



Potable water filtration treatment facility in Cambridge Bay, Nunavut, with storage reservoir and smaller water treatment residuals reservoir.

NUNAVUT COMMUNITIES STRUGGLE WITH WATER SHORTAGE AND SUPPLY ISSUES

By **Ken Johnson**

The mean annual temperatures in Nunavut range from just below minus 10°C in the extreme south-east, to near minus 20°C in the far north. It does not have a significant summer season, and during the cool, brief summer, the ice-filled waters limit the surface temperature to minus 10°C. In July, the warmest month, temperatures are prevented from rising much above 7°C.

In spite of the presence of the Arctic Ocean, Nunavut is one of the driest regions in the world, with a scant 50 mm of precipitation falling in the northern region and 375 mm in the southern region. In general, 50% – 80% of the yearly precipitation falls as snow. Surface water covers approximately 7.5% of the territory.

WATER SUPPLY AND DELIVERY

Nunavut is the largest of the three territories of the Canadian north, with 20% of Canada's land mass and only 30,000 people. Its 25 communities range in size from Grise Fiord with 140 people, in the far north, to Iqaluit, with 7,000 people in the south. Eleven of the 25 communities have over 1,000 people, and all of the communities except one (Baker Lake) are coastal. Surface water provides drinking water to all, because permafrost does not accommodate any groundwater resources.

Community water supplies make use of lakes and rivers, and provide either year-round or seasonal water supply. Surface ice up to two metres thick can damage piping in lakes if it is placed too shallow, and can damage piping in rivers, particularly during spring break-up.

Lakes and rivers that provide a seasonal water supply are used to fill long-term storage reservoirs. Nine Nunavut communities have engineered storage reservoirs that have sufficient water stored for up to a year. An allowance for ice formation must be considered when these are designed.

Proximity of water to the community itself presents another challenge because of the cost of building, operating, and maintaining roads and pipelines. At nearly \$1 million per kilometre for a road and a pipeline in some locations, the economics places distant piped water sources beyond the reach of most communities. Add to this cost the potential for pipeline freezing, and the severe operating conditions in blizzards, and closer becomes a lot better.

continued overleaf...



Top: Buried installation of insulated High Density Polyurethane (HDPE) water line in Resolute, Nunavut. **Above:** Twelve month water supply reservoir in Chesterfield Inlet, Nunavut excavated into bedrock. **Above-right:** Pump out trucked sewage collection from in house sewage tank in Repulse Bay, Nunavut. **Right:** Buried, insulated High Density Polyurethane (HDPE) water and sewer lines between manholes in Rankin Inlet, Nunavut.

Drinking water is disinfected in Nunavut before delivery. However, more substantial treatment using filtration technologies is being introduced into communities to provide multi-barrier protection against contamination. Water treatment improvements are encouraged by public health officials, and may ultimately be mandated by public health regulations.

Water delivery and sewage collection in most Nunavut communities is by trucked services. Large trucks distribute water and collect sewage. Each home has potable water and sewage storage tanks.

There are three communities in Nunavut with piped water and sewer systems, namely Iqaluit, Rankin Inlet, and Resolute. These piped systems are unique and expensive to build, because of the cost of labour and materials. The construction season for buried water and sewer systems is generally limited to three months of the year when the ground has

thawed sufficiently to excavate.

Fire protection is also a unique challenge in Nunavut, because of the reliance on a trucked water level of service in most communities to fight any fires. Fire losses are disproportionately higher than southern regions largely because of this. One simple fire protection measure used is a 12 metre separation distance between buildings.

THE COST OF NUNAVUT WATER

The cost of northern water, for both capital cost and operation and maintenance, is a function of labour and materials, which are influenced by geographic isolation, the extreme cold climate, and permafrost geology.

Water and sewer systems have operating challenges associated with the potential freezing of the piping due to heat loss, which is counteracted with pipe insulation, water circulation, and

water heating. In pipe systems where circulation and heating is limited, freeze protection is achieved by “bleeding” the water system into the sewer system. This may amount to water use that is two to three times what would normally be anticipated.

An example of the capital cost of a piped system is the replacement of the piped system in Resolute, which was tendered several years ago. The lowest tender received for the project was \$44.4 million, which put the project budget approximately \$18 million (70%) over the pre-tender construction estimate of \$26 million. Resolute has a population of 250 people, so the cost per person for the system replacement was nearly \$180,000.

An example of the operation and maintenance costs of a water and sewer system are the costs in the community of Grise Fiord, which is the northernmost community in Canada. The annual cost was over \$2,200 per person in 2002, or 6.4 cents per litre for water and sewer (4.5 cents per litre for water only). Overall water use was 5,680,000 litres, or 95 litres per capita per day.

In comparison to the cost of water in this community, the cost of water is a mere 0.12 cents per litre in Edmonton, Alberta. A quick mathematical comparison places water costs in Grise Fiord a whopping 40 times more expensive. Added to these financial challenges are the technical ones of designing, constructing, operating and maintaining northern water and sewer infrastructure.

EXTREME WATER ISSUES AND THE FUTURE OF NUNAVUT WATER

As challenging as “normal” water supply is in Nunavut, there are several examples of extreme water use issues. In Grise Fiord, the stream that fills the water reservoirs on an annual basis dried up during one filling season, and the community ran out of drinking water before the reservoir could be refilled in the spring. The community resorted to harvesting icebergs, chopping and placing the ice into the reservoir to maintain the water supply.

The communities of Kugluktuk and Kugaaruk are experiencing issues with saltwater intrusion into their river water

supply systems because tidal action is creating a salt water wedge that advances up the river to the point of the water supply intake. In the community of Sanikiluaq, saltwater intrusion is also occurring, with the ocean making its way into the lake that supplies the community.

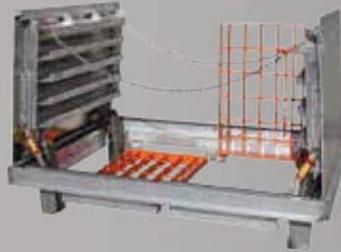
Most northern communities also have limited capacity for dealing with water, whether it be financial, administrative or human resources. This limited capacity is being stretched by increasing regulatory demands. Another factor is increasing sophistication in water and wastewater treatment technology.

Climate change is also emerging as an issue for water supply in Nunavut. The water supply issues in Grise Fiord, Kugluktuk, Kugaaruk and Sanikiluaq may not be conclusively caused by climate change, but the warming of the Arctic is making problems worse. ■

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