

Safe Water for All

Ending the Drinking Water Crisis in First Nations Communities

YELLOW QUILL
FIRST NATION



About Yellow Quill First Nation

Yellow Quill First Nation is a Saulteaux First Nation located 300 kilometres east of Saskatoon, Saskatchewan. Of the nearly 3,000 people in the wider Yellow Quill community, 1,000 reside on-reserve and are served by a healthcare centre, daycare facility, and a K-12 school. Economic development is a key focus for Yellow Quill Holdings Inc., which strives to be a top-10 economic development organization.

As with many rural, remote, and First Nations communities across Canada, Yellow Quill experienced a long-term boil-water advisory. The community's source water had been deemed untreatable by the government, and existing technologies failed to solve the water quality crisis.

By 2004, after a nine-year water advisory and almost two years of testing, research, and development, Yellow Quill saw the implementation of a new water treatment process - Sapphire's Integrated Biological Reverse Osmosis Membrane (SIBROM). Clean water would finally be delivered to Yellow Quill.

The current water treatment plan at Yellow Quill is now one of 22 SIBROM facilities delivered by Sapphire Water to provide safe, clean drinking water to thousands of people in First Nation and remote rural communities across Canada.

Water quality challenges in First Nation communities

According to Indigenous Services Canada, as of July 2018, more than 4,000 homes and nearly 300 community buildings on reserves were affected by 73 ongoing long-term water advisories. Most remote First Nations face several critical challenges in bringing safe, drinkable water to their communities: poor quality source water, ineffective treatment technology, and high costs. In its 2011 National Assessment of First Nations Water and Wastewater Systems, the Department of Indigenous and Northern Affairs (INAC) also found that the overall risk of a water system failing increases with remoteness.

Source water in Yellow Quill: “untreatable”

“We look after the water, and the water looks after us,” said a Yellow Quill community member in Spirit, Safety and a Stand-off, a video produced by the University of Saskatchewan's School of Public Health tracing the history of water quality in the community. “No one touches the water at Yellow Quill now because it's polluted,” she continues referring to the lake that serves as the source water for

“Before Sapphire Water was involved, the water quality was horrible. The water was yellow and brown. We would add juice to disguise the taste and colour. More often than not, I would just drink rain water,” said Eli Neapetung, plant operator.

the community. The short documentary highlighted Yellow Quill's water struggles as they began to emerge in the 1960s following major developments.

Yellow Quill's groundwater was considered ‘untreatable’ by the federal government for safe human consumption. Before the SIBROM, the particle count in Yellow Quill's treated water was 1,600 times that of the distributed water in Saskatoon (40,000 particles/mL vs. 25 particles/mL). An average glass of water would contain 10 million particles - including dead algae, bacteria and viruses.

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Community members had also resorted to drinking sugary beverages, including soda, as substitutes for the water. Over time, the dental health of Yellow Quill's younger community members began to deteriorate as a result, requiring frequent trips to Saskatoon for treatment.

The Sapphire Solution

In 2002, the community of the Yellow Quill First Nation in Saskatchewan had been under a boil water order since 1995 - one of the longest in Canada. With highly brackish well water, engineers and scientists were struggling to find a cost-effective way to provide the community with safe drinking water. Indigenous and Northern Affairs Canada (INAC) reached out to renowned scientist and water treatment expert Dr. Hans Peterson to solve the problem.

Over the course of 21 months, water treatment expert Dr. Peterson conducted an exhaustive on-site study on conventional, advanced, and emerging water treatment processes. By testing different combinations of the technologies, Dr. Peterson discovered that the most effective method of purifying Yellow Quill's water was biological filtration followed by reverse osmosis. He labelled this process as Integrated Biological Reverse Osmosis Membrane (IBROM).

The SIBROM was developed specifically for Yellow Quill, through extensive research - a stark contrast to conventional technologies that disregard the unique challenges of each community and fail to adequately treat source water. “We did the science right. I spent two years at Yellow Quill just trying to figure out the science,” says renowned water treatment expert Dr. Hans Peterson, who invented the IBROM in 2002 which was later commercialized with Sapphire Water.

Destroying contaminants, not just isolating them

Rather than relying heavily on chemicals, Sapphire Water's IBROM pretreats the raw water with biological filtration that utilizes Filtralite®, a clay media that provides a large surface area to house the bacteria. The bacteria attach to the media and form a biofilm that oxidizes contaminants such as iron, manganese, arsenic, ammonium, and hydrogen sulphide.



Yellow Quill First Nation, located near Saskatoon, had been under a nine-year boil-water advisory - one of the longest in Canada. In 2004, it ended its water quality issues after implementing Sapphire Water's SIBROM technology. Today, more than 15 years later, the facility continues to deliver safe, clear, fresh water to the community.

In the second step of the treatment process, a reverse osmosis (RO) membrane is used to eliminate residual contaminants. And lastly, the water is further treated to stabilize its pH levels and make it non-corrosive. No contaminants remain and the entire process produces a consistent source of tasty, healthy, purified, biologically stable water.

Parameter	Raw Water Quality	SIBROM Treated Water Quality	Canadian Drinking Water Guidelines
Ammonia (mg/l)	4.25	0.03	0.05*
Iron (mg/l)	8.15	0.00	<0.3
Manganese (mg/l)	0.350	0.019	<0.05
Arsenic (ug/l)	12	<2	0.010
TDS (mg/L)	1853	123	<500
DOC (mg/L)	9.9	0.5	N/A
Turbidity (NTU)	99.6	0.1	<0.1

*No guideline. Recommended limit to reduce reaction with chlorine. For further technical information, please contact: sas@sapphire-water.com

Cost-effective technology

The SIBROM system offers significantly lower operating costs for several reasons. It offers an immediate, and dramatic reduction in the use of antiscalent and chlorine (up to 90% less). SIBROM also provides longer intervals between backwashes than conventional technologies.

Its modern, digital interface, requires reduced operator intervention and manual inputs. In the long-term, because it removes corrosive elements from the water supply, deterioration of the distribution system and the risk of a watermain break are minimized.

According to Dr. Peterson, if water is to be drinkable and trusted without hesitation, it should provide three important outcomes. First, it should pass the taste and smell test. Second, it should not decline in quality as it passes through the distribution system. Lastly, contaminants such as arsenic and dissolved organic compounds should be well below detection, e.g., 5 micrograms per litre.

Conventional treatment technologies are simply ineffective in treating source water as poor as that found in Yellow Quill—a challenge Sapphire’s system has overcome repeatedly. However, improving water quality requires extensive research to identify the core issue. “It’s all about the science,” says Dr. Peterson. It also requires time, and collaboration with community leaders. “These problems can’t be solved in days.”

In operation for nearly 15 years, Sapphire continues to deliver clean, fresh, safe water to the Yellow Quill community, and exceeds international water quality guidelines.

**“Our community is spoiled with the quality of water,” says Eli.
“We’ve got faith in the plant.”**

About Sapphire Water

Sapphire Water International is a Canadian company specializing in the design and implementation of long-term, leading-edge water and wastewater treatment systems for small and remote communities of up to 1,000 in population. Through its SIBROM technology, Sapphire Water delivers water to these communities that exceeds all international water quality guidelines. There are 20 full-scale SIBROM plants in operation and four under construction in Western Canada today.