflows presented in Table 3 were utilized. The diurnal curve shown on Figure 3 was used to determine the airflow on an hourly basis. The turbine blower electrical consumption varied based on this diurnal variation. The controls save power during late night and early morning hours.

The resulting power consumption for the existing system is 989,000 kilowatt-hours per year (kW-hr/yr). The proposed turbine blowers with DO control would consume 533,000 kW-hr/yr. There will be an annual savings of 456,000 kW-hr/yr.

6.3 Greenhouse Gas Reduction

As a result of the decreased energy consumption with the new turbine blower system, the associated GHGs will also decrease.

These GHG emissions are estimated based on methodologies established in The Climate Registry General Reporting Protocol (TCR GRP) for the WECC California Subregion. The Climate Registry emission factors consider the mix of fuel sources that generate Californiaelectricity. Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are the GHGs considered in this estimate and comprise the majority of GHG emissions generated from wastewater treatment operations.

For this analysis, SOCWA's estimated annual GHG emissions are a result of the annual electricity consumption for the operation of the blowers in both the existing and new systems. GHG emissions originating from the production of purchased electricity are categorized as Scope 2 emissions (i.e., indirect GHG emissions from consumption of purchased electricity, heat, or steam). Scope 2 emissions are not the target of GHG emissions regulations at the state or federal level.

Emission factors were selected based on the location of the facilities, and the electricity consumption data were input into Carollo's GHG emissions model to estimate the quantities of CO_2, CH_4, and N_2O emissions generated. Emissions were then converted into CO_2 equivalent (CO_2e) emissions using the global warming potentials (GWP) of each gas as shown in Table 1. The major GHG in the atmosphere is CO_2. Other GHGs differ in their ability to absorb heat in the atmosphere. For example, CH_4 has 25 times the capacity to absorb heat relative to CO_2 over a 100-year time horizon, so it is considered to have a GWP of 25. N_2O has 298 times the capacity over a 100-year time horizon, having a GWP of 298. Therefore, a pound of emissions of CO_2 is not the same in terms of climatic impact as a pound of CH_4 or N_2O emitted. CO_2e emissions are calculated by multiplying the amount (mass) of emissions of a particular GHG by its GWP. The total emissions factor is equal to 0.5555 kilograms (kg) CO_2e per kilowatt-hour.

Table 1	Greenhouse Gases and Global Warming Potentials DWR Grant Application South Orange County Wastewater Authority
Greenhouse Gas	**GWP(1) (Mass CO_2e/Mass of GHG Emitted)**
CO_2	1
CH_4	25
N_2O	298

Notes:

(1) GWPs are from the Intergovernmental Panel on Climate Change Fourth Assessment Report (2007) for a 100-year time horizon. These GWPs are used today by international convention and the U.S. to maintain the value of the CO_2 "currency," and are used in this inventory to maintain consistency with international practice.

Table 2 shows the estimated GHG emissions for the existing and new blower systems—approximately 297 and 160 metric tons of CO_2e, respectively. This represents a 46-percent reduction in GHG emissions going from the existing system to the new turbine blower system.

Table 2 Annual Metric Tons of Carbon Dioxide Equivalent Emissions from Purchased Electricity
DWR Grant Application
South Orange County Wastewater Authority

Blower System	CO_2	CH_4	N_2O	Total
Existing	295.5	0.3	0.8	296.6
New	159.2	0.2	0.4	159.8

7.0 CAPITAL COST UPDATE

The 2008 report included a cost estimate that considered demolition, the new blowers, piping modifications, and electrical and control systems. This estimate has been updated to current conditions. The estimated capital cost is $1,703,000. This is reported for an October 2014 Engineering News Record Construction Cost Index of 10,748. The detailed estimate is included in Appendix A.

The construction cost includes:

1. Demolition of one blower at a time to keep the activated sludge process in operation during construction.
2. Four 100-hp turbine blowers with associated control panels.
3. Piping and valves arranged so that any blower can serve either the East or West aeration basins.

4. A new programmable logic controller with manufacturer-provided programming to pace blower output to meet DO requirements.
5. Breaker modifications for the lower motor horsepower.
6. New electrical wiring. The major conduits can be reused.

