Town of Deseronto

on the water's edge

Drinking Water System

2017 - *Annual Report*

322 Water Street
Deseronto, Ontario
K0K 1X0

Prepared: January 2018

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 2,946 m^3/d design limitations reduce the sustainable capacity to less than 1700 m^3/d.

During 2017, treated water pumped to the community decreased by approximately 4 percent when compared to 2016. The 2017 maximum day flow of 1800 m^3/d occurred in June. Based on accepted theoretical unit process design capacities, the recorded maximum day flow could not be sustained for an extended period of time. Repairs to the distribution system reduced the short-term elevated flows however process upgrades are needed to increase capacity for future periods of high demand.

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; one collected in June and one in July. 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 during 2017 included the installation of a new electrical service and connection to the new wastewater plant diesel generator. Routine PM and distribution repairs also continued through 2017.

Given the advanced age of the treatment units, lack of back-up treatment units, and minimal reserve capacity during periods of high demand, 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 design and construction to address the above noted deficiencies. Completion of the upgrade project is anticipated in early 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 2017 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 2017 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 flows 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 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 the 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)

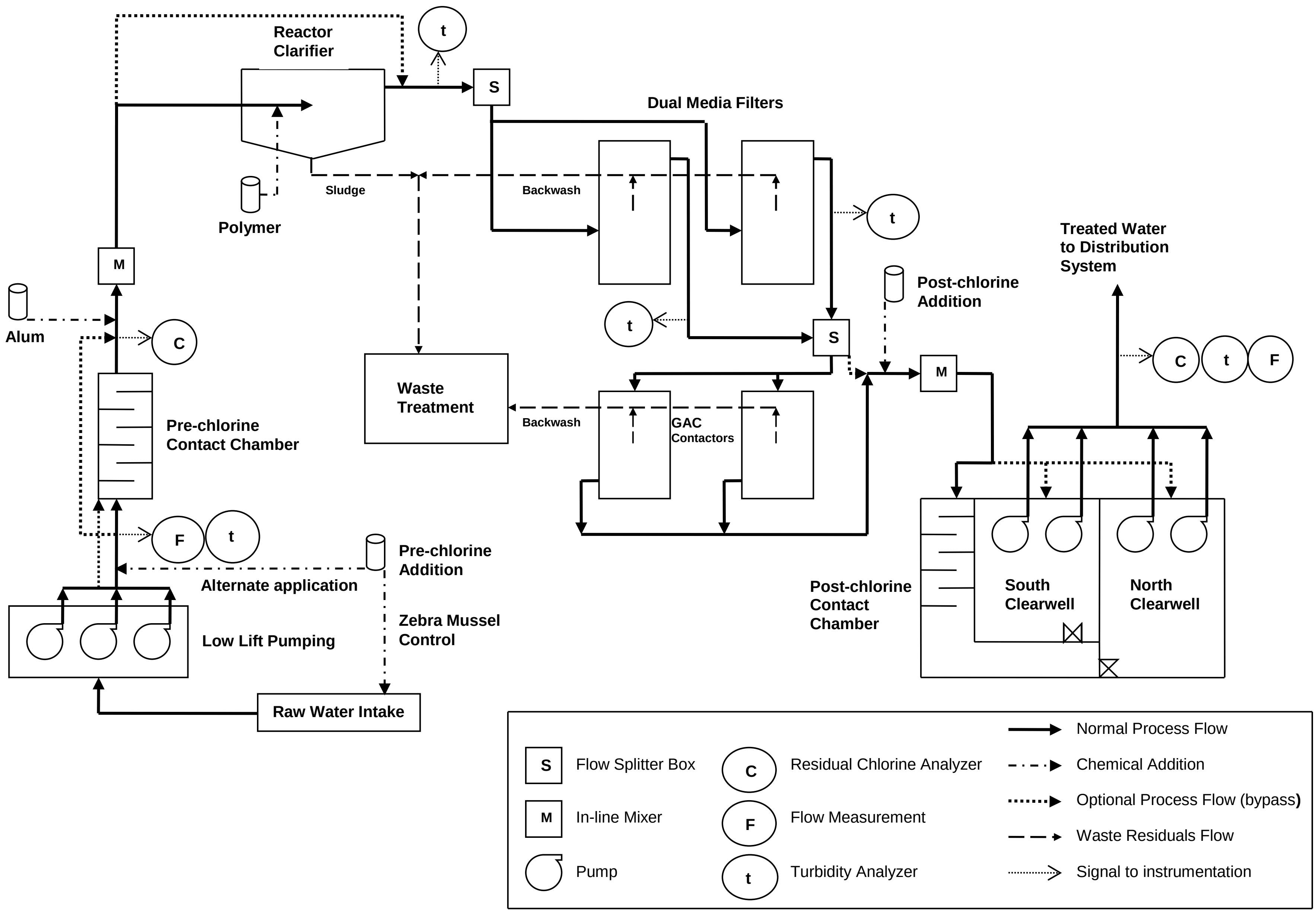
1.9 Laboratory Testing:

