Drinking Water State Revolving Fund Green Project Reserve

# City of Orofino Drinking Water Facility Project
# $8,490,375

## 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* ($1,500,000).

## Business Case GPR Documentation

2. INSTALLS NEW PREMIUM ENERGY EFFICIENT MOTORS AND VFDS IN THE 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)*) ($235,000).

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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 = $8,490,375
- Water savings (green) portion of loan = 18% ($1,500,000)
- 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- 177 million gallons per year (MGY) is currently withdrawn from the Clearwater River to supply the City of Orofino with drinking water[1].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 experience from 8-15% of finished water as backwash;
  - Designed for 10-15% of finished water (10% use and 15% hardware);
  - Chemical use for coagulation/flocculation can be quite high depending on water source.
- ***Membrane Plant***:
  - In the absence of moderate to severe contamination there are 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;
  - Minimal use of chemicals required (small quantity for cleaning etc.).

[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

- 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 process is GPR eligible (Innovative) per Section 4/ 4.5-2a[8]: technology that significantly reduces the use of chemicals, and by (4.5-2b): technology that reduces volume of residuals or amount chemical in residuals.
- The process is also Categorically GPR eligible (Water Efficient) per Section 2.2-13[9]: 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] Attachment 2. April 21, 2010 EPA Guidance for Determining Project Eligibility. p.21,22
[9] Attachment 2. April 21, 2010 EPA Guidance for Determining Project Eligibility. P.18

# 2. Pump and Motor Replacement

## Summary

- Large-scale water treatment system upgrade project includes replacement of pumps and motors in the raw water pump station and in the finished water pump station.
- Estimated loan amount = $8,490,375
- $235,000 pump and motor replacement.
- Estimated energy efficiency (green) portion of loan = 3% ($235,000)

## 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.
- The old finished water pump station will be replaced as well; the number and size of pumps are to be determined in final design.

## Results

- The proposed new pumps and motors will be premium efficiency replacement models.

## Calculated Energy Efficiency Improvements[11]

- Standard pumps on the market have average efficiency ratings of 72.5%.
- Standard motors on the market have average efficiency ratings of 89%.
- The efficiency (wire-to-water) of standard pumps and motors = 72.5% * 89% = 64.5% (pump efficiency times motor efficiency).
- The efficiency of proposed pumps and motors = 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 wire to water efficiency is 29%. This level of efficiency exceeds the 20% recommended minimum for pumps and motors.

## Conclusion

- The system is categorically GPR-eligible by energy efficiency Sect. 3.5-1[12] since the level of efficiency exceeds the 20% recommended minimum for new pumps and motors.

[10] City of Orofino Drinking Water Master Plan Preliminary Conceptual Cost Estimate, CH2M Hill
[11] Note: for standard analysis, will be updated for specific system requirements at final design
[12] Attachment 2. April 21, 2010 EPA Guidance for Determining Project Eligibility. p.20