

Corporation of the Township of North Glengarry  
90 Main Street South  
P.O. Box 700  
Alexandria, ON  
K0C 1A0  
Tel: (613) 525-3087  
Fax: (613) 525-1649

NORTH  
GLENGARRY  
NORD



Municipalité du Canton de Glengarry Nord  
90 Rue Main Sud  
C.P. 700  
Alexandria, ON  
K0C 1A0  
Tel: (613) 525-3087  
Télécopieur: (613) 525-1649

# **The Township of North Glengarry**

## **Alexandria Drinking Water System**

### **2018 Annual and Summary Report**

In compliance with O. Reg 170/03, section 11 and O. Reg 170/03 schedule 22

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## Section 1: Introduction

This report is an annual summary of water quantity, quality system information, system operations and major expenditures for the Alexandria Water Treatment plant and distribution system during the reporting period of January 1, 2018 to December 31, 2018. It was prepared in accordance with section 11 and schedule 22 of the of Ontario's Drinking Water Systems Regulation O. Regulation 170/03.

## Section 2: System Description

The Alexandria Water Treatment Plant is located on Gernish St West within the town of Alexandria. This system uses surface water, from the Mill Pond, as its source to supply the residents with treated water and has a rated capacity of 8014m<sup>3</sup>/day. It is categorized as a large municipal residential drinking water system.

## Section 3: Process and Equipment Description

### Raw Water Intake

Located in Mill Pond, approximately 425m southwest of the water treatment plant, the intake is comprised of a precast concrete pipe, 1.5m diameter and 760mm high, placed on top of a concrete slab housed in a 2.4m by 2.4m timber crib with screening.

A 350mm concrete pipe runs from the intake, east through the Island Park to Park Avenue, then north up Park Avenue before turning east into the water plant, where it enters the low lift chamber.

The flows from Mill Pond to the water plant are based on gravity, and therefore are heavily influenced by water depth in the Mill Pond. In the event levels begin to reduce the Township will communicate with the Raisin River Conservation Authority to ensure levels will be sufficient to supply the raw water demands, which can be achieved through the river damming system in place.

### Low Lift Chamber/Raw Water Well

The chamber/well is 4.7m by 1.5m by 4.0m and located in the southwest corner of the water treatment plant. There are two course screens, openings approximately 6.45m<sup>2</sup>, located between the raw well entry and the low lift chamber to provide a coarse screening prior to pumping.

The low lift pumps consist of two 14.9kW vertical turbine pumps, rated at 6,200m<sup>3</sup>/day at 14.6m total dynamic head (TDH). Each pump is equipped with auto, manual and stop capability through the SCADA control system and at the electrical panel. A flow meter and electric valve are used to control flows from the pumps, the valve will modulate based on flocculation tank levels. At any time if the flows are near the Permit to Take Water (PTTW) restrictions, the valve can be manually operated to ensure the levels are not exceeded.

Chemicals added to the raw well include activated carbon and potassium permanganate. The activated carbon is typically added during warmer water temperatures to aid taste and odour treatment. The potassium permanganate is typically added during colder water temperatures and aids to oxidize manganese, which generally only begins to increase after ice cover of the Mill Pond.

### Coagulation/Flocculation/Sedimentation

A coagulant and polymer feed systems are in place at the water treatment plant, with the coagulant feed entering just prior to an in-line mixer after the low lift pumps. The polymer feed is located just prior to the inlet for the first flocculation tank. All flows after the first flocculation tank are based on gravity.

After chemical addition water enters 2 flocculation chambers operated in series, each measuring 2.6m by 4.6m, and each chamber is equipped with a 0.37kW, 5 rpm agitator for slow and gentle mixing. A depth measurement is taken at the end of the second flocculation tank and this measurement is used to control the flows from the low lift pumps.

After chemical addition and flocculation, the water is directed into a conduit channel directing water to the sediment tanks.

The sediment tanks are comprised of 4 concrete tanks, operated in parallel and each measuring 11.7m by 3.6m by 4.9m. Each tank is baffled by a 4.7m by 2.7m wall located roughly 5.6m from the inlet and on the far side of the wall, tube settlers with a cross sectional area of 3.6m by 6.1m, are used to aid in the settling process. On the bottom of each tank contains sludge hoppers and drain pipes. The program is run through the SCADA system and sludge is removed based on amount of water treated and this can be adjusted as required.

