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DISTRICT OF MACKENZIE WATER SYSTEM ANNUAL REPORT - 2022

Client: District of Mackenzie

L&M Project No.: 1044-67

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TABLE OF CONTENTS

Table of Contents.....	i
1 Introduction	1
2 Community Profile	1
2.1 Community.....	1
2.2 Population	2
2.3 Climate	3
3 Mackenzie Water System Overview	3
3.1 Town Water System	3
3.2 Gantahaz Water System.....	6
3.3 Airport Water System.....	7
4 Treatment & disinfection.....	8
4.1 Town Water System	8
4.2 Gantahaz Water System.....	8
5 Water System Operation & Maintenance	9
6 Water Consumption - 2022.....	10
6.1 Town Water System	10
6.2 Gantahaz Water System.....	11
6.3 Airport Water System.....	12
7 Water Quality Monitoring.....	12
7.1 Chemical Testing Requirements:.....	12
7.2 Bacteriological Testing Requirements:	12
8 Water Quality Results	14
8.1 Bacteriological Testing Results.....	15
8.2 Water Chemistry Testing Results	16
9 Conclusion & Recommendations.....	21
Appendix A – 2022 Water Chemistry Results Summary	
Appendix B – Town System Exceedances (2018-2023)	
Appendix C – Gantahaz System Exceedances (2018-2022)	
Appendix D – Town and Gantahaz Water System Maps	
Appendix E – Water System Operating Permits	

1 INTRODUCTION

The District of Mackenzie (“The District”) operates three separate water distribution systems (Town, Airport, & Gantahaz) which are permitted by the Northern Health Authority (NHA). This 2022 Water System Annual Report has been prepared on behalf of the District as part of the District’s Water System Operating Permit conditions. This report summarizes the following for each of the systems:

- Water System Infrastructure;
- Operation and maintenance activities;
- Water quality monitoring; and
- Recently completed and upcoming capital initiatives.

To maintain compliance with 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.

Please refer to Appendix E for the operating permits for each water system and for questions please contact Jim Fast, Lead Operator, for the District at 250-997-3761 or at utilities@districtofmackenzie.ca.

2 COMMUNITY PROFILE

2.1 *Community*

Mackenzie sits in the Rocky Mountain Trench with the Omineca Mountain Range and Williston Lake to the west and the Rocky Mountains to the east. It is approximately 180km, by road, northwest of Prince George at 55N 18' north latitude and 123N 8' west longitude. Mackenzie is within the traditional territory of the Sekani People and the Town was established in 1966 after the completion of the W.A.C. Bennet Dam and the creation of the Williston Reservoir. Mackenzie is located on glacial soil mostly composed of sand and gravel that is relatively infertile and therefore has no commercial farming using the town’s water.

2.2 Population

Mackenzie is a town dependent on resource industries and as such the population fluctuates based on commodity market conditions. The District of Mackenzie is working hard to diversify its economy to ensure it can weather downturns in the resource industries. As shown in Table 1: Mackenzie Population Summary the population of Mackenzie has stabilized since the dramatic downturn of the local economy that happened in 2009 and the resulting population decrease. Based on information from the District the population has remained unchanged since the last census in 2016. Currently, the population of the community is projected to remain relatively constant with a net population increase of four percent between 2011 and 2036.

Table 1: Mackenzie Population Summary

Year	Total Population	Total Connections	Townsite Population	Townsite Connections	Gantahaz Population	Gantahaz Connections
2001	5206	1850	4835	1747	371	103
2002	5206	1850	4835	1747	371	103
2003	5039	1828	4680	1726	359	101
2004	4873	1806	4525	1705	347	100
2005	4706	1783	4370	1684	335	99
2006	4539	1761	4215	1663	324	98
2007	4333	1711	4024	1616	309	95
2008	4126	1505	3832	1421	294	84
2009	3920	1299	3640	1227	279	72
2010	3713	1092	3449	1032	265	61
2011	3507	1513	3257	1429	250	84
2012	3548	1532	3295	1447	253	85
2013	3590	1552	3334	1466	256	86
2014	3631	1571	3372	1484	259	87
2015	3673	1591	3411	1502	262	88
2016	3714	1610	3449	1521	265	89
2017	3714	1610	3449	1521	265	89
2018	3714	1610	3449	1521	265	89
2019	3714	1610	3449	1521	265	89
2020	3714	1610	3449	1521	265	89
2021	3281	1610	3449	1521	265	89
2022	3281	1610	3449	1521	265	89

Notes:

Census Data

2.3 Climate

Mackenzie has cold winters and warm summers with a substantial significant number of days without rain as shown in Table 2: Mackenzie Climate Summary below. In the winter there is generally snow cover from November until April each year. There is consistent precipitation throughout the whole year, however, in the summer the rainfall often comes in short heavy rains. On the Environment Canada website the Precipitation Data from March to June 2022 looks to be missing but not flagged

Table 2: Mackenzie Climate Summary

	Average Maximum Temperature (°C)		Precipitation (mm)		Maximum Summer Temperature (°C)	Summer Days Without Rain
	May - Oct	Nov - Apr	May - Oct	Nov - Apr		
2011	16.1	-1.1	368	187	28.4	42
2012	17.0	-0.5	227	141	30.6	54
2013	18.8	-0.2	277	194	31.8	56
2014	18.8	-1.6	279	202	34.2	64
2015 ¹	18.2	1.0	101	148	31.5	78
2016 ¹	17.4	1.7	186	78	28.5	73
2017	18.1	-2.1	288	135	32	70
2018 ¹	17.8	-1.0	141	51	33.4	70
2019	16.5	-0.3	305	180	27.8	48
2020 ¹	16.5	0.0	393	143	29.7	40
2021	18	-1.1	257	335	38.7	58
2022 ¹	19.0	-2.0	74.4	77.9	28.4	91

Notes:

Source: Environment Canada Historical Climate Data

(https://climate.weather.gc.ca/climate_data/daily_data_e.html?StationID=48370)

¹ Missing Precipitation Data

3 MACKENZIE WATER SYSTEM OVERVIEW

3.1 Town Water System

The District of Mackenzie currently obtains its drinking water from three relatively shallow wells west of the townsite adjacent to Morfee Lake.

- Well # 1 & # 5 are located in Pumhouse # 1, at First Beach.
- Well # 4 located in Pumhouse #2, at Second Beach

Table 3: Town Water System Well Identification Numbers

Well #	WIN	Pumphouse
1	28314	1
5	20900	1
4	28315	2

Note, due to age and underperformance, Well #2, referenced in past reports was replaced in July 2018 with a new drilled well (Well #5). Well #5 that has a capacity of 70 L/s.



Figure 1: Town Reservoir & Booster Station

Water is pumped from pumphouses 1 & 2 into a 500,000 lgal above grade concrete reservoir. A booster station then pumps the water throughout the distribution system. 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 to the network. 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 approximately divided between asbestos cement (AC) pipe in the older, eastern portion of the network, and newer polyvinyl chloride (PVC) pipe in the western, newer portion of the network. There are five pressure-reducing valve (PRV) stations that divide the Town distribution system into six pressure zones which ensure that pressures are within acceptable ranges throughout the distribution system. For reference, a copy of the water system map for the townsite is attached in Appendix D.

In 1998 a Water System Study was performed by L&M Engineering Limited that examined water system flows and pressure throughout the distribution network. The study also reviewed the recommended and available fire flows. The conclusions and recommendations are based on the Insurance Bureau of Canada Guidelines, however, there are no government regulations requiring any given volume of storage and the District can decide based on financial and other considerations.

