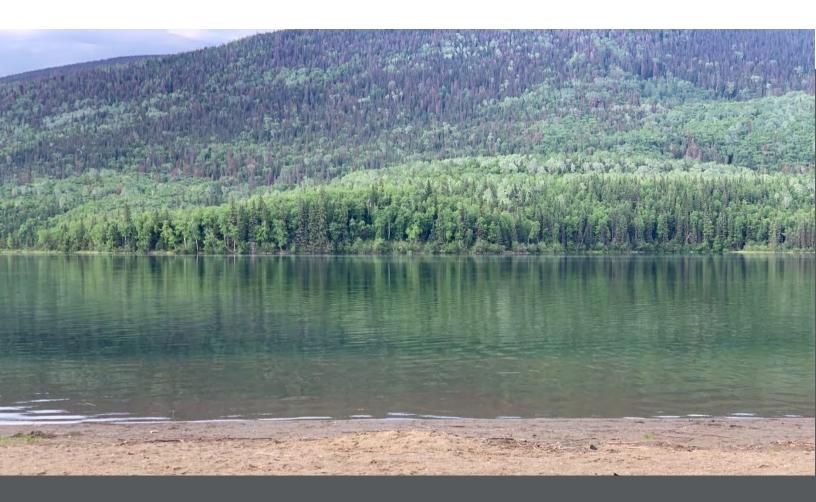
FINAL REPORT





District of Mackenzie 2018 Water System Annual Report

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1.0 Introduction

The District of Mackenzie (District) has prepared this Annual Water System Report for 2018. 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 dominantly 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.

