

Memorandum

Date: May 29th, 2018

Project Name: Development of a Drinking Water Management Program

Project #: OTT-00237662-A0

Subject: Water Audit

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Introduction

EXP Services Inc. has been retained by the City of Iqaluit to conduct a drinking water management study for the City of Iqaluit. Among the initial activities of this study is an audit of drinking water consumption based upon the information received. This has included the gathering of population, Lake Geraldine water consumption, water meter records and water system bleeds data. The following summarizes the results of this data gathering and provides the analytical findings.

Data Sources

The following sources of information have been consulted during the preparation of this memorandum.

- Raw water consumption data, as provided by the City of Iqaluit.
- Population data, as provided from the Nunavut Bureau of Statistics web site.
- The annual report to the Nunavut Water Board, as obtained from the Water Board online registry.
- Metered water use information as provided, through the City of Iqaluit, from the billing system contractor.
- Mapping of the locations of water system bleeds, as provided by the City through Colliers Project Leaders.

Population

Population data is available from the Nunavut Bureau of Statistics. The Bureau provides population estimates for the period 2001 to 2016 for each community. For the purposes of this analysis population data from the period 2008 to 2016 has been used, as this aligns with the period for the water consumption data that was provided by the City. The data is presented in the table below, along with percentage of growth in population from 2008 as the base year.

Table 1 – Population and Population Growth

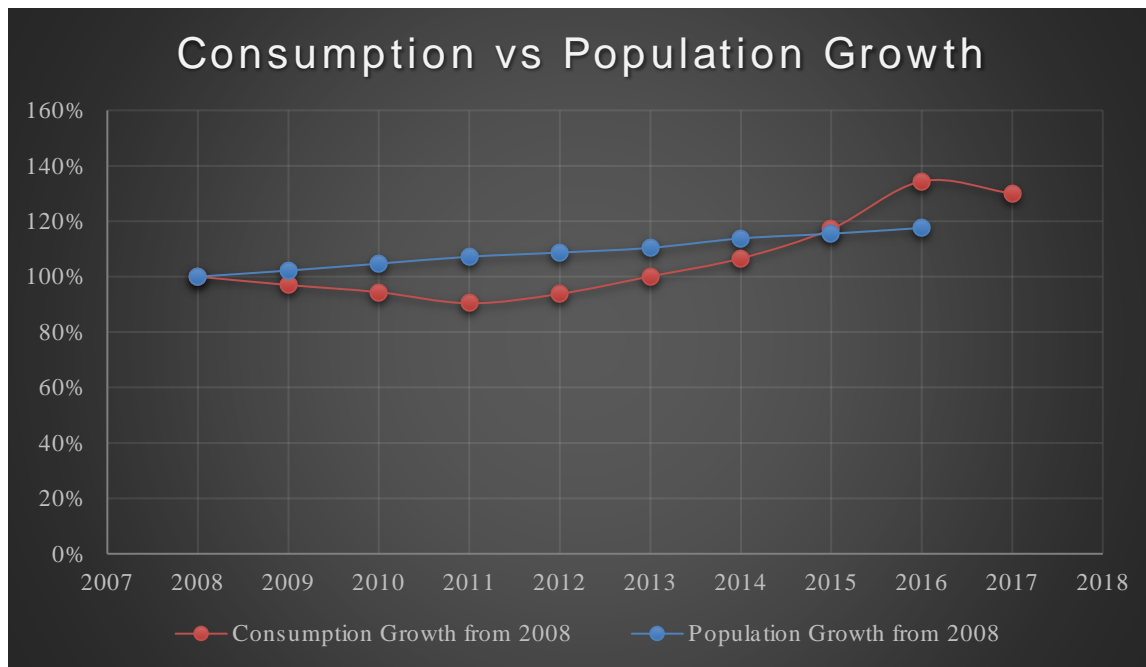
Year	Population	Growth from 2008
2008	6454	-
2009	6593	102.2%
2010	6755	104.7%
2011	6916	107.2%
2012	7013	108.7%
2013	7123	110.4%
2014	7343	113.8%
2015	7456	115.5%
2016	7590	117.6%

Lake Geraldine Water Consumption

The City has provided data for raw water consumption directly from Lake Geraldine for the period 2008 to 2017. This data, together with the growth in population are presented in the following table and graph.

Table 2 – Raw Water Consumption and Population Growth

Year	Raw Water Consumption (m³)	Consumption Growth from 2008	Change from Preceding Year	Population Growth from 2008
2008	929,130	-		-
2009	901,550	97.0%	97.0%	102.2%
2010	877,090	94.4%	97.3%	104.7%
2011	839,610	90.4%	95.7%	107.2%
2012	871,670	93.8%	103.8%	108.7%
2013	930,360	100.1%	106.7%	110.4%
2014	990,140	106.6%	106.4%	113.8%
2015	1,088,690	117.2%	110.0%	115.5%
2016	1,249,150	134.4%	114.7%	117.6%
2017	1,208,200	130.0%	96.7%	



The above data represents water consumption at the intake into the water treatment plant. This data does not account for water losses within the plant, such as backwash flows. These demands are anticipated to be modest and in the range of 2% to 5% of total water taking.

