Journal

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2020

of the Northern Territories
Water and Waste Association

Public Health in the Arctic

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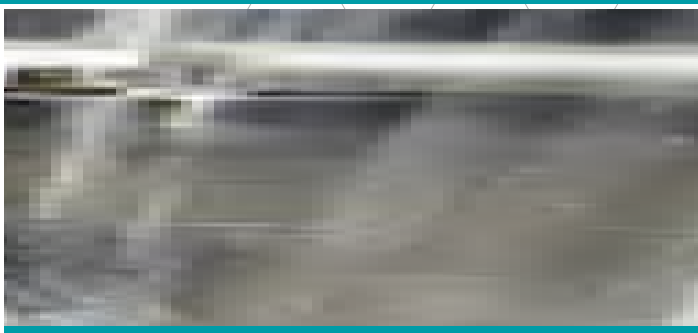

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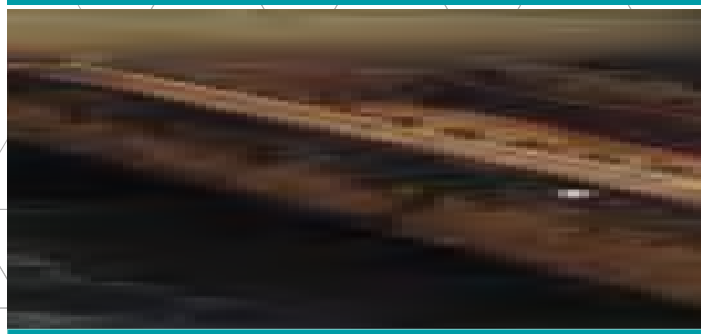

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TABLE OF CONTENTS

INDEX TO ADVERTISERS

ON THE COVER

Photos by Ken Johnson

Clockwise from top left: Self haul for household water in Neskantaga First Nation, Ontario; Water point in Newtok, Alaska; and handwashing in a Native Alaskan home.

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MESSAGE FROM THE EDITOR

KEN JOHNSON

Twenty years ago, the Government of the Northwest Territories initiated a program to upgrade water treatment plants to meet the requirements of the Guidelines for Canadian Drinking Water Quality, and as of October 5, 2020, this goal has been achieved with the commissioning of a new water treatment plant in Wekweètì.

Since 2001, partnerships between the Government of Canada, the Government of the Northwest Territories, and community governments have resulted in 23 upgraded water treatment systems. This is an outstanding achievement, and good news in a year that so much has changed. The Arctic is certainly used to change, but 2020 has presented a changing circumstance that some may have predicted, but no one could certainly have imagined. As northern water professionals, we are all familiar with various aspects of public health, however the COVID circumstance has presented us with another significant layer to how we look at public health in the north. For this reason, the journal theme is public health, with views from Canada, Alaska, and Greenland.

Even though the approach and the circumstances of water in each country varies, the issues of climate, geography, and resources present us all with the same challenges. The international perspectives presented through the Journal will continue to provide our water professionals with information that should inspire us to keep doing what we do, and possibly educate us on what we could do differently, which is so very important to the people of the Arctic.

I would like to thank Pearl Benyk once again this year for her editorial and plain language review of the journal articles – this is icing on the cake for my editorial activity of bringing the journal to press. If any readers would like to reach out to our international northern water peers, or if you have any comments on the Journal, do not hesitate to contact me at EXP (ken.johnson@exp.com or 780.094.9085, voice or text).

Stay well in the coming year, and with some luck and some good public heath management, I hope to see you in Yellowknife in the fall of 2021.

IMPROVING HEALTH IN THE ARCTIC WITH ACCESS TO HOUSEHOLD WATER

Edited from a technical paper by Thomas W. Hennessy, Centers for Disease Control and Prevention (CDC), Alaska; and Jonathan M. Bressler, Alaska Department of Health and Social Services

The eight Arctic nations of the circumpolar Arctic are all considered developed, but several of these countries have a wide range of water, sanitation, and hygiene (WASH) infrastructure and are facing considerable development challenges with water and sanitation, especially in rural and remote communities. Data for the United States from June 2015 shows that, overall, approximately 99 per cent of homes (97 per cent for rural populations) in the entire United States have piped water service and 100 per cent of homes, including rural homes, have piped sanitation service. However, these national estimates mask the reality for many Americans, especially those in rural communities in Alaska, where significant numbers of homes do not have piped, in-home water and sanitation services. This is despite decades of effort to supply all Americans with piped water and sanitation services in their homes.