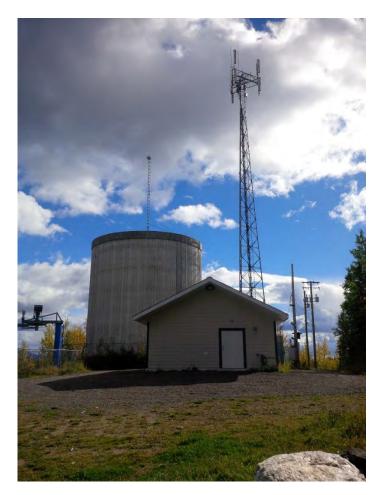


Figure 2.1: Town Reservoir



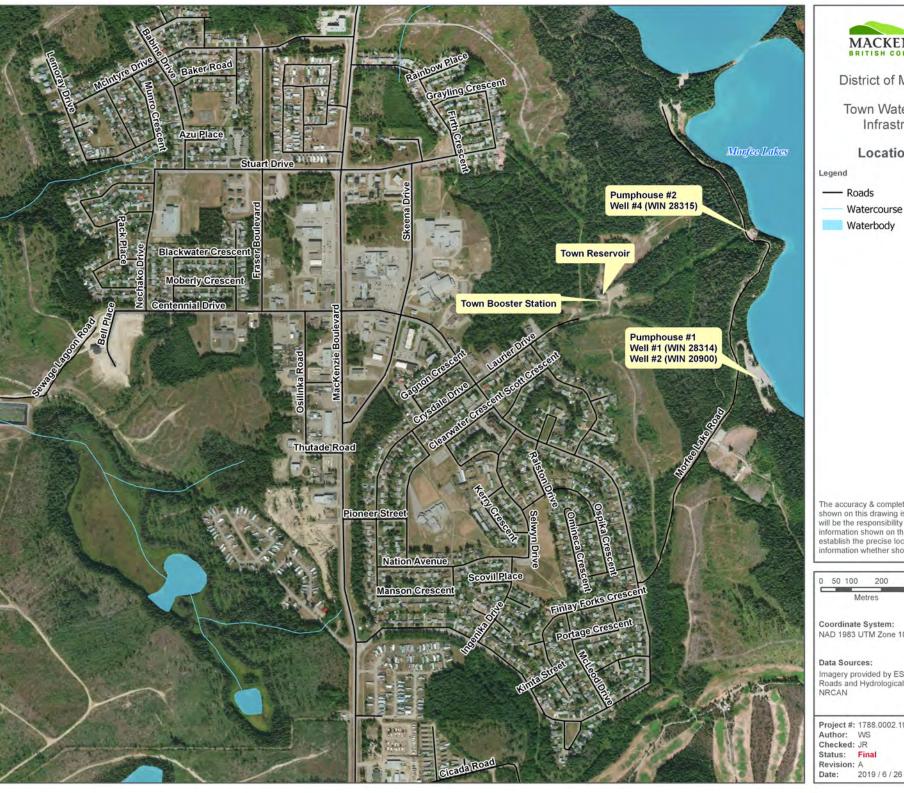


A booster station supplies water from the reservoir to town users. The Town booster station has three electric booster pumps and an emergency diesel fire pump. Booster pumps turn on and off as necessary to maintain pressure in the distribution system. Boosting the pressure is required as the reservoir 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 2.2 shows an overview of the Town System water infrastructure.





MACKENZIE District of Mackenzie Town Water System Infrastructure Location Map - 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. 200 300 Metres

Scale: NAD 1983 UTM Zone 10N 1:12,500 (When plotted at 8.5"x11") Imagery provided by ESRI Roads and Hydrological features provided by NRCAN Project #: 1788.0002.19 URBAN systems

FIGURE 2.2



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 1,350 cubic meter storage reservoir next to Well #1 on Columbia Drive. This reservoir is an above ground, insulated, metal structure.

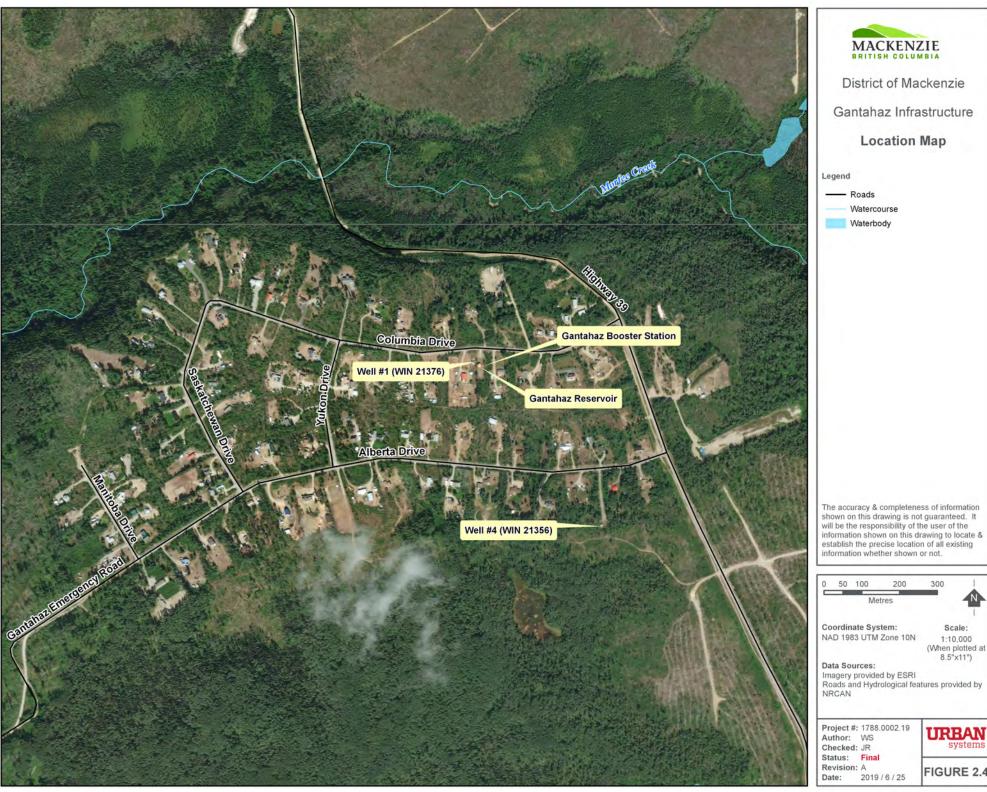


Figure 2.3: Gantahaz Booster Station and Reservoir. (*taken from Google Maps, Image capture: May 2012* © *2019 Google*)

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 also has a portable, gas powered generator that can be used to power the station in a power outage; however, this generator is required to be operated manually.

