



Membrane Filtration at the Greeley Creek Water Treatment Plant



Cover photo courtesy of Dusty Veideman, Photo House, Revelstoke



Dayton & Knight Ltd.
CONSULTING ENGINEERS

City of Revelstoke - Membrane Filtration at the Greeley Creek Water Treatment Plant

Clean Water

A healthy community relies on high quality, pathogen free water for hundreds of uses in our daily lives. That is why the City of Revelstoke decided to invest in the most advanced water treatment technology available. The membrane filtration facility will ensure that the users have a high quality water supply that will serve their communities' needs long into the future.

History of Service

Revelstoke was incorporated as a City in 1899. The early water supply came from Tapping Creek on the eastern slope of Mount Revelstoke, with the intake immediately above the present CP Rail station. With increased water demand due to community growth, the source was shifted several miles east to Bridge Creek in 1915. The source became inadequate and a new pipeline was constructed up the Illecillewaet Valley (pre Trans Canada Highway) to Hamilton Creek, and then, in 1930, to the present location on Greeley Creek.



Greeley Creek intake structure

Supply System

The existing water supply system to the City was designed in the 1920s. A concrete intake structure diverts water to a holding area where the heavier solids carried by the creek settle out. From there, the water flows by gravity through a 600mm diameter pipe to the Trans Canada Highway Reservoir



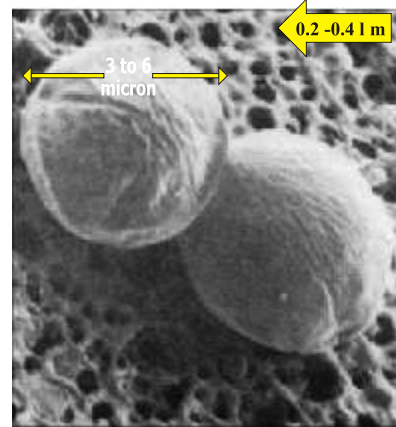
Settling pond



Greeley Creek Watershed

Greeley Creek originates high in the Selkirk Mountains on the northwest slope of Mount Mackenzie and discharges into the Illecillewaet River about 8 kilometers above its confluence with the Columbia River. The watershed is in an area of some of the highest snowfall depths in North America. It varies in elevation from about 670 metres at the intake to a maximum of 2500 metres at Ghost Peak. In the lower levels, the watershed has a mature timber cover interrupted by second growth in slide areas. The northerly orientation of the Greeley Creek valley assures a snow cover in the upper levels into late summer, which is ideal for water supply. This area is distant from established development, devoid of permanent roads and trails, and protected by nature from human trespass by its relative inaccessibility. The Greeley Creek watershed has never been logged.

and then to the City water distribution system. The 1996 project included construction of a new road and powerline to the intake. Chlorine has been used as a disinfectant since 1996 and is added to the water through a facility constructed in the vicinity of the intake. The City has 100 kilometers of water mains, 245 fire hydrants and about 2700 service connections serving approximately 7,350 people.



USFilter Memcor CMF Microfiltration physically prevents Giardia Lamblia cysts (above) and Cryptosporidium oocysts from passing into the filtrate. The CMF's pore size is 20 to 50 times smaller than the dimensions of these disease causing pathogens.

The Completed Project

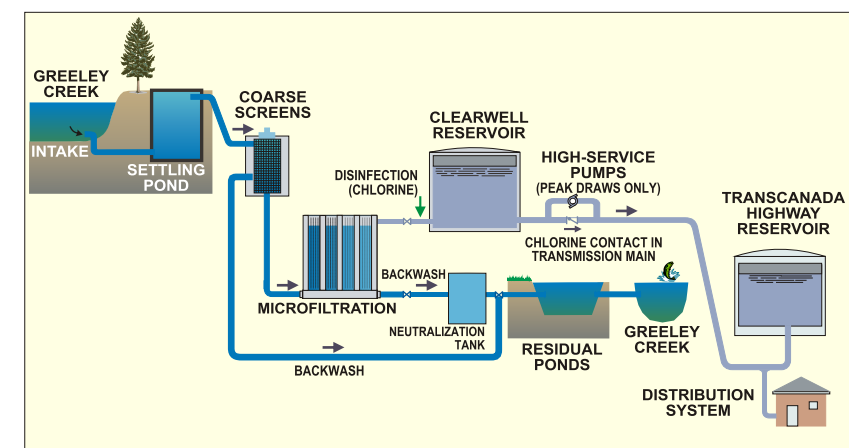
The \$6,000,000 project consists of a new settling pond and improved Greeley Creek intake, a microfiltration membrane system, a clearwell reservoir, disinfection facilities, emergency power supply, and an all new computer system to assist the plant operation. The citizens of the City and the Province of British Columbia have shared equally in the capital cost.



