Town of Deseronto

on the water's edge

Drinking Water System

2016 - *Annual Report*

322 Water Street
Deseronto, Ontario
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Prepared: January 2017

Executive Summary

The Town of Deseronto Water Treatment Plant is a conventional filtration process utilizing chemical coagulation/flocculation, sedimentation, dual media filtration, activated carbon, and chlorine disinfection. Although approved to treat 2946 m^3/d, design limitations reduce the sustainable working capacity to less than 1700 m^3/d.

During 2016, treated water pumped to the community increased by approximately 13 percent when compared to 2015. The increase in flow is attributed to the summer dry conditions. The maximum day flow recorded in July exceeded 90 percent of the sustainable working capacity of the treatment process.

Water samples collected throughout the process at varying frequencies are tested for approximately 80 different parameters to evaluate treatment efficiency and to ensure finished water quality. All samples met the requirements of the Ontario Drinking Water Quality Standards with exception of two distribution samples collected on the same day in November. Testing of those samples indicated a low presence of total coliform organisms. Re-sampling and re-testing did not confirm the initial adverse results.

Maintenance and system improvements were limited to routine PM and distribution repairs as efforts were focused on finishing the upgrades to the wastewater treatment plant and planning the near future major upgrades to the water treatment plant.

Given the advanced age of the treatment units, lack of recommended redundancy, and minimal reserve capacity, the facility is due for significant upgrades. The Town, partnered with the neighbouring Mohawks of the Bay of Quinte, have received funding approval and are proceeding with renewal and upgrade of the water treatment facility to address the above noted deficiencies. Design is scheduled to begin in early 2017 with project completion anticipated in 2019.

Table of Contents

Key Words & Terms

m^3 /d	cubic metres per day, ($1m^3$ = 1000 litres)
mg/L	milligrams per litre, (1 part in 1,000,000)
µg/L	micrograms per litre, (1 part in 1,000,000,000)
ACU	apparent colour measurement units (standard unit to quantify colour in water)
NTU	nephelometric turbidity units (standard unit to quantify turbidity in water)
MAC	maximum acceptable concentration
IMAC	interim maximum acceptable concentration
AO	aesthetic objective (non-health related)

Coagulation / Flocculation refer to the water treatment chemical processes that convert small particles of suspended solids into larger, more settleable clumps.

Disinfection refers to the process that kills disease-causing organisms in water, usually by the addition of chlorine.

Escherichia Coli (E. Coli) refers to a subgroup of fecal coliform bacteria that reside in the digestive systems of warm blooded animals. The presence of *E. Coli* in drinking water is a strong indicator of fecal contamination. *E. Coli* is rapidly destroyed by chlorine.

Heterotrophic Plate Count (HPC) is a microbial test method that quantifies levels of heterotrophic bacteria. Most bacteria, including those common in drinking water systems, are heterotrophs. Increases in the density of HPC bacteria in the distribution system are usually the result of bacterial re-growth which is influenced by the quality of the water entering the system, temperature, flow (i.e. stagnation), presence of a disinfectant residual, construction materials, and the availability of nutrients for growth. HPC in drinking water are not considered a direct health threat.

Inorganic refers to non-carbon based substances. Common inorganic substances in water include metals, minerals, nutrients, and salts.

ODWQS refers to the Ontario Drinking Water Quality Standards. The ODWQS define the standards, objectives, and guidelines to be followed for the provision of a safe and aesthetically acceptable drinking water supply.

Ontario Regulation 170/03 or O.Reg.170/03 refers to the Drinking Water Systems Regulation as amended.

Ontario Regulation 169/03 or O.Reg.169/03 refers to the ODWQS Regulation as amended.

Organic refers to a large group of carbon-based chemical compounds including all animal and vegetable matter plus many synthetic compounds such as pesticides and industrial solvents.

Raw Water is defined as surface (lakes, rivers) or ground water (wells) available as a source of drinking water that has not received any treatment.

Sedimentation refers to the water treatment process that involves reducing the velocity of water in tanks so that the suspended material can settle by gravity.

Total Coliform Bacteria are a group of commonly occurring, mostly harmless bacteria that live in soil and water as well as the gut of animals. Their presence in a water sample may be indicative of inadequate filtration and/or inadequate disinfection.

Turbidity refers to a physical characteristic of water that causes a cloudy appearance. Turbidity is caused by the presence of suspended matter. The substances that cause turbidity can be a source of disease causing organisms, and can shield potentially pathogenic organisms from disinfection.

THM's refers to trihalomethane compounds which are disinfection by-products formed when chlorine combines with organic substances in the water supply. Elevated concentrations of THMs are carcinogenic.

Introduction

The 2016 Annual Drinking Water Report for the Deseronto Water Treatment Plant summarizes plant operations and treated water quality with reference to the requirements of Ontario Regulation 170/03 (O. Reg. 170/03), Ontario Regulation 169/03 (O. Reg. 169/03), Municipal Drinking Water Licence 154-101, Drinking Water Works Permit 154-201, and Permit to Take Water 6262-98DPFG. This report consolidates the reporting requirements specified as "Annual Report" in O.Reg.170/03, Sec. 11, and "Summary Reports for Municipalities" in O.Reg.170/03, Schedule 22.

- Section 1 of the report provides a description of the water treatment process.
- Section 2 summarizes reports to the Ministry of the Environment under Subsection 18(1) of the Safe Drinking Water Act (notices of adverse water quality) or Schedule 16, Section 16-4 of O. Reg.170/03 (notice of inadequate disinfection). Included with Section 2, if applicable, is a description of corrective actions taken to remedy the reported conditions.
- Section 3 discusses flow measurement and analytical data generated from "in-house" analysis, as well as accredited laboratory testing required by O.Reg.170/03. Treatment process chemical use is also reported. The data are presented in summary tables.
- Maintenance and upgrading projects carried out during 2016 are discussed in Section 4.

Copies of the Annual Drinking Water Report are available to the public free of charge from Deseronto Town Hall at 331 Main Street in Deseronto. Reports are also available on-line at http://deseronto.ca/residents/waterwaste-water/reports/.

Additional information on drinking water standards in Ontario is available from the Ontario Ministry of the Environment at http://www.ene.gov.on.ca/environment/dwo/index.htm.

The Town of Deseronto is an accredited operating authority, conforming to the Ontario Drinking Water Quality Management Standard.

Our commitment to the supply of safe, reliable municipal drinking water and to abiding by all applicable legislation and regulations is sustained by our dedication to the implementation, maintenance, and continual improvement of a Quality Management System that conforms to the Ontario Drinking Water Quality Management Standard.

1 - Description of the Deseronto Water Treatment Process

1.1 Origins and Types of Raw Water Contaminants:

As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and can pick up substances resulting from the presence of animals or from human activity. The types of contaminants that may be present in raw water include:

- Microbiological contaminants, such as pathogens, may come from septic systems, livestock, sewage treatment plants, and wildlife. Microbiological quality is the most important component of drinking water quality because of its ability to cause acute illness in consumers.
- Inorganic contaminants, such as salts and metals, which can be naturally occurring or result from urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.
- Organic contaminants can be naturally occurring, but most organic compounds of concern are man-made. Pesticides and herbicides are included in this group and may originate from a variety of sources such as agriculture, urban storm water runoff, and septic systems.