### Filtration

The filtration system consists of four filters measuring 3.9m by 2.9m by 2.8m, which operate in parallel. Each filter has the capability of filtering a maximum flow of 2003m<sup>3</sup>/day; has a surface area of 11.3m<sup>2</sup>; is a mixed media, GAC and sand or anthracite and sand; contains a surface wash system; and is completed by an underdrain system. The filter is also equipped with loss or head monitoring and turbidity monitoring, both of which is used in determining when the filter is to be cleaned.

The backwash system is comprised of 2 pumps, a duty and standby, and all associated piping and valves. The duty pump is rated at 114L/sec at 9.2m TDH, where the standby is rates at 120L/sec at 10.2 TDH. All effluent water is directed to the sludge holding tank, where the supernatant is directed to the sanitary sewer.

### Disinfection

The disinfection system uses chlorine gas, which is injected into the header pipe prior to entering the clearwell. The clearwell is divided into 2 wells (east and west) and each well contains and smaller cell within them, labelled 1-4. The wells are interconnected by valves through piping or sluice gate opening. Influent water enters clearwell 4 and travels towards clearwell 1 before being discharged to the distribution, which allows for the appropriate contact time required.

The actual chlorination system consists of three chlorinators, each having the capacity of 22.7kg/day and are equipped with two vacuum regulators and four chlorine cylinders at use at any one time.

A chloramination system was commissioned on December 20, 2011. As the water leaves the plant, it is dosed with ammonia to create combined chlorine residuals. This enables a longer lasting chlorine residual out in the distribution and the potential for decrease in THM production.

### High Lift Pumps

Three vertical turbine pumps are used to move the water from the clearwell to the distribution piping. The pumps are operated in duty and standby, with No. 1 and No. 3 located in clearwell 1; and No. 2 located in clearwell 4. Pump No. 2 is not to be run unless in an emergency or if all the disinfection requirements are met, as per the Disinfection Procedure.

### Distribution

The distribution system is comprised of varying sized water pipes, valves, and fire hydrants. The current system is located within the town boundaries of Alexandria. It is considered a class 2 distribution and services approximately 1500 connections.

### Automated Monitoring and Control

A fully automated SCADA system was installed in the plant in 2011. This system is capable of monitoring, controlling and recording all the plant processes and data, such as flows, chlorine residual and turbidity readings. The system is also fully alarmed with multiple alarm set points, so that if any parameter is exceeded an alarm will be triggered on the SCADA desk top and through the auto dialer system. The on-call operator is then notified by the monitoring centre, which operates 24 hours a day, 365 days a year.

### Emergency Power

A 175kW diesel powered generator, which is capable of operating the water treatment plant and the Township of North Glengarry office building at full capacity. The automatic transfer switch for this unit is located on the first floor within the water treatment plant.

### Additional Equipment.

All piping, valves, controls and appurtenances along with associated mechanical and electrical equipment not mentioned in the description but are utilized to make up the system.

## Section 4: Flow Summary

In order to assess the rated capacity of the WTP in terms of meeting existing and planned uses of the system, a summary of the raw and treated flow rates of during the period covered by this report was prepared and is presented below. In accordance with the Permit to Take Water and the Alexandria Drinking Water License #181-101 the drinking water system must not draw more than 5,616 m<sup>3</sup>/day of raw water and shall not be operated in a manner to exceed the 8,014m<sup>3</sup>/day rated capacity of the treatment system

During this period, all raw water flows, and treated water flows were compliant with all permit and license requirements and no operational limits were exceeded. The raw water flows are currently at 38.1% of the allowable limit and the treated flows are currently at 22.8% of the total plant rated capacity. The 2018 average treated daily flow was calculated to be 1,834m<sup>3</sup> and the maximum treated daily flow was 2,713m<sup>3</sup> and was observed on June 16. Please refer to the appendices for full 2018 data summary

2018 Flow Summary	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum Raw Daily Flow (m <sup>3</sup> )	2,559	2,726	2,879	2,554	2,534	2,957	2,865	3,124	2,562	3,007	2,729	2,828
Maximum Treated Daily Flow (m <sup>3</sup> )	2,341	2,558	2,480	2,444	2,365	2,713	2,453	2,318	2,366	2,642	2,418	2,569
Average Treated Daily Flow (m <sup>3</sup> )	1,831	1,772	1,742	1,727	1,811	1,948	1,930	1,757	1,750	1,727	1,920	2,084
Average Treated Daily Maximum Instantaneous Flow (L/s)	0.046	0.045	0.047	0.045	0.043	0.055	0.067	0.045	0.054	0.045	0.045	0.047
Rated Maximum Daily Raw Flow for the approved system										5,616 m <sup>3</sup> /day		
Rated Maximum Daily Treated Flow for the approved system										8,014 m <sup>3</sup> /day		
Rated Maximum Instantaneous Flow										0.093 L/s		