The significant conclusions of the study were as follows:

- The existing booster station is capable of meeting existing and projected future demands without upgrading the capacity of the pumps.
- Like many towns the District's fire water storage capacity was identified by previous reporting as being 2,660,000 lgal (12,103,000 L) below the amount recommended by the Insurance Bureau of Canada ("IBC"); and
- With the future addition of a new reservoir, the District's distribution system can supply all the firefighting demands in accordance with the Insurance Bureau of Canada guidelines with the sole exception of a fire at the Pinedale Apartments.

The recommendations of the study were as follows:

- The District should construct a new reservoir to provide additional storage volume. The final location will be confirmed during the design process based on current needs and anticipated future demands. The minimum size of the reservoir should be 1,000,000 lgal (4,540,000 L) although as stated in the conclusions a larger size of 2,660,000 lgal is desirable;

- The District should consider a pipe cleaning program of all distribution pipes to increase pipe smoothness areas of reduced flow

Improvements are planned for the Town water system in summer 2023 as follows:

- Replace the Crysedale Place PRV Station.

3.2 *Gantahaz Water System*

Water for Gantahaz residents is supplied from two deep low capacity wells positioned in a confined aquifer with pitless adapter connections.

- Well #1 is located on Columbia Drive next to the storage reservoir
- Well #4 is located on Alberta Drive

Table: Gantahaz Water System, Well Identification Numbers.

Well #	WIN
1	21376
4	21356

Both wells pump water to a 1,350 m³ (300,000 lgal) storage reservoir next to Well #1 on Columbia Drive. This reservoir is an above-ground, insulated, metal structure.

The Gantahaz water distribution network is pressurized by a booster station located on Columbia Drive next to the storage reservoir and Well #1. The booster station has an electric booster pump with a spare pump and motor located in the building for maintenance purposes. The booster pump increases the water pressure level to approximately 55 psi and services all 90 residences (approximately 265 people).

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 is also equipped with a portable, manually operated gas-powered generator that can be used to power the station in a power outage.

Booster station controls, VFDs, and other building envelope improvements were completed in 2019.



Figure 2: Gantahaz Booster Station and Reservoir

The Gantahaz distribution system is composed of primarily PVC pipes. For reference, we have enclosed a copy of the water system map for the Gantahaz subdivision in Appendix D.

Improvements are planned for the Gantahaz water system in summer 2023 as follows:

- Well 4 chamber rehabilitation including, flow meter, and test point upgrades. Additional improvements including building up around and insulating around the well head to remove the winter heating requirements.

3.3 Airport Water System

The Airport system consists of one well, an open water reservoir, and a fire pump. The primary purpose of the airport system is to provide water for firefighting purposes for several industrial sites in the area, however, the airport system also supplies six structures.

In the summer of 2021 a new well and well pump along with associated equipment and controls were installed to service the fire lagoon. The new well is located near the pump house and the pump house has a wet well that is interconnected to the reservoir, so they are both at the same water level. The fire water reservoir is located adjacent to the pump house and is surrounded by a fence.

The fire suppression reservoir now fills automatically based on the water level of the wet well. Inside the pump house there is an electric jockey pump and in the event of a fire a diesel fire pump operates automatically.

4 TREATMENT & DISINFECTION

4.1 *Town Water System*

The Town water system supply wells are positioned within Aquifer 431 which is categorized as an unconfined sand and gravel aquifer. Source protection plans completed by Kala Geoscience Ltd. in 2015 found that Town Wells #1 and #4 are not under the direct influence of surface water (non-GWUDI). Furthermore, the Well # 5 Drilling and Completion report completed by Western Water Associates Ltd. in 2018 found that Well # 5 was not under the direct influence of surface water (non-GWUDI) nor groundwater at risk of containing pathogens (non-GARP) Seasonal water level fluctuations are not expected to impact the well yields unless there is a very prolonged drought in the region.

The water quality of the Town water supply wells meets all Northern Health health-based objectives and therefore does not require treatment or disinfection but does require long-term water quality monitoring, the results of which are shown in Section 7.

4.2 *Gantahaz Water System*

The Gantahaz water system supply wells are positioned in a deep confined aquifer and are considered not groundwater under direct influence (GWUDI) and not groundwater at risk of pathogens (GARP). Historically, aquifer water quality results have complied with all Northern Health's health-based objectives. However, in 2019 a new maximum allowable concentration of manganese was implemented by Northern Health.

However, over the past several years the levels of iron and manganese in the source water have fluctuated, with the total metal analysis showing the presence of iron ranging from 0.030 to 1.47 mg/L (aesthetic objective: 0.3 mg/L) and manganese ranging from 0.005 to 0.145 mg/L (maximum allowable concentration: 0.12 mg/L and aesthetic objective: 0.02 mg/L).

Testing completed in 2021 throughout the distribution network has indicated the accumulation of manganese in the network is causing significant but inconsistent exceedances of the MAC for manganese.

Based on the monitoring performed in 2021 and the new MAC for manganese, treatment of this water supply will be necessary in the future to reduce source levels and mitigate accumulation in the water network.

The District should monitor the concentrations and develop a plan to decrease concentrations. These plans could be as simple as more frequent flushing or implementing some of the recommendations from the study that the District of Mackenzie engaged L&M Engineering and Conestoga Rover Associates to undertake in 2008. The study researched the following concerns:

- Mitigate the residents' request for improved quality of water;
- Provide a water treatment system that is simple to operate by the householder;
- Provide a water treatment system that is "eco-friendly" and does not introduce chemicals into the environment; and
- Minimize the potential for future maintenance cost expenditures by the District of Mackenzie.

The conclusion of the study was that a new water treatment plant is required to reduce the levels of iron and manganese at that time to acceptable levels. The District does not have available budget but is working on obtaining grant funding to complete this project.

5 WATER SYSTEM OPERATION & MAINTENANCE

The District's water system was upgraded from a Class II to a Class III distribution system in April 2018. The District employs one Class II distribution system operator, Jim Fast, Class 2 ECOP number 8864, and Mark Turnbull, trainee operator. Jim Fast is in the process of obtaining a sufficient number of direct responsible charge (DRC) credits to take the Environmental Operators Certification Program (EOCP) Class III Distribution course.

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 involve several daily, weekly, periodic, and/or 'as-needed' tasks.

Daily tasks performed in 2022 include:

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

Weekly tasks performed in 2022 include:

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

Monthly tasks performed in 2022 include:

- Check static water levels in wells; and
- 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 water mains (twice annually); and
- Exercise control valves, isolation valves, hydrants, and related appurtenances (annually).
- Water quality is discussed in Section 7.

6 WATER CONSUMPTION - 2022

6.1 Town Water System

The total water distributed to the Town distribution system in 2022 was 590,149 m³. Table 4: Town Water System Consumption shows the monthly water consumption for the Town Water system. The average daily flow and average daily per/capita flow for 2022 was 1,617 m³/day and 469 L/day/person respectively. The average daily flow in 2022 was slightly

higher than 2021, 2020, 2019 and 2018 which were 1,513 m³/day 1,432 m³/day, 1,483 m³/day, and 1,580 m³/day respectively.