The Gantahaz distribution system is composed primarily of PVC pipe. The Gantahaz system has approximately 80 connections. Figure 2.4 shows an overview of the Gantahaz System water infrastructure.





1:10,000 (When plotted at 8.5"x11") Imagery provided by ESRI Roads and Hydrological features provided by

300

Scale:

URBAN

FIGURE 2.4

systems



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 Wester 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).

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.





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 by 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 2018 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 2018 include:

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

Monthly tasks performed in 2018 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 – 2018

In 2018, 529,979 cubic meters of water were pumped into the Town distribution system, 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 has not been included as a result. Figure 4.1 shows the monthly water consumption for the Town system. The average daily flow for the year was 1,580 cubic meters per day.

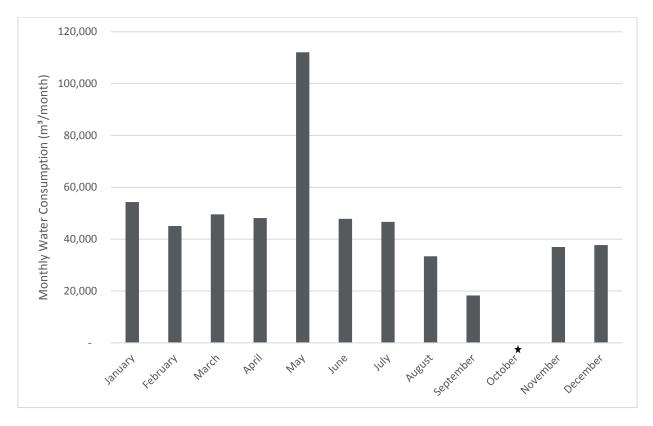


Figure 4.1: Monthly Water Consumption for the Town Water System

★ Note: 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 has not been included as a result.

The Gantahaz system pumped 31,281 cubic meters of water throughout 2018. Figure 4.2 shows the monthly water consumption for the Gantahaz system. The average daily flow for the year was 90 cubic meters per day.





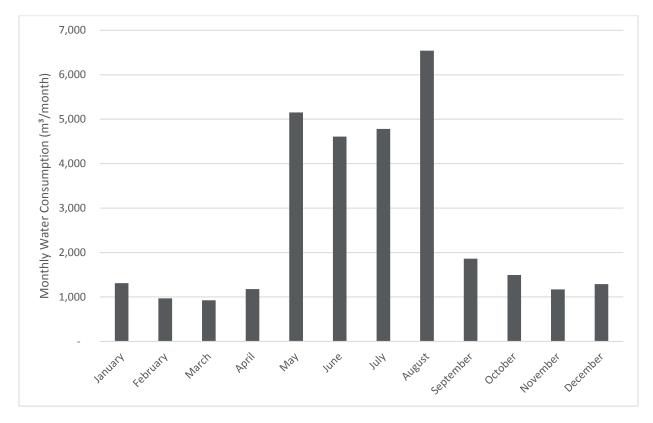


Figure 4.2: Monthly Water Consumption for the Gantahaz Water System

No flow records are available for the Airport System.





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.





Parameter Frequency		Locations	Comments
Town System			·
Escherichia coli, Total Coliforms	Weekly	Mackenzie Hospital	
Escherichia coli, Total Coliforms	Weekly	 Pumphouse #1 (Well #1 & #2) Pumphouse #2 (Well #4) Public works office Town Booster Station Northwest Quadrant (Munro Crescent, Blackwater Crescent, Crooked Creek Crescent) Southeast Quadrant (Pine Crescent, Parsnip Crescent) 	Sample locations are rotated on a weekly basis with one of the listed locations sampled per week.
Comprehensive Drinking Water Test	Annually	Hospital, Town booster station, and various locations throughout the town system.	Including total and dissolved metals.
Gantahaz System	n		
Escherichia coli, Total Coliforms Bi-week		 Gantahaz booster station Gantahaz Well #4 Gantahaz Well # 1. Distribution System (including Columbia Drive, Manitoba Drive, Yukon Drive, and Saskatchewan Drive) 	Sample locations are rotated on a bi-weekly basis, with one of the listed locations sampled bi-weekly.
Comprehensive Drinking Water Annually Test		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.