Similar problems exist for data from Canada, Russia, and Greenland where Arctic WASH deficiencies are lost in the overall national numbers or are lumped into an overall rural category that does not provide an understanding of regional trends or deficiencies.

Although the relationship between a safe, plentiful water supply and health is well recognized, the historic focus of public health related to water service has been to prevent diarrhea-type illnesses caused by microbial contamination of drinking water. While preventing such waterborne infections remains a goal of improved access to high-quality water, access to adequate water quantity is also important for preventing "water-washed" diseases. Water-washed diseases are those where personal sanitation practices, for example hand washing, can prevent transmission of diseases to other people. This issue has become particularly relevant during the current COVID-19 pandemic.

A study of rural Alaska homes without in-home water service showed the average water use was 5.7 litres per person per day. This amount would be categorized as a "very high health concern" because it is less than the 15 litres per person per day that is recommended for disaster response situations, such as refugee camps. Such limited access to water leads to water rationing, where the use of water for drinking and cooking is given higher priority than using water for personal hygiene. Limited access to household water is often found in homes with extreme crowding and many young children; these conditions result in increased spreading of "water-washed" infections and help to explain the high disease rates seen in many Arctic communities.

Overall, the status of water and sanitation services among Arctic communities is not well documented. Available survey information states that in-home access to cold running water ranges from 56 per cent in Northern Greenland to over 99 per cent in Canada. Available survey information also states that regions having water that was sometimes unsafe to drink ranged from one per cent in Northern Greenland to 86 per cent in Nunavut. Available survey information, during the period of 2010 to 2014, states that 70 per cent of rural houses units in Alaska Native Villages had complete plumbing facilities, including running water provided to a sink, a flush toilet, and a shower or bath.

Data on waterborne infectious diseases and outbreaks are typically reported by public health authorities in Arctic nations. Despite data limitations, overall drinking water quality in the Russian Arctic was found to be very poor with considerable contamination by chemical and biological agents, and high rates of waterborne infectious diseases.

In contrast to waterborne infectious diseases, water- washed infectious diseases are typically not reported and tracked. This makes documentation of these infections difficult because a special effort is needed to collect and analyze the rates of infection. However, several studies have shown that increased access to water and sanitation services in the Arctic is associated with reduced risk of water-washed infectious diseases. In Alaska, lower rates of hospitalization or outpatient care visits for respiratory and skin infections is associated with increasing the number of homes of rural Alaska natives with piped water service.

Infant hospitalization rates for lower respiratory tract infections (LRTI) in this population are the highest in the United States – five times higher for all LRTI than for the general US infant population and 11 times higher for documented pneumonia. In contrast, the rate of hospitalization for diarrhea-type infection was comparable to the general US population. This contradicting statistic is likely because safe drinking water is provided in nearly all villages, either by centralized distribution (piped) or decentralized distribution, where residents self-haul treated water from a water station (see cover photo). Diarrhea infections caused by waterborne diseases are not common because this water is safe to drink, but there is not easy access to enough water for cleaning and washing, which leads to rationing of water for these purposes and more respiratory infections.

Serious bacterial infections are also water-washed diseases. A recent study of four Alaska villages was designed to see what would happen when these villages transitioned from self-hauled water and honey buckets to in-home running water and sewer service. The study showed a decrease in the number of clinic visits for diarrhea, respiratory disease, and skin infections after the installation of running water service. Although these studies indicate that there are more waterborne and water-washed infections among people living without in-home water and sanitation service, they do not provide a full view of the differences in health conditions associated with incomplete WASH services across the Arctic.

Without information on the status of WASH services, and health indicators related to these services, regional progress towards water goals will be hard to assess. Also, without a summary of regional data, the opportunity is missed to compare different approaches for achieving improved health for Arctic residents and to develop best practices that fit the unique challenges of the Arctic.

WATER QUANTITY AND HEALTH IN CORAL HARBOUR HOUSEHOLDS

Coral Harbour is an Arctic community located in Nunavut's Kivalliq Region on Southhampton Island, north of Hudson Bay. In Coral Harbour, large families are common, as are multiple generations or extended families living together. Of the 205 private dwellings in the community, the reported average number of persons per household is four; however, the number of people residing in many homes in Coral Harbour may in fact be larger than this. Dwellings in Coral Harbour consist of single houses, semi- detached houses, and row houses. Generally, the single houses have 1,200-litre potable water holding tanks, although, depending on the age of the building, the tank size may vary.