Table 4: Town Water System Consumption

Month	Total Monthly Flow (m ³)	Average Daily Flow (L/s)
January	55110.1	20.58
February	51124.1	21.14
March	61084.6	22.81
April	43149.0	16.65
May	45826.6	17.11
June	43706.3	16.86
July	50271.9	18.77
August	53260.3	19.89
September	38730.3	14.94
October	43358.2	16.19
November	41292.6	15.93
December	63235.4	23.61

6.2 Gantahaz Water System

The total water distributed to the Gantahaz distribution system 2022 was 38,021 m³. Table 5: Gantahaz Water System Consumption shows the monthly water consumption for the Gantahaz system. The average daily flow and average daily per/capita flow for 2022 was 104 m³/day and 393 L/day/person respectively. The average daily flow in 2022 was significantly higher than 2020, 2019, and 2018 which were 71 m³/day, 87 m³/day, and 90 m³/day respectively, but slightly lower than calculated average for 2021 of 119 m³/day.

Table 5: Gantahaz Water System Consumption

Month	Total Monthly Flow (m ³)	Average Daily Flow (L/s)
January	1902.5	0.71
February	1786.5	0.74
March	1225.4	0.46
April	1522.0	0.59
May	2620.6	0.98
June	3307.8	1.28
July	4767.8	1.78

August	7319.1	2.73
September	6750.5	2.60
October	2028.6	0.76
November	2441.9	0.94
December	2348.3	0.88

6.3 Airport Water System

There are no flow records available for the Airport system. Since this system is mainly providing firefighting water, with only six service connections, the water consumption is expected to be low.

7 WATER QUALITY MONITORING

In order 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 the Water System Operation permits and the Drinking Water Protection Regulation.

7.1 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. Additional Testing has been performed to determine where elevated metals are occurring.

7.2 Bacteriological Testing Requirements:

The District's Operating Permits require the submittal of a minimum of five water bacteriological samples per month for the Town system, two bacteriological samples per month for the Gantahaz system, and one 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 not notify users of potential issues.

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

Table 6: DWPR Water Quality Standards

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

The water sampling parameters, locations, and frequency for the District’s water system are shown in Table 7: Water Sampling Parameters, Locations, and Frequency. All samples are sent to an accredited laboratory (ALS Analytical Services). This sampling program meets the requirements outlined in the District’s Water System Operating Permits.

Table 7: Water Sampling Parameters, Locations, and Frequency

Parameter	Frequency	Locations	Comments
Town System			
Escherichia coli, Total Coliforms	Minimum five per month	<ul style="list-style-type: none"> Mackenzie Hospital Pumphouse #1 (Well #1 & #5) 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
Comprehensive Drinking Water Test	Minimum Annually	Town booster station, and various locations throughout the town system.	Including total and dissolved metals.
Gantahaz System			
Escherichia coli, Total Coliforms	Minimum twice per month	<ul style="list-style-type: none"> 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

Comprehensive Drinking Water Test	Minimum Once every three years	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.

8 WATER QUALITY RESULTS

Water samples were sent to ALS Analytical Services for bacteriological and water chemistry laboratory testing. A complete set of lab results can be found on Northern Health’s website: https://www.healthspace.ca/Clients/NHA/NHA_Website.nsf.

Based on the chemistry sampling that was completed, the majority of water samples conformed to the 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 percent safe, and sudden water quality failures can take hours or even days to identify and communicate 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 2022 water quality testing summarized below, there are a few parameters that exceed the guidelines. The parameters that were above the guidelines are the following:

Table 8: Parameters Exceeding Guidelines

Location	Parameter	Guideline	Number of Samples	Number of Samples Over Guideline	Minimum	Average	Maximum
Town (Distribution)	Manganese (Mn) - Total	MAC ≤ 0.12 mg/L AO ≤ 0.02 mg/L	4	Above AO = 4	0.030	0.041	0.071
Town (Distribution)	Turbidity	OG ≤ 1 NTU	4	Above OG = 2	0.50	1.40	2.37
Gantahaz (Source)	Iron (Fe) - Total	AO ≤ 0.3 mg/L	3	Above AO = 3	0.439	0.678	0.993
Gantahaz (Source)	Manganese (Mn) - Total	MAC ≤ 0.12 mg/L AO ≤ 0.02 mg/L	3	Above MAC = 1 Above AO = 3	0.088	0.109	0.129
Gantahaz (Source)	Turbidity	OG ≤ 1 NTU	3	Above OG = 3	2.440	4.823	9.110
Location	Parameter	Guideline	Number of Samples	Number of Samples Over Guideline	Minimum	Average	Maximum
Gantahaz (Distribution)	Arsenic (As) - Total	MAC ≤ 0.01 mg/L	9	Above MAC = 2	0.0021	0.0113	0.065
Gantahaz (Distribution)	Iron (Fe) - Total	AO ≤ 0.3 mg/L	9	Above AO = 3	<0.010	1.163	6.970
Gantahaz (Distribution)	Manganese (Mn) - Total	MAC ≤ 0.12 mg/L AO ≤ 0.02 mg/L	9	Above MAC = 2 Above AO = 6	0.0013	0.323	2.260

MAC = Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration

AO = Guidelines for Canadian Drinking Water Quality Maximum Aesthetic Objective

OG = Guidelines for Canadian Drinking Water Quality recommend 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.

8.1 Bacteriological Testing Results

In 2022, there were 127 Bacteriological Samples taken throughout the district's three systems with each sample tested for E. Coli and Total Coliforms. The Town System had 29 samples taken, Gantahaz System has 89 samples, and the Airport System has 9 samples taken. A summary of the results of the bacteriological water quality sampling is provided in Table 9: Bacteriological Sampling Results. There were no samples in the last year that detected the presence of E. Coli or Total Coliforms.

Table 9: Bacteriological Sampling Results Summary

Parameter	Location	Number of Samples	Minimum	Maximum	Average	Guideline
E. Coli (MPN/100 mL)	Town System	29	<1	<1	<1	MAC < 1 MPN/100 mL
	Gantahaz System	89	<1	<1	<1	
	Airport System	9	<1	<1	<1	
Total Coliforms (MPN/100 mL)	Town System	29	<1	<1	<1	MAC < 1 MPN/100 mL
	Gantahaz System	89	<1	<1	<1	
	Airport System	9	<1	<1	<1	

8.2 Water Chemistry Testing Results

Summaries of the chemical laboratory testing results are provided in Table 10 to Table 12. 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) or parameters that indicate the overall water quality are shown. The full water chemistry summaries can be found in Appendix A – Water Chemistry Results Summaries.

Table 10: Town System - Distribution Water Chemistry

Parameter	GCDWQ			Distribution System				
	MAC	AO	OG	Samples	Below Detection Limit	Minimum	Average	Maximum
Physical Tests (Water)								
Hardness (as CaCO ₃)				4	0	149	154	159
Total Metals (Water)								
Aluminum (Al)			<0.1	4	4	<0.0030	<0.0030	<0.0030
Antimony (Sb)	0.006			4	4	<0.00010	<0.00010	<0.00010
Arsenic (As)	0.01			4	0	0.003	0.003	0.004
Barium (Ba)	1			4	0	0.066	0.069	0.073
Boron (B)	5			4	4	<0.010	<0.010	<0.010
Cadmium (Cd)	0.005			4	3	<0.0000050	0.0000089	0.0000089
Chromium (Cr)	0.05			4	4	<0.00050	<0.00050	<0.00050
Copper (Cu)	2	≤1		4	0	0.023	0.065	0.126
Iron (Fe)		≤0.3		4	0	0.064	0.117	0.254
Lead (Pb)	0.005			4	1	<0.000050	0.0014	0.0038
Manganese (Mn)	0.12	≤0.02		4	0	0.030	0.041	0.071
Mercury (Hg)	0.001			4	4	<0.0000050	<0.0000050	<0.0000050
Selenium (Se)	0.05			4	4	0.000054	0.000054	0.000054