Table 5.1: Water Sampling Parameters, Locations, and Frequency





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. A complete set of lab results can be found on Northern Health's website: https://www.healthspace.ca/Clients/NHA/NHA Website:

The number of bacteriological samples for the Gantahaz system did not meet the sampling frequency outlined by the Gantahaz Permit to Operate (2 samples per month). This is due to a number of factors, including staff changeover and ongoing construction at the Gantahaz booster station affecting operations availability. The District plans to follow the noted sampling frequencies in 2019 for all water systems.

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: <u>https://www.healthlinkbc.ca/healthlinkbc-files/preventing-water-borne-infection</u>

With regards to the 2018 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 could be related to iron or manganese accumulation or oxidation in the water system. Future analysis of raw well water is recommended to determine whether the turbidity exceedances observed in both the Town and Gantahaz systems are a cause for concern.

<u>Iron</u>

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 July 6th on Manitoba Drive, and one December 11th at Well #4. The Town system had only one iron exceedance on Nov. 27th at the Town booster station.

<u>Manganese</u>

Similar to 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.

The District flushes each distribution system twice per year to control the iron and manganese concentrations. The bulk of the iron and manganese exceedances occurred at the source points, rather than at the consumption points within the distribution system, indicating that the system flushing is largely keeping the water quality within the expected range.

The District should continue to monitor iron and manganese levels within their water systems to keep exceedances to a minimum. The reservoir should also be inspected to determine whether sediment buildup is leading to higher results in some testing locations. 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.





	Location	Number of Samples	Minimum	Maximum	Average	Guideline
	Town Distribution System	67	<1	<1	<1	
E. Coli (CFU/100 mL)	Gantahaz Distribution System	7	<1	<1	<1	MAC < 1 CFU/100 mL
	Airport System	11	<1	<1	<1	
	Town Distribution System	67	<1	<1	<1	
Total Coliforms (CFU/100 mL)	Gantahaz Distribution System	7	<1	<1	<1	MAC < 1 CFU/100 mL
(,	Airport System	11	<1	<1	<1	

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

Table 6.2: General Water Chemistry Results for the Town System

	Units	23 Pine Crescent	44 Muncro Crescent	216 Blackwater Crescent	#4 Parsnip Crescent	GCDWQ MAC ¹	GCDWQ AO ²
Date Sampled		27-Jun-2018	27-Jun-2018	27-Jun-2018	27-Jun- 2018		
Colour, True	CU	<5.0	<5.0	<5.0	<5.0		15
Hardness (as CaCO3)	mg/L	150	153	153	152		500
рН	pН	8.48	8.49	8.47	8.46		7-10.5
Total Dissolved Solids	mg/L	177	190	185	185		500
Turbidity	NTU	1.12	0.85	0.83	0.67	1.0 ³	
Chloride (Cl)	mg/L	2.07	2.13	2.10	2.09		250
Fluoride (F)	mg/L	0.055	0.055	0.055	0.055	1.5	
Nitrate (as N)	mg/L	0.0552	0.0571	0.0561	0.0567	10	
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	1	

¹ Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration

² Guidelines for Canadian Drinking Water Quality Maximum Aesthetic Objective

³ 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.

