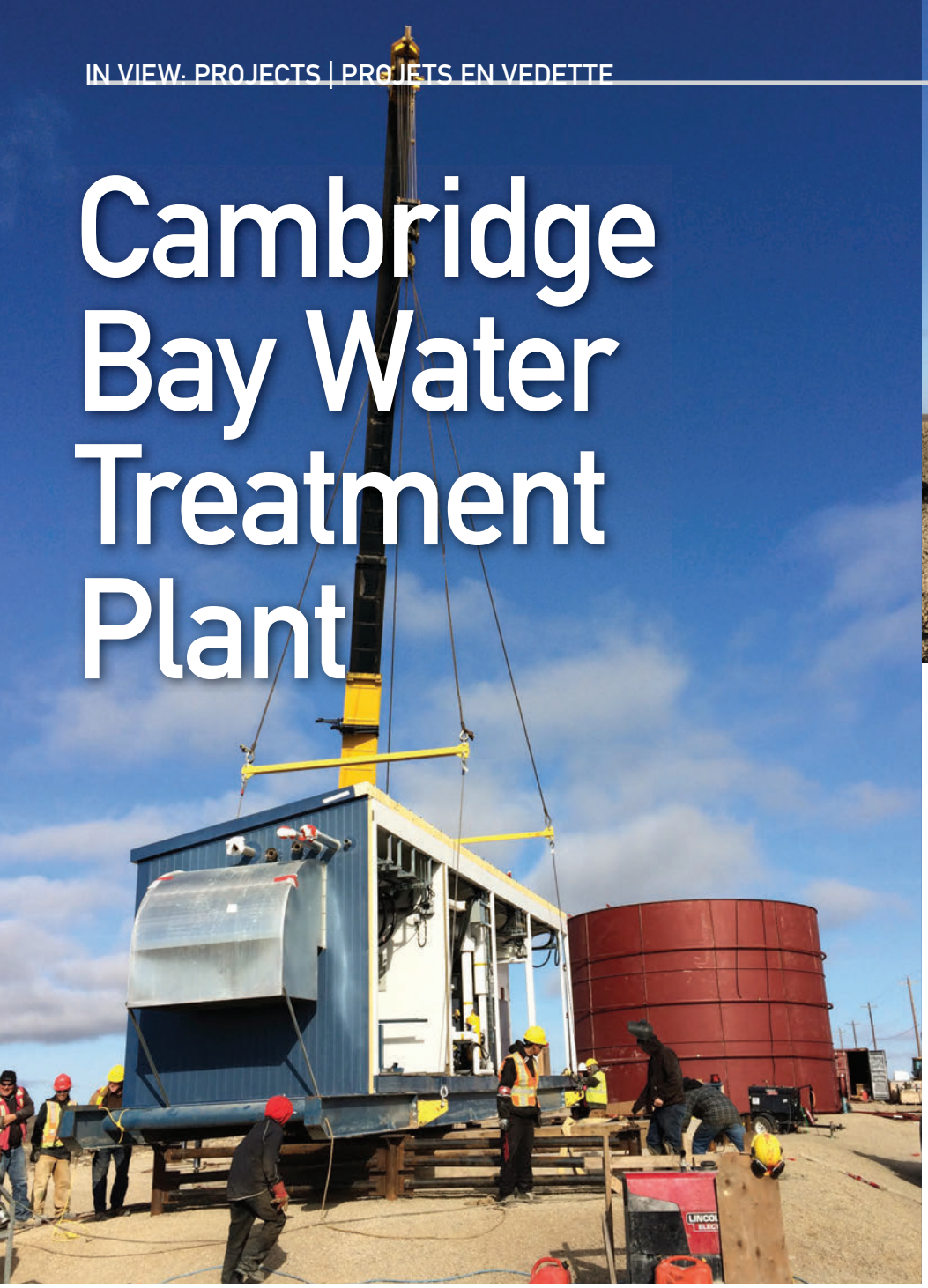
Cambridge Bay Water Treatment Plant



A new water treatment system being built at a remote hamlet 700 kilometres north of Yellowknife will provide a community that currently relies on water trucks with a reliable system.

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Water and wastewater infrastructure is at the core of a community's survival and continues to be highlighted by environmental and regulatory bodies for improvement so that negative impacts to surrounding environments are minimized. As well, in the Arctic regions of Canada the supply, treatment and distribution of clean, safe drinking water is a major problem and expense to municipalities, hamlets, and the federal government. Drinking water treatment systems that exist often have been plagued with struggles ranging from improper installations to specialized requirements for operations and maintenance.