To ensure that tap water is safe to drink, the Ontario Ministry of the Environment (MOE) prescribes treatment and sampling requirements which limit the concentrations of contaminants in water provided by public water systems.

The following describes the Deseronto treatment process and the monitoring that takes place to ensure the safety of our drinking water. A schematic diagram of the treatment process is provided on page 7 following the description given below.

1.2 Raw Water Supply:

Water is drawn from the Bay of Quinte through a 400 mm diameter intake pipe, extending approximately 490 m off-shore, submerged to a depth of approximately 6 m. Coarse screens at the intake crib and at the inlet to the low lift pumping station prevent large debris from passing into the treatment process. Following the screens, raw water flows into a tank referred to as the low lift wet well from where it is pumped to the treatment process.

1.3 Coagulation / Flocculation / Sedimentation:

Coagulation, flocculation, and sedimentation processes all take place in a single cylindrical tank called a reactor clarifier.

A treatment chemical (coagulant) is injected into the raw water immediately upstream from the reactor clarifier. An in-line mechanical mixer rapidly mixes the coagulant into the raw water prior to entering the reactor clarifier. Coagulants are chemicals that cause the gathering together of small suspended particles present in the raw water. The raw water and coagulant then enters the centre contact zone of the reactor clarifier where a coagulation aid (polymer) is added and gentle mixing occurs to promote the formation of larger, sticky particles (flocculation) referred to as flock. As the flock particles become increasingly dense, they settle and accumulate in the bottom portion of the reactor clarifier. The relatively clear water above the settled flock flows to the dual media filters for further treatment.

The quantity of settled flock retained in the reactor clarifier is controlled at a depth sufficient to permit efficient capture of particulate matter present in the raw water while minimizing the overflow of solids from the top of the reactor clarifier to the filters. Excess settled flock is discharged to the waste holding tank.

The Deseronto facility has only one reactor clarifier which requires process interruption (or bypassing) to complete maintenance activities. This lack of redundancy does not conform to current design standards. Performance of the reactor clarifier deteriorates when daily flows exceed 1600 m^3. This capacity limitation is consistent with design criteria referenced from the Ministry of the Environment and Climate Change Guidelines.

1.4 Filtration:

The Deseronto plant has two dual media (sand and anthracite) filters followed by two granular activated carbon (GAC) contactors. Particulate matter, including small quantities of flock carried over from the sedimentation process, is trapped in the dual media filter. The GAC contactors are effective in removing organic compounds, some of which are responsible for unpleasant tastes and odours particularly during the warmer months. GAC is also useful for removing algal toxins, such as those released from decomposing blue-green algae.

Filtered water passes through under-drain nozzles, located at the bottom of the filter and contactor media compartments. The under-drain nozzles are designed to allow the passage of water while retaining the filter media. Filtered water is disinfected prior to entering large treated water reservoirs called clearwells.

Accumulated debris on the filter and contactor media must be periodically removed by backwashing. During backwashing, the filter is isolated from the treatment process while water is forced in a reverse direction through the media. Compressed air is also introduced to agitate the media surface, loosening accumulated debris. The backwash water flushes the debris to the waste holding tank.

Filtration capacity is limited to just over 1700 m^3/d during a backwash sequence as all flow is directed through the single remaining filter. An additional filter is required to meet current design guidelines at the permitted capacity of 2946 m^3/d.

1.5 Chlorination / Disinfection:

Chlorine is typically added to the process in two locations; the raw water to control the accumulation of zebra mussels and other biological growth; and to the treated water for disinfection.

The addition of chlorine to the raw water piping is considered a pre-treatment measure and is referred to as pre-chlorination. Pre-chlorination can be applied at the intake crib (normal point of application) or into the low lift pump discharge header.

The intake crib was last inspected and cleaned in June of 2016. The inspection report confirmed successful operation of the zebra-mussel control system.

The second point of chlorine addition occurs at the treatment plant, immediately downstream from the dual media filters and GAC contactors, and is referred to as post-chlorination. Post-chlorination disinfects the treated water, ensuring that any remaining, potentially pathogenic organisms are inactivated prior to entering the distribution system.

Sufficient chlorine is added at the treatment plant to maintain a residual throughout the distribution system. Maintaining chlorine residual throughout the distribution system is referred to as secondary disinfection. Secondary disinfection is required by the Regulation and is necessary to prevent growth of micro-organisms in the distribution system.

***1.6 Elevated Storage Tank*:**

Treated water is pumped from the clearwells into the distribution system. The treated water storage standpipe is connected to the distribution system grid. The 1135 m^3 standpipe provides relatively constant system pressure and a reserve volume of water for community fire protection.

***1.7 Process Waste Residual Treatment*:**

Waste residuals generated through the treatment process, including filter backwash and settled flock removed from the reactor clarifier, are directed to the waste holding tank. Wastewater from the holding tank is either pumped to the waste clarifier for treatment, or directly to the municipal wastewater treatment plant. The waste clarifier separates the waste stream solids by gravity sedimentation. The settled solids are then pumped to the municipal wastewater treatment plant, and the treated overflow from the top of the clarifier is discharged to the Bay of Quinte.

***1.8 Multiple Barriers to Microbiological Pathogens*:**

Potentially pathogenic organisms are removed from the raw water source by the following processes:

- pre-chlorination
- flocculation / sedimentation
- filtration
- post-chlorination
- distribution system chlorine residual (secondary disinfection)