The following observations are drawn from the above data.

- Water consumption was stable at approximately 930,000 m³ annually for the 6 year period between 2008 and 2013.
- Water consumption rose over the period from 2014 to 2017, with the most dramatic increase occurring in 2016.
- Growth in water consumption appears to be largely independent of growth in population.

2015 Annual Report to the Nunavut Water Board

The most recent Annual Report that is available from the Nunavut Water Board Registry is for the year 2015. This report provides information regarding the total taking of water from Lake Geraldine, together with data regarding flow treated at the City wastewater treatment plant. The following table summarizes water taking and wastewater treatment volumes.

Table 3 – Raw Water and Wastewater Volumes 2015

Month	Raw Water		Wastewater (m ³)
	Taking (m ³)	Variation from Average	
January	90,450	0%	84,009
February	84,790	-7%	74,358
March	99,880	10%	87,315
April	92,300	2%	41,691
May	92,570	2%	3,302
June	88,300	-3%	81,686
July	90,700	0%	87,976
August	90,500	0%	83,171
September	91,400	1%	79,899
October	92,000	1%	83,924
November	83,500	-8%	77,133
December	92,300	2%	82,704
Annual	1,088,690	0%	867,168
Monthly Average	90,724		

The Annual Report notes that the wastewater plant was out of service due to mechanical issues for 44 days during April and May. There is also a note that suggests that total wastewater flows were estimated during periods when flow diverted to the lagoon based upon average flows. Exclusion of the data from April and May leads to a water taking of 903,802 m³ and a wastewater flow of 822,175 m³.

The following observations are drawn from this data.

- Water is taken from Lake Geraldine at an almost constant rate throughout the year.
- When data for April and May is excluded total wastewater flow is 91% of the raw water volume. This indicates that almost all the water taken from Lake Geraldine is discharged into the sewer system.

Metering Records

It is reported that water meters are read by City staff and that data is transmitted to a service contractor for preparation of billing information. The City has requested data from this contractor. The following table summarizes information drawn from this data.

Table 4 – Summary of Metered Water Use

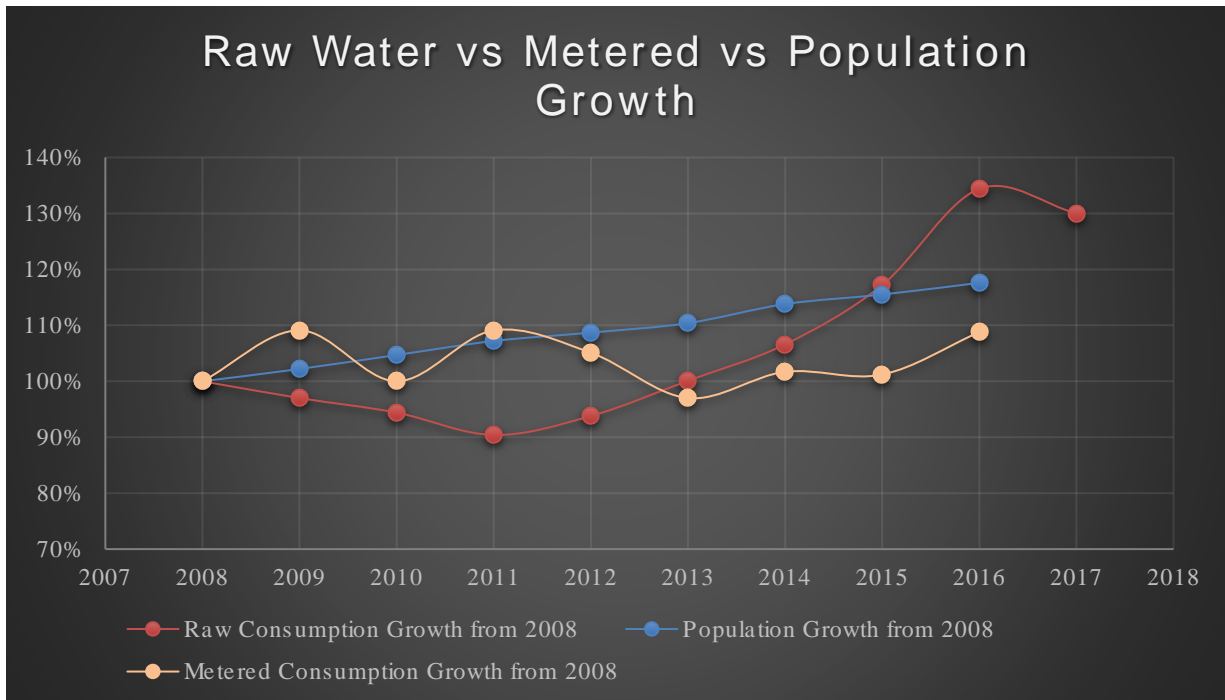
Year	Metered Consumption (m³)
2008	519,371
2009	566,770
2010	519,467
2011	566,812
2012	546,013
2013	504,013
2014	528,232
2015	525,638
2016	565,018
2017	10,527,694

