URBAN SYSTEMS


# District of Mackenzie

## *2019 Water System Annual Report*

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File: 1788.0002.20

# Contents



# Appendices

# 1.0 Introduction

The District of Mackenzie (District) has prepared this Annual Water System Report for 2019. The District operates three closed loop water distribution systems: the Town, Gantahaz, and Airport systems. This report outlines the following for each system:

- Water system infrastructure;
- Operation and maintenance activities;
- Water quality monitoring; and
- Recently completed and upcoming capital initiatives.

This report is required by Northern Health as part of the District's Conditions of Permit for the water systems. To meet the requirements of the Drinking Water Protection Act, this annual report must be made available to the water system users within 6 months of the end of the calendar year.

The operating permits for each system are included in Appendix A.

Please contact Travis Wall, Public Works General Manager for the District of Mackenzie at 250-997-3761 or at travis@districtofmackenzie.ca if you have any questions.

# 2.0 Water System Overview

Mackenzie is a community of about 3,700 residents nestled between the Rocky and Omineca Mountains, approximately 180 km North of Prince George. The District of Mackenzie operates three community water systems: the Town system, the Gantahaz system and the airport system. All three systems are supplied by groundwater wells. The three water systems are not connected.

## 2.1 Town System

For in-town residents, water is sourced from three groundwater wells, two located in Pumphouse 1 at First Beach (Wells #1 and #2) and one in Pumphouse 2 at Second Beach on Morfee Lake (Well #4). Well #1 has an emergency diesel backup motor. The wells draw water from an aquifer composed predominantly of sands and gravels. The well depths, according to the logs at the time of construction, range from 12-21 m. Pumphouses 1 & 2 pump water to a 2,250 cubic meter storage reservoir, located next to Little Mack Ski Hill. The reservoir is a large, above ground concrete structure.

**Figure 2.1: Town Reservoir**

In 2017, the District was successful in obtaining grant funding to improve water security by increasing the number of water sources for the Town water system. Drilling of Well #2 began in September 2017 approximately 25 ft South of Pumphouse 1. The project included updates to the existing Pumphouse 1, including an improved power supply and modern controls. The project was completed on budget in July 2018. Figure 2.2 shows the updated Pumphouse.

**Figure 2.2: Town Pumphouse 1**

A booster station supplies water from the reservoir to town users. The Town booster station has three electric booster pumps and an emergency diesel fire pump. Booster pumps turn on and off as necessary to maintain pressure in the distribution system. Boosting the pressure is required as the reservoir is too low to provide sufficient pressure. The fire pump operates when there is insufficient system pressure to fight a fire and can be started with a cell phone or manually by the Fire Department or by Public Works.

The Town distribution system is roughly divided between asbestos cement (AC) pipe in the older, eastern half and newer polyvinyl chloride (PVC) pipe in the western, newer half. There are five pressure reducing valve (PRV) stations that divide the Town distribution system into six pressure zones and ensure that pressures are within acceptable ranges through the distribution system. The Town system has approximately 1,300 connections.

Figure 2.3 shows an overview of the Town System water infrastructure.


MACKENZIE
BRITISH COLUMBIA

District of Mackenzie

Town Water System Infrastructure

## Location Map

Legend

- Roads
- Watercourse
- Waterbody

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

0 50 100 200 300
Metres

N

**Coordinate System:** NAD 1983 UTM Zone 10N

**Scale:** 1:12,500 (When plotted at 8.5"x11")

**Data Sources:**
Imagery provided by ESRI
Roads and Hydrological features provided by NRCAN

| | |
|---|---|
| **Project #:** | 1788.0002.19 |
| **Author:** | WS |
| **Checked:** | JR |
| **Status:** | Final |
| **Revision:** | A |
| **Date:** | 2019 / 6 / 26 |

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**FIGURE 2.3**

## 2.2 Gantahaz System

Water for Gantahaz residents is supplied from two wells located on Alberta and Columbia Drive (Well #4 and #1 respectively). Both wells are pitless constructed wells. Well #4 is contained in a manhole that requires heating to prevent freezing during the winter. Both wells pump water to a 380 cubic meter storage reservoir next to Well #1 on Columbia Drive. This reservoir is an above ground, insulated, metal structure.

**Figure 2.4: Gantahaz Booster Station and Reservoir.**

Similar to the Town system, the Gantahaz system is pressurized by a booster station. The Gantahaz booster station, located on Columbia Drive next to the reservoir and Well #1, supplies water from the reservoir to the subdivision. The booster station has an electric booster pump with a spare pump and motor kept in the building. An emergency natural gas fire pump is available to supplement system pressures during a fire flow event. The fire pump can be started with a cell phone or manually by the Fire Department or by Public Works. The booster station had a portable, gas powered generator that could be used to power the station in a power outage; however, this generator had to be operated manually. This generator was replaced with a diesel generator in 2019, which will power the booster pumps in a power outage.

The Gantahaz distribution system is composed primarily of PVC pipe. The Gantahaz system has approximately 80 connections. Figure 2.5 shows an overview of the Gantahaz System water infrastructure.

## 2.3 Airport System

The Airport system consists of one well, an open water reservoir, and a fire pump. The predominant purpose of the airport system is to provide water for fire fighting purposes for a number of industrial sites in the area, however, the airport system also supplies six structures. Operators are required to manually fill the reservoir, but the diesel fire pump operates automatically. The facility has an emergency, diesel backup generator located inside the fenced reservoir compound that will start up automatically during a power outage.

## 2.4 Treatment and Disinfection

Source protection plans completed by Kala Geoscience Ltd. in 2015 found that the Town Wells # 1 & #4 and the Gantahaz Wells #1 & #4 are not under the direct influence of surface water (non-GWUDI). The Town Well #2 Drilling and Completion report completed by Western Water Associates Ltd. in 2018 found that Well #2 was not under the direct influence of surface water (non-GWUDI) nor Groundwater at Risk of Containing Pathogens (GARP).