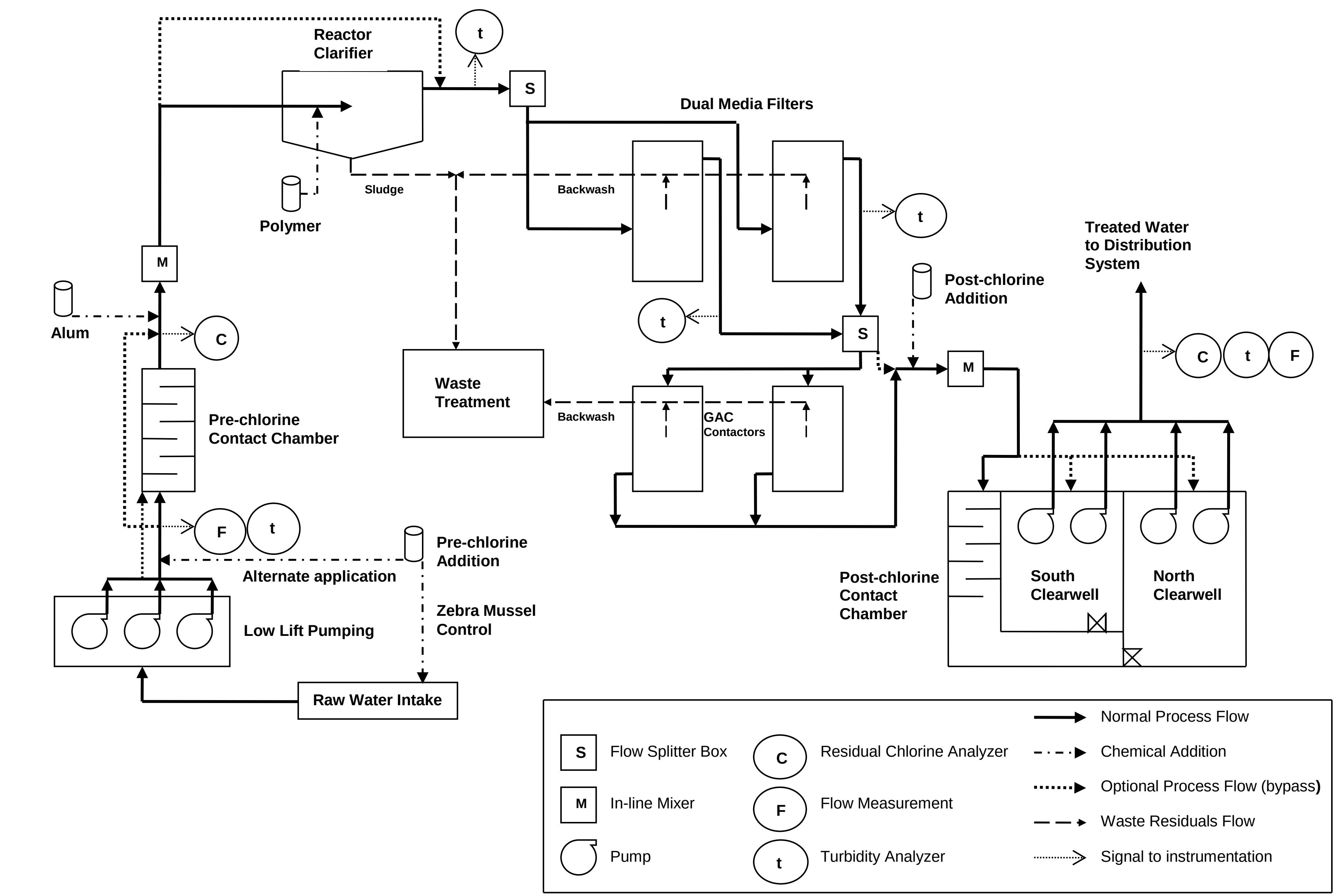
***1.9 Laboratory Testing*:**

Ontario Regulation 170/03 dictates the sampling and monitoring requirements for the Deseronto facilities. Water quality is tested routinely throughout the treatment process and at the extremities of the distribution system. Analytical testing is conducted by an accredited laboratory.

***1.10 Alarms and Staffing*:**

The Deseronto Water Treatment Plant is staffed during daytime hours on week days, and is visited on weekends and holidays for routine system checks. During off-hours, process irregularities or building security breaches are detected by the plant alarm system and relayed to an on-call operator who is available 24 hours per day, 7 days per week.

Deseronto Water Treatment Plant Process Schematic



2 - Adverse Water and Other Deficiencies

Indication of adverse water quality was observed on one occasion in 2016. On November 8^{th}, bacteriological testing of samples collected from the treatment plant lab and from the west end sample hydrant on the water distribution system indicated the presence of 4 and 2 cfu/100mL total coliforms respectively. Re-sampling and testing was conducted on the following day at the affected locations and at an additional distribution system location. All re-sampled locations were clear of adverse water quality indicators.

The above noted events were reported to the Hastings Prince Edward County Health Unit and to the Spills Action Centre as required by regulation.

3 - Flow Measurement and Analytical Testing

3.1 *Raw and Treated Water Flow*:

Raw water is pumped to the treatment facility from the Bay of Quinte in accordance with the terms and conditions of Permit to Take Water 6262-98DPFG (expires June 1, 2023). During 2016, the permitted maximum day flow of 2946 m^3/d was not exceeded at any time.

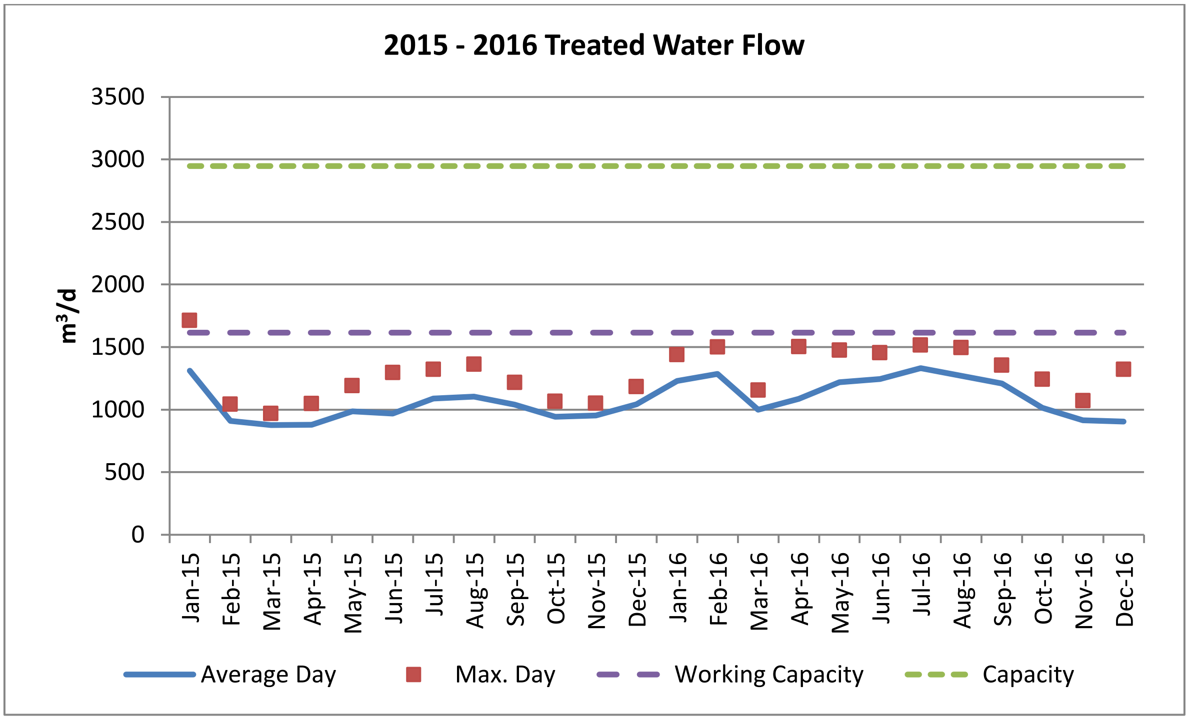
Raw and treated water flow data for 2015 are summarized in Table 1.

