Drinking Water State Revolving Fund Green Project Reserve
- Interim -

City of Orofino Drinking Water Facility Project

SRF Loan #DW 1106

$9,690,375

Interim Green Project Reserve Justification

Categorical & Business Case GPR Documentation

1. INSTALLS MEMBRANE FILTRATION TECHNOLOGY TO REPLACE WATER-INEFFICIENT CONVENTIONAL SAND FILTRATION PLANT (Water Efficiency). Categorical GPR per 2.2-13: *Internal plant water reuse (such as backwash water recycling)*; also, (Innovative) Business Case GPR per 4.5-2a: *projects that significantly reduce …the use of chemicals in water treatment*; and, 4.5-2b: *treatment …that significantly reduces the volume of residuals….or lowers the amount of chemicals in the residuals* ($1,608,200).

Business Case GPR Documentation

2. INSTALLS PREMIUM ENERGY EFFICIENT MOTORS AND VFDS IN THE NEW RAW WATER AND FINISHED WATER PUMP STATIONS (Energy Efficiency). Business Case GPR per 3.5-1: *Energy efficient …new pumping systems… (including variable frequency drives (VFDs)*) ($310,000).

Prepared by the State of Idaho SRF Loan Program
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1. Treatment Process Selection – Membrane Filtration

Summary

- A new water treatment plant will be constructed to replace the existing conventional dual media filtration plant. The new treatment process will be a microfiltration/ultrafiltration pressure membrane system.
- The new process will significantly reduce the use of chemicals, chemical residuals, and the amount of product water required for backwashing.
- Loan amount = $9,690,375
- Water savings (green) portion of loan = 18% ($1,608,200) (Supplier Delivered Price)
- Annual water savings = 33 million gallons (MG)
- Reduction in chemical use = 95%

Background

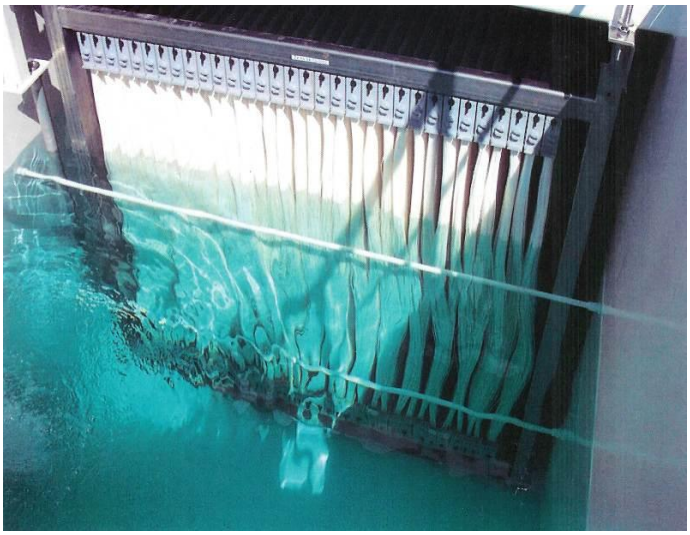
- 177 million gallons per year (MGY) is currently withdrawn from the Clearwater River to supply the City of Orofino with drinking water[1].
- The Clearwater River sub-basin is one of the most biologically rich and diverse drainages in the Columbia Basin[2] and contains federally protected fish species
- The existing water treatment plant was constructed in 1953. The conventional treatment process consists of chemical addition, rapid mixing, flocculation, sedimentation, dual media filtration, and chlorine disinfection.
- The City currently uses a total of $18,000/year of these treatment chemicals[3]:
  - Liquid Alum (5,400 gal) = $7,500
  - Solid Alum (4,500 lb.) = $2,500
  - Soda Ash (25,000 lb.) = $7,200
  - Polymer (N1986 floc aid, 20 gal) = $585
- The City backwashes up to 5 times a day at 15,000 gallons per backwash; backwashing averages 15% to 22% lost water[3], amounting to approximately 33MG/year.

Results[4]

- A feasibility study identified two potential treatment options to replace the existing plant: conventional dual media filtration and pressure membrane filtration[5].

  Conventional Filtration Plants:
  - Generally use from 8-15% of finished water as backwash;
  - Chemical use for coagulation/flocculation can be quite high depending on water source.

  Membrane Plant:
  - In the absence of moderate to severe contamination, much lower operator costs;
  - Higher quality product water than a conventional filtration plant;
  - Designed to use a maximum of 5% finished water for backwash purposes;



[1] City of Orofino Water Master Plan, January 2009, CH2M Hill
[2] Biological Assessment, City of Orofino Water System Improvements Project, April 2011, CH2M Hill
[3] City of Orofino Water Plant Superintendent, March 16, 2011
[4] Siemens Water Technology, March 8, 2011
[5] City of Orofino Water Facility Plan, March 2010

- Minimal use of chemicals required (small quantity for cleaning etc.).