Sodium (Na)		≤200		4	0	3.590	3.703	3.800
Uranium (U)	0.02			4	0	0.002	0.002	0.002
Zinc (Zn)		≤5		4	2	<0.0030	0.016	0.025
General Parameters								
Chloride		≤250		4	0	6.69	6.82	6.94
Fluoride	1.5			4	0	0.045	0.046	0.047
Nitrate (as N)	10			4	0	0.044	0.048	0.052
Nitrite (as N)	1			4	4	<0.0010	<0.0010	<0.0010
Sulfate		≤500		4	0	7.26	7.42	7.60
Langelier Index				4	0	0.515	0.531	0.554
Solids, Total Dissolved (calc)		≤500		4	0	187	198	212
Colour, True		≤15		4	4	<5.0	<5.0	<5.0
Alkalinity, Total (as CaCO ₃)				4	0	154	154	154
Turbidity			≤1	4	0	0.50	1.40	2.37
pH		7.0-10.5		4	0	8.26	8.30	8.33

Table 11: Gantahaz System - Source Water Chemistry

Parameter	Units	Date Sampled			13-Jan-2022	13-Jan-2022	8-Feb-2022
		GCDWQ			Gantahaz Source	Gantahaz Source	Gantahaz Source
		MAC	AO	OG	Columbia Well #4	Well #1	Well #1
Physical Tests (Water)							
Hardness (as CaCO ₃)	mg/L				162	165	171
Total Metals (Water)							
Antimony (Sb)-Total	mg/L	0.006			<0.00020	<0.00020	<0.00020
Arsenic (As)-Total	mg/L	0.01			0.00515	0.00495	0.00555
Barium (Ba)-Total	mg/L	2			0.104	0.1070	0.1010
Boron (B)-Total	mg/L	5			<0.0500	<0.050	<0.050
Cadmium (Cd)-Total	mg/L	0.005			<0.000010	<0.000010	<0.000010
Chromium (Cr)-Total	mg/L	0.05			<0.00050	<0.00050	<0.00050
Copper (Cu)-Total	mg/L	2	≥1		0.00065	0.00082	0.00060
Iron (Fe)-Total	mg/L		≥0.3		0.603	0.439	0.993
Lead (Pb)-Total	mg/L	0.005			<0.00020	0.00076	0.00057
Magnesium (Mg)-Total	mg/L				8.71	12.60	12.30
Manganese (Mn)-Total	mg/L	0.12	≥0.02		0.129	0.08760	0.10900
Mercury (Hg)-Total	mg/L	0.001			<0.000010	<0.00001	<0.00001
Selenium (Se)-Total	mg/L	0.05			<0.00050	<0.00050	<0.00050
Sodium (Na)-Total	mg/L		≥200		2.49	5.13	4.98

Uranium (U)-Total	mg/L	0.02			0.00287	0.00612	0.00569
Zinc (Zn)-Total	mg/L		≥5		0.0236	0.0314	0.025
General Parameters							
Chloride	mg/L		≤250		0.87	<0.10	0.11
Fluoride	mg/L	1.5			<0.10	<0.10	<0.10
Nitrate (as N)	mg/L	10			<0.010	<0.010	<0.010
Nitrite (as N)	mg/L	1			<0.010	<0.010	<0.010
Sulfate	mg/L		≤500		14.2	8.7	8.3
Solids, Total Dissolved (calc)	mg/L		≤500		188	176	186
Colour, True	CU		≤15			<5.0	<5.0
Alkalinity, Total (as CaCO ₃)	mg/L				180	169	183
Cyanide, Total	mg/L	0.2				<0.0020	<0.0020
Turbidity	NTU			≤1	2.44	2.92	9.11
pH			7.0-10.5		7.59	7.72	8.19
Conductivity (EC)	uS/cm				310	302	298

Table 12: Gantahaz System - Distribution Water Chemistry

Parameter	Units	GCDWQ			Distribution System				
		MAC	AO	OG	Samples	Below Detection Limit	Minimum	Average	Maximum
Physical Tests (Water)									
Hardness (as CaCO ₃)	mg/L				9	0	159	164	178
Total Metals (Water)									
Aluminum (Al)-Total	mg/L			>0.1	9	3	<0.0050	0.0071	0.0080
Antimony (Sb)-Total	mg/L	0.006			9	9	<0.00020	<0.00020	<0.00020
Arsenic (As)-Total	mg/L	0.01			9	0	0.00209	0.01128	0.0651
Barium (Ba)-Total	mg/L	2			9	0	0.094	0.115	0.220
Boron (B)-Total	mg/L	5			9	9	<0.0500	<0.0500	<0.0500
Cadmium (Cd)-Total	mg/L	0.005			9	9	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Total	mg/L	0.05			9	9	<0.00050	<0.00050	<0.00050
Copper (Cu)-Total	mg/L	2	≥1		9	0	0.0036	0.0286	0.1480
Iron (Fe)-Total	mg/L		≥0.3		9	1	<0.010	1.163	6.970
Lead (Pb)-Total	mg/L	0.005			9	4	<0.00020	0.0007	0.0025
Manganese (Mn)-Total	mg/L	0.12	≥0.02		9	0	0.0013	0.3227	2.2600
Mercury (Hg)-Total	mg/L	0.001			9	9	<0.000010	<0.000010	<0.000010
Selenium (Se)-Total	mg/L	0.05			9	9	<0.00050	<0.00050	<0.00050
Sodium (Na)-Total	mg/L		≥200		9	0	2.34	2.42	2.50
Uranium (U)-Total	mg/L	0.02			9	0	0.0028	0.0029	0.0031

Zinc (Zn)-Total	mg/L	≥5	9	0	0.0048	0.0161	0.0696
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8.2.1 Turbidity

The GCDWQ recommends that turbidity typically is below 1.0 NTU for groundwater sources. In some cases, a less stringent value 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).

In the Town System, turbidity results exceeded 1.0 NTU in two of four samples. The average of the samples 1.40 NTU.

In the Gantahaz System, all three source water samples and samples exceeded the operational guideline of 1.0 NTU. The turbidity sample in the source water ranged from 2.44 to 9.11 NTU with an average of 4.82 NTU.

Future analysis including field testing of the turbidity in the raw water is recommended to determine whether the turbidity exceedances observed in both the Town and Gantahaz are a cause for concern.

8.2.2 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 rust-colored 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.

Five iron exceedances occurred in twelve samples from the Gantahaz subdivision, with three occurring in the source water and two in the distribution network. The results ranged from 0.439 to 0.993 mg/L with an average of 0.678 mg/L from three samples of the source water. In the distribution network results ranged from <0.010 to 6.97 mg/L with an average of 6.97 mg/L from nine samples. The 6.97 mg/L result is an outlier and is likely due to the mobilization of metals accumulated with the pipes because the results from the same location one month later had an iron concentration of 0.985 mg/L.

Given that the primary concern for iron concentrations above the AO is colour and taste the system should be monitored and any complaints about the aesthetic should be recorded for future consideration.

Appendix B and C contains graphs showing all the iron concentrations from sampling taken between 2018 and February 2022 for the Town and Gantahaz Water Systems.

8.2.3 Manganese

Similar to iron, manganese can form a precipitate that can cause maintenance issues in distribution systems, resulting 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 that 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 discolored water due to manganese and to improve consumer confidence in drinking water quality.

As noted in Table 8: Parameters Exceeding Guidelines 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. Appendix B and C contains graphs showing all the manganese concentrations from sampling taken between 2018 and February 2022 for the Town and Gantahaz Systems.