The Guidance Document for Determining Groundwater at Risk of Containing Pathogens was developed in 2015 and updated in 2017. It is used in conjunction with Ministry of Health policies and guidelines to confirm treatment and disinfection requirements. It is recommended that the Town Wells #1 & #4 and the Gantahaz wells #1 & #4 be re-evaluated under the GARP current regulation.

Well water from the Town, Airport, and Gantahaz systems is pumped directly into their respective distribution systems without treatment or disinfection. Water quality monitoring and testing results are presented in Sections 5 and 6.


MACKENZIE
BRITISH COLUMBIA

District of Mackenzie

Gantahaz Infrastructure

**Location Map**

Legend

- Roads
- Watercourse
- Waterbody

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Metres

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**Coordinate System:**
NAD 1983 UTM Zone 10N

**Scale:**
1:10,000
(When plotted at 8.5"x11")

**Data Sources:**
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Roads and Hydrological features provided by NRCAN

**Project #:** 1788.0002.19
**Author:** WS
**Checked:** JR
**Status:** Final
**Revision:** A
**Date:** 2019 / 6 / 25

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**FIGURE 2.5**

# 3.0 System Operation & Maintenance

The District's water system was changed from a Class II to a Class III distribution system in April 2018. The District employs two Class II distribution system operators: Travis Wall and Wayne Moody. These operators are in the process of obtaining the sufficient number of direct responsible charge (DRC) credits to take the Environmental Operators Certification Program (EOCP) Class III Distribution course, with the hope of achieving Class III certification in 2020.

Regular inspections, maintenance and water quality testing are performed by the system operators to ensure optimal operation of the District's water system. Operation and maintenance of the water system involves several daily, weekly, and periodic, or 'as-needed' tasks.

Daily tasks performed in 2019 include:

- Record well pump run times at each well;
- Record flow meter totalizer and flow;
- Inspect the well and booster station pumps to ensure normal operation;

Weekly tasks performed in 2019 include:

- Inspect pressure reducing valves;
- Clean water system buildings;

Monthly tasks performed in 2019 include:

- Check static water level in wells;
- Inspect backup motors and run motors for 60 minutes;

Periodic, or "as-needed" tasks include:

- Troubleshoot minor electrical and mechanical equipment problems;
- Check propane heaters and propane tanks (winter);
- Record the time and nature of any alarms received on the water system and take appropriate action;
- Flush and clean the watermains (twice a year); and
- Exercise control valves, isolation valves, hydrants and related appurtenances (annually).

Water quality monitoring is discussed in Section 5.0.

# 4.0 Water Consumption – 2019

In 2019, 541,253 cubic meters of water were pumped into the Town distribution system. Water usage in 2019 was lower on a per capita basis than in 2018, with an average daily flow of 1,483 cubic meters per day in 2019, compared to 1,580 cubic meters per day in 2018. In 2018, 529,979 cubic meters were pumped, excluding flows from the month of October. Due to the upgrades to Pumphouse #1, the monitoring equipment for the Town system was not accurate for the month of October, flow data for October 2018 was not available as a result.

Figure 4.1 shows the monthly water consumption for the Town system in 2018 and 2019.

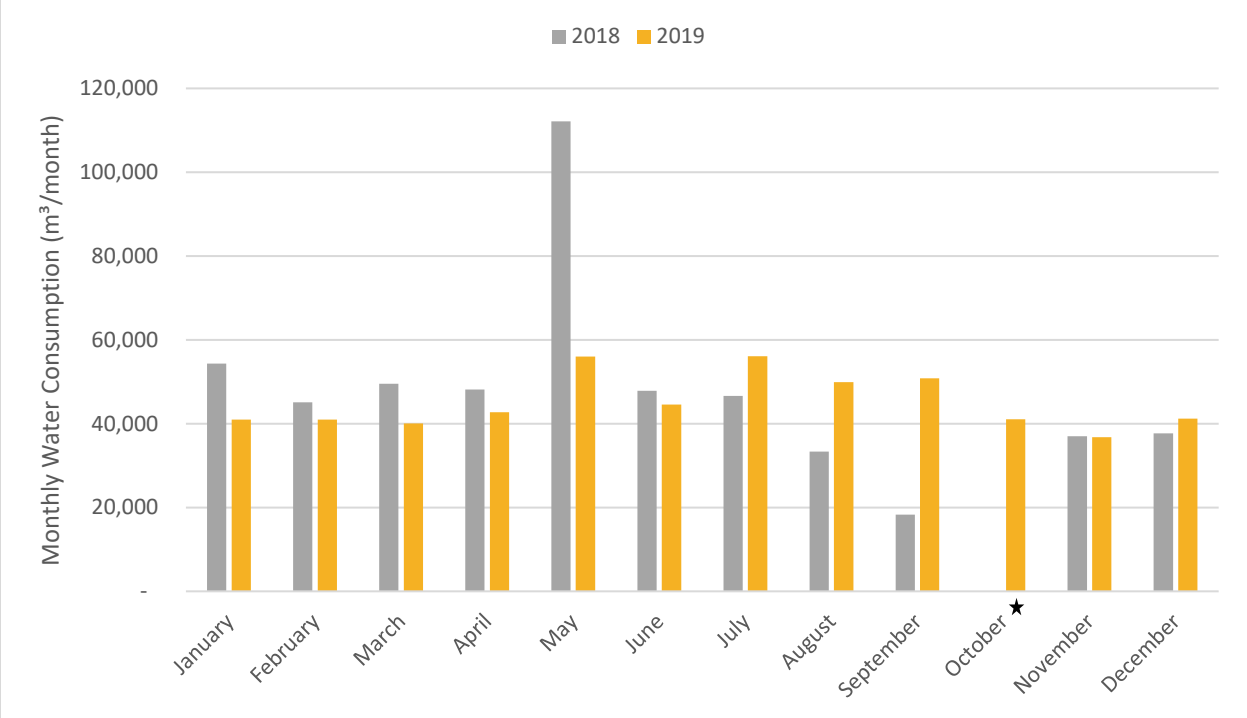


**Figure 4.1: Monthly Water Consumption for the Town Water System**

★ Note: Due to the upgrades to Pumphouse #1 in 2018, the monitoring equipment for the Town system was not accurate for the month of October, flow data for October 2018 has not been included as a result.