Table 1 – Raw and Treated Water Flow

	Raw Water				Treated Water			
Month	Minimum Daily Flow (m^3/d)	Maximum Daily Flow (m^3/d)	Average Daily Flow (m^3/d)	Total Monthly Flow (m^3)	Minimum Daily Flow (m^3/d)	Maximum Daily Flow (m^3/d)	Average Daily Flow (m^3/d)	Total Monthly Flow (m^3)
January	1147	1526	1337	41449	1044	1440	1229	38110
February	1142	1553	1378	39971	1024	1501	1285	37273
March	971	1248	1098	34039	835	1158	1000	31007
April	970	1616	1159	34769	901	1503	1086	32592
May	1056	1623	1280	39681	1000	1475	1218	37755
June	1058	1580	1303	39089	1023	1455	1245	37337
July	1178	1596	1393	43171	1043	1517	1330	41245
August	1122	1536	1321	40954	1055	1497	1270	39377
September	1139	1481	1278	38329	1071	1356	1208	36248
October	918	1372	1109	34378	812	1244	1015	31460
November	848	1194	986	29572	778	1072	915	27452
December	861	1078	979	30353	769	1323	906	28087
Year Avg.			1217				1142	
Year Total				445312				417943
Year Max./Min.	848	1623			769	1517		
Permitted Capacity						**2946**		
Permit to Take Water		**2946**						

Treated water production averaged 1142 m^3/d, which is approximately 13 percent greater than the 2015 average day flow. The maximum day treated water flow recorded during 2016 was 1517 m^3/d, representing 51 percent of the permitted plant capacity of 2946 m^3/d. It is important to note however that, based on historical operating experience and supported by the results of a technical evaluation conducted in 2003, the actual sustainable working capacity of the plant is less than

1700 m^3/d. **Therefore the maximum day flow is more realistically expressed as greater than 90 percent of the sustainable plant capacity**. Treated water average and maximum day flows for each month of 2015 and 2016 are shown in the chart below.



A significant decrease in treated water demand was observed from January 2015 to February 2015. The cause is attributed to 3 repairs completed on customer service pipes and distribution mains. Similarly, demand decreased between February and March of 2016 due to 3 service repairs completed toward the end of February. During 2016 a total of 9 distribution system leaks were repaired.

Locations of service leaks and main breaks can go undetected for extended periods of time as they often start slow and become worse over time. System leaks are typically located when water is observed on the surface of the ground or when customers report low pressure or noise from distribution pipes. Leaking water doesn't easily surface due to the drainage provided by the fractured limestone geology underlying the Town. Undetected service breaks impose a significant burden on plant capacity. Single service leaks have, in the past, accounted for as much as 15 – 20 percent of total plant flow.

The raw and treated water flow meters are calibrated annually by a qualified technician.

3.2 Temperature, Colour, Alkalinity, pH, and Hardness:

Temperature, colour, alkalinity, and pH are measured in raw and treated water typically twice each week and are summarized for 2016 in Table 2. All are related to the operation of the coagulation and flocculation processes. Temperature and pH are also related to the effectiveness of the disinfection process. Hardness is a measure of dissolved minerals in water and is also included in Table 2. At elevated levels, hardness can create scaling on pipes, plumbing fixtures, and appliances.

Table 2 – Temperature, pH, Alkalinity, Hardness, and Colour

Month	Raw Water				Treated Water				
	Temp. (C)	pH	Alkalinity (mg/L $CaCO_3$)	Colour (ACU)	Temp. (C)	pH	Alkalinity (mg/L $CaCO_3$)	Hardness (mg/L)	Colour (ACU)
January	4.1	7.7	103	36	2.6	7.2	92	113	0
February	4.4	7.7	120	31	2.6	7.1	108	120	0
March	6.4	7.6	104	27	4.6	7.2	96	114	1
April	10.1	7.8	97	39	8.8	7.2	88	105	1
May	16.0	7.7	93	34	15.5	7.1	84	98	1
June	19.2	7.7	88	33	19.0	6.9	80	103	0
July	23.8	7.8	95	52	23.6	6.9	79	106	0
August	25.3	7.9	92	74	25.4	6.9	77	110	1
September	22.9	8.1	86	124	23.4	6.9	71	102	0
October	16.4	7.9	92	77	16.5	6.9	72	107	0
November	10.9	7.7	100	42	9.9	7.1	83	107	0
December	7.0	7.8	102	37	5.3	7.3	92	110	0
Annual Avg.	13.9	7.8	98	51	13.1	7.1	85	108	0
Aesthetic Obj.					<15	6.5 - 8.5	30 - 500	80 - 100	5

Notes: -Aesthetic Obj. - refers to non-health related objectives from the ODWQS

-Expressed as monthly arithmetic mean values calculated from 2X/wk samples (daily treated pH and Temp.)

Temperature: The data show that the raw water supply varies significantly in temperature over the course of the year. Raw and treated water temperatures measured daily ranged from approximately 4 C to 25 C. Temperature extremes present challenges to the treatment process. The sedimentation process tends to be slower and some chemical coagulants react less quickly in cold water. At the other extreme, warm water promotes the growth of plants and algae in the raw water source, requiring higher chemical dosages and increased frequency of filter backwashing for effective treatment.

Colour: Colour develops in raw water sources most often from the decay of naturally occurring organic matter. The resulting colloidal and dissolved organic compounds react with coagulant chemicals and tend to increase dosage requirements. At the treatment plant, colour is removed by chemical oxidation during pre-chlorination, in the coagulation / sedimentation process, and through the granular activated carbon contactors.

Monthly average raw water colour measurements ranged from 27 ACU to 124 ACU. Effective removal was achieved through the treatment process as colour did not exceed the aesthetic objective of 5 NTU in any treated water samples collected during 2016.

pH: pH has an impact on the performance of coagulants and on the effectiveness of the disinfection process. Both raw and treated water pH values remained relatively stable and within an acceptable range, averaging 7.8 and 7.1 respectively.

Alkalinity: Closely related to pH, alkalinity is a measurement of the acid buffering capacity of water. (The higher the alkalinity, the more acid that can be added before a change in pH occurs.) Several substances naturally present in raw water are measured as alkalinity, the majority of which are carbonate compounds. Coagulants, when added to water, combine with the alkalinity to produce insoluble metal hydroxides (floc particles) that play an important role in the sedimentation process. The primary coagulant used in the process is acidic and therefore decreases alkalinity. If too much natural alkalinity is consumed by the coagulant, there may be insufficient alkalinity remaining for optimal floc formation. Therefore, if a noticeable drop in pH (and alkalinity) is occurring, it may be necessary to lower the coagulant dosage to conserve alkalinity, or alter the process by adding alkalinity to the incoming raw water.

Raw and treated water alkalinities were relatively consistent through 2016 averaging 98 mg/L and 85 mg/L, respectively. All treated water alkalinity measurements were within the ODWQS recommended operational range.

Hardness: Hard water can cause scaling in pipes and fixtures while water that is low in hardness tends to be corrosive. According to the ODWQS, the ideal range is between 80 and 100 mg/L.

Testing of treated water from the Deseronto process indicated moderate hardness (marginal potential for scaling), averaging 108 mg/L. Hardness in water is not a health concern, but rather an aesthetic characteristic.