In the Town System, manganese AO exceedances were observed in 4 of the 4 samples but no sample exceeded the MAC. In the distribution network, the results ranged from 0.0298 to 0.0707 mg/L with an average of 0.041 mg/L from four samples.

Nine samples from the Gantahaz subdivision exceeded the aesthetic objective with three samples also exceeding the maximum acceptable concentration. One of three source samples and two of the nine distribution network samples were above the MAC. The

results ranged from 0.088 to 0.129 mg/L with an average of 0.109 mg/L from three samples of the source water. The distribution network results ranged from 0.013 to 2.26 mg/L with an average of 0.323 mg/L from 9 samples. The 2.26 mg/L result is an outlier and is likely due to the mobilization of metals accumulated with the pipes because the results from the same location one month later had a concentration of 0.349 mg/L.

The District flushes each distribution system twice annually to control the iron and manganese concentrations due to accumulation in the network. The highest concentrations of iron and manganese exceedances occurred at multiple points throughout the distribution system. This indicates that those exceedances are primarily due to the accumulation and release of minerals.

8.2.4 Arsenic

Arsenic is naturally occurring from weathering of soils and minerals and is classified as a human carcinogen. The GCDWQ has a Maximum Acceptable Concentration (MAC) of 0.01 mg/L with a recommendation to achieve an arsenic concentration As Low As Reasonably Achievable (ALARA).

No exceedances were found in the Town Water System but there were two samples from the same location within the Gantahaz distribution network that exceeded the maximum allowable concentration. The 0.0651 mg/L result is an outlier and is likely due to the mobilization of metals accumulated with the pipes because the results from the same location one month later had an iron concentration of 0.0102 mg/L. The other ten samples from Gantahaz system were all below the MAC with an average concentration of 0.0037 mg/L. The maximum concentration detected in the source water was 0.0056 mg/L indicating this is a potential accumulation and release issue. Appendix B contains a graph showing all the arsenic concentrations from sampling taken between 2018 and February 2022 for the Gantahaz Systems.

As with all of the metal concentrations, the arsenic level should be closely monitored, and it is recommended that additional system flushing should occur.

9 CONCLUSION & RECOMMENDATIONS

The water quality of the three water systems in the District of Mackenzie are of good water chemistry with some exceedances of the manganese MAC and one occurrence of the arsenic

MAC in the distribution system. The microbiological quality of the water is excellent with no E. Coli and Total Coliforms found in the water system.

The District of Mackenzie is committed to ensuring that the community has safe and secure drinking water. In 2023, the District will be undertaking additional water sampling and analysis to determine the extent and impact that manganese and other metals are having on the water system while exploring options to improve water quality for the end-users.

If you have any questions or comments regarding the content of this report please contact Jim Fast, Lead Operator, for the District at 250-997-3761 or at utilities@districtofmackenzie.ca.

APPENDIX A – 2022 WATER CHEMISTRY RESULTS SUMMARY

Table 13: Town System - Distribution Water Chemistry

		GCDWQ			Distribution System				
		MAC	AO	OG	Samples	Below Detection Limit	Minimum	Average	Maximum
Physical Tests (Water)									
Hardness (as CaCO ₃)	mg/L				4	0	149	154	159
Total Metals (Water)									
Aluminum (Al)	mg/L			<0.1	4	4	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	0.006			4	4	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.01			4	0	0.003	0.003	0.004
Barium (Ba)	mg/L	2			4	0	0.066	0.069	0.073
Beryllium (Be)	mg/L				4	4	<0.000100	<0.000100	<0.000100
Boron (B)	mg/L	5			4	4	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	0.005			4	3	<0.000005	0.0000089	0.0000089
Calcium (Ca)	mg/L				4	0	47.500	49.200	51.500
Chromium (Cr)	mg/L	0.05			4	4	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L				4	4	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	2	≤1		4	0	0.023	0.065	0.126
Iron (Fe)	mg/L		≤0.3		4	0	0.064	0.117	0.254
Lead (Pb)	mg/L	0.005			4	1	<0.000050	0.0014	0.0038
Lithium (Li)	mg/L				4	0	0.004	0.004	0.004
Magnesium (Mg)	mg/L				4	4	7.330	7.480	7.650
Manganese (Mn)	mg/L	0.12	≤0.02		4	0	0.030	0.041	0.071
Mercury (Hg)	mg/L	0.001			4	4	<0.000005	<0.000005	<0.000005
Molybdenum (Mo)	mg/L				4	0	0.000	0.000	0.000
Nickel (Ni)	mg/L				4	4	<0.00050	<0.00050	<0.00050
Potassium (K)	mg/L				4	0	0.635	0.650	0.672
Selenium (Se)	mg/L	0.05			4	4	0.000054	0.000054	0.000054
Silver (Ag)	mg/L				4	3	<0.000010	0.000041	0.000041
Sodium (Na)	mg/L		≤200		4	0	3.590	3.703	3.800
Thallium (Tl)	mg/L				4	4	<0.000010	<0.000010	<0.000010
Tin (Sn)	mg/L				4	0	0.005	0.005	0.005
Titanium (Ti)	mg/L				4	4	<0.00030	<0.00030	<0.00030
Uranium (U)	mg/L	0.02			4	0	0.002	0.002	0.002
Vanadium (V)	mg/L				4	4	<0.00050	<0.00050	<0.00050
Zinc (Zn)	mg/L		≤5		4	2	<0.0030	0.016	0.025

General Parameters									
Chloride	mg/L		≤250		4	0	6.69	6.82	6.94
Fluoride	mg/L	1.5			4	0	0.045	0.046	0.047
Nitrate (as N)	mg/L	10			4	0	0.044	0.048	0.052
Nitrite (as N)	mg/L	1			4	4	<0.0010	<0.0010	<0.0010
Sulfate	mg/L		≤500		4	0	7.26	7.42	7.60
Langelier Index	-				4	0	0.515	0.531	0.554
Solids, Total Dissolved (calc)	mg/L		≤500		4	0	187	198	212
Colour, True	CU		≤15		4	4	<5.0	<5.0	<5.0
Alkalinity, Total (as CaCO ₃)	mg/L				4	0	154	154	154
Cyanide, Total	mg/L	0.2			4	0			
Turbidity	NTU			≤1	4	0	0.50	1.40	2.37
pH	pH units		7.0-10.5		4	0	8.26	8.30	8.33
Conductivity (EC)	uS/cm				4	0	306	309	312