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





	Units	23 Pine Crescent	44 Muncro Crescent	216 Blackwater Crescent	#4 Parsnip Crescent	Pump House #1	Pump House #1	Public Works Lunchroom	Public Works Lunchroom	Mackenzie Hospital	Mackenzie Hospital	Town Booster Station	Town Booster Station	GCDWQ MAC ¹	GCDWQ AO ²
		27-Jun-2018	27-Jun-2018	27-Jun-2018	27-Jun-2018	27-Nov-2018	11-Dec-2018	27-Nov-2018	11-Dec-2018	27-Nov-2018	11-Dec-2018	27-Nov-2018	11-Dec-2018		
Aluminum (Al)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.0030	<0.0050	<0.0030	<0.0050	<0.0030	<0.0050	<0.0030		0.1
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00050	<0.00010	<0.00050	<0.00010	<0.00050	<0.00010	0.006	
Arsenic (As)-Total	mg/L	0.00102	0.00090	0.00096	0.00097	0.00312	0.00266	0.00219	0.00242	0.00213	0.00192	<0.00050	0.00321	0.01	
Barium (Ba)-Total	mg/L	0.060	0.058	0.059	0.059	0.072	0.060	0.072	0.068	0.072	0.071	0.078	0.071	1	
Boron (B)-Total	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.010	<0.10	<0.010	<0.10	<0.010	<0.10	<0.010	5	
Cadmium (Cd)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.000010	<0.000005	<0.000005	<0.000005	0.0000068	<0.000005	0.00001	<0.000005	0.005	
Chromium (Cr)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0001	<0.0010	<0.0001	<0.0010	<0.0001	<0.0010	<0.0001	0.05	
Copper (Cu)-Total	mg/L	0.181	0.083	0.158	0.099	0.002	0.001	0.137	0.103	0.297	0.381	0.004	0.001	2	1
Iron (Fe)-Total	mg/L	0.070	0.059	0.061	0.050	0.091	0.087	0.076	0.098	0.074	0.068	1.530 ³	0.166		0.3
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.000085	<0.00050	0.00021	<0.00050	0.00011	0.00282	0.00057	0.005	
Manganese (Mn)-Total	mg/L	0.029	0.007	0.012	0.014	0.076	0.064	0.016	0.021	0.025	0.022	0.218 ³	0.096	0.12 (as of May 2019)	0.02 (as of May 2019)
Selenium (Se)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.05	
Sodium (Na)-Total	mg/L	2.8	2.9	2.9	2.9	2.9	3.0	2.8	2.9	2.9	2.7	3.1	2.8		200
Uranium (U)-Total	mg/L	0.00065	0.00066	0.00067	0.00066	0.00224	0.00213	0.00199	0.00195	0.00198	0.00204	0.00032	0.00198	0.02	
Zinc (Zn)-Total	mg/L	<0.050	<0.050	<0.050	<0.050	<0.0050	<0.0030	0.0116	0.0035	0.0065	0.0043	0.2400	0.0219		5

Table 6.3: Total Metal Water Quality Results for the Town System

¹ Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration

² Guidelines for Canadian Drinking Water Quality Maximum Aesthetic Objective

³ These values appear to be anomalous. It is possible there was an error in the laboratory test procedure or in the laboratory data entry. It is recommended that iron and manganese continue to be monitored over the coming year. If there is another water quality result in this range, another test should immediately be performed to confirm an error has not occurred.

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

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	Units	#37 Manitoba Drive	#8 Yukon Drive	#6 Saskatchewan Drive	#1 Columbia Drive	GCDWQ MAC ¹	GCDWQ AO ²
Date Sampled		06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18		
Colour, True	CU	<5.0	<5.0	<5.0	<5.0		15
Hardness (as CaCO3)	mg/L	159	161	157	161		500
рН	pН	8.32	8.34	8.34	8.34		7-10.5
Total Dissolved Solids	mg/L	192	197	195	195		500
Turbidity	NTU	4.26	1.2	2.2	0.16	1.0 ³	
Chloride (Cl)	mg/L	<0.5	<0.5	<0.5	<0.5		250
Fluoride (F)	mg/L	0.094	0.097	0.098	0.098	1.5	
Nitrate (as N)	mg/L	0.086	0.095	0.044	0.028	10	
Nitrite (as N)	mg/L	0.003	0.004	0.003	0.001	1	
Total Organic Nitrogen		<0.06	<0.06	<0.06	<0.06		500

Table 6.4: General Water Chemistry Results for the Gantahaz System

¹ Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration

² Guidelines for Canadian Drinking Water Quality Maximum Aesthetic Objective

³ 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.

