6.4 GREEN PROJECT RESERVE

6.4.1 INTRODUCTION

The purpose of this section is to summarize and justify the eligibility of certain components of the Mountain Water & Sanitation District's wastewater treatment system upgrade project for the CDPHE's Green Project Reserve program. The CDPHE's GPR sets aside a minimum of 20% of SRF funding for the purpose of funding green infrastructure, water or energy efficiency improvements, or other environmentally innovative activities.

The District plans on constructing a facility that will have two components that meet or exceed the requirements of the GPR program:

Table 11. Component Summary

Part	Category	Section	Item	Business Case
Component #1	Energy Efficiency	3.2-2	Reduction in Energy Consumption (savings greater than 20%)	Categorical Eligible
Component #2	Environmentally Innovative	4.5-5b	Significant Reduction in Residuals	Business Case Required

Component #1 is categorically eligible for the GPR program. This report will therefore summarize why this component is eligible and how it exceeds the program's minimum requirements. A business case is included in this report for Component #2 to justify eligibility for the GPR program.

The two qualifying components for the GPR consist of the following:

Table 12. Project Components

Part	Item
Component #1	Install WWTP process equipment that consumes less energy to treat the wastewater
Component #2	Install anaerobic digestion to decrease biosolids generation

6.4.2 COMPONENT #1: INSTALL WWTP ENERGY EFFICIENT PROCESS EQUIPMENT

Energy efficiency is defined by the Green Project Reserve Program as "the use of improved technologies and practices to reduce the energy consumption of water quality projects, use energy in a more efficient way, and/or produce/utilize renewable energy." The District's existing wastewater treatment plant was installed approximately 30 years ago. The proposed project will use wastewater treatment process equipment that will consume less energy than the existing facility by 1) using biological processes that require less energy and 2) consist of equipment that is more efficient than the existing equipment. This section will show how at least a 20% energy savings is achieved over current usage.

The District maintains records of the power consumed by the existing wastewater treatment facility. These records are used to determine existing power demands as follows:

Table 13. Current WWTP Power Consumption

Item	Approximate Consumption (monthly)	Unit Cost	Unit	Price
Monthly Base Rate	1	$ 30.00	LS	$30.00
Service Charge	15,000	$ 0.06363	kWh	$954.45
Energy Charge	30	$ 11.60	kW	$348.00
			Total:	$1,332.45
The District spent $15,913.56 for electricity at the WWTP in 2010.				
This checks with the annual cost of the monthly estimate (12 x $1,332.34 = $15,989)				
Power records include consumption of the existing WWTP and district office.				
Must therefore deduct the power consumed by the District office for this evaluation.				
District office =	1,500	square feet		
Average Consumption[1] =	$1.34	per square foot per year		
Office electricity use =	$2,010	per year		
Office electricity use =	$168	per month		
WWTP Electricity use =	$1,165	per month		

Notes:
1) Energy Information Administration. 1995 Commercial Buildings Energy Consumption Survey

The proposed SBR treatment utilizes a combination of energy efficient processes to achieve an energy efficient process. The Fluidyne ISAM is a four-basin package system that uses gravity to feed wastewater into an anaerobic selector. This anaerobic chamber results in a passive process that reduces the solid content of the wastewater stream by 30% or more. The solids are digested over time by obligate anaerobic bacteria without any energy expended by the user. Anaerobic digestion is preferable to an aerobic digestion system because electricity is required to power the blowers required to perform aerobic digestion.

The second in-line basin, an anoxic tank, has an interact period with the aerated wastewater returned from the SBR reactor. The anoxic conditions of the basin naturally select for specific bacteria that treat the waste stream for biological nutrient removal, including nitrogen. There is a submersible pump within the anoxic basin that forward-feeds the now partially treated waste stream into the aerobic portion. Up to this point, raw sewage has been partially treated without requiring any energy.

In conventional WWTP design, it common for a pump to only perform one function such as the forward feed of water/sludge, aeration/mixing, return flow, or sludge removal. The Fluidyne SBR design uses a single motive pump to perform 3 different functions to save on upfront capital cost, long term maintenance, and operating cost. These functions include forward feed, aerating/mixing, and WAS recirculation, saving capital and energy costs. The motive pump will be regulated by a VFD to further improve the efficiency of the pumps, and closely match the pump's output to actual demand. The current WWTP design does not use VFDs to regulate motor output.