Table 14: Gantahaz System - Source Water Chemistry

Parameter	Units	GCDWQ			Date Sampled	13-Jan-2022	13-Jan-2022	8-Feb-2022
		MAC	AO	OG	Lab Sample ID	Gantahaz Source Columbia Well #4	Gantahaz Source Well #1	Gantahaz Source Well #1
Physical Tests (Water)								
Hardness (as CaCO3)	mg/L					162	165	171
Total Metals (Water)								
Aluminum (Al)-Total	mg/L			>0.1		<0.0050	0.0279	0.187
Antimony (Sb)-Total	mg/L	0.006				<0.00020	<0.00020	<0.00020
Arsenic (As)-Total	mg/L	0.01				0.00515	0.00495	0.00555
Barium (Ba)-Total	mg/L	2				0.104	0.1070	0.1010
Boron (B)-Total	mg/L	5				<0.0500	<0.050	<0.050
Cadmium (Cd)-Total	mg/L	0.005				<0.000010	<0.000010	<0.000010
Calcium (Ca)-Total	mg/L					50.6	45.1	48.0
Chromium (Cr)-Total	mg/L	0.05				<0.00050	<0.00050	<0.00050
Cobalt (Co)-Total	mg/L					<0.00010	<0.00010	0.00021
Copper (Cu)-Total	mg/L	2	≥1			0.00065	0.00082	0.00060
Iron (Fe)-Total	mg/L		≥0.3			0.603	0.439	0.993
Lead (Pb)-Total	mg/L	0.005				<0.00020	0.00076	0.00057
Magnesium (Mg)-Total	mg/L					8.71	12.60	12.30
Manganese (Mn)-Total	mg/L	0.12	≥0.02			0.129	0.08760	0.10900
Mercury (Hg)-Total	mg/L	0.001				<0.000010	<0.00001	<0.00001
Molybdenum (Mo)-Total	mg/L					0.00125	0.00272	0.00258
Nickel (Ni)-Total	mg/L					<0.00040	<0.00040	0.0005
Potassium (K)-Total	mg/L					0.74	1.11	0.96
Selenium (Se)-Total	mg/L	0.05				<0.00050	<0.00050	<0.00050
Sodium (Na)-Total	mg/L		≥200			2.49	5.13	4.98
Uranium (U)-Total	mg/L	0.02				0.00287	0.00612	0.00569
Zinc (Zn)-Total	mg/L		≥5			0.0236	0.0314	0.025
General Parameters								
Chloride	mg/L		≤250			0.87	<0.10	0.11
Fluoride	mg/L	1.5				<0.10	<0.10	<0.10
Nitrate (as N)	mg/L	10				<0.010	<0.010	<0.010
Nitrite (as N)	mg/L	1				<0.010	<0.010	<0.010
Sulfate	mg/L		≤500			14.2	8.7	8.3
Langelier Index	-						0.1	0.7
Solids, Total Dissolved (calc)	mg/L		≤500			188	176	186
Temperature, at pH	°C							
Colour, True	CU		≤15				<5.0	<5.0
Alkalinity, Total (as CaCO3)	mg/L					180	169	183
Alkalinity, Phenolphthalein (as CaCO3)	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	mg/L							

Alkalinity, Carbonate (as CaCO3)	mg/L						
Alkalinity, Hydroxide (as CaCO3)	mg/L						
Cyanide, Total	mg/L	0.2				<0.0020	<0.0020
Turbidity	NTU			≤1	2.44	2.92	9.11
pH			7.0-10.5		7.59	7.72	8.19
Conductivity (EC)	uS/cm				310	302	298

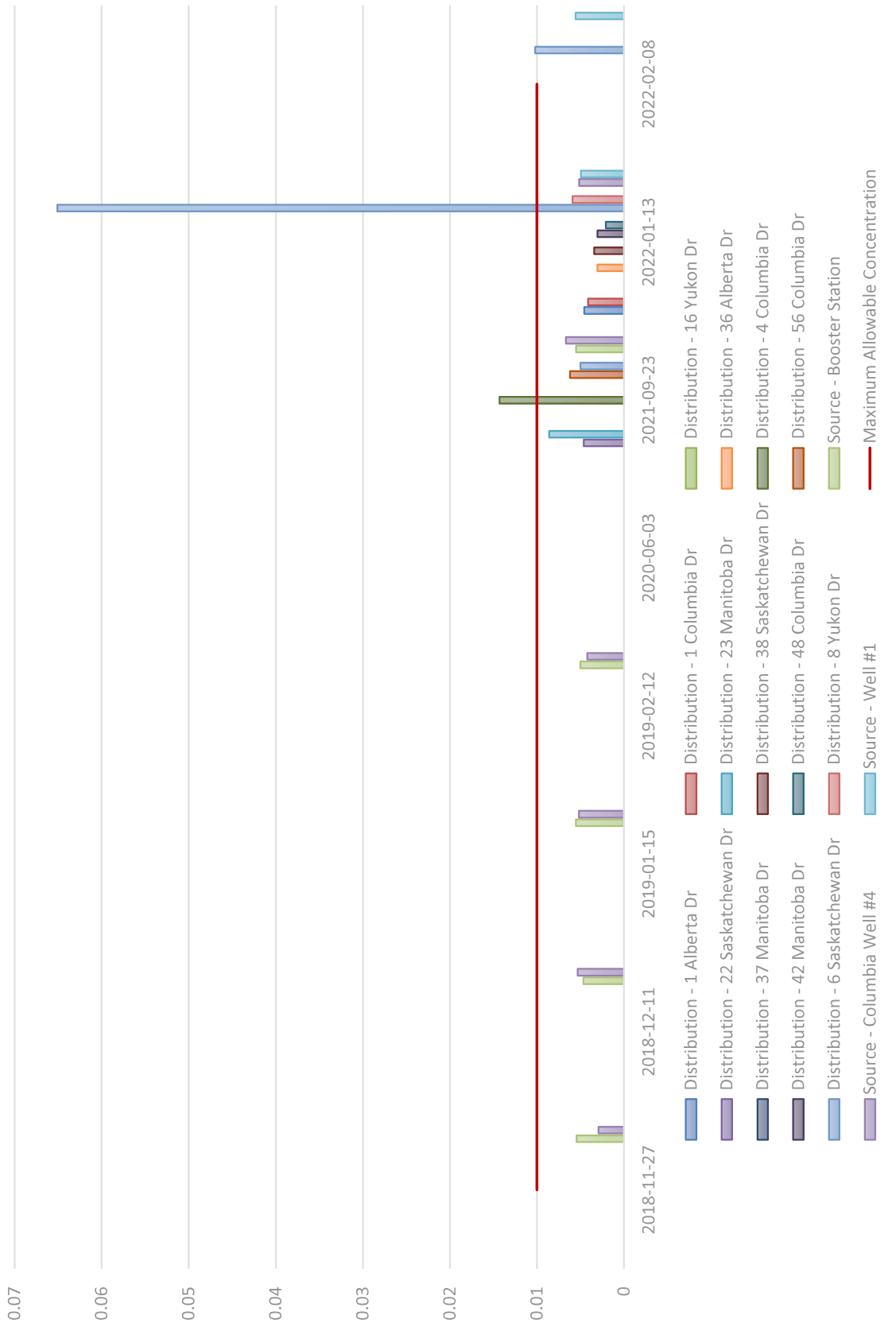
Table 15: Gantahaz System - Distribution Water Chemistry

Parameter	Units	GCDWQ			Distribution System				
		MAC	AO	OG	Samples	Below Detection Limit	Minimum	Average	Maximum
Physical Tests (Water)									
Hardness (as CaCO3)	mg/L				9	0	159	164	178
Total Metals (Water)									
Aluminum (Al)-Total	mg/L			>0.1	9	3	<0.0050	0.0071	0.0080
Antimony (Sb)-Total	mg/L	0.006			9	9	<0.00020	<0.00020	<0.00020
Arsenic (As)-Total	mg/L	0.01			9	0	0.00209	0.01128	0.0651
Barium (Ba)-Total	mg/L	2			9	0	0.094	0.115	0.220
Boron (B)-Total	mg/L	5			9	9	<0.0500	<0.0500	<0.0500
Cadmium (Cd)-Total	mg/L	0.005			9	9	<0.000010	<0.000010	<0.000010
Calcium (Ca)-Total	mg/L				9	0	49.1	51.0	56.2
Chromium (Cr)-Total	mg/L	0.05			9	9	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Total	mg/L				9	8	<0.00010	0.00012	0.00036
Copper (Cu)-Total	mg/L	2	≥1		9	0	0.0036	0.0286	0.1480
Iron (Fe)-Total	mg/L		≥0.3		9	1	<0.010	1.163	6.970
Lead (Pb)-Total	mg/L	0.005			9	4	<0.00020	0.0007	0.0025
Magnesium (Mg)-Total	mg/L				9	0	8.57	8.93	9.15
Manganese (Mn)-Total	mg/L	0.12	≥0.02		9	0	0.0013	0.3227	2.2600
Mercury (Hg)-Total	mg/L	0.001			9	9	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L				9	0	0.0004	0.0012	0.0014
Nickel (Ni)-Total	mg/L				9	4	<0.00040	0.0009	0.0019
Potassium (K)-Total	mg/L				9	0	0.68	0.7544	0.7900
Selenium (Se)-Total	mg/L	0.05			9	9	<0.00050	<0.00050	<0.00050
Sodium (Na)-Total	mg/L		≥200		9	0	2.34	2.42	2.50
Uranium (U)-Total	mg/L	0.02			9	0	0.0028	0.0029	0.0031
Zinc (Zn)-Total	mg/L		≥5		9	0	0.0048	0.0161	0.0696