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





	Units	#37 Manitoba Drive	#8 Yukon Drive	#6 Saskatchewan Drive	#1 Columbia Drive	#1 Columbia Drive	Gantahaz Booster Station	Gantahaz Booster Station	Gantahaz Well #4	GCDWQ MAC ¹	GCDWQ AO ²
Date Sampled		06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18	27-Nov-2018	27-Nov-2018	11-Dec-2018	11-Dec-2018		
Aluminum (AI)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.0050	<0.0030	0.0033		0.1
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	0.006	
Arsenic (As)-Total	mg/L	0.00884	0.00407	0.00473	0.00419	0.00292	0.00544	0.00467	0.00534	0.01	
Barium (Ba)-Total	mg/L	0.099	0.098	0.101	0.097	0.101	0.110	0.102	0.106	1	
Boron (B)-Total	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.010	<0.010	5	
Cadmium (Cd)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00001	0.00001	<0.00001	<0.00001	0.005	
Chromium (Cr)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0010	<0.00010	<0.00010	0.05	
Copper (Cu)-Total	mg/L	0.0279	0.0204	0.0045	0.0035	0.0087	<0.0010	0.0007	0.0011	2	1
Iron (Fe)-Total	mg/L	0.679	0.117	0.182	0.030	<0.030	0.269	0.228	0.372		0.3
Lead (Pb)-Total	mg/L	0.0011	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0001	0.0005	0.005	
Manganese (Mn)-Total	mg/L	0.042	0.011	0.024	0.009	0.005	0.134	0.091	0.140	0.12 (as of May 2019)	0.02 (as of May 2019)
Potassium (K)-Total	mg/L	0.91	0.95	0.93	0.95	<2.0	<2.0	0.65	0.63	0.001	
Selenium (Se)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0001	<0.0001	<0.0001	<0.0001	0.05	
Sodium (Na)-Total	mg/L	4.9	5.3	5.2	5.4	2.8	2.8	2.7	2.6		200
Uranium (U)-Total	mg/L	0.005	0.005	0.005	0.005	0.003	0.003	0.003	0.003	0.02	
Zinc (Zn)-Total	mg/L	0.0077	0.0064	<0.0050	<0.0050	<0.0050	0.0223	0.0119	0.0097		5

Table 6.5: Total Metal Water Quality Results for the Gantahaz System.

¹ Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration

² Guidelines for Canadian Drinking Water Quality Maximum Aesthetic Objective

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





7.0 Capital Works and Other Initiatives

7.1 Morfee Well Project

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. The Morfee Well Project was started in July 2017 with the drilling of a test well approximately 25 ft South of Pumphouse 1 on Morfee Lake. Drilling of the production well began in September 2017 using a different type of drill rig intended to minimize overspill of water and disturbance of sand and silt. The projected water yield could not be achieved due to a very rare formation of the layers of gravel, sand, and silt layers. Another production well was drilled using a slightly different rig closer to the original test well. After about a week of drilling and another few days of development, water was produced at a higher capacity than projected. The project included updates to the existing Pumphouse 1 including an improved power supply and modern controls. The Morfee well project was completed on budget in July 2018.

7.2 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 will include 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 is expected to be completed in 2019.

8.0 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. The District hopes to receive funding by Fall 2019.





9.0 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. Review the new manganese regulation, and how it impacts the District's water system. This will include additional water quality sampling to determine whether there is an ongoing exceedance of the MAC. If needed, the District will consider altering operational parameters, such as the distribution system flushing frequency, and reservoir cleaning.
- 2. Review the water quality sampling program to ensure the best possible information on the water system is received.

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





10-411-7011 (LC - Appr. - 06/11pc)

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



PERMIT TO OPERATE

A Drinking Water System with 301-10000 Connections

System Name:	Mackenzie CWS Morfee Lake
Physical Location :	Mackenzie CWS 1 Mackenzie Boulevard Maakanzie BC
Owner Name:	Mackenzie BC District Of Mackenzie

> Maintain a minimum of 5 water bacteriology samples per month unless the Environmental Health Officer requests a greater frequency.