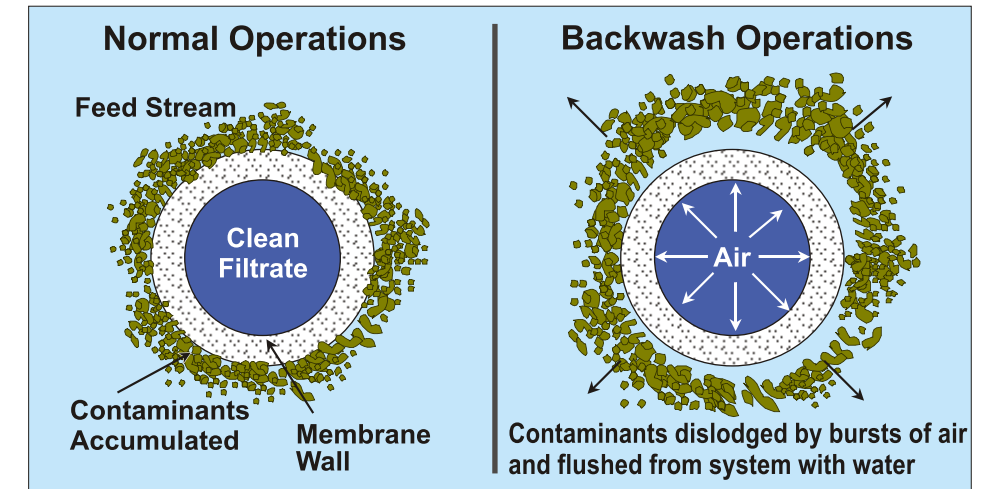
Membrane Unit

The principal removal is achieved by a microfiltration membrane system, which has millions of hollow fibres with millions of microscopic pores. As the Greeley Creek water passes through the microscopic pores, the suspended particles greater than 0.2 microns such as bacteria, cryptosporidium oocysts and giardia cysts are all removed. There are 5 USFilter Memcor CMF (Continuous Microfiltration) membrane units, each containing 90 modules that house 20,000 fibres each. No chemicals are added to the microfiltration membrane process.

As the feed stream flows from the outside to the center of the hollow fibre,



Schematic of Revelstoke's Microfiltration System



CMF operations

contaminants accumulate on the outer wall of each fibre. Every one to two hours the process is "backwashed" for a two minute period. Compressed air (90 psi) flows from the inside of the fibre to the outside of the fibre to dislodge the contaminants. Raw water is used to sweep the contaminants away. Every thirty to sixty days, the membranes are soaked in caustic and/or acid for several hours to dislodge particles not removed by backwashing. The backwash water flows to two solids settling ponds for disposal. After filtration, minor amounts of chlorine are added to destroy viruses and maintain the water quality to the user's tap.

The treated water quality meets the Drinking Water Guidelines of the Ministry of Health. In addition, the membrane system will provide protection against any new organisms greater than 0.2 microns that may become future health issues.

Project Approach

The City adopted a design and construction management approach for the project. The City retained Dayton & Knight Ltd. to design and Maple Reinders to manage the construction of the plant on a fast track. Malcolm Pirnie assisted Dayton and Knight with the procurement and design of the membrane system. The approach was adopted to ensure a water treatment plant at the earliest possible date and to avoid higher costs with outside construction during the winter snowfall period. Based on a public tender and a life cycle cost, the City prepurchased the membrane system from USFilter Memcor. The design was broken into phases with each phase tendered as the design was completed. The first contract for site clearing was let in August 1999 and the plant was complete by June 2000; an elapsed time of eleven months.

Operation

The plant is operated by the highly trained City staff who devote their skills and efforts to ensure a safe and dependable water supply to the citizens of Revelstoke.



FACILITY FACTS:

Capacity

- present - 13.2 ML/d @ 0.5°C
- 15.1 ML/d @ 8°C
- 16.7 ML/d @ 12°C for the estimated 2007 population of 8530 persons.
- future - expandable to 25ML/d for 14,200 persons at Official Community Plan buildout.

Supply

- surface water from Greeley Creek

Settling Pond

- number - 1
- dimensions - 100 m long
 - 10 m wide
 - 2m deep
- volume - 2000m³
- detention time - 3.5 hrs. @ 13.2 ML/d

Strainers

- number - 2
- screen size - 500 microns

Membrane Filtration

- number - 5 units
- modules - 90 per unit
- tanks - backwash tank
 - clean-in-place tank
- membrane pore size
 - 0.2 micron
 - 20,000 fibres per module
- membrane material
 - polypropylene

Clearwell

- number - 1
- size - 910,000 litres
 - 16 m diameter
 - 5m high

Disinfection

- chlorination - contact in clearwell and transmission main

Pumping Systems

- membrane feed - through the plant by gravity
- finished water - gravity feed to the City, with pumping during peak water demand period only
- 3 pumps - 11.3 to 17.0 ML/d (1 standby)

Treatment Performance

- maximum turbidity < 0.10 NTU
- Giardia removal > 99.9999%
- Cryptosporidium removal >99.9999%

Filter Backwash Settling Ponds

- number - 2
- dimensions - 18 m long
 - 12 m wide
 - 2m deep



Greeley Creek Water Treatment Plant

Dayton & Knight Ltd. was incorporated in British Columbia in 1965. The company is largely made up of technicians and professional engineers. Management rests with four senior engineers who are active in the day-to-day activities of the organization.

Fields of specialization include sewage collection, treatment, disposal, and reclaimed water reuse; water supply, treatment, and distribution; stormwater management; solid waste management; SCADA systems; trenchless technology; and asset management.

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