3.3 Turbidity:

Turbidity refers to a physical characteristic of water that causes a cloudy appearance. Turbidity is caused by the presence of suspended matter. It is of concern in treated water as it may include disease causing organisms, or material that can shield potentially pathogenic organisms from disinfection. Adequate removal of turbidity through the treatment process is therefore necessary to ensure the effectiveness of the disinfection process.

Table 3 is a summary of turbidity measured in raw water as it enters the plant, effluent discharged from each filter, and in treated water prior to entering the distribution system.

Table 3 – Raw, Filtered, and Treated Water Turbidity

Month	Raw Water Turbidity			Dual Media Filter #1			Dual Media Filter #2			Treated Water Turbidity		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
January	0.69	4.79	1.67	0.04	0.47	0.08	0.03	0.48	0.12	0.04	0.11	0.05
February	0.69	3.82	1.60	0.04	0.26	0.06	0.02	0.33	0.09	0.05	0.29	0.06
March	0.49	3.10	1.22	0.02	0.14	0.05	0.02	0.24	0.06	0.05	0.09	0.05
April	0.73	3.99	1.69	0.04	0.12	0.05	0.02	0.25	0.07	0.05	0.09	0.06
May	0.59	1.61	1.00	0.04	0.18	0.06	0.03	0.25	0.07	0.06	0.18	0.06
June	0.79	3.32	1.75	0.03	0.49	0.07	0.02	0.48	0.07	0.05	0.48	0.06
July	1.65	5.29	3.59	0.04	0.17	0.08	0.04	0.29	0.10	0.05	0.19	0.06
August	2.33	11.90	7.46	0.05	0.26	0.09	0.00	0.30	0.10	0.06	0.47	0.07
September	9.30	19.60	12.19	0.05	0.22	0.09	0.03	0.19	0.07	0.05	0.21	0.06
October	4.18	11.90	7.51	0.04	0.38	0.06	0.00	0.26	0.04	0.05	0.20	0.06
November	1.42	3.63	2.22	0.03	0.21	0.04	0.01	0.15	0.03	0.05	0.20	0.05
December	1.62	3.78	2.47	0.03	0.41	0.04	0.03	0.14	0.05	0.05	0.15	0.05
Avg.			3.70			0.07			0.07			0.06
Max./Min.	0.49	19.60		0.02	0.49		0.00	0.48		0.04	0.48	
ODWS MAC					**1.0**			**1.0**				

Notes:

Raw values are averages of grab samples collected typically 2X/wk and measured using Hach 2100P portable turbidity meter

Dual media filters and treated turbidity values are continuous measurements recorded every 5 minutes

Raw (untreated) water turbidity, based on monthly averages of bench top measurements during 2016, indicated a source water of variable clarity, averaging 3.7 NTU and ranging from 0.5 NTU to

20 NTU.

Filtered water turbidity, measured continuously in the effluent from filters 1 and 2 both averaged 0.07 NTU. Maximum values were 0.49 NTU for filter 1 and 0.48 NTU for filter 2. Filter performance was comparable to that observed in the previous year and continued to consistently meet regulatory requirements.

The rules for disinfecting drinking water require that at least 95 percent of filtered water turbidity measurements in a given month are less than 0.3 NTU. Calculations confirmed that the 95 percent rule was satisfied during each month of 2016.

Process alarms are installed at various stages of treatment to alert staff to abnormally high turbidity well in advance of significant process failure or approaching the compliance limit. In the event that turbidity exceeds an alarm set point, the low lift pumps automatically shut off, halting the treatment process until the problem is corrected.

Accuracy of the raw, process, and treated water continuous monitoring instruments is verified at least twice weekly using portable bench top instrumentation. Both continuous and bench top measurement instruments are routinely maintained and calibrated in accordance with manufacturer recommendations.

3.4 Disinfection and Bacteriological Testing:

Disinfection of the water supply protects public health by ensuring the inactivation of potentially harmful micro-organisms that may have passed through the treatment process or entered the distribution system by other means. A minimum free residual of 0.2 mg/L, maintained throughout the distribution system, is recommended in the *Procedure for Disinfecting Drinking Water in Ontario.* Less than 0.05 mg/L free residual is considered an adverse condition and may pose a potential threat to public health. Additionally, the *Guideline* requires that treated water must be mixed with the disinfectant and held for a minimum period of time before distributing to customers. This is referred to as CT which is calculated as the product of the disinfectant concentration and the amount of time the water is exposed to the disinfectant. CT is directly related to the rate of pathogen inactivation.

Chlorine residuals are monitored continuously in raw water (upstream from the treatment process) and in treated water. The treated water analyzer is equipped with alarms that alert the operators to process abnormalities and will automatically shut down the process to prevent improperly disinfected water from entering the distribution system.

Disinfectant residuals and bacteriological results are summarized in Tables 4a, 4b, and 4c. Chlorine residual measurement instruments are routinely calibrated and maintained by operations staff according to manufacturer specifications.

Table 4a – Treated Water Disinfection and Bacteriological Analytical Data

Month	Treated Water								
	Free Cl_2 Residual			Total Cl_2 Residual			Total Coliforms	E. Coli	Heterotrophic Plate Count
	Min (mg/L)	Max (mg/L)	Avg (mg/L)	Min (mg/L)	Max (mg/L)	Avg (mg/L)	(org./100mL)	(org./100mL)	(org./1mL)
January	0.72	1.94	1.51	1.38	1.84	1.60	0	0	<10
February	1.06	1.89	1.55	1.45	2.08	1.75	0	0	<10
March	1.22	1.89	1.58	1.50	2.09	1.83	0	0	<10 - 20
April	1.03	1.72	1.47	1.31	1.97	1.64	0	0	<10 - 10
May	0.94	1.87	1.52	1.29	1.88	1.58	0	0	<10 - 20
June	0.94	2.54	1.69	1.40	2.15	1.78	0	0	<10
July	0.89	2.06	1.56	1.39	2.04	1.65	0	0	<10 - 10
August	0.97	2.26	1.56	1.34	1.90	1.66	0	0	<10 - 10
September	0.95	2.05	1.62	1.58	1.89	1.75	0	0	<10
October	1.37	2.27	1.71	1.71	2.13	1.89	0	0	<10
November	1.25	2.42	1.63	1.55	2.15	1.88	0-4	0	<10 - 10
December	0.92	1.64	1.35	1.25	1.81	1.55	0	0	<10 - 20
# of samples	continuous			365	365	365	53	53	52
Annual Min/Max/Avg	0.72	2.54	1.56	1.25	2.15	1.71			

Notes:

-total chlorine residual values are derived from bench-top analysis of grab samples collected daily

-free chlorine residual values represent on-line continuous measurements recorded every 5 minutes.