Household wastewater is stored in separate tanks and pumped out using vacuum trucks, which discharge the wastewater into a lagoon system. In most communities, both water supply and wastewater disposal pump-out services are provided daily or at least three days per week to each home. In order to reduce the incidences of gastrointestinal and skin diseases, homes in Nunavut with trucked water service need to receive 90 litres per person per day, and if the homes have piped water supply, the average amount of water available is 225 litres per person per day.

These levels of water delivery service, which are the amount of water delivered per person per day either by water trucks or by pipe, are based on research completed in the mid 1980s. This research looked at how often gastrointestinal and skin diseases occurred when people were able to use various amounts of water per person, per day. Based upon the research, 90 litres per capita per day was recommended and became policy for the amount for trucked water supply systems in the communities of the Northwest Territories, which included Nunavut at the time.

Research shows that the health and well-being of family members is affected by various water-related factors. These factors include how many people are living in the household; how much water they are using; how often there are delays in the water delivery; how people deal with these delays; and how the shortage of water limits the ability of the household members to follow health and sanitation advice given by public health officials.

Municipal water delivery in Coral Harbour is often inconsistent and delayed, so that households do not always have the amount of water they need. These water delays may be caused by winter weather, mechanical problems with the water reservoir pumps or delivery trucks, municipal holidays, and difficulties keeping the water operator positions filled.

The ways residents deal with water delivery delays include collecting their own untreated water, or ice, from local rivers and lakes; relying on neighbours and extended family to share the water they have access to; and altering their daily activities based on whether or not they have the amount of water they need at the time they want it. There also remains the significant personal preference for collecting untreated water, regardless of any water delivery delay, because the untreated water tastes better, particularly for making tea.

Filling portable water storage tank in Coral Harbour.

Typical 1,200 litres potable water storage tank in a Coral Harbour house.

Edited from a technical paper by Kiley Daley, Heather Castleden, and Rob Jamieson, Dalhousie University; Chris Furgal, Trent University; and Lorna Ell, Coral Harbour

Overcrowded living spaces in Nunavut communities are an important factor, and equally important may be how this relates to the provision of water. Another key health aspect of the ways people cope with the water delays or shortages is that certain sub-sections of the population are more likely than others to have poor health due to these delays and shortages. Water shortages and delays may be more than an inconvenience for some residents, and this may limit the ability of these residents to follow public health-related practices and routines.

The Hamlet of Coral Harbour should be commended on their level of communication when dealing with water delays, especially their use of public messages to the community about water delays and requests that residents conserve water. The hamlet should also be commended for periodically hiring workers to harvest blocks of ice from nearby water sources for use by the community for preparing tea and other food preparation. Some older members of the community still prefer to use un-chlorinated water for certain uses.

Distribution system challenges do exist and some households in Coral Harbour do not receive adequate quantities of municipally delivered water. As a result, their health and well-being may be negatively affected if they cannot supplement their domestic water supply by other means. In particular, the consequences of shortages and interruptions are more serious in situations of overcrowded housing, and families with young children and households dealing with communicable infections. Essentially, housing inadequacies and the resulting water insecurity are causing health risks related to the transmission of infectious diseases.

These community challenges related to the supply of water do not suggest that community-wide changes, such as the installation of a fully piped centralized system, is needed for the future. On the contrary, the existing trucked system generally provides the appropriate level of service in Coral Harbour. It has been reported that nearly 50 per cent of residents rarely run out of domestic water. Rather, other health determinants, such as adequate housing, improved health care systems, and individual behaviour should be considered as things which could improve the situation for those who do, or could, experience problems with the water supply.

The water supply standard of 90 litres per person per day was based on research that assumed conditions are all the same within Inuit communities and households. Future planning for water supply infrastructure, particularly things such as the size of household water tanks and the frequency of water delivery should take into consideration the unique social challenges that exist in individual Nunavut communities. Although the size of a water tank in a four-person public housing unit is the standard, the number of people living there is not. Water supply standards that are based on the actual number of occupants per household, and realistically achievable municipal water delivery schedules, may be more appropriate and accurate for some situations.

While the standard level of service for water supply is adequate for some families, those living in overcrowded households are getting considerably less water per person than the water policy standard. Although some people in some sub-sections of the population are coping by getting water somewhere else, like sharing water with other households, water shortages are limiting their ability to follow public health standards and negatively impacting their overall well-being.

