

Memo



Stantec

To: Dale Colerick
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File: 187307950

Date: June 15, 2009

**Reference: Green Infrastructure for Improvements to the Brush WWTF –
Response to Request for Additional Information Concerning Green
Project Reserve Funding**

The purpose of this memo is to provide additional information to the Financial Solutions Unit of Water Quality Control Division (WQCD) of Colorado State Health Department (CDPHE) concerning the green infrastructure portions of the improvements to the Brush Wastewater Treatment Facility (WWTF), and provide the basis for how the project meets the requirements for the Green Project Reserve Funding that is included in the American Recovery and Reinvestment Act (ARRA). In the April 16, 2009 Memo to the City of Brush (City), individual project components were identified as “green project reserve” components (green infrastructure, water and energy efficiency, and innovative technology). The following provides additional detail on the eligible project components and includes where necessary a “Business Case” for satisfying the requirements of project components that are considered non-categorical or “traditional” as defined by the CWSRF Attachment 7. A summary of the total and individual green project components costs have been estimated on Page 6 of this memo. The total estimated cost eligible for Green Project Reserve funding is **\$340,000**. The cost details and business case calculations are provided in Appendix A.

Energy Efficiency

Additional details are provided below for the following project components and strategies that will be implemented to increase energy efficiency. Since much of the mechanical equipment at the plant is over 40 years old it is very inefficient compared with more modern and advanced technology equipment. Also, the process layout of the plant will be modified to minimize the amount of pumping required to move flow through the plant. Improvements in energy efficiency are as follows:

1. The existing system includes two booster pump stations for pumping flow from the clarifiers to the first stage and second stage trickling filters. This inefficient system layout will be replaced with one primary sewage lift station and will gravity feed the remaining process flow through the plant. The new lift station will include three pumps on VFD controllers for matching the output of the pumps to the influent flows. The hydraulic profile of the new plant has been designed to maximize potential energy and reduce the amount of pumping required. An energy savings of approximately 71% is estimated for main liquid train pumping through the plant. Appendix A includes the business calculation for this component.

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- **Classification:** Energy Efficiency
 - **Justification:**
 - a) Newer technology equipment, higher efficiency motors, and improved system layout for pumps and process equipment satisfy the requirement under item **I** of Energy Efficiency, CWSRF Attachment 7 since it is the “use of improved technologies and practices to reduce the energy consumption of water quality projects.”
 - b) This component satisfies the requirement under equivalent project examples in item **IV a.** of Energy Efficiency, CWSRF Attachment 7 as “energy efficient retrofits and upgrades to pumps and treatment processes.”
 - **Associated Costs:** \$248,000
2. Leak detection sensors installed in dry-well/pit structures to provide early warning of pipe leakages and prevent large water losses due to pipe breakage. (categorized as Water Efficiency in April 16 Memo, but included here based upon expanded definition in CWSRF Attachment 7)
- **Classification:** Energy Efficiency
 - **Justification:**
 - a) Leak detection systems satisfy the requirement under item **I** of Energy Efficiency, CWSRF Attachment 7 since it is the “use of improved technologies and practices to reduce the energy consumption of water quality projects.”
 - b) This component satisfies the requirement under equivalent project examples in item **IV b.** of Energy Efficiency, CWSRF Attachment 7 as “leak detection equipment for treatment works.”
 - **Associated Costs:** \$3,000

Water Efficiency

The following details are provided for the design strategies and construction methods that will be implemented to increase the water efficiency of the plant and conserve water throughout the project.

Reference: Green Infrastructure for Improvements to the Brush WWTF – Response to Request for Additional Information Concerning Green Project Reserve Funding

1. Existing restroom facilities located in the Digester building and Office/Admin Building will be removed and replaced with high efficiency (water conserving) fixtures including urinals, toilets, faucets, and showers.
 - **Classification:** Water Efficiency
 - **Justification:**
 - a) Leak detection systems satisfy the requirement under item I of Water Efficiency, CWSRF Attachment 7 since it is the “use of improved technologies and practices to deliver equal or better services with less water.”
 - b) This component satisfies the requirement under equivalent project examples in item V b. of Energy Efficiency, CWSRF Attachment 7 as “retrofit or replacement of water using fixtures, fittings, equipment or appliances.”
 - **Associated Costs:** \$3,000

2. The existing disinfection system consists of chlorination with sodium hypochlorite. This system will be replaced with a UV Disinfection system that requires zero use of chemical feed solutions. These modifications will allow for installation of a duplex pumping system immediately downstream of the UV system to reuse treated effluent as a non-potable water source as service water for the plant.
 - **Classification:** Water Efficiency
 - **Justification:**
 - a) Reuse of treated effluent as a non-potable water source satisfies the requirement under item I of Water Efficiency, CWSRF Attachment 7 since it is the “use of improved technologies and practices to deliver equal or better services with less water.”
 - b) This component satisfies the requirement under equivalent project examples in item V e. of Energy Efficiency, CWSRF Attachment 7 as “reclamation, recycling, and reuse of existing rainwater, condensate, degraded water, stormwater, and/or wastewater streams.”
 - **Associated Costs:** \$18,000