The control equipment in the Gantahaz booster station was upgraded in Fall 2019, the flow meter readings from August to November were not reliable as a result. Excluding August to November, the Gantahaz system pumped 21,045 cubic meters of water in 2019. Figure 4.2 shows the monthly water consumption for the Gantahaz system. The average daily flow for the year was 87 cubic meters per day. In comparison, 31,281 cubic meters of water were pumped in the Gantahaz system in 2018, with an average daily flow of 90 cubic meters per day.

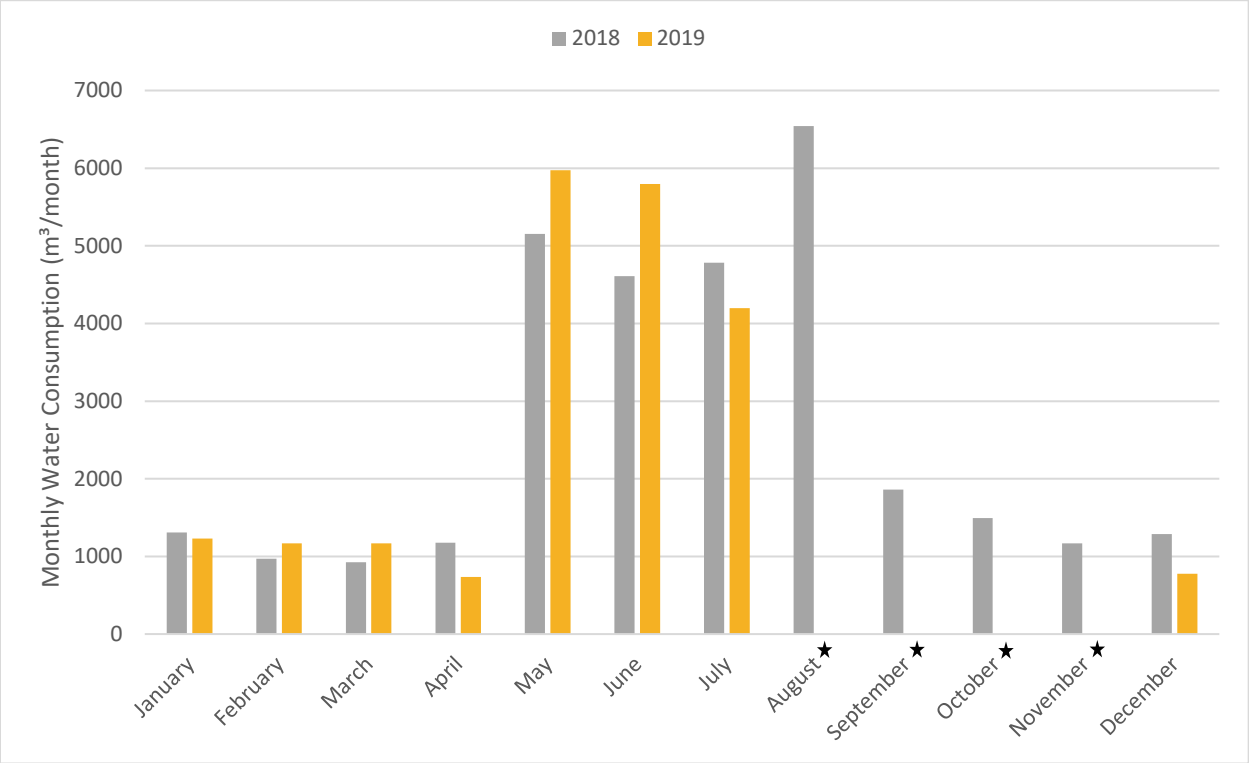


**Figure 4.2: Monthly Water Consumption for the Gantahaz Water System**

★ Note: Due to upgrades to the control equipment in the Gantahaz booster station in Fall 2019, the monitoring equipment for the system was not accurate from August to November 2019, flow data for this period has not been included as a result.

No flow records are available for the Airport System. It is recommended that a flowmeter be installed for the airport system to allow for flow tracking.

# 5.0 Water Quality Monitoring

To ensure continued high standards of drinking water quality and delivery for the District of Mackenzie, the District sends water samples to ALS Analytical Services for bacteriological and chemical testing. The District's sampling program has been designed to meet the requirements of their operating permits and the Drinking Water Protection Regulation.

**Chemical Testing Requirements:**

The District's Operating Permits require the submittal of water chemistry data annually to Northern Health for the Town system, every three years for the Gantahaz system, and every five years for the Airport system. Annual chemical water quality results are assessed to ensure compliance with the Guidelines for Canadian Drinking Water Quality (GCDWQ) published by Health Canada.

**Bacteriological Testing Requirements:**

The District's Operating Permits require the submittal of a minimum of 5 water bacteriological samples per month for the Town system, 2 bacteriological samples per month for the Gantahaz system, and 1 bacteriological sample per month for the Airport System. The Drinking Water Protection Regulation (DWPR) requires that water suppliers monitor for total coliform bacteria and *Escherichia coli* at a certified lab. This testing is used to monitor the distribution system, and to notify users of potential issues.

The standards for water quality are set out in Schedule A of the DWPR as follows:

| Parameter: | Standard: |
|---|---|
| Fecal coliform bacteria | No detectable fecal coliform bacteria per 100 ml |
| Escherichia coli | No detectable *Escherichia coli* per 100 ml |
| Total coliform bacteria | |
| (a) 1 sample in a 30-day period | No detectable total coliform bacteria per 100 ml |
| (b) more than 1 sample in a 30-day period | At least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml |

The water sampling parameters, locations, and frequency for the District's water system are shown in Table 5.1. All samples are sent to an accredited laboratory (ALS Analytical Services). This sampling program meets the requirements outlined in the District's Permits to Operate.