POTENTIAL PERMAFROST PANDEMIC

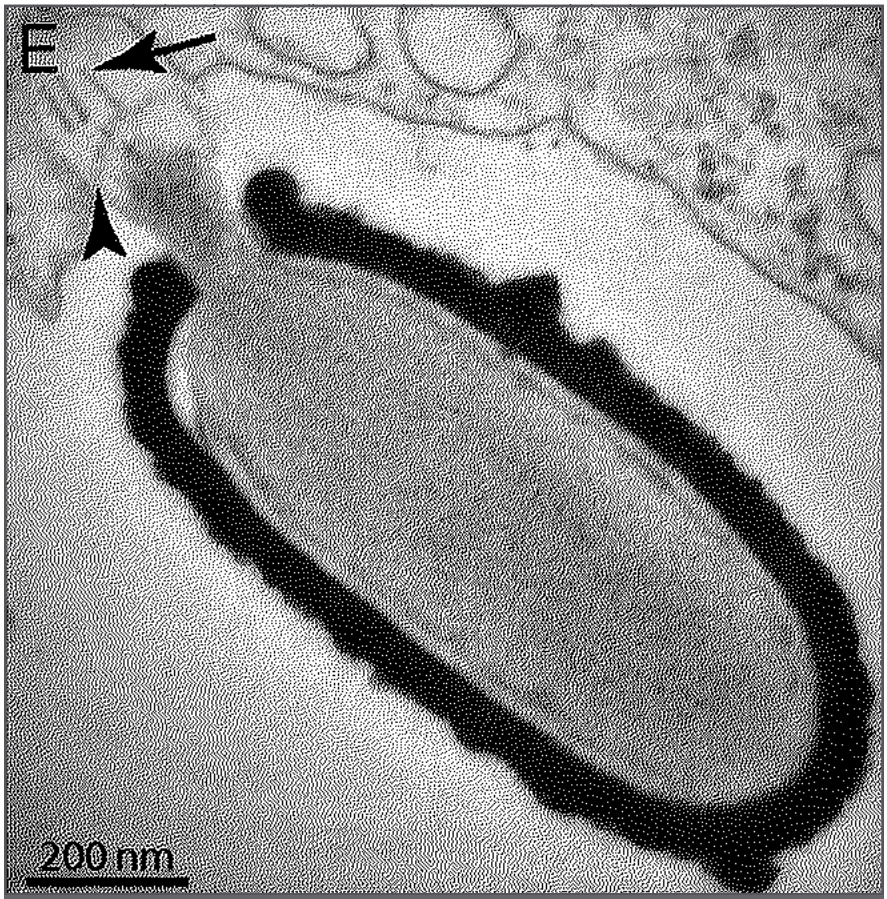
Edited from articles by Jimmy Thomson, April 2020, and Zach Boren, July 2020

A veterinarian checks reindeer for deadly anthrax outside Yar-Sale town in the Siberian Peninsula.

As the Arctic warms, viruses and microbes frozen for hundreds, if not thousands, of years are rising from the thawing ground. In response to this development, 50 scientists from around the world assembled in Hannover, Germany in November 2019 to discuss what is considered an emerging public health issue.

The frozen earth that covers much of the Arctic is home to living microbial communities. For centuries, they had lain dormant, barely active, or completely suspended, subsisting on minuscule pockets of water in between the layers of ice. With the Arctic warming at two to five times the global average rate, those pockets of water are becoming pools; the rivulets are becoming rivers, and the puddles ponds of the Arctic are waking up, and the microscopic organisms embedded in the land are coming back to life.

The scientists meeting in Germany agreed that the climate is warming and the permafrost is thawing. However, they wanted to know what it all means for humans and the future of infectious diseases. In 2017, a team of Belgian researchers speculated about the threats to human health from microbes that were previously frozen in permafrost. They described that the permafrost is a gigantic reservoir of ancient microbes or viruses that may come back to life if environmental conditions continue to change and set them free. A research study has been able to resurrect two viruses which emerged from a single sample of 700-year-old caribou droppings.



The recently discovered giant Pithovirus is seen replicating inside its host, before destroying it.

In 2014, scientists discovered a giant virus frozen in a 30,000-year-old ice core. Like a scene out of a sci-fi movie, the scientists thawed it and watched it take over an amoeba. This virus discovery suggests that thawing permafrost — as a result of global warming or industrial exploitation of circumpolar regions — might pose a threat to human and animal health.