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Green Infrastructure

Additional detail is provided for the following green infrastructure elements of the project:

1. Civil site layout design includes the planned construction of gravel, porous, access roads and parking areas instead of pavement for maintaining pervious areas and infiltration/groundwater recharge.
 - **Classification:** Green Infrastructure
 - **Justification:**
 - a) Use of permeable roadway systems could be considered under item I of Green Infrastructure, CWSRF Attachment 7 since it is part of a policies such as “infill and redevelopment that reduce overall imperviousness in a watershed.”
 - b) This component satisfies the requirement under equivalent project examples in item V c. of Green Infrastructure, CWSRF Attachment 7 as “implementation of wet weather management systems for parking areas which include: the incremental cost of porous pavement, bioretention, trees, green roofs, and other practices that mimic natural hydrology and reduce effective imperviousness at one or more scales.”
 - **Associated Costs:** \$20,000

Environmentally Innovative Projects

Additional details are provided below on the innovative and unique strategies that will be implemented to use resources in a more sustainable way, reduce project costs, and reduce the overall site impact of the project.

1. Reuse/Recycle Material from Demolition of Existing Trickling Filters: The two existing trickling filter structures are 100-feet in diameter and consist of 12” thick concrete walls approximately 8-feet high. The filters are filled with river rock to a depth of five feet with an estimated volume of 1,500 cubic yards of rock. These structures will be demolished to provide space for the new primary clarifiers and a future secondary clarifier. In order to divert construction waste from the landfill and maximize use of recycled material the center-pivot rotating mechanism will be removed and sent to a steel recycling center and the rebar in the concrete walls will be extracted and sent to a steel recycling center. In addition, a temporary on-site crusher will be used to crush the demolished concrete walls

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and river rock into aggregate to be used for structural fill and road base material. The benefits of recycling and re-using the trickling filter structures will be the following: 1) Reduce the amount virgin imported material required for construction. The amount of new aggregate required for structural fill and road base will be reduced by a least 3,000 cubic yards based upon demolishing both trickling filters, 2) Minimize the environmental impacts and carbon footprint associated with transportation costs of fill and aggregate material, and 3) Realized cost savings for offsetting structural fill and drainage gravel costs.

- **Classification:** Environmentally Innovative Projects
- **Justification:**
 - Reuse and recycling of existing onsite material satisfies the requirements under item **I** of Environmentally Innovative Projects, CWSRF Attachment 7 since it demonstrates “new and/or innovative approaches to managing water resources in a more sustainable way, including projects that achieve pollution prevention or pollutant removal with reduced costs.”
 - This component satisfies the requirement under equivalent project examples in item **III h.** of Green Infrastructure, CWSRF Attachment 7 as “the water quality portion of projects that demonstrate the energy savings and greenhouse reduction benefits of sustainable site practices.”
- **Associated Costs:** **\$48,000**

Summary of Costs

The table on the following page shows the estimated costs for each ARRA Green Project Reserve category. Based upon the definitions and example cases provided in CWSRF Attachment 7 and the June 1, 2009 request for additional information from the WQCD, the cost amount for the individual categories have been adjusted from the initial April 16 Memo to more accurately reflects which components of project apply to the Green Project Reserve categories and based upon more detailed cost estimates. Please refer to Appendix A for details of the costs.

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Summary of Green Project Reserve Costs

Category	Item (s)	Cost (\$)	Notes
Energy Efficiency	New Influent Pump Station, Leak Detection	251,000	
Water Efficiency	Water Efficient Fixtures	21,000	
Green Infrastructure	Permeable Access Roads	20,000	Gravel access road and Parking area
Environmentally Innovative Projects	Recycling and Reuse of existing Trickling Filter units	48,000	Cost for demolition and crushing
Total		340,000	

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Attachment:

c. Greg Woodward, Stantec

APPENDIX A
SUPPORTING CALCULATIONS

Supporting Calculations

ENERGY EFFICIENCY

Energy Savings Calculation:

$$\frac{kWh/year \text{ existing case} - kWh/year \text{ proposed case}}{kWh/year \text{ existing case}}$$

1. The existing plant liquid train requires that process flows be pumped twice. There are two sets of vertical turbine pumps that transfer liquid from the primary clarifier to the 1st Stage Trickling Filter and a second set of pumps that transfer liquid from the 1st Stage Trickling Filter to the 2nd Stage Trickling. The PER indicates that the pumps have the ability to operate at lower speed at night (approx. 700 gpm). This is assumed to act like a VFD such that the pumps operate at 50% of their capacity for 10 hours per day. The result is that the pumps operate at 79% of rated capacity throughout the year. The lag pumps operate very infrequently when the peak hour flow is experienced. The proposed case includes only one pump station and has the ability to better match the influent flows with new VFDs that are designed to work with the pumps that are specified. The result is that the new pumps operate at average 66% of their rated capacity to match the average annual design flow of 1.34 MGD. Please note that the power usage at reduced speeds varies by the cube of that speed according the laws of affinity.