**Table 5.1: Water Sampling Parameters, Locations, and Frequency**

| Parameter | Frequency | Locations | Comments |
|---|---|---|---|
| **Town System** | | | |
| Escherichia coli, Total Coliforms | Weekly | Mackenzie Hospital | |
| Escherichia coli, Total Coliforms | Bi-Weekly | • Public works office<br>• Northwest Quadrant (Crooked River Crescent)<br>• Southeast Quadrant (Parsnip Crescent) | Sample locations are rotated on a bi-weekly basis with one of the listed locations sampled every other week. |
| Comprehensive Drinking Water Test | Annually | Hospital, Town booster station, and various locations throughout the town system. | Including total and dissolved metals. |
| **Gantahaz System** | | | |
| Escherichia coli, Total Coliforms | Bi-weekly | Gantahaz booster station | |
| Escherichia coli, Total Coliforms | Quarter-annually | Manitoba Drive | |
| Comprehensive Drinking Water Test | Annually | Gantahaz booster station, Well #1, Well #4, and various locations throughout the Gantahaz subdivision. | Including total and dissolved metals. |
| **Airport System** | | | |
| Escherichia coli, Total Coliforms | Monthly | Airport | |
| Comprehensive Drinking Water Test | Once every five years | Airport | Including total and dissolved metals. |

# 6.0 Water Quality Results

Water samples were sent to ALS Analytical Services for bacteriological and chemical laboratory testing. A summary of the results of the water quality sampling are provided in Tables 6.1-6.5. For clarity, only chemical testing parameters with a Maximum Allowable Concentration (MAC) or Aesthetic Objective (AO) in the Guidelines for Canadian Drinking Water Quality (GCDWQ) are shown. The samples were taken from a combination of source points (at the well) and various locations within the distribution system.

A complete set of bacteriological test results can be found on Northern Health's website: https://www.healthspace.ca/Clients/NHA/NHA_Website.nsf.

The bacteriological sampling frequency for the Town, Gantahaz, and Airport systems met or exceeded the permit requirements. Bacteriological samples were all good / non-detect.

Based on the general chemistry sampling that was completed, the majority of water samples conformed to the Guidelines for Canadian Drinking Water Quality (GCDWQ), and overall the groundwater quality is very good which is why the systems are being operated without treatment/disinfection. Please note that Northern Health recommends the following caveat for all water systems:

> *No water supply is 100 per cent safe, and sudden water quality failures can take hours or even days to identify and communicate out to the entire community. People who have HIV/AIDs, are undergoing chemotherapy or have compromised immune systems are advised to consider boiling their water or installing an in-home drinking water treatment device capable of reducing their risk of illness. For additional info, please refer to the following: https://www.healthlinkbc.ca/healthlinkbc-files/preventing-water-borne-infection*

With regards to the 2019 water quality testing summarized below, there are a few parameters of note:

**Turbidity**

The GCDWQ recommends that turbidity generally be below 1.0 NTU for groundwater systems. In some cases, a less stringent value for turbidity may be acceptable if it is demonstrated that the system has a history of acceptable microbiological quality and that a higher value for turbidity will not compromise disinfection (which is not applicable in this case). Some of the turbidity results exceeded 1 NTU, but as they were distribution samples, the results are likely

related to iron or manganese accumulation or oxidation in the water system. The District should continue to monitor these results.

**Iron**

The GCDWQ has an aesthetic objective of 0.3 mg/L for iron. Iron is objectionable in water supplies for several reasons unrelated to health. Iron can precipitate as a rust coloured silt which can result in an unpalatable taste as well as stain laundry and plumbing fixtures. In addition, iron can promote the growth of "iron bacteria" which can cause a slimy coating in water distribution pipes. Two iron exceedances occurred in the Gantahaz subdivision, one on Jan. 15th recorded at both the Gantahaz booster station and Well #4, and a second on Feb. 12th at Well #4. The Town system had only one iron exceedance on Nov. 12th at 44 Munro Crescent.

**Manganese**

Like iron, manganese can form a precipitate that can cause maintenance issues in distribution systems, result in laundry/plumbing staining in households, and cause objectionable taste issues. In the past, the GCDWQ had only an aesthetic objective of 0.05 mg/L for manganese. However, as of May 10, 2019 the guideline was updated to include a new Maximum Acceptable Concentration (MAC) of 0.12 mg/L and a reduced Aesthetic Objective (AO) of 0.02 mg/L. The MAC was added because new research has shown that at higher concentrations it can pose adverse neurological effects in infants and children, primarily to the central nervous system, followed by the reproductive system. Infants who consume powdered baby formula reconstituted from water that is high in manganese are at the greatest risk. Although the MAC was established based on infants, this value is intended to protect all Canadians. The AO was reduced to minimize the occurrence of discoloured water due to manganese and to improve consumer confidence in drinking water quality.

As noted in Tables 6.3 and 6.5, the manganese results are somewhat variable for both the Town and Gantahaz water systems. The results vary depending on the location, and are sometimes below the AO, and some of the results exceed the new MAC. There were three exceedances of the MAC, one in the town system (at the Town booster station), and two in the Gantahaz system (at Well #4).

The District flushes each distribution system twice per year to control the iron and manganese concentrations. The water quality results indicate that the system flushing is largely keeping the water quality within the expected range.

In 2019, the District inspected the Town reservoir to confirm manganese deposits within the reservoir were not being carried into the distribution system. There were no signs during this inspection that manganese deposits were a concern.