Free chlorine residual measured in treated water at the plant averaged 1.56 mg/L, which is consistent with the average observed in 2015. It is important to note that chlorine residual typically declines in proportion to the distance from the point of application. Relatively high chlorine residuals are required leaving the plant to ensure that the guideline minimum residual of 0.2 mg/L is maintained throughout the distribution system. Testing of approximately 150 grab samples collected from sample stations located at the distant extremes of the distribution system as well as continuous monitoring data from one remote location indicate that the minimum free chlorine residual measured in the distribution system during 2016 was 0.2 mg/L.

Table 4b – Distribution Water Disinfection and Bacteriological Data

Month	Distribution Water: Distribution Free Cl_2 Min (mg/L)	Max (mg/L)	Avg (mg/L)	Total Coliforms (org./100mL)	E. Coli (org./100mL)	HPC (org./1mL)
January	0.73	1.93	1.43	0	0	<10 - 40
February	0.80	1.98	1.40	0	0	<10
March	0.95	1.86	1.42	0	0	<10
April	0.79	1.86	1.34	0	0	<10 - 10
May	0.64	2.06	1.47	0	0	<10
June	0.39	2.73	1.50	0	0	<10 - 10
July	0.45	2.97	1.19	0	0	<10
August	0.20	2.70	1.19	0	0	<10 - 10
September	0.45	2.00	1.26	0	0	<10
October	0.37	2.68	1.44	0	0	<10 - 50
November	0.50	2.63	1.38	0 - 2	0	<10 - 10
December	0.60	1.94	1.16	0	0	<10 - 1120
# of samples	continuous			157	157	156
Annual Min/Max/Avg	0.20	2.97	1.35			

Notes:

Reported maximum and average free chlorine residual values represent continuous measurements recorded every 5 minutes

Reported minimum free chlorine residual values represent continuous measurements and analysis of grab samples collected from 3 locations each week

Samples for bacteriological testing are collected typically from 3 of 4 dedicated sample hydrants once each week

Verification of the disinfection process is demonstrated by testing treated water samples for indicators of bacteriological contamination. Throughout 2016 approximately 200 treated water samples were collected at the water treatment plant and from various locations in the distribution system. Indication of adverse water quality was observed in 2 samples, both collected on November 8th. Immediate re-sampling and testing at the affected locations showed no indication of adverse water.

Raw water (untreated source water from the Bay of Quinte), as discussed in Section 1.5, is chlorinated at the intake crib to control the growth of zebra mussels and to prevent other growth in the intake pipe prior to entering the treatment process. Chlorine residual in raw water is continuously measured immediately upstream from the treatment process to verify dosage. An underwater inspection and cleaning of the intake crib conducted in June 2016 indicated successful operation of the pre-chlorination / zebra mussel control system. The intake crib is inspected and cleaned at a frequency of every three to five years. The previous inspection was done in 2013.

The bacteriological quality of raw water is routinely tested to detect changes in source water quality that may require adjustments to the treatment process or additional monitoring. Bacteriological quality tends to deteriorate when water temperature is warm due to increased algae growth, and during heavy rainfall events which wash surface contaminants into the source water. Raw water bacteriological trends and chlorine residuals in 2016 were relatively consistent with those observed in 2015.

Table 4c – Raw Water Pre-chlorination and Bacteriological Data

Month	Raw Water			Pre-chlorinated Raw Water					
	Total Coliforms (org./100mL)	E. Coli (org./100mL)	HPC (org./1mL)	Free Cl_2 Residual			Total Cl_2 Residual		
				Min (mg/L)	Max (mg/L)	Avg (mg/L)	Min (mg/L)	Max (mg/L)	Avg (mg/L)
January	0 - 39	0 - 1	10	0.02	0.22	0.10	0.17	0.64	0.33
February	0	0	10	0.01	0.22	0.09	0.02	0.46	0.25
March	0 - 2	0 - <2	90	0.01	0.28	0.08	0.18	0.48	0.26
April	0 - 4	0	30	0.01	0.10	0.06	0.14	0.26	0.18
May	0 - 2	0 - <2	450	0.01	0.17	0.07	0.14	0.52	0.22
June	14 - OG	0 - OG	69	0.01	0.15	0.07	0.03	0.45	0.18
July	1 - OG	0 - OG	>2000	0.02	0.16	0.08	0.09	0.29	0.17
August	2 - >400	<2	>2000	0.01	0.16	0.09	0.05	0.24	0.16
September	30 - OG	<2 - OG	>2000	0.02	0.15	0.09	0.05	0.29	0.16
October	<2 - OG	<2 - OG	1670	0.02	0.19	0.08	0.09	0.36	0.21
November	<2 - 24	0 - <2	170	0.02	0.15	0.05	0.13	0.34	0.21
December	0 - 1	0 - <2	10	0.02	0.16	0.07	0.13	0.36	0.25
# of samples	52	52	12	365					
Min/Max/Avg				0.01	0.28	0.08	0.02	0.64	0.22
Range	0 - OG	0 - OG	10 - >2000						

Notes:

Reported free and total chlorine residuals are measured in daily grab samples

3.5 Process Chemical Addition:

Three chemicals are used in the treatment process including a poly-aluminum chloride blend, anionic polymer, and chlorine. Table 5 summarizes the use of those chemicals during 2016.

Table 5 – Treatment Process Chemical Use and Aluminum Residual

Month	Coagulant			Polymer		Pre Chlorine Gas		Post Chlorine Gas	
	Monthly Usage (L)	Average Dosage (mg/L)	Treated Water Al residual (ug/L)	Monthly Usage (L)	Average Dosage (mg/L)	Monthly Usage (kg)	Average Dosage (mg/L)	Monthly Usage (kg)	Average Dosage (mg/L)
January	2660	23.5	0.042	2944	0.13	27.7	0.63	110.3	2.74
February	1686	23.2	0.029	1812	0.13	16.3	0.58	76.3	3.00
March	1782	23.1	0.043	2186	0.15	20.0	0.66	79.4	2.95
April	1753	23.4	0.022	1993	0.14	18.6	0.63	70.4	2.67
May	2056	24.0	0.030	2588	0.16	21.3	0.64	92.2	3.02
June	2845	34.8	0.034	2437	0.15	18.2	0.56	77.3	2.65
July	3742	39.7	0.019	3107	0.17	29.0	0.80	100.0	2.97
August	3954	41.6	0.020	3052	0.17	30.4	0.83	100.2	2.95
September	3735	43.0	0.025	2526	0.15	32.7	0.98	101.6	3.25
October	3590	43.2	0.010	2427	0.15	34.0	1.06	77.1	2.63
November	2584	33.0	0.013	2205	0.15	28.6	0.94	72.3	2.54
December	2849	31.5	0.006	2587	0.15	38.6	1.10	78.8	2.43
Average	2770	32.0	0.024	2489	0.15	26.3	0.78	86.3	2.82
Year Total	33235			29865		315		1036	

The average dosage of coagulant during 2016 was 31 mg/L (expressed as mg active ingredient/L), which was consistent with that observed in 2015 (32 mg/L). The total volume of coagulant used during 2016 was approximately 9 percent higher than that required in the previous year, corresponding with the increase in treated water production.

