Clean Water State Revolving Fund Green Project Reserve

- Final -

Hayden Area Regional Sewer Board WWTP Upgrade Project

SRF Loan #WW1309, WW1310 (pop. 22,750)

$15,777,754

Final Green Project Reserve Justification

Categorical and Business Case GPR Documentation

1. INSTALLS ADVANCED ENERGY EFFICIENT LIGHTING. Categorical GPR per 3.2-2: *projects that achieve a 20% reduction in energy consumption;* Business Case per 3.5-7: "*Upgrade of POTW lighting to energy efficient sources such as……compact fluorescent, light emitting diode (LED).*" ($121,976).

Business Case GPR Documentation

2. INSTALLS INNOVATIVE MULTI-STAGE ACTIVATED BIOLOGICAL PROCESS FOR BIOLOGICAL NUTRIENT REDUCTION (Innovative). Environmentally Innovative GPR-eligible per Section 4.5-5a: "*Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment; 4.5-5b: …significantly reduce the volume of residuals, or lower the amount of chemicals in the residuals*." ($3,294,216).
3. INSTALLS VARIABLE FREQUENCY DRIVES. GPR-per Section 3.4-1: *"Project must be cost effective. An evaluation must identify energy savings and payback on capital and operation and maintenance costs that does not exceed the useful life of the asset" and 3.5-9: "Variable Frequency Drives can be justified based upon substantial energy savings."* ($15,000).
4. INSTALLS SCADA CONTROL TECHNOLOGY. GPR-eligible per Section 3.4-1: *"Project must be cost effective. An evaluation must identify energy savings and payback on capital and operation and maintenance costs that does not exceed the useful life of the asset" and Section 3.5-8: SCADA systems can be justified based on substantial energy savings".* ($85,905).

1. Installs Energy Efficient Lighting

Summary

- Energy efficiency from the installation of LED lighting.
- Estimated loan amount = $15,777,754
- Estimated energy-efficient (green) portion of loan = .8% ($121,976)

Energy Efficiency Improvements

- LED lighting is approximately 20.6% more energy efficient than a plant wide combination of typical high pressure sodium, metal halide, and fluorescent lighting for relatively the same light output.

Conclusion

- The proposed improvements are GPR-eligible as they greater than 20% more efficient than a standard installation.
- **GPR Costs**: LED Lighting = $216,337
- **GPR Justification**: Advanced fluorescent lighting and LED lighting is Categorically GPR-eligible per 3.2-2: *projects that achieve a 20% reduction in energy consumption; it is also* GPR-eligible by a Business Case per 3.5-7: *Upgrade of Control Building lighting to energy efficient sources such as...compact fluorescent, light emitting diode (LED).*[1]

LUMINAIRE ENERGY CONSERVATION SCHEDULE[2]

	BASE		PROPOSED					
TYPE	LAMP TYPE	WATTS / FIXTURE	LAMP TYPE	WATTS / FIXTURE	TOTAL LUMINAIRES	TOTAL BASE ENERGY (W)	TOTAL PROPOSED ENERGY (W)	TOTAL NET ENERGY SAVINGS (W)
A1	(2) 3500K 32W T8	58	LED 4556 LU	45	15	870	675	195
A2	(3) 3500K 32W T8	85	LED 6489 LU	71	6	510	426	84
B1	(1) 3500K 32W TT	32	LED 2000 LU	32	16	512	512	0
C	(1) 3500K 13W TT	18	LED 858 LU	20	3	54	60	-6
E	(2) 3500K 32W T8	58	T8 LED 1650 LU	38	3	174	114	60
F	(6) 3500K 18W COIL	120	(6) LED 1100 LU	90	1	120	90	30
H	(1) 3500K 18W TT	16	LED 1106 LU	30	1	16	30	-14
K	(1) 3500K 17W T8	20	LED 645 LU	11	3	60	33	27
L	(1) 3500K 32W T8	25	T8 LED 1650 LU	19	2	50	38	12
M	(2) 3500K 32W TT	68	LED 3397 LU	57	8	544	456	88
N	(1) 4000K 400W MH	461	LED 24199 LU	363	7	3227	2541	686
N2	(2) 4000K 400W MH	922	LED 48398 LU	726	3	2766	2178	588
N3	(1) 4000K 250W MH	295	LED 9309 LU	110	1	295	110	185
P	(2) 3500K 32W T8	56	LED 5450 LU	47	42	2352	1974	378
Q	(2) 3500K 32W TT	68	LED 2540 LU	45	8	544	360	184
					COLUMN TOTAL	12094	9597	2497
						ENERGY REDUCTION		**20.6%**

[1] Attachment 2. 2012 EPA Guidance for Determining GPR Eligibility

[2] 12-24-13 S. Krallman PE, J-U-B Engineers, Inc.