An additional energy savings feature included with the SBR design is the use of ORP sensing. This capability allows the operator to monitor the demand for oxygen, preventing over-aeration in the SBR reactor. The operator will be able to automatically perform the feature by creating setpoints in the PLC.

The process design calculations from Fluidyne (included in the appendix) estimate the cost requirements of the wastewater treatment to be approximately 243 kWh/day. The Fluidyne estimate includes the energy demand of the motive pumps and blowers. The pumps and blowers consume the overwhelming majority of the power used to treat the wastewater. There are however other components that consume power such as the control panel, miscellaneous valves, the SCADA panel, ultrasonic flow meter, building lights and heat, and chemical feed pumps. These additional devices are estimated to require an additional 25% in power consumption,

increasing the total plant's consumption to 304 kWh/day.

The power consumption calculation by Fluidyne is based off of the design flow of 100,000 GPD with a BOD concentration of 374 mg/L. The calculations by Fluidyne need to be adjusted to make a direct comparison to the actual historic flow rate of the facility, 46,391 GPD, to determine if a 20% power savings will be achieved.

Table 14. Energy Savings Summary

	Existing Facility	Proposed Facility	Monthly Cost Savings	Energy Savings
Daily Demand		304 kWh/Day		
Monthly Demand		9,120 kWh		
Monthly Demand (adjusted for flow)		4,231 kWh		
Service Charge Rate		$0.06363 kWh		
Monthly Service Charge		$269		
Energy Charge Rate		$11.60 kW		
Monthly Energy Charge		$400		
Monthly Cost	$1,165	$669	$496	42%

The energy savings realized with the installation of the SBR process of approximately 42% is greater than the 20% needed to be considered categorically eligible for the for the GPR program.

6.4.3 COMPONENT #2: ANAEROBIC SLUDGE DIGESTION

Environmentally innovative projects are defined by the Green Project Reserve Program as "those that demonstrate new and/or innovative approaches to delivering services or managing water resources in a more sustainable way." The Mountain Water and Sanitation District will meet this objective by significantly reducing the amount of biosolids generated by the new facility and mitigating negative environmental impacts, such as those generated by hauling of the sludge.

Section 4.5-5b states that treatment technologies or approaches that significantly reduce the volume of residuals, minimize generation of residuals, or lower the amount of chemicals in the residuals may be eligible for the GPR program. A business case is required for this section and therefore presented as follows.

The District historically hauls approximately 172,700 gallons of biosolids each year. Each truck has the capacity of 5,000 gallons resulting in 35 trips per year, or about one load each week and a half. The District pays the hauler $400 per load to haul and dispose of its sludge.

Numerous wastewater facilities, including the RBC currently installed at the District, utilize aerobic digestion as a means to reduce the volume of sludge by repeatedly over-aerating the WAS in an attempt to "burn up" the residual organic pollutants. This is a diminishing-return operation that severely limits the overall efficiency of any WWTP. The Fluidyne SBR utilizes an in-line anaerobic selector as a sludge storage basin as well as a sludge digester. The anaerobic action digests the sludge, reducing the volume. Also, the sludge is compacted upwards of 3-4% solids through gravimetric settling. To achieve these concentrations, conventional plants must enlist the use of costly belt presses and drying pits. Conventional approaches require space, labor, energy, and substantial capital cost. Digestion and compaction improves the longer the sludge is retained in the anaerobic basin, decreasing the need for hauling.

Conventional aerobic digestion is not an efficient method because it requires aerobic bacteria to digest aerobic bacteria. This process requires digestion of existing bacteria so that its bio-nutrients can be broken down into simpler compounds. Bacteria, when unable to self-sustain, enter into a sporocyte stage that resists degradation or consumption. Fluidyne avoids this situation by putting aerobic bacteria into an anaerobic basin so that they can be killed more efficiently. Fluidyne's approach does not require electricity to digest and compact the bacteria. Fluidyne's approach allows the organic molecules to be dissolved and then recycled throughout the treatment process. This strategy provides a more thorough treatment and a greater by-product release of CO_2, H_20 and N_2. These compounds are non-hazardous when released into the environment and pose less of an environmental risk than their alternative forms, CH_4 and NH_3.

The Fluidyne calculations estimate that the new treatment facility will generate 256 gallons per day (93,440 gallons per year) of biosolids for 100,000 gallons per day of flow. Adjusting the sludge generation for 46,391 GPD of flow decreases sludge production to 43,348 gallons per year. This calculation adjustment is needed to make an equivalent comparison to before and after sludge generating amounts. The new plant will require sludge to be hauled about 9 times per year if the District continues to use trucks with a capacity of 5,000 gallons.