*The District should continue to monitor iron and manganese levels within their water systems to better understand the water quality results. Conducting a Biological Activity Reaction Test (BART) on the groundwater wells is recommended to determine if iron and manganese are the result of bacteria.*

*Also, manganese levels should be monitored in the raw well water on all water systems, and the results should be reviewed with Northern Health to determine whether a water quality advisory should be issued if manganese exceeds the guideline.*

**Table 6.1: Bacteriological Sampling Results for the Town, Gantahaz, and Airport Systems**

| | Location | Number of Samples | Minimum | Maximum | Average | Guideline |
|---|---|---|---|---|---|---|
| E. Coli (CFU/100 mL) | Town Distribution System | 68 | <1 | <1 | <1 | MAC < 1 CFU/100 mL |
| | Gantahaz Distribution System | 32 | <1 | <1 | <1 | |
| | Airport System | 12 | <1 | <1 | <1 | |
| Total Coliforms (CFU/100 mL) | Town Distribution System | 68 | <1 | <1 | <1 | MAC < 1 CFU/100 mL |
| | Gantahaz Distribution System | 32 | <1 | <1 | <1 | |
| | Airport System | 12 | <1 | <1 | <1 | |

**Table 6.2: General Water Chemistry Results for the Town System[1]**

| | Units | GCDWQ MAC[2] | GCDWQ AO[3] | Average | Maximum | Minimum | Count | Non-Detect |
|---|---|---|---|---|---|---|---|---|
| Colour, True | CU | | 15 | ND | ND | ND | 6 | 6 |
| Hardness (as CaCO3) | mg/L | | 500 | 159 | 179 | 134 | 14 | 0 |
| pH | pH | | 7-10.5 | 8.29 | 8.31 | 8.26 | 6 | 0 |
| Total Dissolved Solids | mg/L | | 500 | 204 | 210 | 194 | 6 | 0 |
| Turbidity | NTU | 1.0[4] | | ***2.35*** | ***6.38*** | ***1.15*** | 6 | 0 |
| Chloride (Cl) | mg/L | | 250 | 6.58 | 6.71 | 6.46 | 6 | 0 |
| Fluoride (F) | mg/L | 1.5 | | 0.05 | 0.055 | 0.05 | 6 | 0 |
| Nitrate (as N) | mg/L | 10 | | 0.0550 | 0.0613 | 0.0524 | 6 | 0 |
| Nitrite (as N) | mg/L | 1 | | ND | ND | ND | 6 | 6 |
| Total Organic Nitrogen | mg/L | | | 0.066 | 0.066 | 0.066 | 6 | 5 |
| Total Organic Carbon | mg/L | | | 0.58 | 0.64 | 0.52 | 6 | 4 |

[1] Results are from distribution system samples

[2] Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration

[3] Guidelines for Canadian Drinking Water Quality Maximum Aesthetic Objective

[4] Guidelines for Canadian Drinking Water Quality recommends that turbidity should generally be below 1.0 NTU for groundwater systems. In some cases, a less stringent value for turbidity may be acceptable if it is demonstrated that the system has a history of acceptable microbiological quality and that a higher turbidity value will not compromise disinfection.

[5] ND indicates a non-detect result

***Red bold italics*** notes exceedance of MAC; ***Green bold italics*** notes exceedance of AO.

**Table 6.3: Total Metal Water Quality Results for the Town System[1]**

| | Units | GCDWQ MAC[2] | GCDWQ AO[3] | Average | Maximum | Minimum | Count | Non-Detect |
|---|---|---|---|---|---|---|---|---|
| Aluminum (Al)-Total | mg/L | | 0.1 | ND | ND | ND | 14 | 14 |
| Antimony (Sb)-Total | mg/L | 0.006 | | 0.00018 | 0.00019 | 0.00016 | 14 | 12 |
| Arsenic (As)-Total | mg/L | 0.01 | | 0.00216 | 0.00322 | 0.00038 | 14 | 0 |
| Barium (Ba)-Total | mg/L | 1 | | 0.063 | 0.070 | 0.041 | 14 | 0 |
| Boron (B)-Total | mg/L | 5 | | ND | ND | ND | 14 | 14 |
| Cadmium (Cd)-Total | mg/L | 0.005 | | 0.0000081 | 0.000010 | 0.0000065 | 14 | 12 |
| Chromium (Cr)-Total | mg/L | 0.05 | | ND | ND | ND | 14 | 14 |
| Copper (Cu)-Total | mg/L | 2 | 1 | 0.094 | 0.252 | 0.001 | 14 | 0 |
| Iron (Fe)-Total | mg/L | | 0.3 | 0.136 | ***0.514*** | 0.016 | 14 | 1 |
| Lead (Pb)-Total | mg/L | 0.01 | | 0.00079 | 0.00261 | 0.00006 | 14 | 5 |
| Manganese (Mn)-Total | mg/L | 0.1200 | 0.02 | ***0.040*** | ***0.147*** | 0.007 | 14 | 0 |
| Potassium (K)-Total | mg/L | | | 0.64 | 0.70 | 0.49 | 14 | 0 |
| Selenium (Se)-Total | mg/L | 0.05 | | 0.00006 | 0.00007 | 0.00006 | 14 | 11 |
| Sodium (Na)-Total | mg/L | | 200 | 3.1 | 3.5 | 2.7 | 14 | 0 |
| Uranium (U)-Total | mg/L | 0.02 | | 0.00158 | 0.00177 | 0.00115 | 14 | 0 |
| Zinc (Zn)-Total | mg/L | | 5 | 0.0123 | 0.0431 | 0.0032 | 14 | 5 |