2. POTW UNIT PROCESS: BIOLOGICAL NUTRIENT REDUCTION

Summary

- An innovative biological nutrient reduction (BNR) system has been incorporated into the treatment process that will significantly reduce the amount of chemicals used to remove phosphorus and to buffer pH.
- Total Loan amount = $15,777,754
- Estimated Categorical energy efficient (green) portion of loan = 21% ($3,294,216)

Background

- It is anticipated that HARSB's NPDES permit will have phosphorus effluent limits.
- BNR is a proven innovative technology that significantly reduces the amount of chemicals used to treat wastewater; BNR also significantly reduces the amount of residuals produced, as well as the amount of chemicals in the residuals.
- The existing secondary treatment system will be configured to provide BNR of phosphorus and non-biological nitrogen (i.e. nitrate, NO3-N). The reduction of nitrate will improve the BNR of phosphorus and will recover alkalinity.
- Anaerobic and anoxic tanks will be added to the existing secondary treatment process to perform the BNR.

Treatment Description

- In BNR return activated sludge from the secondary clarifiers is brought into contact with the influent wastewater in the anaerobic tanks. The anaerobic conditions promote the growth of organisms used to biologically remove phosphorus. BNR without chemical addition is capable of lowering the phosphorus concentration to 1.5 mg/L.
- Nitrified water is recirculated through the anoxic tanks to be denitrified. The removal of nitrate improves the performance of the biological phosphorus removal process by removing an alternate oxygen source.
- Efficient solids separation, necessary to maintain the low phosphorus, is provided via modern clarifiers.

Innovative Process Justification[3]

- The GPR-eligibility of BNR was established by comparison to a Baseline Standard Practice (BSP). The BSP was derived from an analysis of viable and relevant treatment technologies[4] .
- The BSP for HARSB is phosphorus removal by chemical precipitation using alum and providing supplemental alkalinity by chemical addition using magnesium hydroxide.
- Compared to the BSP over the design period for the project (present – 2032), BNR eliminates the use no alum, uses 2,062 tons less magnesium hydroxide and generates no alum sludge. Overall, BNR uses 19,560 tons less chemical than the BSP. The estimated quantities of chemicals used, sludge generated and the savings BNR will create are summarized in the table.

	BSP	BNR	Savings
Alum used	6,494 tons	0 tons	6,494 tons
Magnesium Hydroxide used	2,721 tons	659 tons	2,062 tons
Chemical sludge generated	11,004 tons	0 tons	11,004 tons
Total	20,219 tons	659	19,560 tons

- Compared to the BSP over the design period for the project (present – 2032), BNR will save more than $4 million in chemicals and sludge disposal cost. The estimated cost of chemicals used, cost to dispose of sludge and the savings BNR will create are summarized in the table below.

	BSP	BNR	Savings
Cost of Alum	$ 2,597,543	$ 0	$ 2,597,543
Cost of Magnesium Hydroxide	$ 1,536,319	$ 372,090	$1,164,230
Cost of Chemical Sludge Disposal	$ 495,189	$ 0	$ 495,189
Total	$ 4,629,052	$ 372,090	$ 4,256,962

Conclusion

- BNR is GPR-eligible as it is an innovative process that eliminates the use of alum for phosphorus reduction, eliminates the generation of alum sludge, and significantly reduces the use of magnesium hydroxide for pH control.
- **GPR Costs**: Biological nutrient removal system = $ 3,294,216
- **GPR Justification**: The process is GPR-eligible per Section 4.5-5a: *Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment; 4.5-5b: …significantly reduce the volume of residuals, or lower the amount of chemicals in the residuals*.

[3] 12-24-13 S. Krallman PE, J-U-B Engineers, Inc.

3. VARIABLE FREQUENCY DRIVES

Summary

- Energy efficient practices incorporated in the design of the WWTP upgrade include the installation of variable frequency drives (VFD) for three 7.5 Hp mixers in the equalization tank.
- Total Loan amount = $15,777,754
- Estimated energy efficient (green) portion of loan = 0.1% ($15,000)

Description

- An equalization tank is used in the wastewater treatment process to reduce the variability of flow and loads entering the treatment plant. Mixers inside the tank keep solids suspended and the influent blended. The water level in the tank is variable. Less mixing energy is needed when the tank is low compared to when it is full. VFDs are be used to match the energy input and the volume of water in the tank.