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 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 two occasions in 2017. On June 6th and on July 18th, bacteriological testing of samples collected from the north-end Brant Street sample hydrant on the water distribution system indicated the presence of 1 and 9 cfu/100mL total coliforms respectively. Re-sampling and testing was conducted on the following day at the water treatment plant, the affected location and at another nearby north-end 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:

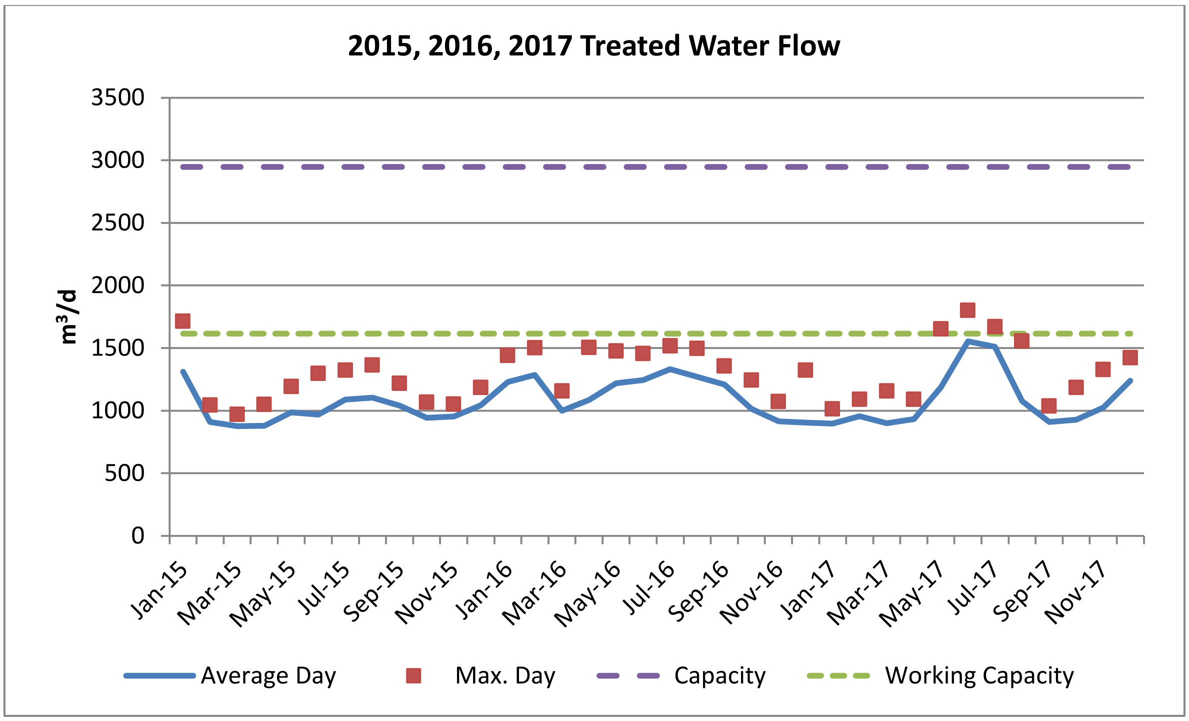
Raw water is pumped to the treatment facility from the Bay of Quinte in accordance with the terms and conditions of Permit to Take Water 6262-98DPFG (expires June 1, 2023). During 2017, the permitted maximum day flow of 2946 m^3/d was not exceeded at any time. The maximum instantaneous flow rate of 2050 L/min was exceeded for a brief period (<5 min) on September 6th when two low lift pumps were run simultaneously while performing preventive maintenance checks. The maximum recorded flow was 2233 L/min.

Raw and treated water flow data for 2017 are summarized in Table 1.