[1] Results are from a combination of source and distribution system samples

[2] Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration

[3] Guidelines for Canadian Drinking Water Quality Maximum Aesthetic Objective

[4] ND indicates a non-detect result

***Red bold italics*** notes exceedance of MAC; ***Green bold italics*** notes exceedance of AO.

**Table 6.4: General Water Chemistry Results for the Gantahaz System[1]**

| | Units | GCDWQ MAC[2] | GCDWQ AO[3] | Average | Maximum | Minimum | Count | Non-Detect |
|---|---|---|---|---|---|---|---|---|
| Colour, True | CU | | 15 | ND | ND | ND | 6 | 6 |
| Hardness (as CaCO3) | mg/L | | 500 | 163 | 170 | 151 | 10 | 0 |
| pH | pH | | 7-10.5 | 8.37 | 8.38 | 8.36 | 6 | 0 |
| Total Dissolved Solids | mg/L | | 500 | 200 | 205 | 195 | 6 | 0 |
| Turbidity | NTU | 1.04 | | ***3.21*** | ***7.27*** | 0.77 | 6 | 0 |
| Chloride (Cl) | mg/L | | 250 | 0.57 | 0.60 | 0.56 | 6 | 2 |
| Fluoride (F) | mg/L | 1.5 | | 0.081 | 0.086 | 0.069 | 6 | 0 |
| Nitrate (as N) | mg/L | 10 | | 0.0626 | 0.0747 | 0.0463 | 6 | 0 |
| Nitrite (as N) | mg/L | 1 | | 0.0023 | 0.0050 | 0.0011 | 6 | 2 |
| Total Organic Nitrogen | mg/L | | | 0.083 | 0.083 | 0.083 | 6 | 5 |
| Total Organic Carbon | mg/L | | | 0.88 | 1.06 | 0.70 | 6 | 4 |

[1] Results are from distribution system samples

[2] Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration

[3] Guidelines for Canadian Drinking Water Quality Maximum Aesthetic Objective

[4] Guidelines for Canadian Drinking Water Quality recommends that turbidity should generally be below 1.0 NTU for groundwater systems. In some cases, a less stringent value for turbidity may be acceptable if it is demonstrated that the system has a history of acceptable microbiological quality and that a higher turbidity value will not compromise disinfection.

[5] ND indicates a non-detect result

***Red bold italics*** notes exceedance of MAC; ***Green bold italics*** notes exceedance of AO.

**Table 6.5: Total Metal Water Quality Results for the Gantahaz System[1]**

| | Units | GCDWQ MAC[2] | GCDWQ AO[3] | Average | Maximum | Minimum | Count | Non-Detect |
|---|---|---|---|---|---|---|---|---|
| Aluminum (Al)-Total | mg/L | | 0.1 | ND | ND | ND | 10 | 10 |
| Antimony (Sb)-Total | mg/L | 0.006 | | ND | ND | ND | 10 | 10 |
| Arsenic (As)-Total | mg/L | 0.01 | | 0.00403 | 0.00554 | 0.00289 | 10 | 0 |
| Barium (Ba)-Total | mg/L | 1 | | 0.093 | 0.103 | 0.086 | 10 | 0 |
| Boron (B)-Total | mg/L | 5 | | ND | ND | ND | 10 | 10 |
| Cadmium (Cd)-Total | mg/L | 0.005 | | ND | ND | ND | 10 | 10 |
| Chromium (Cr)-Total | mg/L | 0.05 | | ND | ND | ND | 10 | 10 |
| Copper (Cu)-Total | mg/L | 2 | 1 | 0.00789 | 0.04910 | 0.00051 | 10 | 0 |
| Iron (Fe)-Total | mg/L | | 0.3 | ***0.388*** | ***0.610*** | 0.258 | 10 | 5 |
| Lead (Pb)-Total | mg/L | 0.01 | | 0.00099 | 0.00219 | 0.00025 | 10 | 5 |
| Manganese (Mn)-Total | mg/L | 0.1200 | 0.02 | ***0.062*** | ***0.135*** | 0.005 | 10 | 1 |
| Potassium (K)-Total | mg/L | | | 0.76 | 0.84 | 0.62 | 10 | 0 |
| Selenium (Se)-Total | mg/L | 0.05 | | ND | ND | ND | 10 | 10 |
| Sodium (Na)-Total | mg/L | | 200 | 3.2 | 4.0 | 2.3 | 10 | 0 |
| Uranium (U)-Total | mg/L | 0.02 | | 0.00341 | 0.00424 | 0.00236 | 10 | 0 |
| Zinc (Zn)-Total | mg/L | | 5 | 0.0350 | 0.0833 | 0.0064 | 10 | 4 |

[1] Results are from a combination of source and distribution system samples

[2] Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration

[3] Guidelines for Canadian Drinking Water Quality Maximum Aesthetic Objective

[4] ND indicates a non-detect result

***Red bold italics*** notes exceedance of MAC; ***Green bold italics*** notes exceedance of AO.

# 7.0 Capital Works and Other Initiatives

## 7.1 Gantahaz Booster Station Upgrades

In the fall of 2018, the District began upgrades to the Gantahaz booster station. The controls on the Gantahaz booster station were inefficient and out of date. The building was showing signs of age and had insufficient space for the proposed control equipment. Improvements included the addition of a variable frequency drive to the booster station pump for increased efficiency, building upgrades, updating the controls, improved electrical supply, and the installation of a diesel generator to power the booster pumps in the case of a power outage. This project was completed in 2019.

## 7.2 Fire Hydrant Maintenance

In 2019, the District began maintenance to the fire hydrants in the town water system. 30 hydrants were service throughout 2019, with 3 totally replaced. An additional 30 hydrants will be serviced in 2020.

## 7.3 Town PRV Station Upgrades

The District is actively seeking funding to upgrade five pressure reducing valve (PRV) stations in the town water system. The PRV stations divide the Town distribution system into six pressure zones and ensure that pressures are within acceptable ranges through the distribution system. These stations are all contained in buried chambers, meaning confined space entry procedures and specialty equipment is needed for inspection and maintenance. Even with these measures, entering the space is still a high safety risk for operations staff. The proposed upgrades include the complete replacement of the PRV stations, including the electrical, controls, and structures. Three of the stations will be converted to above ground structures, access will be improved to the remaining two buried structures to ensure safe entry is possible for operations staff. No announcement has been made to date on the status of the grant application.

# 8.0 Conclusion

The District of Mackenzie remains committed to providing a safe, reliable water source for residents. To meet this goal, the District plans to perform the following over the coming year:

1. Additional water quality sampling will be undertaken to determine whether there is an ongoing exceedance of the maximum acceptable concentration for manganese, including monitoring at the wells and in the distribution system. If needed, the District will consider operational practices, such as the distribution system flushing frequency, and reservoir cleaning to improve results where possible.
2. Conduct a Biological Activity Reaction Test (BART) on the groundwater wells to determine if iron and manganese may be increasing due to well screen fouling.
3. Re-evaluate the Town Wells #1 & #4 and the Gantahaz wells #1 & #4 under the GARP Guidance document.
4. Install a flowmeter on the Airport water system.