Conditions of Permit

> 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

Environmental Health Officer

2-Jul-2019 Permit Revised Date



10-411-7011 (LC - Appr. - 06/11pc]



Appendix B

Manganese Fact Sheets from Northern Health



MANGANESE IN DRINKING WATER

Changes to acceptable concentrations: Effective May 10, 2019

Ρ	Previous limit	New limit			
A	O: 0.05mg/L	MAC: 0.12mg/L	AO: 0.02mg/L		

Manganese in drinking water

Manganese is widely distributed in air, water and soil. Manganese may be present in the environment from natural sources (rock and soil weathering) or as a result of human activities (industrial, landfills). Manganese in an essential nutrient and some manganese is required for proper bodily function. However, 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. Manganese can also affect the taste and appearance of drinking water. New information on effects of manganese in drinking water of 0.12mg/L (milligrams per litre) and a reduced Aesthetic Objective (AO) of 0.02mg/L. Although the MAC was established based on infants, this value is intended to protect all Canadians. The reduced AO is intended to minimize the occurrence of discoloured water due to manganese and to improve consumer confidence in drinking water quality.

What the drinking water guideline changes mean for drinking water system operators

Northern Health will work with water suppliers (owners/operators) of systems that are approaching or exceeding the new limits and support the implementation of these more stringent water quality requirements. This may include developing new or modifying existing water quality monitoring programs and, if needed, establishing plans to mitigate exceedances. Timelines for improvements will be established in consultation with your Environmental Health Officer.

For more information:

Guidelines for Canadian Drinking Water Quality: https://www.canada.ca/en/health-canada/services/environmental-workplace-health/water-quality/drinking-water/canadian-drinking-water-guidelines.html

Safe drinking water system operations: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/drinking-water-quality/how-drinking-water-is-protected-in-bc

For information on accredited laboratories: www.cala.ca

Healthlink BC File for Manganese not yet available See https://www.healthlinkbc.ca/services-and-resources/healthlinkbc-files for a list of all Healthlink BC files

Example of information page for public (from Village of Burns Lake website): http://office.burnslake.ca/public-works/water/



NEW GUIDELINES FOR LEAD AND MANGANESE IN DRINKING WATER May 2019

NEWSLETTER

Water System Owners and Operators,

New guidelines for lead and manganese in drinking water

Health Canada is updating the acceptable limits for two chemical parameters that may affect your water system. Updates to the Guidelines for Canadian Drinking Water Quality include new Maximum Acceptable Concentrations (MAC) of Manganese and Lead, as well as a reduced Aesthetic Objective (AO) for Manganese.

Parameter	Previous limit	New limit		
Lead	MAC: 0.01mg/L	MAC: 0.005mg/L		
Manganese	AO: 0.05mg/L	MAC: 0.12mg/L AO: 0.02mg/L		

The new MACs are based on research that higher concentrations in drinking water may be associated with neurological effects in children and infants.

Northern Health requests that all drinking water supply systems review their chemical water quality sample results. If test results indicate that manganese or lead concentrations exceed these new MACs please contact your Environmental Health Officer immediately.

You may be required to adjust your current water quality monitoring program and, if needed, develop and implement an action plan to meet these new requirements.

Routine testing and monitoring of drinking water quality is a requirement of the Drinking Water Protection Act. If you have not tested for chemical parameters as indicated by your Operating Permit conditions, please arrange testing with an accredited laboratory.

For further information or assistance with the new MACs and AO, please contact your Environmental Health Officer. More information related to lead and manganese, and the potential impact of the adjusted guideline on water suppliers and users, can be found on the NH website (<u>northernhealth.ca</u>), under Services>Environmental Health>Drinking Water and clicking "Drinking Water Resources".

Northern Interior Prince George 250-565-2150

Northeast Dawson Creek 250-719-6500 Northwest Terrace 250-631-4222

the northern way of caring

Health Protection & Disease Prevention 4th Floor, 1600-3rd Ave. Prince George, BC V2L 3G6 Phone: 250-565-2150