Table 1 – Raw and Treated Water Flow

Month	Raw Water				Treated Water			
	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	844	1088	978	30327	767	1014	897	27807
February	893	1170	1016	28441	785	1091	957	26788
March	825	1165	958	29706	765	1157	900	27906
April	857	1123	994	29831	793	1089	932	27950
May	961	1665	1226	37997	921	1652	1186	36780
June	1458	1863	1619	48575	1391	1800	1554	46619
July	1395	1748	1583	49088	1262	1671	1511	46842
August	892	1597	1151	35695	801	1554	1076	33344
September	860	1125	959	28785	809	1037	910	27308
October	768	1247	966	29942	736	1186	929	28794
November	858	1429	1072	32154	815	1329	1026	30767
December	1160	1483	1297	40195	1055	1422	1240	38455
Year Avg.			1152				1093	
Year Total				420736				399360
Year Max./Min.	768	1863			736	1800		
Permitted Capacity						**2946**		
Permit to Take Water		**2946**						

Treated water production averaged 1093 m^3/d, which is approximately 4 percent less than the 2016 average day flow. The maximum day treated water flow recorded during 2017 was 1800 m^3/d, representing 61 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 the sustainable plant capacity. Treated water average and maximum day flows for each month of 2015, 2016, and 2017 are shown in the chart below.



Significant decreases in treated water demand are observed from January to February 2015, February to March 2016, December 2016 to January 2017, and August to September 2017. The cause is attributed to repairs completed on customer service pipes and distribution mains. During 2017, 3 service leaks were repaired by Town staff.

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 their service lines. 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 2017 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	5.7	7.7	117	46	4.0	7.26	105	119	0
February	5.5	7.7	96	23	3.8	7.29	90	112	0
March	5.6	7.8	105	48	3.8	7.30	88	115	0
April	10.0	7.8	90	52	9.1	7.29	82	107	0
May	14.3	7.8	108	53	14.2	7.17	87	102	0
June	20.1	7.8	95	47	19.9	7.12	86	116	0
July	23.1	7.9	116	48	23.2	7.09	93	116	0
August	23.4	7.9	103	71	23.6	7.04	91	127	0
September	21.0	7.8	113	57	21.3	6.87	86	125	0
October	17.2	7.6	91	37	17.7	6.88	86	149	0
November	9.2	7.7	107	47	9.4	6.95	90	133	0
December	5.0	7.7	88	44	4.4	7.07	84	128	0
Annual Avg.	13.3	7.8	102	48	12.9	7.1	89	121	0.0
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 daily pH and temp (all others 2 samples/wk.)

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 24 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 23 ACU to 71 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 2017.

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 2017 averaging 102 mg/L and 89 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 121 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	0.57	3.98	1.41	0.03	0.27	0.04	0.03	0.11	0.05	0.05	0.12	0.06
February	0.47	1.62	0.82	0.04	0.15	0.04	0.03	0.11	0.05	0.05	0.09	0.06
March	0.70	4.20	1.89	0.04	0.17	0.05	0.05	0.22	0.07	0.05	0.09	0.06
April	1.28	2.54	1.81	0.04	0.12	0.05	0.03	0.21	0.08	0.05	0.11	0.06
May	1.23	3.78	2.17	0.05	0.22	0.06	0.02	0.33	0.07	0.06	0.11	0.07
June	1.48	2.44	1.84	0.05	0.42	0.07	0.01	0.46	0.08	0.06	0.17	0.08
July	1.46	2.78	2.25	0.04	0.18	0.08	0.03	0.17	0.08	0.06	0.19	0.08
August	2.27	4.75	3.31	0.05	0.16	0.07	0.03	0.31	0.09	0.06	0.16	0.08
September	1.49	3.90	2.65	0.04	0.14	0.07	0.03	0.28	0.06	0.06	0.14	0.07
October	0.70	3.82	1.93	0.03	0.15	0.05	0.02	0.10	0.04	0.05	0.13	0.06
November	0.99	3.16	1.74	0.03	0.14	0.04	0.03	0.16	0.05	0.05	0.19	0.05
December	0.73	2.90	1.39	0.04	0.39	0.06	0.05	0.36	0.07	0.06	0.13	0.06
Avg.			1.93			0.06			0.07			0.06
Max./Min.	0.47	4.75		0.03	0.42		0.01	0.46		0.00	0.19	
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 2017, indicated a source water of moderately variable clarity, averaging 1.9 NTU and ranging from 0.5 NTU to 4.8 NTU.

Filtered water turbidity, measured continuously in the effluent from filters 1 and 2 averaged 0.06 NTU and 0.07 NTU respectively. Maximum values were 0.42 NTU for filter 1 and 0.46 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 2017.