The existing DO monitors and basin control valves can be incorporated into the system.

8.0 SUMMARY

The existing centrifugal blowers have several limitations with respect to reliable delivery of air to the activated sludge basins. For peak demands, there is insufficient air unless the third mechanical standby blower is run. This increases electrical demand costs. For the minimum aeration demands, the blower output is too great. Air and power are wasted. The blowers that serve the West aeration basins require potable water to cool the speed-increaser gears.

Newer technologies are much more efficient with respect to power consumption. They can provide air over a wider range of demands, better meeting both peak and minimum conditions. Turbine blowers were considered and recommended for implementation. Four blowers with associated controls would replace the existing.

This project provides the following benefits:

1. Water savings: 1,734,000 gallons per year.
2. Electrical power savings: 456,000 kW-hr/yr.
3. GHG reduction: 137 metric tons per year of equivalent carbon dioxide emissions.

The estimated capital cost to implement this project is $1,703,000.

APPENDIX A – CAPITAL COST ESTIMATE

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DETAILED COST ESTIMATE

PROJECT : SOCWA Coastal TP - Blower Upgrades
JOB # : 9759A.00
LOCATION **Laguna Niguel, CA**
ELEMENT : **Blower Upgrade and Modifications**

DATE : 12/2/2014
BY : JAW
REVIEWED BY: DKW

SPEC. NO.	DESCRIPTION	QUAN	UNIT	MATERIAL	LABOR	EQUIP	UNIT COST	SUBTOTAL	SALES TAX	CA PREMIUM	SUBTOTAL	TOTAL
									7.75%	10%		
	Demolish Existing Blower, 150HP	3	EA	$ -	$ 5,395.50	$ 1,234.72	$ 6,630.22	$ 19,890.66	$ -	$ 1,989.07	$ 21,879.73	
												$ 22,000
	Neuros Blower 100NX, 100HP	4	EA	$ 103,600.00	$ 5,395.50	$ 1,234.72	$ 110,230.22	$ 440,920.88	$ 32,116.00	$ -	$ 473,036.88	
												$ 473,000
	8" 10S 316 Welded SST Pipe	40	LF	$ 106.00	$ 31.50	$ 1.70	$ 139.20	$ 5,568.00	$ 328.60	$ 556.80	$ 6,453.40	
	8" 10S 90° Welded 316L SST Elbow	4	EA	$ 717.28	$ 960.14	$ 208.38	$ 1,885.80	$ 7,543.20	$ 222.36	$ 754.32	$ 8,519.88	
	8" 10S 316L SST Tee	4	EA	$ 1,062.17	$ 1,440.21	$ 430.56	$ 2,932.94	$ 11,731.76	$ 329.27	$ 1,173.18	$ 13,234.21	
	8" SST Check Valve	4	EA	$ 5,825.00	$ 420.00	$ 27.06	$ 6,272.06	$ 25,088.24	$ 1,805.75	$ 2,508.82	$ 29,402.81	
	8" SST Butterfly Valve	4	EA	$ 5,650.00	$ 329.43	$ 27.06	$ 6,006.49	$ 24,025.96	$ 1,751.50	$ 2,402.60	$ 28,180.06	
												$ 86,000
										SUBTOTAL		$ 581,000
								ELECTRICAL & INSTRUMENTATION MODIFICATIONS			20%	$ 116,000
									TOTAL DIRECT COST			**$ 697,000**
									DESIGN CONTINGENCY		30%	$209,000
										SUBTOTAL		$ 906,000
									GENERAL CONDITIONS		20%	$181,000
										SUBTOTAL		$ 1,087,000
								GENERAL CONTRACTOR OH&P			15%	$163,000
										SUBTOTAL		$ 1,250,000
								TOTAL ESTIMATED CONSTRUCTION COST				**$ 1,250,000**
								ENGINEERING, LEGAL & ADMIN. FEES			15%	$188,000
								OWNER'S RESERVE FOR CHANGE ORDERS			10%	$125,000
								TOTAL ESTIMATED PROJECT COST				**$ 1,563,000**
										August 2008 ENR-LA		9,895
										October 2014 ENR-LA		10,784
								REVISED TOTAL ESTIMATED PROJECT COST				**$ 1,703,425**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented herein.