Please contact Travis Wall, Public Works General Manager for the District of Mackenzie at 250-997-3761 or at travis@districtofmackenzie.ca if you have any questions on the content of this report.

# Appendix A

*Water System Operating Permits*

# PERMIT
# TO OPERATE

A Drinking Water System with
1 Public Connection

System Name: **Mackenzie CWS Airport**

Physical Location: **Mackenzie CWS**
**1 Mackenzie Boulevard**
**Mackenzie BC**

Owner Name: **District Of Mackenzie**

Conditions of Permit

> Maintain a minimum of one water bacteriology sample per month unless the Environmental Health Officer requests a greater frequency.
> Maintain an up-to-date Emergency Response Plan.
> Submit water chemistry data every 5 years, unless the Environmental Health Officer requests a greater frequency.

25-May-2005
Effective Permit Date

Environmental Health Officer

3-July-2019
Permit Revised Date

DECAL
NOT REQUIRED

northern health
the northern way of caring

# PERMIT
# TO OPERATE

A Drinking Water System with
15-300 Connections

System Name: **Mackenzie CWS Gantahaz Subdivision**

Physical Location: **Mackenzie CWS**
**1 Mackenzie Boulevard**
**Mackenzie BC**

Owner Name: **District Of Mackenzie**

Conditions of Permit

> Maintain a minimum of 2 water bacteriology samples per month unless the Environmental Health Officer requests a greater frequency.
> Maintain an up-to-date Emergency Response Plan.
> Operator must be trained and certified at the level specified by the Environmental Operators Certification Program.
> Submit water chemistry data every 3 years, unless the Environmental Health Officer requests a greater frequency.

30-Mar-2001
Effective Permit Date

Environmental Health Officer

2-Jul-2019
Permit Revised Date

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the northern way of caring

# PERMIT
# TO OPERATE

A Drinking Water System with
301-10000 Connections

System Name: **Mackenzie CWS Morfee Lake**

Physical Location: **Mackenzie CWS**
**1 Mackenzie Boulevard**
**Mackenzie BC**

Owner Name: **District Of Mackenzie**

Conditions of Permit

> Maintain a minimum of 5 water bacteriology samples per month unless the Environmental Health Officer requests a greater frequency.
> Maintain an up-to-date Emergency Response Plan.
> Operator must be trained and certified at the level specified by the Environmental Operators Certification Program.
> Submit water chemistry data every 1 years, unless the Environmental Health Officer requests a greater frequency.

30-Mar-1996
Effective Permit Date

A. Snell
Environmental Health Officer

2-Jul-2019
Permit Revised Date

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# Appendix B

*Manganese Fact Sheets from Northern Health*

# FREQUENTLY ASKED QUESTIONS - MANGANESE

## What is manganese and how am I exposed to it?

Manganese is an essential element (or nutrient) for all living organisms and is present in various kinds of foods. It is also found in some drinking water sources. Consuming a small amount of manganese from food or water is needed to stay healthy.

## Why was the guideline for manganese in drinking water revised?

| Previous limit | New limit | |
|---|---|---|
| *AO: 0.05mg/L | **MAC: 0.12mg/L | AO: 0.02mg/L |

*Aesthetic Objective
**Maximum Acceptable Concentration

Manganese has long been considered to only be an aesthetic concern in drinking water, causing discoloured water and/or staining of laundry or fixtures. However, new research has shown that exposure to high levels of manganese in drinking water poses a greater health risk than previously thought. The new evidence has shown that consuming drinking water with high levels of manganese may impact the memory, attention, motor function, and the overall intellectual development of infants and young children.

## Who is at risk from drinking elevated levels of manganese in drinking water?

Although exposure to high levels of manganese in drinking water can pose a health risk to the general population as a whole, infants are at greater risk from manganese in drinking water than children and adults because their brains are developing rapidly, they drink more water relative to their body weight, and they absorb more manganese and are less able to remove it from their bodies in comparison to children and adults. Infants consuming formula prepared with contaminated drinking water are particularly at risk.

## Should I use tap water to bottle-feed my infant?

Formula, reconstituted with tap water, can be a source of exposure to manganese for bottle-fed infants. In areas where the level of manganese in drinking water is above the Health Canada guideline (0.12 mg / L), it is recommended that an alternate source of water (e.g. bottled water) be used to prepare infant formula. If you are on your own water source (i.e. a private well) you should test your drinking water.

## Can I transfer manganese to my infant if I am pregnant or breast feeding?

The amount of manganese transferred from an expecting mother is not fully understood, however, it is expected that the manganese absorption and excretion would be managed by the mother's body. Breastfeeding is not likely to be a significant route of exposure. New and expecting mothers whose drinking water source has a manganese concentration above the maximum acceptable concentration may wish to use an alternate source of drinking water. Contact your physician if you have health concerns.

## What health effects can result from exposure to manganese in drinking water?

Although humans need to ingest small amounts of manganese to be healthy, too much manganese in drinking water can lead to some health effects, primarily affecting the central nervous system. The health effects from manganese exposure are related to neurological function, and related symptoms could include changes in behaviour, poor memory, or reduced motor function.

## Is short-term exposure to manganese in drinking water at levels above the maximum acceptable concentration (MAC) a health risk?

The guideline was established to be protective of the most sensitive population, which is formula-fed infants. If the manganese level in your drinking water is above the guideline, you should consider using an alternate source of water to make infant formula. Short-term exposure to levels of manganese in drinking water above the MAC can be a health risk, particularly to infants. Infants are at greater risk from manganese in drinking water than children and adults because their brains are developing rapidly, they drink more water based on body weight, and they absorb more manganese and are less able to remove it from their bodies.