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	1.01	1.66	1.34	1.31	1.76	1.51	0	0	<10
February	1.13	2.36	1.45	1.43	2.94	1.72	0	0	<10 - 10
March	1.09	1.78	1.44	1.22	1.85	1.64	0	0	<10 - 10
April	1.09	1.83	1.49	1.38	1.87	1.64	0	0	<10 - 10
May	0.82	1.84	1.44	1.22	1.89	1.52	0	0	<10 - 40
June	0.61	2.37	1.47	1.10	1.90	1.45	0	0	<10 - 20
July	0.67	2.17	1.52	1.13	2.09	1.56	0	0	<10 - 10
August	0.71	2.22	1.73	1.27	2.19	1.78	0	0	<10 - 20
September	0.97	2.17	1.64	1.35	2.14	1.82	0	0	<10
October	1.42	2.21	1.82	1.70	2.13	1.95	0	0	<10 - 10
November	1.25	2.28	1.67	1.56	2.20	1.83	0	0	<10
December	0.81	1.92	1.58	1.49	2.03	1.74	0	0	<10 - 10
# of samples	continuous			365	365	365	54	54	52
Annual Min/Max/Avg	0.61	2.37	1.55	1.10	2.94	1.68			

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 1.55 mg/L, which is consistent with the average observed in 2016. 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 2017 was 0.4 mg/L.

Table 4b – Distribution Water Disinfection and Bacteriological Data

Month	Distribution Water					
	Distribution Free Cl_2			Total Coliforms	E. Coli	HPC
	Min (mg/L)	Max (mg/L)	Avg (mg/L)	(org./100mL)	(org./100mL)	(org./1mL)
January	0.36	1.94	1.20	0	0	<10 - 10
February	0.67	3.38	1.37	0	0	<10 - 10
March	0.55	1.83	1.14	0	0	<10
April	0.42	1.71	1.12	0	0	<10 - 20
May	0.38	2.11	1.06	0	0	<10 - 10
June	0.40	2.76	1.47	0 - 1	0	<10 - 10
July	0.53	2.53	1.47	0 - 9	0	<10 - 10
August	0.49	2.56	1.70	0	0	<10 - 30
September	0.59	2.43	1.48	0	0	<10
October	0.50	2.14	1.57	0	0	<10 - 10
November	0.81	2.11	1.52	0	0	<10 - 10
December	0.60	2.45	1.55	0	0	<10 - 10
# of samples	continuous			160	160	52
Annual Min/Max/Avg	0.36	3.38	1.39			

Notes:

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

Reported minimum and maximum 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 2017 over 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; one collected on June 6th and the other on July 18th. Re-sampling and testing failed to confirm the initial adverse results, showing no indication of contamination.

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. Grab samples of raw water are also collected daily and tested for free and total chlorine residual.

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 rate of growth, and during heavy rainfall events when surface contaminants are washed into the source water. Raw water bacteriological trends and chlorine residuals in 2017 were relatively consistent with those observed in 2016.

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 - <2	0 - <2	20	0.03	0.27	0.12	0.03	0.35	0.27
February	0	0	30	0.02	0.19	0.08	0.22	0.40	0.30
March	0 - 4	0	60	0.01	0.17	0.09	0.06	0.36	0.19
April	0 - 2	0	50	0.01	0.20	0.06	0.06	0.23	0.16
May	0 - 11	0	470	0.01	0.11	0.05	0.06	0.19	0.14
June	3 - OG	0 - OG	290	0.01	0.09	0.04	0.06	0.25	0.16
July	0 - OG	0 - OG	330	0.04	0.20	0.09	0.03	0.26	0.16
August	0 - OG	0 - OG	480	0.03	0.07	0.05	0.09	0.24	0.13
September	0 - OG	0 - OG	370	0.02	0.11	0.04	0.04	0.17	0.10
October	0 - OG	0 - OG	>2000	0.01	0.09	0.03	0.05	0.19	0.13
November	0 - 4	0	190	0.01	0.10	0.04	0.01	0.22	0.13
December	0	0	20	0.01	0.16	0.06	0.01	0.36	0.25
# of samples	52	52	12	365					
Min/Max/Avg				0.01	0.27	0.06	0.01	0.40	0.18
Range	0 - OG	0 - OG	20 - >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 2017.