- Idaho communities with pressure membrane filtration plants commonly experience 95% - 98% recovery of feed water, especially in the Northern part of Idaho (main contaminants of concern being turbidity/suspended solids[6]);
- Usually compressed air and a small amount of water is used for backwash (typically 2% to 5% of finished water is used in backwash);
- Very few chemicals are used with membrane filtration plants in Idaho as compared to rapid sand filtration or direct filtration.

Benefits

- Membrane filtration reduced the amount of chemicals required in the treatment process by over 90%.
- Membrane filtration also leads to over 95% less finished water required for backwashing[7].
- The lower water requirement for backwashing and wasting results in a much smaller quantity of residuals for disposal.
- The lower backwashing rate results in less withdrawal of raw water from the river source, thus conserving a valuable resource.

Conclusion

- The microfiltration/ultrafiltration pressure membrane system was chosen over the conventional filtration system because of the higher quality of finished water produced, the need for less chemicals, the much smaller quantity of residuals resulting from the process, and the much lower product water requirements for backwashing.
- Valuable resources are conserved by reducing the amount of water withdrawn from the river source as well as increasing the amount of finished water available for public use.
- The project results in a more energy efficient operation = 35 % of the energy requirement of historical costs.
- **GPR Costs**: microfiltration/ultrafiltration pressure membrane system = $1,608,200[8] (Supplier's Price)
- **GPR Justification**[9]:
  - The process is Categorically GPR-eligible (Innovative) per Section 4/ 4.5-2a: *technology that significantly reduces the use of chemicals*, and by (4.5-2b): *technology that reduces volume of residuals or amount of chemical in residuals.*
  - The process is also Categorically GPR-eligible (Water Efficient) per Section 2.2-13: *internal plant water reuse*.

[6] March 9, 2011 phone call, B. Phinney P.E. (Keller Assoc) – K McNeill, IDEQ
[7] March 18, 2011 email, J. Wiskus P.E. (CH2M Hill) – K. McNeill IDEQ
[8] Sept. 12, 2013 email, J. Wiskus P.E. (CH2M Hill) – K McNeill IDEQ
[9] Attachment 2. April 21, 2010 EPA Guidance for Determining Project Eligibility. p.21,22

2. New Pumping Systems

Summary

- Large-scale water treatment system upgrade project includes new pump stations for raw water and finished water consisting of premium energy efficient motors and VFDs.
- Estimated loan amount = $9,690,375
- $310,000 pump and motor replacement (from Contractor's Schedule).
- Estimated energy efficiency (green) portion of loan = 3% ($310,000)

Background

- The raw water intake structure and pump station was constructed in 1930 and utilizes two vertical turbine pumps rated at 970 and 750 gpm to pump 1.08 MGD of river water to the treatment plant[10].
- The new raw water pump station will pump 2.23 MGD of river water to the new treatment plant; the number and size of pumps are to be determined in final design.
- A new finished water pump station will be constructed as well; the number, size, manufacturer, model and other design information related to the system will be determined in final design.
- The proposed new pumping systems will have premium energy efficient motors with VFD pumps.

Calculated Cost Effectiveness of Improvements[11]

- A standard pump on the market has an average efficiency rating of 72.5%.
- Standard motors on the market have an average efficiency rating of 89%[12]
- The efficiency of standard pump system = 72.5% * 89% = 64.5% (pump efficiency times motor efficiency).
- The efficiency of the proposed system with premium motors/VFDs = 89% * 93.5% = 83.2%
- To compare the efficiency of proposed pumps and motors with standard pumps and motors, divide the total efficiency of the proposed components by the efficiency of the standard components: 83.2% / 64.5% = 1.29
- Thus, the increased efficiency is 29%. This level of efficiency exceeds the 20% recommended minimum for pumps and motors for the Business Case qualification.

Conclusion

- The project would result in a more energy efficient operation as the new systems result in a 29% increased efficiency over the system to be replaced.
- **GPR Costs**: Raw Water & Finished Water New Pumps/VFDs = $310,000 (from Contractor's values)
- **GPR Justification**:
  - The new pumping systems are Business Case GPR-eligible, qualifying per Sect. 3.5-1 (Energy Efficiency): "*Energy efficient… new pumping systems… (including variable frequency drives (VFDs)"* which are cost-effective.
  - The new premium energy efficient motors are also Categorically GPR-eligible per Sect. 3.2-3 (Energy Efficiency): *National Electric Manufacturers Association (NEMA) Premium energy efficiency motors*.

[10] City of Orofino Drinking Water Master Plan Preliminary Conceptual Cost Estimate, CH2M Hill
[11] Note: this is a preliminary analysis and will be updated for specific system characteristics once pump system schedules are released
[12] Standard EPact Motor Efficiency Tables, 1997