Viruses and microbes may also present another problem because they could contain the blueprints for resistance to antibiotics or other medicines. If given the chance, they could share that information with their modern relatives.

These microbes may be referred to as "zombie" viruses and they make for attention-grabbing headlines. But for people living in the Arctic, infectious diseases that come from more mundane sources could pose a much greater threat. Climate change and human intrusions are changing the landscape, opening new ways for microbes to get around and infect animals and humans.

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- Water Quality Reports

Ensuring Safe Drinking Water

- Source Water Protection
- Water Treatment
- Monitoring and Testing
- Boil Water Advisories
- What We Test For

FAQ's

Roles and Responsibilities

ing programs are bringing more people to the Arctic than ever before, just as the soil is beginning to offer a multitude of freshly virulent germs. Global warming is also inviting new species to move north, some of which are hosts for pathogens that can infect humans. Taking drinking water straight out of Arctic streams and lakes, a common practice in many places, is becoming more risky as beavers push farther into the North. Beavers are hosts to parasites like Giardia, which causes "beaver fever," a painful, diarrhea-inducing abdominal sickness. Mosquitoes carrying West Nile virus are being found farther and farther north as well. This is adding stress to the limited medical resources in the Arctic.

If wildlife is affected, humans can be affected, too. Diseases can jump from animals to humans and deplete the animal food sources people rely on.

The thawing permafrost may be home to bacteria and viruses we haven't yet encountered, or equally troublingly, ones that we have encountered in the recent past with disastrous results, such as the Spanish flu or smallpox. As the Arctic heats up, a group of scientists are investigating the risk that deadly diseases from the distant past may return.

For decades, only the Russians seriously investigated whether, and for how long, microbes could survive in the permafrost, but the wider scientific community is now taking note.

At the meeting in Hannover, the participants came from all relevant fields of scientific study including climatology, geology, and virology. It's important to understand that these mysterious microbes are frozen in the earth rather than in the polar ice sheets. Rising temperatures are increasing the depth of the permafrost's "active layer", which historically has varied from one to two metres in depth from the surface. For periods of the summer, this layer contains water instead of ice.

The permafrost need not entirely thaw nor be thawed all year round for microorganisms now frozen in the earth to come to life or make their way to the talik — a layer above the permafrost that is rarely, if ever, frozen. That active layer, ever larger and active for longer, becomes a new habitat, where an increase in unfrozen water is enough to activate some biological processes. In fact, these microbes may take the opportunity to move toward the talik, where it's less likely to refreeze.

Perhaps the most widely known outbreak of an Arctic disease was Anthrax, which is caused by a bacterium. There was an outbreak reported in 2016, and this outbreak killed thousands of reindeer in Siberia and infected around a dozen people. It's not known whether the Anthrax bacteria emerged from the permafrost.

Once unfrozen, these permafrost microbes must find a host to survive, but they have a problem because there aren't many people living in these regions where they exist. Those people who do live in the area, often in indigenous villages, may not have frequent contact with outsiders, meaning the spread of infection would likely be limited to individual, widely separated communities.

NESKANTAGA FIRST NATION: CANADA'S LONGEST BOIL WATER ADVISORY

Edited from an article by Kaycie Lane, University of Massachusetts, and Graham Gagnon, Dalhousie University

Self haul for household water at Neskantaga First Nation.

Neskantaga First Nation is a remote Oji-Cree First Nation band government in northern Ontario, situated along the shore of Attawapiskat Lake in the District of Kenora, and 430 kilometres north of Thunder Bay. The community is connected to the rest of Ontario by a local airfield and by winter roads and ice roads to points south, via the Northern Ontario Resource Trail. The reported population of the community is 400 people.

The Neskantaga First Nation community has been under a "boil water advisory" since 1995, when the water treatment plant failed. The situation gained national attention between 2004 to 2016, when Canadian news outlets began to cover the story about the unsafe water supply. In 2006, a plan was in place to complete repairs to the failed water treatment plant. However, this program was cancelled when the federal government changed.

The water crisis at Neskantaga First Nation resulted in the shutdown of the community's school, hundreds of evacuations, and the declaration of a state of emergency. The situation draws attention to a continuing and unacceptable problem in Canada: a lack of access to clean drinking water in Indigenous communities across the country.