### Section 5: Sampling and Laboratory Analysis Summary

The Township of North Glengarry uses Cadouceon Laboratories as the primary provider for all sample analysis. Cadouceon Laboratories is an accredited laboratory under the Ministry of the Environment and Climate Control requirements. Refer to table below for all results as required.

2018 Microbiological Testing Completed as per Schedule 10, 11 and/or 12 of O. Reg 170/03					
Location	Number of Samples	Range of E. Coli or Fecal Results (#-#)	Range of Total Coliform Results (#-#)	Number of HPC Samples	Range of HPC Results (#-#)
Raw	52	0 - 73	8 - 160	0	
Treated	52	0 - 0	0 - 0	52	< 2 - 34
Distribution	167	0 - 0	0 - 0	157	< 2 - 507

2018 Operational Testing as per Schedule 7, 8 and or 9 of O. Reg 170/03		
Parameter	Number of Grab Samples	Range of Results unit of measure is mg/L unless otherwise indicated (#-#)
Turbidity	255	0.35 ntu – 11.30 ntu
WTP Chlorine	253	0.73 – 2.67
Dist Combined Chlorine	164	0.26 – 1.26
Fluoride (If the DWS provides fluoridation)		n/a

Additional Sampling or Testing in Accordance with System Approval Requirement or Order				
Date of Order or Approval Amendment	Parameter	Date Sampled	Result	Unit of Measure
n/a				

<b>2018 Summary of Inorganic Parameters Tested</b> Annual sampling or most recent result (1ppm = 1mg/L)					
Parameter	Sample Date	Standard (maximum concentration)	Result Value	Unit of Measure	Exceedance
Antimony	June 25, 2018	0.006 mg/L	< 0.0001	mg/L	No
Arsenic	June 25, 2018	0.01 mg/L	0.0003	mg/L	No
Barium	June 25, 2018	1.0 mg/L	0.013	mg/L	No
Boron	June 25, 2018	5.0 mg/L	0.006	mg/L	No
Cadmium	June 25, 2018	0.005 mg/L	< 0.000015	mg/L	No
Chromium	June 25, 2018	0.05 mg/L	< 0.002	mg/L	No
Lead	September 14, 2017	0.01mg/L	0.00045	mg/L	No
Mercury	June 25, 2018	0.001mg/L	< 0.00002	mg/L	No
Selenium	June 25, 2018	0.01 mg/L	< 0.001	mg/L	No
Uranium	June 25, 2018	0.02 mg/L	< 0.00005	mg/L	No
Fluoride	July 11, 2017	1.5 mg/L	< 0.1	mg/L	No
Nitrite	January 14, 2018	1.0 mg/L	< 0.1	mg/L	No
Nitrate	January 14, 2018	10.0 mg/L	< 0.1	mg/L	No

<b>2018 Summary of Lead Testing</b> (1ppm = 1mg/L)							
Location/ Type	Number of Samples	Range of Lead Results (##)	Unit of Measure	Range of Alkalinity Results (##)	Unit of Measure	Average pH	Exceedance
Residential Plumbing							
Non-Residential Plumbing							
Distribution	6		mg/L	56 - 91	mg/L	7.03	0

<b>2018 Summary of Organic Parameters Tested</b> Annual sampling or most recent result (1ug/L = 0.001mg/L)					
Parameter	Sample Date	Standard (maximum concentration)	Result Value	Unit of Measure	Exceedance
Alachlor	June 25, 2018	0.005 mg/L	< 0.3	ug/L	No
Atrazine + N-dealkylated metabolites	June 25, 2018	0.005 mg/L	< 0.5	ug/L	No
Azinphos-methyl	June 25, 2018	0.02 mg/L	< 1	ug/L	No
Benzene	June 25, 2018	0.001 mg/L	< 0.5	ug/L	No
Benzo(a)pyrene	June 25, 2018	0.00001 mg/L	< 0.005	ug/L	No
Bromoxynil	June 25, 2018	0.005 mg/L	< 0.3	ug/L	No