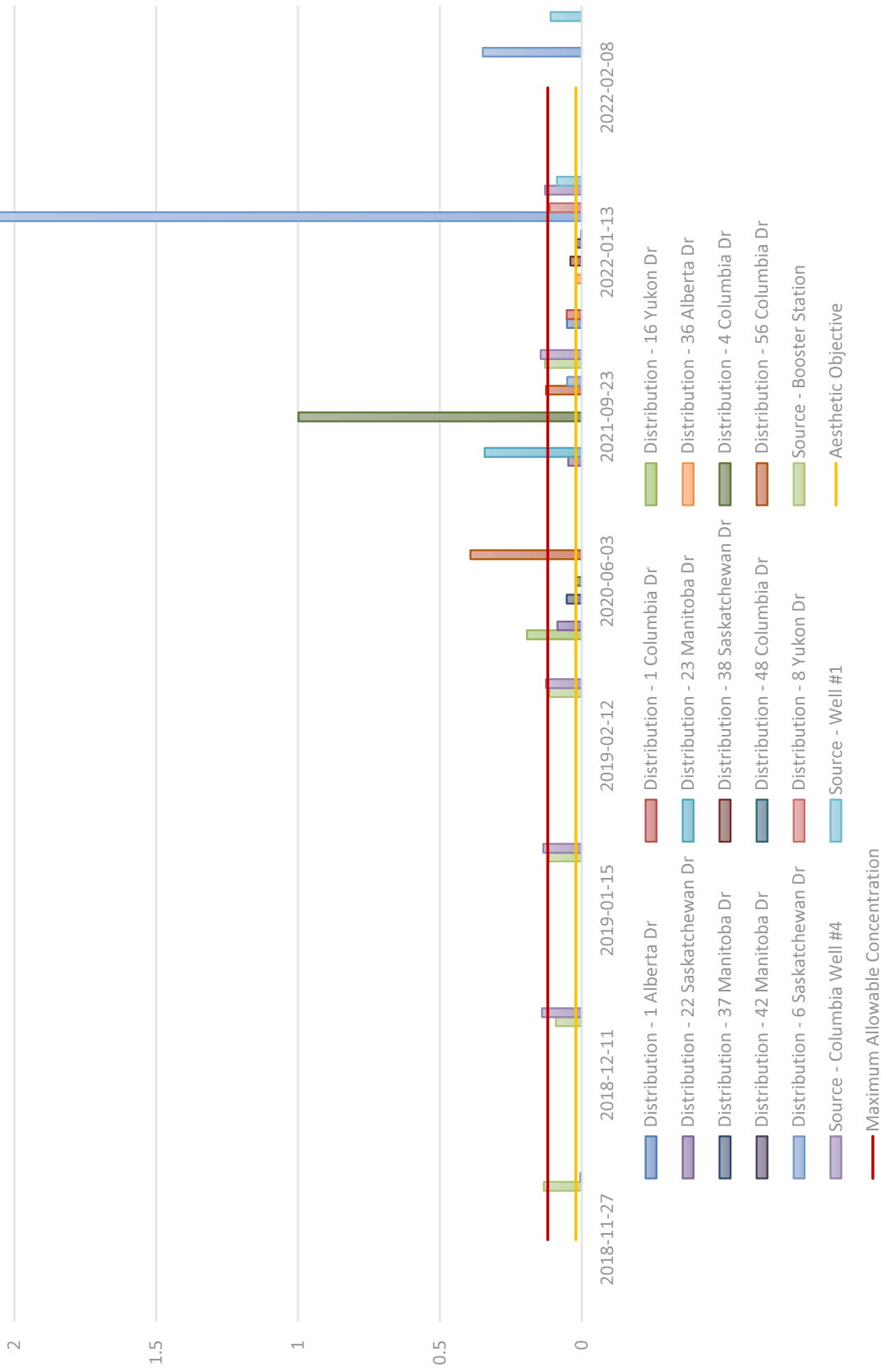
APPENDIX B – TOWN SYSTEM EXCEEDANCES (2018-2023)

APPENDIX C – GANTHAHAZ SYSTEM EXCEEDANCES (2018-2022)

Arsenic (mg/L)



Manganese (mg/L)