The net impacts to the environment are significant and measureable. The most significant impacts are those mitigated from hauling the sludge. The current process is inefficient and the process yields a significant amount of residuals that must unnecessarily be hauled off and disposed of offsite. The hauling adds additional vehicle trips to the road system, fuel consumption, and release of emissions. The amount of fuel and mileage savings by implementing the SBR process is quantified below:

Table 15. Fuel Savings

Item	Number	Units
Trips per Year (current)	35	Trips
Trips per Year (proposed)	9	Trips
Trip Length (roundtrip)	172	Miles
Miles per Year (current)	6,020	Miles
Miles per Year (proposed)	1,548	Miles
Vehicle Fuel Consumption	10	MPG
Yearly Fuel Consumption (current)	602	Gallons
Yearly Fuel Consumption (proposed)	155	Gallons
Yearly Fuel Savings	447	Gallons
Miles Saved (yearly)	4,472	Miles

The cost savings realized by decreasing the amount of residuals generated are considerable. It costs $400 per load to haul sludge offsite. The District can save considerable money by decreasing the frequency of hauling:

Table 16. Cost Savings

Item	Number	Units
Trips per Year (current)	35	Trips
Trips per Year (proposed)	9	Trips
Cost per trip	$400	Dollars
Hauling cost per year (current)	$14,000	Dollars
Hauling cost per year (proposed)	$3,600	Dollars
Yearly Savings	$10,400	Dollars

The annual cost savings do not show the additional capital cost savings that would occur by not having to construct additional sludge holding facilities and aeration capabilities.

6.4.4 GREEN PROJECT RESERVE CONCLUSION

The incremental "green" benefits realized by upgrading the existing wastewater treatment plant to a Fluidyne SBR are significant, both environmentally and financially. The environmental benefits include, but are not limited to:

- Lower energy use
- Less demand on power generating facilities
- Reduced vehicle trips
- Fewer emissions generated
- Small volume of biosolids that must be accepted off site

- Smaller treatment works footprint
- Reduced odor from anaerobic sludge digestion
- Reduced biological nutrients in effluent discharge
- Improved receiving stream quality

The financial benefits achieved by improving sustainability are significant. Those savings are summarized below:

Table 17. Cost Savings Summary

Item	Amount
Category #1	$5,892/year
Category #2	$10,400/year
Total:	$16,292/year

Given the substantial environmental and economic benefits, the District believes that $870,327 of the project costs is eligible for the Green Project Reserve Program. The costs are detailed as follows:

Table 18. Green Project Reserve Eligible Costs

Item	Cost
WWTP Equipment Package	$292,600
Concrete Tanks	$290,000
Excavation	$25,000
WWTP Treatment Building	$40,000
Equipment Installation	$125,000
Engineering Design Fees	$97,727
Grand Total	**$870,327**

The project therefore qualifies for inclusion into the GPR program by meeting the requirement that at least 20% ($400,000) of the project's costs qualify for the program.

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Mr. Doug Camrud, P.E.
Water Quality Control Division
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246-1530

June 19, 2012

RE: Mountain Water & Sanitation District
Green Project Reserve Qualification Review - Response to Comments
GLU Project Number 040033W

Dear Mr. Camrud,

I am writing in response to your letter dated June 15, 2012 that requested additional information on the Green Project Reserve Statement for the Mountain Water & Sanitation District wastewater treatment facility.

The following paragraphs provide responses to your requests. I have summarized your comments in bold and then responded to each. The numbers of the comments and responses match the numbers presented in your letter.

1) **Please update the energy efficiency evaluation to take into consideration that some or all of the existing equipment is 30 years old and is currently operating at a lower efficiency than at the time of the installation based on name plate data.**

Section 3.2-2 of the Guidance for Determining Project Eligibility states that energy used by the existing system should be based on name plate data when the system was first installed, recognizing that an old system is currently operating at a lower efficiency than at the time of installation. AquaWorks DBO determined that providing power consumption demand from actual electricity bills was superior to the method called for in the Guidance Document, for the following reasons:

- As the Guidance Document states, the calculations used to determine power consumption should recognize that the old system is currently operating at a lower efficiency than at the time of installation. However, the Guidance Document does not provide for a method

to correct the loss in efficiency. Any modification to the name plate data to account for age would be an estimate and would provide a less certain consumption number.