For adults and older children, who drink less water relative to their body weight than bottle-fed infants, short-term exposure to manganese in drinking water slightly above the guideline is not a concern. However, if this is a long-term situation, a permanent solution such as the use of a treatment device or an alternate source of drinking water should be considered.

## Did drinking manganese in the past impact my health?

For communities with historical issues related to elevated levels of manganese in their drinking water, there may be concern regarding potential health impacts, particularly if infants have been relying on tap water. When considering risk, it is important to note:

- The new maximum acceptable concentration (MAC) of manganese given in Health Canada's guidelines is based on animal studies and includes safety factors to ensure even sensitive individuals are protected. Concentrations approaching, but remaining less than, the MAC are not associated with increased health risks in any individuals.
- Health Canada calculated the MAC assuming that people would be constantly exposed to elevated levels of manganese for long periods of time. Occasionally consuming water with manganese concentrations slightly greater than the MAC is unlikely to cause any health issues.
- Health Canada has adopted a precautionary approach due to the limitations on the available information. Manganese concentrations greater than the guideline are only representative of a potential risk to health, but do not represent measurable health impacts.

If you have been consuming water with elevated levels of manganese and are experiencing, or have concerns regarding these issues, you should consult your physician.

## If levels of manganese in my water are above the guideline value, can I still use it to bathe, shower and wash hands?

Exposure to manganese through skin contact is not harmful. The exposure risk from hand washing, showering, or bathing from water with manganese is unlikely to be significant. Inhalation of manganese aerosols during showering has not been directly evaluated but it is not expected to pose a risk to human health.

## How do I know if there is manganese in my drinking water?

The only way to determine if you have elevated levels of manganese in your drinking water is to have it tested. Water with high levels of manganese can have a purple, brown, or blackish colour; however, a better indicator is discolouration of fixtures such as kettles or toilet tanks. Manganese may also facilitate the growth of manganese bacteria which may form black-brown (manganese) slime and produce a foul odor that may be mistaken for sewage contamination. Contact can be made with your water supplier to request information on manganese results.

- For permitted water supply systems the results of chemical/metal testing are publically available at www.healthspace.ca/nha

## Do I need to test my water to make sure the treatment is working?

Routine testing on treated water should be conducted to verify that the device is working. Analysis of water samples should be conducted by an accredited laboratory.

## How does manganese get in my drinking water? Do groundwater supplies have more manganese than water from lakes or rivers?

Home drinking water treatment systems are an option for reducing high levels of manganese. Appropriate treatment to reduce levels of manganese in drinking water include: reverse osmosis, ion exchange/water softeners and oxidizing filters. These treatment systems are typically installed at the point-of-entry into the home. They can also be used at the point-of-use (e.g. taps or faucets). Boiling water will not remove manganese and may actually increase the manganese concentration.

Look for a water treatment device that is certified by the Standards Council of Canada (SCC). Certification means that a device works as claimed by the manufacturer. *Note: There are currently no devices specifically intended for removing only manganese. However, any device that meets NSF/ANSI Standard 42 is able to reduce manganese to safe levels.

How you select an appropriate treatment system will depend on a variety of factors, including ‘how much’ and the ‘form’ of manganese. Other factors that would influence treatment choice include: hardness, iron, alkalinity, sulphide, ammonia and dissolved organic carbon concentrations. It is recommended that you consult a water treatment professional to assess and determine appropriate treatment for your water.

## How does Health Canada’s guideline for manganese compare internationally?

Health Canada has established a health-based maximum acceptable concentration (MAC) for manganese in drinking water of 0.12 milligrams per litre (mg/L) and an aesthetic objective of 0.02 mg/L. Health Canada is the first national jurisdiction to develop a health-based limit for manganese in drinking water that takes into account new science suggesting potential effects on the central nervous system during development. The calculated health-based limit, which is the basis for the MAC, is lower than the United States Environmental Protection Agency’s non-regulatory health advisory (0.3 mg/L), the Australian Drinking Water Guideline (0.5 mg/L), and the ‘health-based value’ established by the World Health Organization (0.4 mg/L, though no formal guideline was established).

Similarly, Health Canada’s aesthetic objective is based on new research and is also lower than those currently established by other agencies. The U.S. EPA established a secondary maximum contaminant level for manganese in drinking water of 0.05 mg/L, based on aesthetic considerations. The Australian Drinking Water Guideline has an aesthetic guideline of 0.1 mg/L for manganese in drinking water.

## How should drinking water systems be monitored to determine if the drinking water exceeds the maximum acceptable concentration (MAC) for manganese?

Health Canada recommends that water sources should be tested to determine if manganese is present. This should include sampling during periods when manganese is mostly likely to be elevated in surface waters such as during thermal stratification in the summer and lake turnover in the fall. While manganese concentrations in groundwater are less likely to fluctuate between seasons, large variations have been observed between wells located in close proximity to each other. Therefore, all wells in a well field should be tested. Monitoring of surface water should be conducted quarterly with weekly monitoring during summer/ fall in lakes and reservoirs subject to stratification and/or large fluctuations in manganese concentrations. Groundwater sources should be monitored semi-annually. Authorities may consider reduced monitoring when it has been demonstrated that manganese is present at concentrations equal to or below 0.02 mg/L in the source water and/or appropriate treatment is in place.

## How do I obtain more information?

Please visit our webpage for more information and links to a number of resource materials:

https://www.northernhealth.ca/services/environmental-health/drinking-water/drinking-water-resources or email us at php@northernhealth.ca

## REFERENCES

1. https://www.canada.ca/en/health-canada/programs/consultation-manganese-drinking-water/manganese-drinking-water.html

| | |
|---|---|
| Website: | TitleCanada.ca |
| Article Title: | Manganese in Drinking Water |
| Date Published: | June 03, 2016 |
| Date Accessed: | May 17, 2019a |

2. https://www.healthlinkbc.ca/healthlinkbc-files/manganese-drinking-water

| | |
|---|---|
| Article title: | Manganese in Drinking Water |
| Website title: | HealthLink BC |