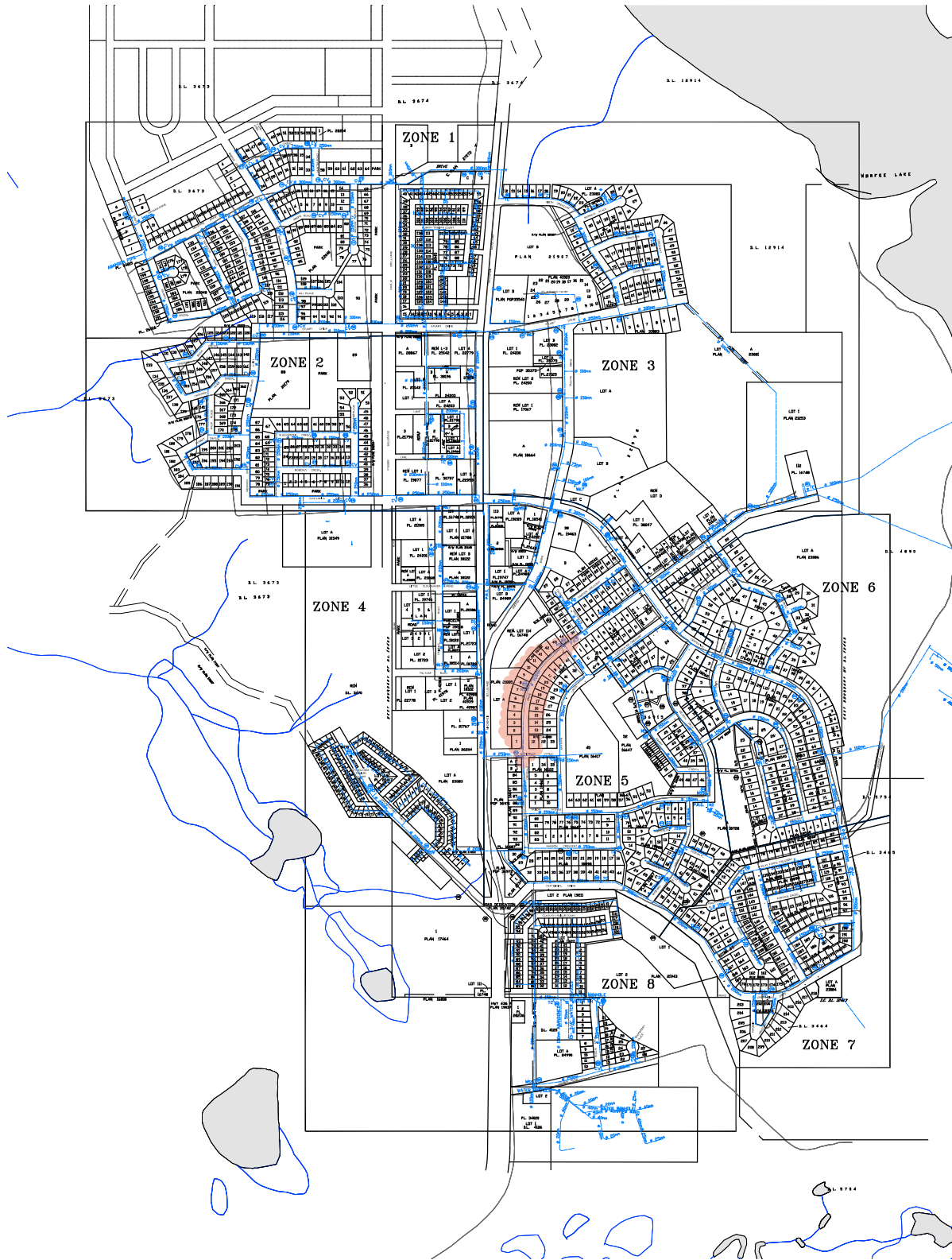


APPENDIX D – TOWN AND GANTHAZ WATER SYSTEM MAPS




DISTRICT OF MACKENZIE

WATER SYSTEM SERVICING LAYOUT



LEGEND

- FIRE HYDRANT
- VALVE
- WELL
- PUMP HOUSE
- RESERVOIR
- WATER LINE
- - - EXISTING LEGAL



NO.	DATE	REVISION	BY



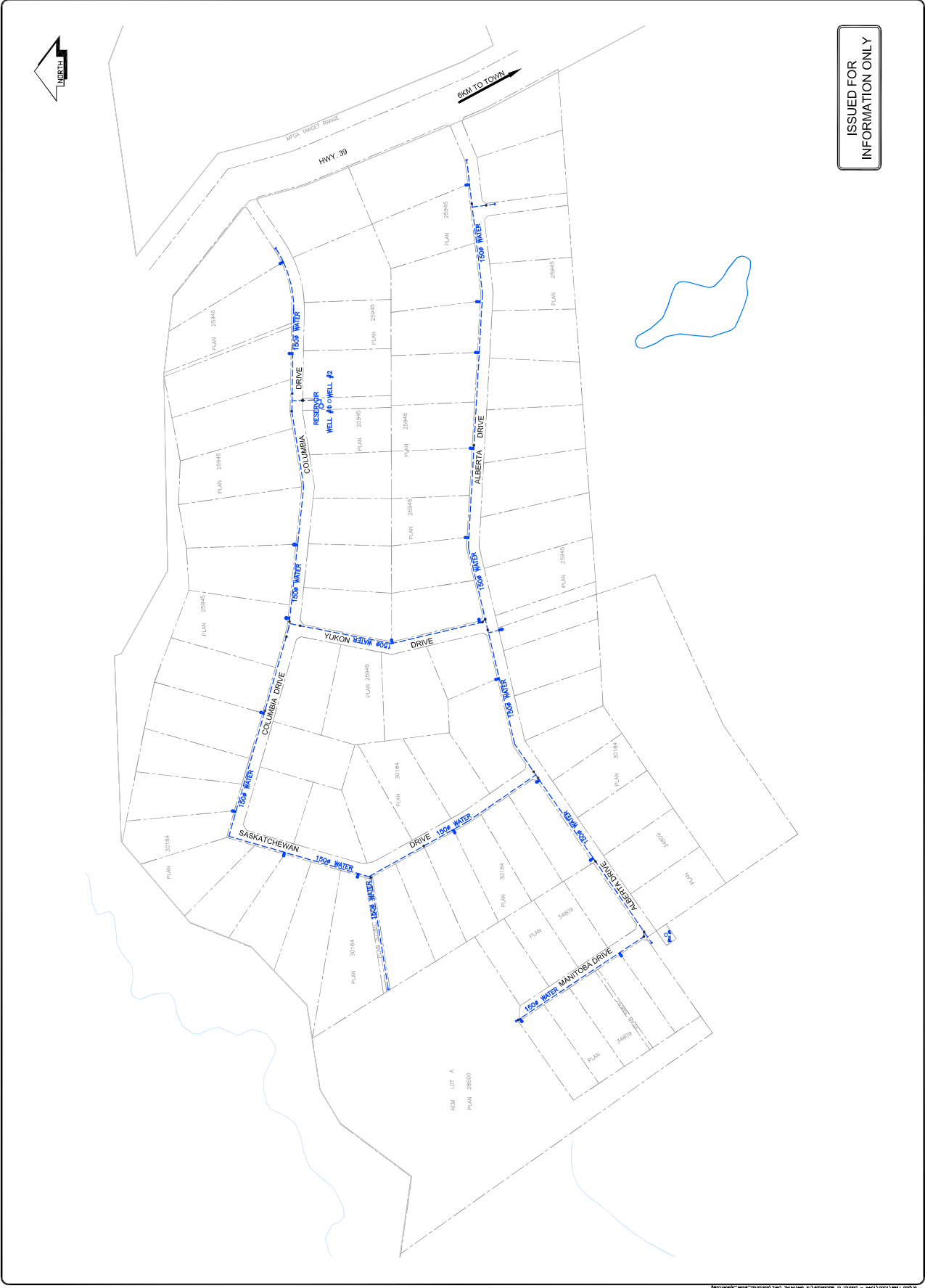
ENGINEERING LIMITED
 1201 FOURTH AVENUE
 WILLOW GROVE, ALBERTA
 T4A 0G6
 TEL: (780) 526-4477
 FAX: (780) 526-4887

DRAWING NO.	
CHECKED BY	
DESIGNED BY	
DRAWN BY	
DATE	12/02/08
SCALE	1:10000
PROJECT NO.	
CLIENT	
CONTRACT NO.	
CONTRACT DESCRIPTION	

MACKENZIE DISTRICT
 GANTAHAZ RURAL SUBDIVISION
 WATER SYSTEM

CONSULTANTS PROJECT NO.
1044-00-00
 DRAWING NO.
MAP 01

SHEET NO.
 1 OF 1
 REV. NO.
 0



APPENDIX E – WATER SYSTEM OPERATING PERMITS

PERMIT TO OPERATE

A Drinking Water System with
15-300 Connections

System Name: Mackenzie CWS Gantahaz Subdivision

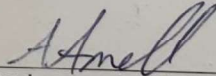
Physical Location: Mackenzie CWS
1 Mackenzie Boulevard
Mackenzie BC

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
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 Operator 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. Smell
Environmental Health Officer

2-Jul-2019
Permit Revised Date



PERMIT TO OPERATE

A Drinking Water System with
1 Public Connection

System Name: Mackenzie CWS Airport

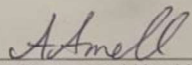
Physical Location: Mackenzie CWS
1 Mackenzie Boulevard
Mackenzie BC

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-March-2005
Effective Permit Date


Environmental Health Officer

3-July-2019
Permit Revised Date

**DECAL
NOT REQUIRED**



northern health
the northern way of caring