- Energy consumption and cost by a WWTP is not only based on the power demand of each individual component, but is also based on how often the equipment is used and, more importantly, the peak power usage of the facility. Looking at a name plate for equipment and determining power use will accurately give us instantaneous power demand, but will not reveal the cost to run that equipment over a 24-hour period or the cost to run that equipment when other equipment also demands power.
- The existing WWTP consists of a wide array of equipment, including pumps, blowers, control panels, chemical feed pumps, building lights, HVAC systems, and other items. Name plate information is available for select equipment but not for all items. Accounting for items without name plates requires estimation, resulting in a less accurate number than presented in the Preliminary Engineering Report.

An estimate could still be developed using the name plate information; however, we do not believe that this approach will be as accurate as the information presented in the Preliminary Engineering Report.

2) **Please update the energy efficiency evaluation to take into consideration the additional power consumption of all new WWTP equipment.**

The additional equipment that could be installed with the project but was not included in the Green Project Reserve Statement includes the following:

Item	Amount		
Fluidyne Equipment Package	243	kWh/day	
Control Panel	61	kWh/day	Included in the PER
Miscellaneous Valves			
SCADA Panel			
Ultrasonic Flow Meter			
Building Lights & Heat			
Chemical Feed Pumps			
Mechanical Bar Screen	49	kWh/day	Added with this letter
Influent Pump Station			
Effluent Pumps			
Total	353	kWh/day	

Table 14 in the Preliminary Engineering Report needs to be updated as follows to reflect the energy consumption from the additional equipment; however, the case made in Section 6.4.2 of

the PER still qualifies for the program because the energy savings achieved with the new facility is greater than the 20% required by the Guidance Document:

	Existing Facility	Proposed Facility	Monthly Cost Savings	Energy Savings
Daily Demand		353 kWh/Day		
Monthly Demand		10,590 kWh		
Monthly Demand (adjusted for flow)		4,903 kWh		
Service Charge Rate		$0.06363 kWh		
Monthly Service Charge		$311		
Energy Charge Rate		$11.60 kW		
Monthly Energy Charge		$464		
Monthly Cost	$1,165	$775	$390	33%

3) **Please update the Green Project Reserve environmentally innovative business case for the reduction in residuals through anaerobic sludge digestion by evaluating the payback period.**

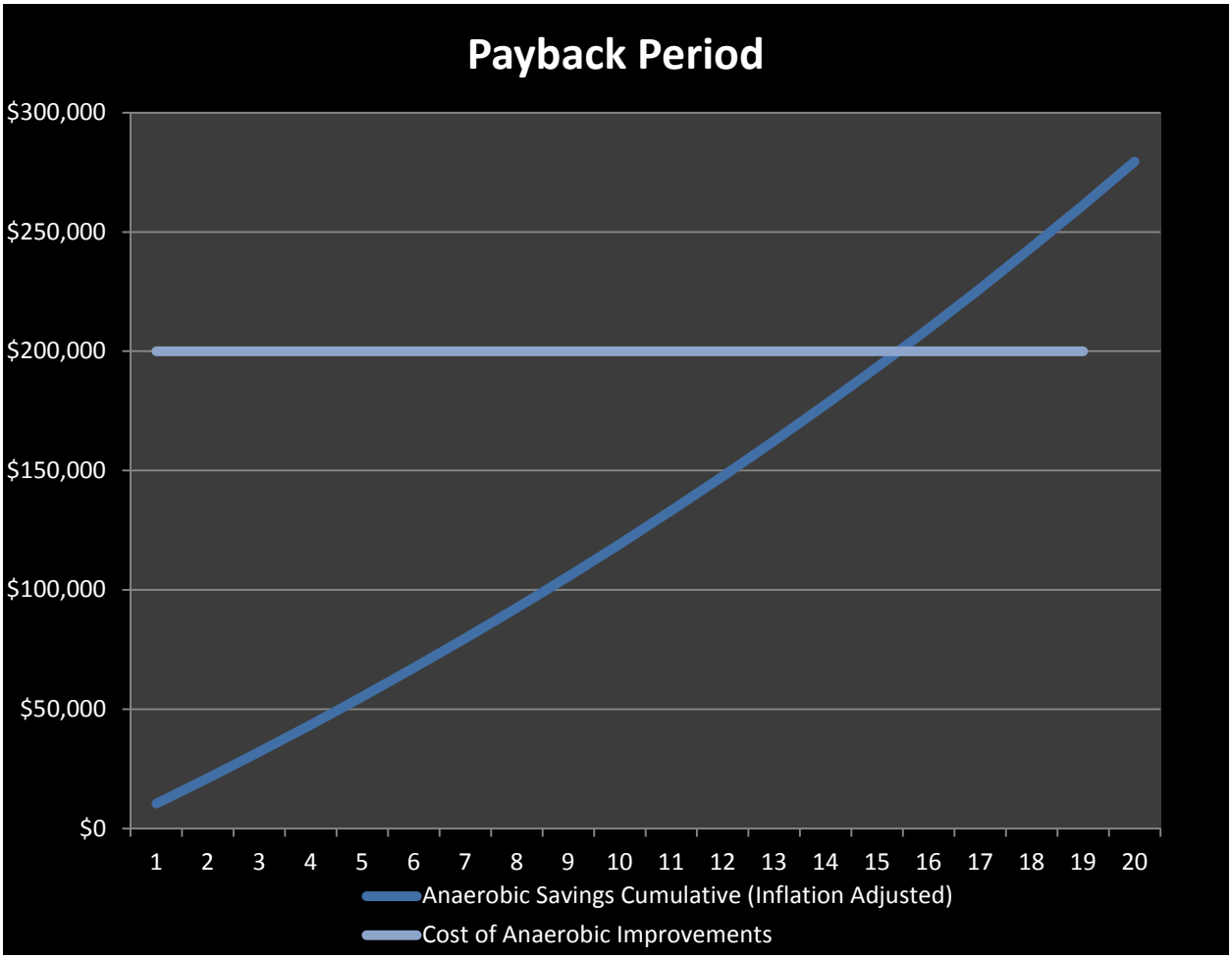
A table and graph showing the twenty year payback period for the anaerobic sludge digestion component is shown below. The expense to implement the anaerobic digestion is paid back in between years fifteen and sixteen:

Year	Anaerobic Digestion Savings	Anaerobic Savings (Inflation Adjusted)	Anaerobic Savings Cumulative (Inflation Adjusted)	Cost of Anaerobic Improvements	Payment for Anaerobic Improvements
1	$10,400	$10,400	$10,400	$200,000	$10,000
2	$10,400	$10,712	$21,112		$10,000
3	$10,400	$11,033	$32,145		$10,000
4	$10,400	$11,364	$43,510		$10,000
5	$10,400	$11,705	$55,215		$10,000
6	$10,400	$12,056	$67,271		$10,000
7	$10,400	$12,418	$79,690		$10,000
8	$10,400	$12,791	$92,480		$10,000
9	$10,400	$13,174	$105,655		$10,000
10	$10,400	$13,570	$119,224		$10,000

11	$10,400	$13,977	$133,201		$10,000
12	$10,400	$14,396	$147,597		$10,000
13	$10,400	$14,828	$162,425		$10,000
14	$10,400	$15,273	$177,698		$10,000
15	$10,400	$15,731	$193,429		$10,000
16	$10,400	$16,203	$209,632		$10,000
17	$10,400	$16,689	$226,321		$10,000
18	$10,400	$17,190	$243,510		$10,000
19	$10,400	$17,705	$261,215		$10,000
20	$10,400	$18,236	$279,452		$10,000
Total:	$208,000	$279,452			$200,000

Note #1: Inflation Rate of 3% used.

Note #2: Interest Rate of 0% used (GPR Qualified).



4) **Please review and revise the list of eligible costs in the Green Project Reserve evaluation and include appropriate justification for each eligible cost.**

Twenty percent of the total project cost must be green eligible for the entire project to qualify for the Green Project Reserve Program. Therefore, $400,000 of the opinion of probable costs in Table 19 of the Preliminary Engineering Report must be considered green eligible.

The Guidance Document does not provide the procedure to follow when one line item in Table 19 will contribute to both achieving green status and will be non-eligible for the green program. Many of the line items serve multiple purposes. In response, AquaWorks DBO attempted to distribute green project costs on a project-wide basis in Table 18 of the PER. Your request to revise the list of eligible costs on a line items basis and include appropriate justification should provide the additional detail required to determine that a minimum of 20% of the costs are green eligible. The clarification you requested is attached to this letter in a separate table.

I hope that the responses adequately address your outstanding comments. Please feel free to contact me at (303) 477-5915 if you have any questions.

Sincerely,

AQUAWORKS DBO, INC.

