

Clean Water State Revolving Fund Green Project Reserve
Green Project Reserve Technical Memorandum



City of Post Falls WWTP Upgrade Project
SRF Loan #WW1801 (pop. 33,434)
\$24,100,060

Green Project Reserve Technical Memorandum

Categorical GPR

1. INSTALLS UV SYSTEM WITH FLOW PACING (Energy Efficiency). Categorically GPR per Section 3.2.2: *“Projects that achieve a 20% reduction in energy consumption are categorically eligible for GPR”* (\$461,196).

Business Case GPR Documentation

2. CONVERSION OF OXIDATION DITCH TO DISSOLVED OXYGEN CONTROL FOR AERATORS (Energy Efficiency). Business Case 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”* (\$150,000).
3. CONVERSION OF OXIDATION DITCHES TO FULL BNR (Environmentally Innovative). Business Case GPR per Section 4.5-5a: *“Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment”* (\$1,534,000).
4. INSTALLATION OF VFDs & SCADA (Energy Efficiency). Business Case GPR-eligible per Section 3.5-8: 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 3.5-8 *“SCADA systems can be justified based upon substantial energy savings”* and 3.5-9 *“Variable Frequency Drives can be justified based upon substantial energy savings”* (\$150,000).

1. INSTALLS DOSE-SENSING UV SYSTEM

Summary

- The UV system will automatically turn on and off to maintain the minimum set-point operational UV dose.
- Total Loan amount = \$24,100,060
- Estimated energy efficient (green) portion of loan = \$461,196 (2%) (design estimate).

Background

- The Water Reclamation Facility (WRF) uses UV technology to disinfect water prior to discharge.
- The current system is an older generation UV system, is in need of repairs, and is not fully redundant. This requires the City to rely on a chemical backup disinfection system, which is both problematic and expensive to operate. The old system also lacks technologies such as dose-pacing the operation of the lamps based on continuous UV transmittance (UVT) and/or UV intensity monitoring.
- By installing a new UV system equipped with dose-pacing technologies, only the minimum UV dose needs to be given and can be optimized based on flow through the system as well as the clarity (quality) of the water by the use of the UVT analyzer.

GPR Justification

- By installing automatic dose pacing technologies, the WRF can cut energy usage by applying the minimum dose needed. This will save energy consumption at the plant while maintaining adequate disinfection.
- The current method is conducted by dosing at a set rate for the WRF's lowest transmittance, which is 48% UVT. For continuous dosing at this UVT, the system requires 244,368 kWh and \$17,594 annually.
- With dose pacing, the UV system will be able to dose for what is needed, which is an average of 65% UVT. With dose pacing, the system will require 180,456 kWh and \$12,992 annually.
- Through these upgrades, the WRF will save 63,912 kWh and \$4,601.65 per year, a savings of 26%.

Conclusion

- The installation of the UV system is GPR eligible because it is cost effective as shown above.
- **GPR Costs:** UV System = The GPR eligible cost is the cost of the energy saved = **\$491,196** (Design estimated costs)
- GPR Justification: The new UV technology is GPR-eligible per Section 3.2-2: "*Projects that achieve a 20% reduction in energy consumption are categorically eligible for GPR.*"

2. OXIDATION DITCH Aeration DO Control System

Summary

- As part of the project, the existing oxidation ditches 1, 2, and 4 will be upgraded to include dissolved oxygen control for the aeration system.
- Total loan amount = \$24,100,060
- Estimated energy-efficient (green) portion of loan = \$150,000 (<1%).

Background

- The City of Post Falls owns and operates a Water Reclamation Facility (WRF) to reclaim municipal wastewater generated within its boundaries and from the nearby City of Rathdrum, Idaho.
- With the current treatment system, the dissolved oxygen (DO) setpoint is held uniformly at a target setpoint that is manually adjusted, requiring more energy as the ability to turn the system down during low-loading periods cannot easily be realized.
- With the upgrade, the operator will be able to input the desired DO concentration to be maintained in the oxidation ditch and the programmable logic controller will change the aerator speed to maintain the DO setpoint based on DO probes in each of three Oxidation ditches.

GPR Justification

- The dissolved oxygen sensor measures DO concentration in the oxidation ditch and automatically adjust to keep the DO dose at the minimum level required to maintain the process, which will reduce energy usage significantly.
- With this technology, the WRF will be able to reduce the DO from 2.0 to 1.0 mg/L.
- The current system will use 51,265,708 kWh and \$3,258,697 over the course of its useful life. By reducing DO, the system will use 38,369,286 kWh and \$2,800,958; which is a 14% savings.

Conclusion

- The proposed improvements are GPR-eligible as the energy savings pay back the cost of the improvements before the end of its useful life.
- **GPR Costs:** The GPR eligible cost = 3 DO analyzers and associated SCADA Controls at \$50,000 each =
Total = \$150,000
- GPR Justification: The new DO technology 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.”*

3. CONVERSION OF OXIDATION DITCHES 1, 2 AND 4 TO FULL BNR

Summary

- Large-scale wastewater plant improvement project includes conversion of three oxidation ditches to full BNR; whereby reducing nitrogen and recovering alkalinity and reducing necessary aeration input for treatment.
- Total loan amount = \$24,100,060
- Estimated Categorical energy efficient (green) portion of loan = \$1,534,000 (6.4%) (design estimate).