Existing Case

Item	Description	Motor (Hp)	kW	*Percent Pump Speed	hrs/day	hrs/year	kWh/year
1st Stage Trickling Filter Pump (Lead)	Vert. Turbine, 1400 gpm, Johnston	10	7.5	79%	24	8760	32,220
1st Stage Trickling Filter Pump (Lag - operate 1 hour per month to meet Peak Demands)	Vert. Turbine, 1200 gpm, Fairbanks Morse	10	7.5	100%	1	2	15
2nd Stage Trickling Filter Pump (Lead)	Vert. Turbine, 1400 gpm, Johnston	10	7.5	79%	24	8760	32,220
2nd Stage Trickling Filter Pump (Lag - operate 1 hour per month to meet Peak Demands)	Vert. Turbine, 1200 gpm, Johnston	10	7.5	100%	1	2	15

Total kWh/year

64,470

Proposed Case

Item	Description	Motor (Hp)	kW	*Percent Pump Speed	hrs/day	hrs/year	kWh/year
Influent Pump Station No. 3 Pump (Lead - operates 12 hours per day at 1.34 MGD, and 2 hours per year at full speed to meet PHF)	Submersible, 1420 gpm @31' TDH, ITT Flygt. VFD Controlled	20	14.9	66%	12	4380	18,818
Influent Pump Station No. 2 Pump (Lag - Operates 2 hour per year to meet PHF of 4.03 MGD)	Submersible, 1420 gpm @31' TDH, ITT Flygt. VFD Controlled	20	14.9	100%	1	2	30
Influent Pump Station No. 3 Pump (Redundant - operates 12 hours per day at 1.34 MGD, tradeoff with Pump No. 1)	Submersible, 1420 gpm @31' TDH, ITT Flygt. VFD Controlled	20	14.9	66%	12	4380	18,818

Total kWh/year **18,847**

Energy Savings **71%**

Associated Costs

Item	Design Costs	Material+Const.Costs	Total
New Influent Pump Station	\$32,250	\$215,000	\$248,000
(Includes installation, controls, and wet well construction)			

2. Leak detection sensors installed in dry-well/pit structures to provide early warning of pipe leakages and prevent large water losses due to pipe breakage.

Associated Costs

Item	Design Costs	Material+Const.Costs	Total
Mositure Detection Sensor Unit - alarms at Min. 1/16 in. water depth, wired to site PLC, Installation	\$400	\$2,600	\$3,000

location and approx no. of sensors: Headworks MCC, (2) Primary Pump Station, (2) Secondary Pump Station, (2) Digester Tank Bldg, (2) UV Control Panel Room, (1) DAF Room (2)
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WATER EFFICIENCY

1. Existing restroom facilities located in the Digester building and Office/Admin Building will be removed and replaced with high efficiency (water conserving) fixtures including urinals, toilets, faucets, and showers.

Associated Costs

Item	Design Costs	Material+Const.Costs	Total
Digester Bldg - (1) Low Flush Toilet, 1.28 gpf, meets EPA Water Sense Program	\$0	\$500	\$500
Digester Bldg - (1) Water Saving Shower Head, 1.75 gpm	\$0	\$300	\$300
Digester Bldg - (1) Faucet, low flow aerator option, Meets EPA Water Sense Program	\$0	\$330	\$330
Office/Admin Building - (1) Low Flush Toilet, 1.28 gpf, meets EPA Water Sense Program	\$0	\$500	\$500
Office/Admin Building - (1) Water Saving Shower Head, 1.75 gpm	\$0	\$300	\$300
Office/Admin Building - (2) Faucets, low flow aerator option, Meets EPA Water Sense Program	\$0	\$650	\$650

Total Cost **\$3,000**

2. Installation of a duplex pumping system immediately downstream of the UV system to reuse treated effluent as a non-potable water source as service water for the plant.

Associated Costs

Item	Design Costs	Material+Const.Costs	Total
Wilco 6-inch Submersible (Duplex), 8.5 hp	\$3,000	\$15,000	\$18,000

GREEN INFRASTRUCTURE

1. Civil site layout design includes the planned construction of gravel, porous, access roads and parking areas instead of pavement for maintaining pervious areas and infiltration/groundwater recharge.

Associated Costs

Item	Area (sy)	Unit Cost*	Total
Site Access Roads: 6-inch, coarse gravel road base	2,870	\$5.85	\$17,000
Parking Area - Gravel road base	460	\$5.85	\$3,000
Total Cost			\$20,000

*Colorado Department of Transportation (CDOT) 2008 Cost Data, Feb. 19, 2009 Report, Aggregate Base Course Class 3 Item 304-03005

ENVIRONMENTALLY INNOVATIVE PROJECTS

1. Reuse/Recycle Material from Demolition of Existing Trickling Filters

Associated Costs

Description	Design Costs	Material+Const.Costs	Total
- Demo. Trickling Filter - Remove steel center pivot arm / tubing and send to recycle center - Extract structural steel and send to recycle center - Crush concrete and rock media for use a structural fill	\$0	\$48,000	\$48,000