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	1708	21.9	0.013	2175	0.14	26.3	0.88	63.2	2.28
February	1481	20.2	0.007	1982	0.14	24.5	0.87	70.7	2.64
March	1541	20.1	0.009	1922	0.13	24.5	0.83	73.8	2.65
April	1796	23.4	0.009	2220	0.15	23.6	0.79	67.4	2.42
May	2472	25.3	0.011	2950	0.16	35.8	0.94	97.8	2.64
June	3860	30.7	0.019	3622	0.15	33.1	0.69	114.2	2.45
July	4672	36.9	0.022	3768	0.15	34.9	0.72	131.8	2.82
August	3835	41.8	0.028	3411	0.19	24.0	0.64	114.8	3.50
September	3183	42.8	0.017	2778	0.19	19.1	0.66	79.0	2.89
October	3205	41.5	0.013	3026	0.20	23.1	0.77	83.3	2.93
November	2843	34.9	0.007	3028	0.19	18.2	0.56	89.8	2.93
December	2556	24.5	0.011	3595	0.18	25.9	0.65	106.0	2.77
Average	2763	30.3	0.014	2873	0.16	26.1	0.75	91.0	2.74
Year Total	33153			34478		313.0		1091.8	

The average dosage of coagulant during 2017 was 30 mg/L (expressed as mg active ingredient/L), decreased slightly when compared to that observed in 2016 (32 mg/L). The total volume of coagulant used during 2017 was equivalent to that used the previous year.

Polymer dosage was slightly higher than observed in 2016 averaging 0.16 mg/L, with total volume increased by approximately 13%.

Dissolved aluminum is measured in the treated water due to the necessary addition of aluminum-based 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 2017 averaged 0.014 mg/L showing a slight decrease in the average observed the previous year (0.017 mg/L). Aluminum residual measurements did not exceed the ODWQS operational guideline. Monthly average treated water aluminum residuals are summarized in Table 5.