It appears that the data for 2017 is in error. On this basis the data for 2017 has been excluded from the analysis.

The following table and graph presents annual metered water use, growth in metered use from 2008 and the growth in population from 2008.

Table 5 – Metered Water Use Analysis

Year	Metered Consumption (m³)	Metered Consumption Growth from 2008	Population Growth from 2008	Raw Water Consumption Growth from 2008
2008	519,371	-	-	-
2009	566,770	109.1%	102.2%	97.0%
2010	519,467	100.0%	104.7%	94.4%
2011	566,812	109.1%	107.2%	90.4%
2012	546,013	105.1%	108.7%	93.8%
2013	504,013	97.0%	110.4%	100.1%
2014	528,232	101.7%	113.8%	106.6%
2015	525,638	101.2%	115.5%	117.2%
2016	565,018	108.8%	117.6%	134.4%



The following observations may be made from the metered consumption data.

- Metered consumption, as provided from billing records was almost constant between 2008 and 2015. There was a modest increase from 2015 to 2016.
- There does not appear to be a correlation between reported metered consumption and population growth.

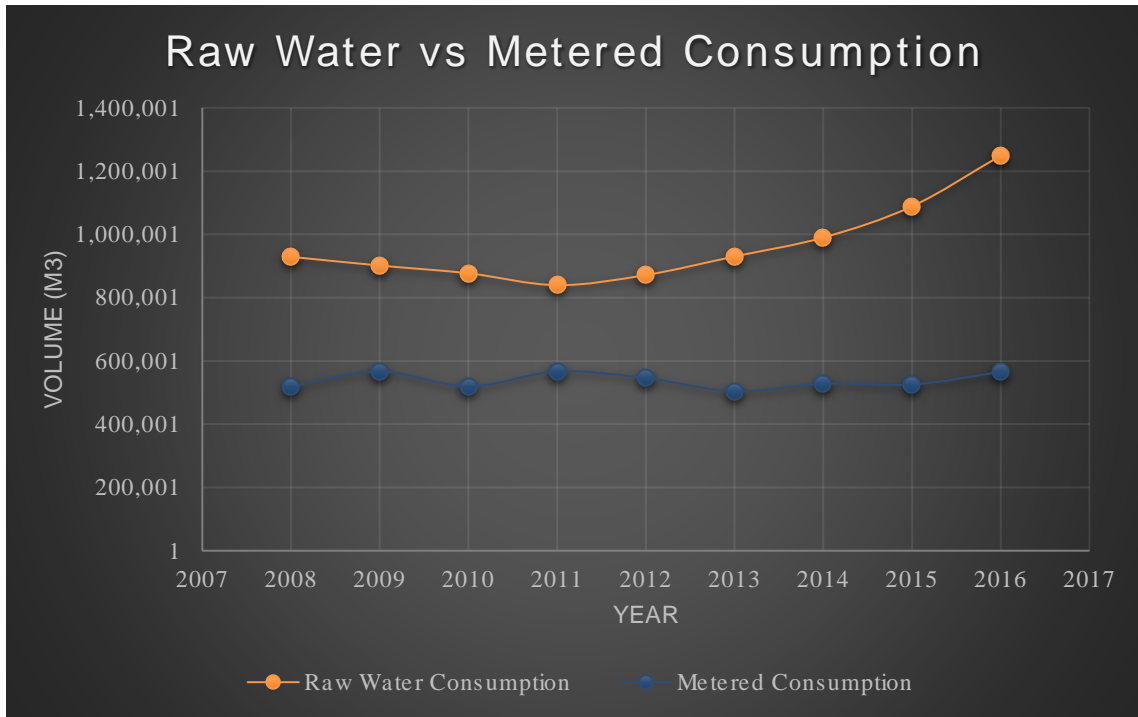
Correlation of Raw Water and Metered Data

The following table and graph summarizes raw water consumption and metered records for the period 2008 to 2016.