The crisis at Neskantaga First Nation was caused by a treatment failure due to a broken pump system, resulting in untreated water entering the water distribution system. These unaddressed operational concerns have resulted in a way of life that is unfamiliar to most Canadians. In too many First Nations communities, obtaining safe water is energy intensive, safety is not guaranteed, and people get sick from waterborne illnesses and skin rashes.

Neskantaga First Nation has been under a boil-water advisory for 25 years and it is not alone. Long-term boil water advisories are currently in effect in 56 First Nations across Canada. This is something the federal Liberals have pledged to eliminate by 2021.

While boil-water advisories are crucial, they leave many communities seeking short-term solutions that can be unreliable.

Boil-water advisories are a water-management tool that represents a strong regulatory intervention in perceived or known emergency situations. There are two types of advisories contemplated by Health Canada: precautionary and emergency. Precautionary advisories are issued due to operational concerns about a water system that may cause unsafe water delivery to consumers. Emergency advisories are issued when microbiological contamination is present in water. In both cases, emphasis is placed on preventing microbially-contaminated water from being consumed by a community.

While an emergency advisory is an informative measure for communicating messages about acute water safety to consumers, the overuse and misuse of precautionary advisories is concerning. Precautionary advisories focus primarily on perceived operational matters affecting microbial risk. As a result, they provide a limited and skewed view of water safety, and do not commu-

Inside the non-operating water treatment facility at Neskantaga First Nation.

nicate the wide range of issues that may impact public health.

Studies have shown over 40 per cent of First Nations water systems have advisories in place due to operational concerns. A 2011 First Nations Water Report identified systemic, long-standing operational concerns. To overcome this situation will require dedicated financial, personnel and capacity resources. A new approach for managing water and reducing risk to Indigenous peoples is needed to meet these significant challenges.

Achieving safe drinking water in First Nations systems requires a multi-faceted approach focused on improving the underlying concerns about water systems, not temporarily removing drinking water advisories in communities. In 2006, an expert panel recommended the formation of a First Nations Water Commission to meet the challenges faced by First Nations systems. This inspired a collaborative approach with the Atlantic Policy Congress of First Nations Chiefs leading to the formation of the Atlantic First Nations Water Authority (AFNWA) in 2018. The first of its kind, water authority is dedicated to sustainability by providing safe water to communities for generations and is focused on addressing the root causes of drinking water advisories, not just removing advisories in the short term.

Water governance in Indigenous communities has suffered from a lack of clear regulatory guidance, including Indigenous perspectives and beliefs. Without proper engagement, water treatment design in Indigenous communities has not taken community goals for water operations and aligned them with the current best practices in the water industry. For example, the lack of access to STEM (science, technology, engineering and math) training that is designed for Indigenous learners, and is appropriate for technical fields like water treatment, has resulted in a broken system with insufficient capacity to address a basic need.

The AFNWA supports initiatives to address root causes of advisories. Through support from its First Nations communities and partnerships with water industry stakeholders, this collaborative approach encourages a sustainable set of procedures for water management, focusing on the issues that are relevant and urgent in community water systems. One of the initiatives of the AFNWA is a long-term education plan for Indigenous water professionals to govern, manage and operate water systems.

As the Neskantaga First Nation story illustrates, the current approach has resulted in more than 25 years of inefficiencies and unsafe water. A new approach should be sought. While the solutions proposed by the AFNWA may not be suited to all communities, in the spirit of nation-to-nation building, fundamental shifts are required for all Canadians to access clean water.

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BEHCHOKO
WATER AND SEWER ACTIVITIES

By Galvin Simpson, Public Works Manager, Tlicho Community Government of Behchoko

Galvin Simpson (pictured) has a busy summer with maintenance activities on the water and sewer systems serving the community of Behchoko, formerly known as Rae-Edzo.

Addition of enzyme to the sewage lagoon to improve the biological activity, and hence treatment, in the lagoon.

Repairing a service connection leak in the water distribution system – the leak was found the "old fashioned" way by following the stream of water of the leak from where it surfaced.

A hydrant test is organized for one of the community's hydrant access vaults, incorporating a length of hose, a pressure gauge and a flow diffuser.

Arrival at Surveillance Network Program (SNP) sampling point E3.

Access vault inspection underway with condition assessment and steam cleaning.

Behchoko hydrant test underway.

Hiking to one of the sampling points in the Surveillance Network Program (SNP) for the sewage lagoon, as part of the water licence compliance for Behchoko.