GPR Justification[5]

- The GPR-eligibility of VFDs was established by comparison to a Baseline Standard Practice (BSP). The BSP is to operate the mixers without VFDs.
- The water level in the equalization tank varies between full and empty. On average, the tank is one-half full and needs one-half of the mixing energy need when full.
- The estimated annual energy cost for the BSP and VFD is summarized in the table below. The corresponding cost savings are estimated using an energy cost of 0.06$/kWh. The simple payback period was based on an installed cost of $5,000 per VFD. The useful life of a VFD is assumed to be greater than 10 years.

Equalization tank mixer	BSP	VFD	Savings
Energy usage per mixer	49,275 kW-hr/yr	24,638 kW-hr/yr	24,638 kW-hr/yr
Operating cost per mixer	$ 2,957/yr	$ 1,478/yr	$ 1,478/yr
Payback Period		----	3.4 yrs

Conclusion

- VFDs are GPR-eligible as they are cost effective (as shown in the table above).
- **GPR Costs**: Equalization tank VFDs = $ 15,000
- **GPR Justification**: The process is GPR-eligible per Section 3.4-1*: "Project must be cost effective. An evaluation must identify energy savings and payback on capital and operation and maintenance costs that does not exceed the useful life of the asset"* and 3.5-9 [5]: *"Variable Frequency Drives can be justified based upon substantial energy savings."*[6]

[4] Wastewater Treatment Facility Plan – Final Hayden Area Regional Sewer Board, November 2012 by J-U-B Engineers, Inc.

[5] 12-24-13 S. Krallman PE, J-U-B Engineers, Inc.

[6] Attachment 2. 2012 EPA Guidance for Determining GPR Eligibility

4. SCADA Control Technology

Summary

- SCADA Control Technology (SCADA) will be installed for on-site control and monitoring of the treatment plant in order to minimize power usage and cost and to optimize treatment effectiveness.
- Total Loan amount = $15,777,754
- Estimated energy efficient (green) portion of loan = .5% ($85,905)
- Estimated annual energy savings $74,575 per year.

Description

- SCADA Control Technology is used to monitor equipment and the treatment process remotely and by computer.

GPR Justification[7]

- The GPR-eligibility of SCADA VFDs was established by comparison to a Baseline Standard Practice (BSP). The BSP is to operate the equipment and treatment process manually.
- Oxidation ditches: the aeration system of the existing oxidation ditches will be tied to the dissolved oxygen levels in the oxidation ditch through the PLCs. The PLC's control the speed of the aerators; thus, SCADA monitors and controls tank oxygen levels and aerator speed. Oxidation ditches: It is estimated that optimizing aeration system will reduce energy usage by 20%: Installed aeration = 280 HP. 20% savings = 367,920 kW-hr/year.
- Dewatering system: SCADA will be used to operate sludge dewatering equipment with significantly reduced operator attention. It is estimated that SCADA will reduce the amount of time an operator must be present by 6 man hours/day. Dewatering: Remote SCADA control saves labor = 6 man hours/day, 250 days/year = 1,500 hrs/yr = $ 52,500/year in labor costs
- PLANT: Through a computer based Graphical User Interface (GUI) program the plant's processes will be monitored and observed remotely. The SCADA GUI will save energy through reduced travel to and from the plant
- The estimated annual energy cost for the BSP and SCADA is summarized in the table below. The corresponding cost savings are estimated using an energy cost of 0.06$/kWh. The useful life of SCADA is assumed to be greater than 10 years.

	BSP	SCADA	Savings
Oxidation ditches energy usage	1,839,600 kW-hr/yr	1,471,680 kW-hr/yr	367,920 kW-hr/yr
Oxidation ditch operating cost	$110,376/yr	$ 88,300/yr	$ 22,075/yr

Conclusion

- The use of SCADA is GPR-eligible because it is cost effective (as shown in the table above).
- **GPR Costs:** SCADA = $85,905
- **GPR Justification:** The SCADA is GPR-eligible per Section 3.4-1*: "Project must be cost effective. An evaluation must identify energy savings and payback on capital and operation and maintenance costs that does not exceed the useful life of the asset"* and Section 3.5-8[8]: *SCADA systems can be justified based on substantial energy savings.*

[7] 12-24-13 S. Krallman PE, J-U-B Engineers, Inc.
[8] Attachment 2. April 21, 2010 EPA Guidance for Determining Project Eligibility.