Polymer dosage was consistent with that observed in 2015 averaging 0.15 mg/L, while total volume increased by approximately 14% due to the increased treated water production.

Dissolved aluminum is measured in the treated water due to the necessary use the aluminum-based primary coagulant in the treatment process. Optimized process control is recommended to reduce this “residual” aluminum to under the operational guideline of 0.1 mg/L. High residual aluminum can cause scaling of the pipes in the distribution system, interference with certain industrial processes, and re-flocculation in the distribution system.

Aluminum residuals measured in treated water samples collected during 2016 averaged 0.017 mg/L showing a marked decreased in the average observed the previous year (0.024 mg/L). Aluminum residual measurements did not exceed the ODWQS operational guideline. Monthly average treated water aluminum residuals are also summarized in Table 5.

The total mass of chlorine used in the treatment process increased by approximately 9 percent when compared to 2015 due to the increased volume of treated water produced. Average pre-chlorine dosage increased by 19 percent while average post-chlorine dosage decreased by approximately 11 percent.

3.6 Other Organic and Inorganic Testing:

Analyses of over 70 additional organic and inorganic parameters in the treated water are required at various frequencies. The majority of those substances, listed as Schedules 23 and 24 in O.Reg.170/03, must be tested at least annually. Testing for nitrite, nitrate, and THMs is required quarterly, while sodium and fluoride must be tested once every five years. The results of those analyses are summarized in Tables 6 and 7.

Concentrations of all tested substances were either below the analytical method detection limits (either not present or in trace levels too low to quantify) or well below the maximum acceptable concentrations listed in the ODWQS.

The average concentration of THMs (by-products of the disinfection process) measured in 2016 was consistent with that observed in the previous year.

Table 6 – Schedule 23, Fluoride, Sodium, Lead, Nitrite, and Nitrate

Parameter	Limit mg/L	Limit Type	Date Sampled	# of samples	Treated Maximum Conc. mg/L	Limit Exceeded?
Antimony	0.006	IMAC	19-Jan-16	1	<0.0001	no
Arsenic	0.025	IMAC	19-Jan-16	1	0.0003	no
Barium	1	MAC	19-Jan-16	1	0.034	no
Boron	5	IMAC	19-Jan-16	1	0.007	no
Cadmium	0.005	MAC	19-Jan-16	1	<0.00002	no
Chromium	0.05	MAC	19-Jan-16	1	<0.002	no
Fluoride	1.5	MAC	20-Jan-15	1	0.1	no
Mercury	0.001	MAC	19-Jan-16	1	<0.00002	no
Selenium	0.01	MAC	19-Jan-16	1	<0.001	no
Sodium	200	AO	20-Jan-15	1	9.4	no
Uranium	0.02	MAC	19-Jan-16	1	<0.00005	no
Nitrate	10.0	MAC	2016	4	0.3	no
Nitrite	1.0	MAC	2016	4	<0.1	no

NOTES:

Nitrate and nitrite values are maximum concentrations measured in quarterly samples.

MAC - ODWS maximum acceptable concentration

IMAC - ODWS interim maximum acceptable concentration

AO - ODWS aesthetic objective

Quarterly Nitrate / Nitrite Results (mg/L)

	Q1	Q2	Q3	Q4
Nitrate	0.3	0.3	0.2	0.10
Nitrite	<0.1	<0.1	<0.1	<0.1

Table 7 – Schedule 24 Parameter Concentration Data

Parameter	Units	ODWS		Date Sampled	# of sples	Result	Limit Exceeded
		Limit	Type				
Alachlor	µg/L	5	IMAC	19-Jan-16	1	<0.3	no
Atrazine + Metabolites	µg/L	5	IMAC	19-Jan-16	1	<0.5	no
Azinphos-methyl	µg/L	20	MAC	19-Jan-16	1	<1	no
Benzene	µg/L	5	MAC	19-Jan-16	1	<0.5	no
Benzo(a)pyrene	µg/L	0.01	MAC	19-Jan-16	1	<0.005	no
Bromoxynil	µg/L	5	IMAC	19-Jan-16	1	<0.3	no
Carbaryl	µg/L	90	MAC	19-Jan-16	1	<3	no
Carbofuran	µg/L	90	MAC	19-Jan-16	1	<1	no
Carbon tetrachloride	µg/L	5	MAC	19-Jan-16	1	<0.2	no
Chlorpyrifos	µg/L	90	MAC	19-Jan-16	1	<0.5	no
Diazinon	µg/L	20	MAC	19-Jan-16	1	<1	no
Dicamba	µg/L	120	MAC	19-Jan-16	1	<5	no
1,2-dichlorobenzene	µg/L	200/3	MAC/AO	19-Jan-16	1	<0.1	no
1,4-dichlorobenzene	µg/L	5/1	MAC/AO	19-Jan-16	1	<0.2	no
1,2-dichloroethane	µg/L	5	IMAC	19-Jan-16	1	<0.1	no
1,1-dichloroethene	µg/L	14	MAC	19-Jan-16	1	<0.1	no
Dichloromethane	µg/L	50	MAC	19-Jan-16	1	<0.3	no
2,4-dichlorophenol	µg/L	900/0.3	MAC/AO	19-Jan-16	1	<0.1	no
2,4-dichlorophenoxy acetic acid	µg/L	100	IMAC	19-Jan-16	1	<5	no
Diclofop-methyl	µg/L	9	MAC	19-Jan-16	1	<0.5	no
Dimethoate	µg/L	20	IMAC	19-Jan-16	1	<1	no
Diquat	µg/L	70	MAC	19-Jan-16	1	<5	no
Diuron	µg/L	150	MAC	19-Jan-16	1	<5	no
Glyphosate	µg/L	280	IMAC	19-Jan-16	1	<25	no
Malathion	µg/L	190	MAC	19-Jan-16	1	<5	no
MCPA	µg/L	0.1	MAC	11-Oct-16	1	<0.00012	no
Metolachlor	µg/L	50	IMAC	19-Jan-16	1	<3	no
Metribuzin	µg/L	5	MAC	19-Jan-16	1	<3	no
Monochlorobenzene	µg/L	80/30	MAC/AO	19-Jan-16	1	<0.2	no
Paraquat	µg/L	10	IMAC	19-Jan-16	1	<1	no
Pentachlorophenol	µg/L	60, 30	MAC/AO	19-Jan-16	1	<0.1	no
Phorate	µg/L	2	IMAC	19-Jan-16	1	<0.3	no
Picloram	µg/L	190	IMAC	19-Jan-16	1	<5	no
Polychlorinated Biphenyls (PCB's)	µg/L	3	IMAC	19-Jan-16	1	<0.05	no
Prometryne	µg/L	1	IMAC	19-Jan-16	1	<0.1	no
Simazine	µg/L	10	IMAC	19-Jan-16	1	<0.5	no
Terbufos	µg/L	1	IMAC	19-Jan-16	1	<0.3	no
Tetrachloroethylene	µg/L	30	MAC	19-Jan-16	1	<0.2	no
2,3,4,6-Tetrachlorophenol	µg/L	100/1	MAC/AO	19-Jan-16	1	<0.1	no