<b>2018 Summary of Organic Parameters Tested</b>					
<i>Annual sampling or most recent result (1ug/L = 0.001mg/L)</i>					
<i>Parameter</i>	<i>Sample Date</i>	<i>Standard (maximum concentration)</i>	<i>Result Value</i>	<i>Unit of Measure</i>	<i>Exceedance</i>
<i>Carbaryl</i>	June 25, 2018	0.09 mg/L	< 3	ug/L	No
<i>Carbofuran</i>	June 25, 2018	0.09 mg/L	< 1	ug/L	No
<i>Carbon Tetrachloride</i>	June 25, 2018	0.002 mg/L	< 0.2	ug/L	No
<i>Chlorpyrifos</i>	June 25, 2018	0.09 mg/L	< 0.5	ug/L	No
<i>Diazinon</i>	June 25, 2018	0.02 mg/L	< 1	ug/L	No
<i>Dicamba</i>	June 25, 2018	0.12 mg/L	< 5	ug/L	No
<i>1,2-Dichlorobenzene</i>	June 25, 2018	0.2 mg/L	< 0.1	ug/L	No
<i>1,4-Dichlorobenzene</i>	June 25, 2018	0.005 mg/L	< 0.2	ug/L	No
<i>1,2-Dichloroethane</i>	June 25, 2018	0.005 mg/L	< 0.1	ug/L	No
<i>1,1-Dichloroethylene (vinylidene chloride)</i>	June 25, 2018	0.014 mg/L	< 0.1	ug/L	No
<i>Dichloromethane</i>	June 25, 2018	0.05 mg/L	< 0.3	ug/L	No
<i>2-4 Dichlorophenol</i>	June 25, 2018	0.9 mg/L	< 0.1	ug/L	No
<i>2,4-Dichlorophenoxy acetic acid (2,4-D)</i>	June 25, 2018	0.1 mg/L	< 5	ug/L	No
<i>Diclofop-methyl</i>	June 25, 2018	0.009 mg/L	< 0.5	ug/L	No
<i>Dimethoate</i>	June 25, 2018	0.02 mg/L	< 1	ug/L	No
<i>Diquat</i>	June 25, 2018	0.07 mg/L	< 5	ug/L	No
<i>Diuron</i>	June 25, 2018	0.15 mg/L	< 5	ug/L	No

<b>2018 Summary of Organic Parameters Tested</b>					
<i>Annual sampling or most recent result (1ug/L = 0.001mg/L)</i>					
<i>Parameter</i>	<i>Sample Date</i>	<i>Standard (maximum concentration)</i>	<i>Result Value</i>	<i>Unit of Measure</i>	<i>Exceedance</i>
<i>Glyphosate</i>	June 25, 2018	0.28 mg/L	< 25	ug/L	No
<i>Haloacetic Acid</i>	January 15, 2019		60.6	ug/L	No
<i>Malathion</i>	June 25, 2018	0.19 mg/L	< 5	ug/L	No
<i>2 Methyl-4 Chlorophenoxyacetic (MCPA)</i>	June 25, 2018	0.1 mg/L	< 10	ug/L	No
<i>Metolachlor</i>	June 25, 2018	0.05 mg/L	< 3	ug/L	No
<i>Metribuzin</i>	June 25, 2018	0.08 mg/L	< 3	ug/L	No
<i>Monochlorobenzene</i>	June 25, 2018	0.08 mg/L	< 0.2	ug/L	No
<i>Paraquat</i>	June 25, 2018	0.01 mg/L	< 1	ug/L	No
<i>Pentachlorophenol</i>	June 25, 2018	0.06mg/L	< 0.1	ug/L	No
<i>Phorate</i>	June 25, 2018	0.002 mg/L	< 0.3	ug/L	No
<i>Picloram</i>	June 25, 2018	0.19 mg/L	< 5	ug/L	No
<i>Polychlorinated Biphenyls (PCB)</i>	June 25, 2018	0.003 mg/L	< 0.05	ug/L	No