Background

- Currently the original “west side” of the facility including oxidation ditches 1 to 4, do not provide for nitrogen removal, and nitrification often requires supplemental magnesium hydroxide (MAG) to add supplemental alkalinity consumed through the nitrification process; stabilizing the effluent pH. The MAG is expensive and cumbersome to store and pump to the injection point at the facility.
- The proposed improvements will aid in nitrogen removal at the WRF providing for alkalinity recovery through a denitrification step reducing the need for MAG (chemical) and will also recover a fraction of the necessary oxygen (energy) for treatment.

GPR Justification

- The proposed improvements will improve nitrogen removal, which will require less magnesium hydroxide supplement to be added.
- Improved nitrogen removal will aid in improved energy and oxygen recovery.
- Current usage is approximately 45 gallons per day. With the upgrades, magnesium hydroxide will be used intermittently and is conservatively assumed to be over 90% reduction (rather than daily), which will reduce magnesium hydroxide usage by 295,000 gallons and save \$641,561 over the course of its useful life.
- This also reduces the energy requirements (supplemental aeration) for BOD removal from the wastewater (2.86 lb O₂ equivalent per lb of NO₃-N removed). Assuming an effluent nitrate reduction of 15 mg/L, this equates to approximately a 9.4% reduction in overall energy input of \$264,555 over its useful life.

Conclusion

- Significant chemical and energy savings result when converting the existing oxidation ditches to full BNR mode.
- **GPR Costs:** Conversion to BNR = **Total = \$1,534,000** (design estimate)
- **GPR Justification:** The conversion of oxidation ditches to full BNR is GPR-eligible per Section 4.0 Environmentally Innovative: 4.5-5a “*Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment.*”

4. VARIABLE FREQUENCY DRIVES (VFDs) AND SCADA CONTROL

- Energy efficient practices incorporated in the design of the WRF upgrade include the installation of variable frequency drives (VFD) and SCADA control technology.
- Total loan amount = \$24,100,060
- Estimated energy efficient (green) portion of loan = 0.62% (\$150,000) (design estimate)
- Estimated pay-back period on annual energy savings = 3.8 years.

Background

- Anoxic internal recirculation (IR) pumps recirculated biological mixed liquor and introduce it to the influent wastewater. The water level in the tank is constant, but the biological load is not, creating a condition that varies the need for increased pumping rate. Less pumping rate is needed when the influent biological loads are low compared to when higher loads are being treated. VFDs are used to match the pump energy input to the biological process needs. SCADA control technology is used to determine and control the correct pumping rate.
- Membrane feed pump station wet-well mixers are used to keep solids suspended and 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 used to match the energy input to the volume of water in the tank. SCADA control technology is used to determine and control the correct mixing rate.
- Secondary Effluent (Intermediate) Pumps are used to pump the secondary effluent water into the plate settler treatment system at a constant rate. VFDs are used to match the pumping rate to the flow rate needed. SCADA control technology is used to determine and control the correct pumping rate.
- Membrane Feed Pumps are used to pump the plate settler treated water to the membrane filters. VFDs are used to match the pumping rate to the flow rate needed. SCADA control technology is used to determine and control the correct pumping rate.
- Utility Water Pumps are used to pump reclaimed effluent for various in-plant washdown and process needs. The demand changes as various process elements call for water; reducing and increasing the system flow requirements. VFDs are used to match the pumping rate to the flow rate needed. SCADA control technology is used to determine and control the correct pumping rate.

GPR Justification

- The GPR-eligibility of VFDs and SCADA control technology was established by comparison to a Baseline Standard Practice (BSP). The BSP is to operate the mixers and pumps continuously at full speed.
- The GPR case is to operate the mixers and pumps with VFDs and use SCADA technology to match the mixing and pumping rate to the water depth in the tanks and the flow rate needed as described.
- Variable frequency drives (VFD) for the following equipment:
 - Anoxic Recirculation Pumps (ODs 1, 2 and 4 and 6)
 - Secondary Effluent Pumps
 - Membrane Filter Feed Pumps
 - Membrane Wet-well Mixers
 - Utility Water Pumps
- SCADA will control operation of the VFDs.
- The estimated annual energy costs are summarized in the tables below. The corresponding cost savings are estimated using an energy cost of 0.07\$/kWh. The simple payback period was based on an installed

cost of \$5,000 per VFD (0 to 20 hp) and \$10,000 per VFD (20 to 50 hp). The useful life of a VFD is assumed to be greater than 10 years.

	BSP	GPR (VFD)	Savings (power)	Savings	Cost of Eqpt	Payback (yrs)
	kW-hr/yr	kW-hr/yr	kW-hr/yr	\$/yr	\$	
Anoxic IR Pumps OD 1, 2 and 4	2,606,400	1,817,102	789,298	\$ 2,908	\$ 30,000	10.3
IPS Pumps	5,748,451	4,474,051	1,274,400	\$ 4,695	\$ 20,000	4.3
MF Feed Pumps	36,254,436	31,713,928	4,540,508	\$ 16,728	\$ 60,000	3.6
MF WetWell Mixing	4,964,571	2,482,286	2,482,286	\$ 8,879	\$ 10,000	1.1
UW Pumps	6,695,639	4,978,693	1,716,946	\$ 6,326	\$ 30,000	4.7
TOTAL			10,803,437	\$ 39,536	\$ 150,000	3.8

The payback period is 3.8 years.

Conclusion

- The use of VFDs and SCADA control technology is GPR eligible because it is cost effective as shown above.
- **GPR Costs:** VFDs and SCADA control technology = **\$150,000** (design estimate)
- **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 3.5-8 *“SCADA systems can be justified based upon substantial energy savings”* and 3.5-9 *“Variable Frequency Drives can be justified based upon substantial energy savings.”*