Table 7 – Schedule 24 Parameter Data (2)

Parameter	Units	ODWS		Date Sampled	# of samples	Result	Limit Exceeded
		Limit	Type				
Triallate	µg/L	230	MAC	19-Jan-16	1	<10	no
Trichloroethylene	µg/L	50	MAC	19-Jan-16	1	<0.1	no
2,4,6-Trichlorophenol	µg/L	5, 2	MAC, AO	19-Jan-16	1	<0.1	no
Trifluralin	µg/L	45	IMAC	19-Jan-16	1	<0.5	no
Vinyl Chloride	µg/L	2	MAC	19-Jan-16	1	<0.2	no
Bromodichloromethane	µg/L	-	-	2016	4	6.6	-
Bromoform	µg/L	-	-	2016	4	0.1	-
Chloroform	µg/L	-	-	2016	4	59.6	-
Dibromochloromethane	µg/L	-	-	2016	4	0.5	-
TOTAL THMs	µg/L	100	MAC	2016	4	66.5	no

NOTES:
Samples for THM analysis collected from distribution sample hydrant
THM MAC is based on 4-quarter running average (2015 average shown)

Quarterly THM Results (µg/L)

	Q1	Q2	Q3	Q4
Bromodichloromethane	5.2	4.0	9.4	7.6
Bromoform	**0.1**	**0.1**	**0.1**	**0.1**
Chloroform	66.9	68.8	59.1	43.5
Dibromochloromethane	**0.1**	**0.1**	1.0	0.6
Total	72.1	72.8	69.5	51.6

3.7 Distribution System Lead Testing

Lead can be present in drinking water systems as the result of corrosion of lead solder, lead in brass fittings/fixtures, or lead pipes in plumbing or building service lines. Although most of those sources of lead have been eliminated from modern construction materials, elevated concentrations are periodically detected in water samples collected in older neighborhoods where lead service lines still exist. As a result, in 2007 the Province imposed mandatory lead testing at all municipal drinking water systems. This precautionary testing was primarily focused on protecting the health of the vulnerable population which, in the case of lead contamination, is young children (<6 yr) and pregnant women. While drinking water is a minor contributor to blood lead levels, municipal lead testing helps identify potential sources of contamination and will provide opportunities to further improve the high quality of public water supplies.

From 2008 through 2010, a total of 120 samples were collected from residential and non-residential plumbing. Of those, only 6 exceeded the standard. Additional testing at the sites where the standard was exceeded clearly indicated that minimal lead remained in the water after flushing for as little as several seconds.

Residential lead testing was not required during 2011 and 2012 as past results from the Deseronto system demonstrated a very low health risk.

The lead sampling program resumed at a reduced rate in 2013, with results from all tested locations well below the ODWQS maximum acceptable concentration.

Based on the favorable past results, residential lead sampling is no longer required unless changes in other water characteristics are observed; specifically pH and alkalinity. Testing of pH and alkalinity in the distribution system continues to be a semi-annual requirement while lead in the distribution system must be measured once every three years. Analytical data for distribution system lead, pH, and alkalinity from 2013 to 2016 are provided in Table 8. No significant changes to those parameters have been observed.

Table 8 – Distribution Lead, pH, and Alkalinity

	West Sample Hydrant			North Sample Hydrant			East Sample Hydrant		
Sample Date	**Lead** mg/L	**pH**	**Alkalinity** mg/L	**Lead** mg/L	**pH**	**Alkalinity** mg/L	**Lead** mg/L	**pH**	**Alkalinity** mg/L
25-Feb-2013	0.00031	6.98	92	0.00050	6.98	92			
25-Sep-2013	0.00079	6.75	67	0.00092	6.78	67			
14-Jan-2014		6.90	86					6.87	86
12-Aug-2014		6.92	82					6.95	82
20-Jan-2015		7.02	94					6.97	96
07-Jul-2015		6.78	90					6.65	91
26-Jan-2016	0.00044	7.09	97				0.00032	7.14	97
26-Jul-2016	0.00067	6.58	82				0.00034	6.81	84
Limit / Objective	**0.01**	6.5 – 8.5	30 - 500	**0.01**	6.5 – 8.5	30 - 500	**0.01**	6.5 – 8.5	30 - 500

3.9 Microcystin Testing

Blooms of blue-green algae are common in the Bay of Quinte during warm summer and early fall months. When blue-green algae decay, it releases toxic compounds called microcystins.

To monitor for microcystins in Deseronto drinking water, samples of both raw and treated water are sampled and tested weekly from June to October. Measureable concentrations of microcystins in the raw untreated Bay water are seasonally common but are typically below the drinking water standard of 1.5 ug/L microcystin-LR. During 2016 the maximum concentration of microcystin-LR measured in untreated water was 0.60 ug/L.

Microcystins are removed through the Deseronto treatment process by oxidation (chlorine addition) and by adsorption through the granular activated carbon contactors. The treatment process has been effective in removing microcystin from the raw water as it was not detected in any treated water sample collected in 2016.

3.10 Waste Clarifier Performance Monitoring

The waste clarifier treats the waste generated from the water treatment process including filter backwash, and reactor clarifier sludge. Treated effluent from the waste clarifier is discharged to the Bay of Quinte. The effluent is sampled at least once per month and tested for total suspended solids (TSS). The annual average concentration of TSS was 5 mg/L which is well below the maximum permitted average concentration of 25 mg/L. Flow to the waste clarifier during 2016 did not exceed the design capacity of 350 m^3/d. Performance data for the waste clarifier is provided in Table 9.

Table 9 – Waste Clarifier Performance Data

Month	Avg. Flow (m^3/d)	Max. Flow (m^3/d)	TSS (mg/L)
January	151.4	158.1	<3
February	160.8	165.1	<3
March	153.7	157.7	8
April	132.9	133.4	3
May	126.3	129.8	<3
June	104.9	107.3	<3
July	124.1	128.1	<3
August	113.0	113.5	<3
September	139.3	140.0	18
October	145.1	149.8	<3
November	137.1	144.4	<3
December	135.7	138.0	<3
Maximum		165.1	18
Average	135.3		5
DWWP Limit		**350**	**25**

where: Avg. Flow - Average daily flow for each month.
Max. Flow - Maximum day flow measured each month.
TSS - total suspended solids
DWWP TSS limit based on annual average of monthly sples

4 – System Maintenance and Improvements

The drinking water facility, although maintained and performing well, is aging and has little reserve capacity remaining. The present facility does not meet current design standards and requires major equipment and electrical upgrades. The Town, partnered with the neighbouring Mohawks of the Bay of Quinte, have been awarded funding assistance through the Small Communities Fund to complete the required upgrades.

Consultant selection is presently underway. It is anticipated that design will be completed in 2017 followed by approximately one year of constructions and commissioning of the renewed facility in early 2019. Renewal of the facility will significantly improve the reliability of the drinking water system by reducing the risk of failure, and will provide ample capacity for desired future growth in the Town and in the neighbouring First Nations Community.