The total mass of chlorine used in the treatment process decreased by approximately 4 percent when compared to 2016 corresponding to the 4% decrease in treated water production. Average pre-chlorine dosage decreased by 19 percent while average post-chlorine dosage increased by approximately 9 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 2017 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	03-Jan-17	1	<0.0001	no
Arsenic	0.025	IMAC	03-Jan-17	1	0.0004	no
Barium	1	MAC	03-Jan-17	1	0.029	no
Boron	5	IMAC	03-Jan-17	1	<0.005	no
Cadmium	0.005	MAC	03-Jan-17	1	<0.00002	no
Chromium	0.05	MAC	03-Jan-17	1	0.002	no
Fluoride	1.5	MAC	20-Jan-15	1	0.1	no
Mercury	0.001	MAC	03-Jan-17	1	<0.00002	no
Selenium	0.01	MAC	03-Jan-17	1	<0.001	no
Sodium	200	AO	20-Jan-15	1	9.4	no
Uranium	0.02	MAC	03-Jan-17	1	<0.00005	no
Nitrate	10.0	MAC	2017	4	0.4	no
Nitrite	1.0	MAC	2017	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	0.4	0.1	<0.1
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	03-Jan-17	1	<0.3	no
Atrazine + Metabolites	µg/L	5	IMAC	03-Jan-17	1	<0.5	no
Azinphos-methyl	µg/L	20	MAC	03-Jan-17	1	<1	no
Benzene	µg/L	5	MAC	03-Jan-17	1	<0.5	no
Benzo(a)pyrene	µg/L	0.01	MAC	03-Jan-17	1	<0.005	no
Bromoxynil	µg/L	5	IMAC	03-Jan-17	1	<0.3	no
Carbaryl	µg/L	90	MAC	03-Jan-17	1	<3	no
Carbofuran	µg/L	90	MAC	03-Jan-17	1	<1	no
Carbon tetrachloride	µg/L	5	MAC	10-Jan-17	1	<0.2	no
Chlorpyrifos	µg/L	90	MAC	03-Jan-17	1	<0.5	no
Diazinon	µg/L	20	MAC	03-Jan-17	1	<1	no
Dicamba	µg/L	120	MAC	03-Jan-17	1	<5	no
1,2-dichlorobenzene	µg/L	200/3	MAC/AO	10-Jan-17	1	<0.1	no
1,4-dichlorobenzene	µg/L	5/1	MAC/AO	10-Jan-17	1	<0.2	no
1,2-dichloroethane	µg/L	5	IMAC	10-Jan-17	1	<0.1	no
1,1-dichloroethene	µg/L	14	MAC	10-Jan-17	1	<0.1	no
Dichloromethane	µg/L	50	MAC	10-Jan-17	1	<0.3	no
2,4-dichlorophenol	µg/L	900/0.3	MAC/AO	03-Jan-17	1	<0.1	no
2,4-dichlorophenoxy acetic acid	µg/L	100	IMAC	03-Jan-17	1	<5	no
Diclofop-methyl	µg/L	9	MAC	03-Jan-17	1	<0.5	no
Dimethoate	µg/L	20	IMAC	03-Jan-17	1	<1	no
Diquat	µg/L	70	MAC	03-Jan-17	1	<5	no
Diuron	µg/L	150	MAC	03-Jan-17	1	<5	no
Glyphosate	µg/L	280	IMAC	03-Jan-17	1	<25	no
Malathion	µg/L	190	MAC	03-Jan-17	1	<5	no
MCPA	µg/L	100	MAC	03-Jan-17	1	<0.00012	no
Metolachlor	µg/L	50	IMAC	03-Jan-17	1	<3	no
Metribuzin	µg/L	80	MAC	03-Jan-17	1	<3	no
Monochlorobenzene	µg/L	80/30	MAC/AO	10-Jan-17	1	<0.2	no
Paraquat	µg/L	10	IMAC	03-Jan-17	1	<1	no
Pentachlorophenol	µg/L	60, 30	MAC/AO	03-Jan-17	1	<0.1	no
Phorate	µg/L	2	IMAC	03-Jan-17	1	<0.3	no
Picloram	µg/L	190	IMAC	03-Jan-17	1	<5	no
Polychlorinated Biphenyls (PCB's)	µg/L	3	IMAC	03-Jan-17	1	<0.05	no
Prometryne	µg/L	1	IMAC	03-Jan-17	1	<0.1	no
Simazine	µg/L	10	IMAC	03-Jan-17	1	<0.5	no
Terbufos	µg/L	1	IMAC	03-Jan-17	1	<0.3	no
Tetrachloroethylene	µg/L	30	MAC	10-Jan-17	1	<0.2	no
2,3,4,6-Tetrachlorophenol	µg/L	100/1	MAC/AO	03-Jan-17	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	03-Jan-17	1	<10	no
Trichloroethylene	µg/L	50	MAC	10-Jan-17	1	<0.1	no
2,4,6-Trichlorophenol	µg/L	5, 2	MAC, AO	03-Jan-17	1	<0.1	no
Trifluralin	µg/L	45	IMAC	03-Jan-17	1	<0.5	no
Vinyl Chloride	µg/L	2	MAC	10-Jan-17	1	<0.2	no
Bromodichloromethane	µg/L	-	-	2017	4	6.2	-
Bromoform	µg/L	-	-	2017	4	0.1	-
Chloroform	µg/L	-	-	2017	4	59.1	-
Dibromochloromethane	µg/L	-	-	2017	4	0.3	-
TOTAL THMs	µg/L	100	MAC	2017	4	65.5	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	6.3	4.0	4.7	9.7
Bromoform	**0.1**	**0.1**	**0.1**	**0.1**
Chloroform	40.2	64.4	46.7	85.1
Dibromochloromethane	**0.3**	**0.1**	1.0	0.5
Total	46.8	68.4	51.4	95.3

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 2017 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
10-Jan-2017		7.35	89					7.33	89
11-Jul-2017		7.17	83					7.16	83
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 decays 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 2017 the maximum concentration of microcystin-LR measured in untreated water was 0.23 ug/L.

Microcystins are removed through the Deseronto treatment process by oxidation (chlorine addition) and by adsorption in 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 2017.

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 4 mg/L which is well below the maximum permitted average concentration of 25 mg/L. Flow to the waste clarifier during 2017 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	8
August	113.0	113.5	<3
September	139.3	140.0	<3
October	145.1	149.8	10
November	137.1	144.4	<3
December	135.7	138.0	<3
Maximum		165.1	10
Average	135.3		4
DWWP Limit			**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 which are now underway

In the fall of 2017, the main electrical feeder lines were replaced and re-routed to a new transformer and diesel generator. The diesel generator was installed in 2015 and now services both the water plant and adjacent wastewater treatment plant.

Design of the upgraded treatment process is complete and the Town is presently in the process of selecting a general contractor to complete the work. It is anticipated that the construction contract will be awarded by early March 2017 followed by approximately one year of construction and commissioning of the upgraded facility by mid-2019.

This project will significantly improve the reliability of the drinking water supply, and will provide ample capacity for desired future growth in the Town and in the neighbouring Mohawks of the Bay of Quinte First Nations Community.