An aging and undersized system with assorted upgrades

The hamlet of Cambridge Bay, Nunavut, is located approximately 700 kilometres northeast of Yellowknife, Northwest Territories, and was experiencing problems with its drinking water treatment system.

The hamlet's aged and undersized potable water infrastructure was causing significant issues in shortages and reliability concerns. The system had been upgraded several times since the construction of its first intake pump house in 1970. In 1980 a new insulated water line, central distribution pump house, water storage tanks, and upgrades to the existing intake pump house were completed. In 2002, further significant upgrades and modifications were completed consisting of a new insulated water line, access vaults, and refurbished boiler stations.

Since then various replacements and maintenance items had been completed at the facility. The community's potable water system at this point consisted of assorted "upgrades," resulting in a much needed complete overhaul.

From a potable water demand perspective and according to Community Government Services representatives, it was estimated that the community's population was projected to

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Far left: part of the packaged water treatment system being lifted onto piles. Left: backwash tank (yellow), water treatment plant, and potable water storage tank (not yet insulated).

grow from 1,613 in 2010 to approximately 3,788 by 2045. With the addition of a future Canada High Arctic Research Station (CHARS), the project population may be at high as 4,013 by 2045.

The current water delivery system consists of a combination of underground distribution lines and trucked services. There are three 12,500-L water trucks, with a fourth truck for emergency use. The trucks typically operate on a seven-day delivery schedule with an eight-hour delivery day. The government owns and operates the drinking water treatment system in collaboration with the community.

Stantec Consulting's local office in Yellowknife was first requested by the Government of Nunavut and the hamlet to investigate and problem-solve the issues. The newly designed system would include a new intake structure, pump house, and treatment facility. The replacement and addition of underground distribution lines was also a component.

New intake, pump house, water treatment plant and distribution lines

In 2011 Stantec stepped up to the challenge and was contracted to design upgrades to the system. The upgrades have been developed in two phases. In phase I, a new lake intake and pump house was installed. In phase II, the 1.7-km supply lines from the new intake to the new water treatment plant are being replaced, with construction expected to be completed in the fall of 2016.

Water Lake is distanced from both the community and human activity, making it relatively free from potential anthropogenic contamination at present. The water is of good quality for potable use, being slightly hard, well buffered, slightly alkaline, and slightly under-saturated with respect to calcium carbonate. Previous microbiological analyses of treated water showed that the addition of chlorine successfully eliminates most of the organisms tested. A comparison of the chemical analysis of the community's raw supply water to the CCME Guidelines for Canadian Drinking Water Quality showed tested parameters as below the recommended maximum limits, qualifying the existing water source as suitable for the new design.

The central feature of the improved water supply system is a water treatment plant using a zeolite-based filtration system, combined with chlorination and UV treatment. The system chosen can handle a design flow of 1,200 L/min and generates half the backwash wastewater compared to alternate systems that were considered — an important feature as the backwash must be collected in a 60-m^3 insulated steel tank stored on site and hauled away by trucks. A 570-m^3 tank will store the treated water, which will be pumped through the underground infrastructure as well as distributed by trucks to homes.

The project will also modify and improve the existing supply mains in the community. A new 2,000-m long water main will create a complete circulation loop that will help reduce the operation and maintenance costs of the existing main. The new loop will also service the future Canadian High Arctic Research Station currently in construction.

With the provision of a high-pressure water service throughout the community, significant cost savings are starting to be realized on several levels: from insurance cost savings realized thanks to a great increase in firefighting measures, to capital cost savings for building developments due to the removal of the need for individual storage tanks. Also, the community will be able to continue to expand the water distribution network over time, reducing the reliance on expensive water truck deliveries.

The challenges

Some of the challenges Stantec and the design team overcame were: maintaining high efficiency and maintaining a continual supply of potable water during the entire phased project. The project required a high level of professional services across a broad range of disciplines, with people experienced in Arctic design and construction. The design constraints include:

- harsh Arctic climate;
- permafrost-rich soils;
- cold water (temperatures ranging from 0°C to 10°C);
- short construction season;
- remote location;
- treatment process waste disposal;
- limited piped services;
- limited availability of local tradesmen;
- limited material and equipment availability;
- high construction and service costs; and
- high electrical and diesel fuel costs. ■

OWNER: Government of Nunavut
CLIENT & CONTRACTOR: NDL Construction
PRIME CONSULTANT: Stantec Consulting
OTHER KEY PLAYERS: BI Pure Water (construction of packaged water treatment plant)