Table 6 – Raw Water Consumption and Metered Data

Year	Raw Water Consumption (m ³)	Metered Consumption (m ³)	Ratio Metered Data to Raw Water Consumption
2008	929,130	519,371	55.9%
2009	901,550	566,770	62.9%
2010	877,090	519,467	59.2%
2011	839,610	566,812	67.5%
2012	871,670	546,013	62.6%
2013	930,360	504,013	54.2%
2014	990,140	528,232	53.3%
2015	1,088,690	525,638	48.3%

2016	1,249,150	565,018	45.2%
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The following observations are drawn from this data.

- Recently metered, and thus billed, water consumption is less than ½ of the water taking from Lake Geraldine.
- The portion of the water taking from Lake Geraldine that is reported by the meter readings has decreased by approximately 4% annually since 2011.

Estimate of Unaccounted Water

The raw water consumption and metered use data have been used to prepare the estimate of unaccounted for water summarized in the following table.

Table 7 – Unaccounted Water Estimate

Year	Raw Water (m ³)	Metered (m ³)	Unaccounted	
			(m ³)	(%)
2008	929,130	519,371	409,759	44.1%
2009	901,550	566,770	334,780	37.1%
2010	877,090	519,467	357,623	40.8%
2011	839,610	566,812	272,798	32.5%
2012	871,670	546,013	325,657	37.4%
2013	930,360	504,013	426,347	45.8%

2014	990,140	528,232	461,908	46.7%
2015	1,088,690	525,638	563,052	51.7%
2016	1,249,150	565,018	684,132	54.8%

Water use that was not captured by the billing system has generally been of the order 40%. This portion of total water consumption has increased over 2015 and 2016 to more than 50% of the water taken from Lake Geraldine.

Per Capita Water Demands

The following table summarizes the estimate of per capita water demands, both in terms of raw water consumption and metered use.

Table 8 – Per Capita Water Consumption

Year	Population	Per Capita Consumption	
		Raw Water (L/capita-day)	Metered (L/capita-day)
2008	6454	394	220
2009	6593	375	236
2010	6755	356	211
2011	6916	333	225
2012	7013	341	213
2013	7123	358	194
2014	7343	369	197
2015	7456	400	193
2016	7590	451	204

The following are noted regarding per capita water consumption.

- The metered demands during the initial years of the evaluation are consistent with expectations for a northern community.
- The gradual decline in per capita metered consumption does not align with expectations. This decline has been modest.
- There has been an ongoing increase in raw water per capita consumption since 2011. This is contrary to the trend of metered demand.

Water Bleeds

Water is bled from the distribution system at various locations. These bleeds have frequently been implemented to reduce the risk of freeze of the watermains or sewer lines. In response to a request, the City has provided a hand marked drawing depicting the locations of known water system bleeds. These drawings highlighted 18 locations where bleeds were operating throughout the city's utilidor.

A brief review of the Plateau Subdivision drawings identified a pair of locations where there are known bleeds. For current purposes it will be assumed that there are 20 bleeds currently operating.

The water system bleeds have frequently been provided on an as-needed basis to reduce the risk of freeze. There does not appear to be a system to track the location, purpose, flow rate and cross connection measures for the bleeds. There also does not appear to be a process of review of the ongoing need for bleeds at the various locations where they have been installed.

An estimate of water use arising from 20 bleeds has been made. It has been assumed that each bleed represents a constant water demand of 20 L/min. This leads to an estimated annual water demand of approximately 200,000 m³. It appears that bleeds represent approximately 1/3 of the unaccounted water consumption.

General Observations

The following general observations are drawn from the above analysis.

- Raw water consumption was relatively stable between 2008 and 2013. Water demand rose from 2014 onwards. The rate of water consumption appears to rise more dramatically than population.
- It appears that almost all the water taken from Lake Geraldine is conveyed to the wastewater treatment plant.
- Metered water use does not appear to be strongly influenced by population growth.
- Metered water use for 2015 and 2016 represents less than ½ of the water taken from Lake Geraldine.
- There has been an ongoing increase in per capital raw water demands. At the same time there has been a gradual decline in the metered per capita water use. These appear to be contradictory trends.
- It appears that distribution system bleeds represent approximately 1/3 of the unaccounted water consumption.

Potential Issues for Consideration

The variation in trends between raw water use and metered demands suggest some questions for consideration.

- Does the current metering system capture all water users? The issues to consider include metering of all water use into buildings and reading of all water meters.
- Does the system that manages meter reading include adjustments for some water users that lead to under-reporting?

- Are the existing water meters un-reporting consumption? This could be for a list of reasons including meter wear and age.
- Has there been a documented increase in the number of watermain breaks, and what was the management of those breaks? This might include the site of a break, type of break, response, period required to implement the response and actions during the interim.
- Is there an opportunity for conservation through management of the watermain bleeds? This would include the resolution of the issues that lead to the institution of these bleeds.