Adam Sommers, P.E., AICP

cc. Mr. Scott Garncarz, CDPHE FSU
Ms. Terry Miers, Mountain Water & Sanitation District

Division:	Item:	Quantity:	Unit Cost:	Item Cost:	Green Eligible:	Justification
2	**Site Construction**					
	Site Clearing	1	LS	$10,000	$2,000	Volume of anaerobic tanks is 20% of total tank volume. Use 20% of this cost.
	Rock Breaking/Crushing	1	LS	$75,000	$15,000	Volume of anaerobic tanks is 20% of total tank volume. Use 20% of this cost.
	Excavation	1	LS	$25,000	$5,000	Volume of anaerobic tanks is 20% of total tank volume. Use 20% of this cost.
	Bedding	1	LS	$20,000	$4,000	Volume of anaerobic tanks is 20% of total tank volume. Use 20% of this cost.
	Backfill & Grading	1	LS	$15,000	$3,000	Volume of anaerobic tanks is 20% of total tank volume. Use 20% of this cost.
	Site Piping	1	LS	$45,000		
	Site Restoration	1	LS	$7,500	$1,500	Volume of anaerobic tanks is 20% of total tank volume. Use 20% of this cost.
	Erosion Control	1	LS	$5,000		
	Demo Existing WWTP & Phasing of New WWTP	1	LS	$125,000	$25,000	The existing facility needs to be removed for the installation of the anaerobic tanks. Use 20% of demo costs.
	Remove and Replace Chain Link Fencing	1	LS	$25,000		
3	**Concrete**					
	Precast Tanks (ISAM x 2, SAM x 2, EQ x 1)	1	LS	$175,000	$76,125	Anaerobic tanks is 43.5% of precast tank volume. Use 43.5% of this line item.
	Cast in Place Concrete (SBR Tanks x 2)	1	LS	$115,000		
	Miscellaneous Concrete (Barscreen, Building Slab, Generator Pad)	1	LS	$50,000		
5	**Metals**					
	Hatches	1	LS	$17,500	$4,375	There are currently 4 hatches on the anaerobic tanks. Use 25% of metals costs.
6-10	**Building Related**					
	Controls & Blower Building	1	LS	$40,000	$4,000	Some of the building area is needed to protect electrical and mechanical equipment need to achieve GPR. Use 10%.
11	**Equipment**					
	Wastewater Process Treatment Equipment (Package by Manufacturer)	1	LS	$269,200	$134,600	Fluidyne was the most energy efficient equipment based upon anaerobic digestion and VFDs. Use 50% of cost for Fluidyne.
	Headworks (Automatic Barscreen)	1	LS	$30,000		
	Flow Measurement (Flume & Ultrasonic Flow Meter)	1	LS	$7,500		
	Autodialer/SCADA	1	LS	$10,000		
	Backup Generator	1	LS	$30,000		
	Chemical Metering (3 duty: 1 shelf spare)	1	LS	$10,000		
	Miscellaneous	1	LS	$15,000		
	Equipment Installation	1	LS	$125,000	$62,500	Use half of this number for the installation of the Fluidyne equipment needed for GPR criteria.
15	**Mechanical**					
	HVAC Labor & Materials	1	LS	$17,500		
16	**Electrical (not including bringing three phase power to site)**					
	Line Voltage Electrical Improvements	1	LS	$75,000	$37,500	Use half of this number to install the energy efficient electrical equipment including Fluidyne control panel.
	Instrumentation and Controls	1	LS	$35,000	$8,750	Use 25% of this cost to account for instrumentation needed to run the Fluidyne process, i.e. ORP probes.
	Subtotal:			$1,374,200	$383,363	
	Contractor General Conditions			$60,000	$16,738	Proportional to the percentage of green eligible costs versus non-green eligible.
	Contractor Overhead & Profit:	10.0%		$137,420	$38,336	Proportional to the percentage of green eligible costs versus non-green eligible.
	Design Engineering (Process, Civil, Geotechnical, Structural, Electrical, HVAC):	6.75%		$92,759	$25,877	Proportional to the percentage of green eligible costs versus non-green eligible.
	Bidding, SRF Administration, & Construction Engineering Consulting:	6.0%		$82,452	$23,002	Proportional to the percentage of green eligible costs versus non-green eligible.
	Contingency:	10.0%		$137,604	$38,336	Proportional to the percentage of green eligible costs versus non-green eligible.
	Permit Fees (to CDPHE)			$9,190		
	Additional Items, Fees, and Contingency			$106,375	$29,676	Proportional to the percentage of green eligible costs versus non-green eligible.
	Grand Total:			$2,000,000	$555,328	