2018 Summary of Organic Parameters Tested					
Annual sampling or most recent result (1ug/L = 0.001mg/L)					
Parameter	Sample Date	Standard (maximum concentration)	Result Value	Unit of Measure	Exceedance
Prometryne	June 25, 2018	0.001 mg/L	< 0.1	ug/L	No
Simazine	June 25, 2018	0.01 mg/L	< 0.5	ug/L	No
THM	January 14, 2019	0.100 mg/L	73.5	ug/L	No
Terbufos	June 25, 2018	0.001 mg/L	< 0.3	ug/L	No
Tetrachloroethylene	June 25, 2018	0.03 mg/L	< 0.2	ug/L	No
2,3,4,6-Tetrachlorophenol	June 25, 2018	0.1 mg/L	< 0.1	ug/L	No
Triallate	June 25, 2018	0.23 mg/L	< 10	ug/L	No
Trichloroethylene	June 25, 2018	0.005 mg/L	< 0.1	ug/L	No
2,4,6-Trichlorophenol	June 25, 2018	0.005 mg/L	< 0.1	ug/L	No
Trifluralin	June 25, 2018	0.045 mg/L	< 0.5	ug/L	No
Vinyl Chloride	June 25, 2018	0.002 mg/L	< 0.2	ug/L	No

Inorganic or Organic Parameters that exceeded half the standard prescribed in Schedule 2 of Ontario Drinking Water Quality Standards			
Only complete if category is large municipal residential, small municipal residential, large municipal non-residential, small municipal non-residential, large non-municipal non-residential			
Parameter	Result Value	Unit of Measure	Date of Sample
n/a			

### Section 6: Significant Expenses Incurred

No significant expenses were

- Install required equipment
- Repair required equipment
- Replace required equipment
- None during this period

Briefly Describe Incident and/or Expenses Incurred:

No.	Project Name	Description	Cost
1	Distribution Residential Meter Replacement	Distribution meters to be replaced over 10-year period commencing in 2016, with estimated 150 meters to be changed per year. 331 meters were installed in 2018.	\$ 9,500
2	Watermain Replacement and Installation	Remove existing 100mm water main on Centre St between Main St North and Bishop St North and install new 150mm watermain.	\$ 85,000
3	Hydrant and Valve Replacement	On-going annual project to replace defective or ageing equipment. In 2018 6 defective valves were repaired or replaced depending on damage observed during excavation	\$ 27,000
4	Maxville Water Project	Construction of 80% of the distribution system in Maxville Construction of 50% of the transmission main, to be connected to the Alexandria Drinking Water System when full project completed	\$ 18 Million



No.	Project Name	Description	Cost
5	Small Equipment	Purchase of hydraulic saw and hydraulic pump	\$4,300
6	Chlorine Probe Replacement	Prominent chlorine probed found to be defective, replaced probes 1606, 1681, 1680	\$4,810
7	Energy Management	Install energy monitors to comply with Energy Conservation and Demand Management Plan	\$3000
8	Sludge Valve Installation	Replace defective sludge removal vales in Basin 4	\$16,000
9	Transfer Switch Retrofit	Damage to internal breaker, caused by wear and tear. Unit replaces with retrofit kit	\$7,015
10	Replace Chemical Pumps	Budgeted to upgrade coagulant and polymer pumps due to age and operation	\$10, 250

### Section 7: Compliance with Licenses, Permits, Approvals and Orders

The system is an approved system through the accreditation process that was rolled out by the Ministry of the Environment and Climate Control in 2011. The operating authority strives to remain compliant with the Drinking Water Quality Management Standard, the Safe Drinking Water Act and all associated procedures or a guideline. This approach is utilized for creating a multi-barrier approach to ensure safe drinking water.

The following table is a listing of all permits and or licenses that apply to this system:

Description	Number	Version	Issue Date	Expiry Date
Water Works License	181-101	2	March 22, 2016	March 21, 2021
Water Works Permit	181-201	3	March 22, 2016	March 21, 2021
Water Works Permit	Schedule C	2	January 22, 2018	
Permit to Take Water	0512-8VVPRD		July 6, 2012	July 8, 2022

This system actively engages in all required internal and external auditing, as per the Drinking Water Management Standard. The latest external third-party surveillance audit was completed on November 15, 2018. The results indicated an effective system with 8 minor opportunities for improvement.

As previously described in section 4, all flows were found to be in compliance of all limits listed in permits, licenses and regulations.

All disinfection equipment was operated in such a manner that all license requirements were met at all times. The treatment system was operated at all times to ensure compliance with the Procedure for Disinfection of Drinking Water in Ontario.

All equipment was maintained as per operations manuals and/or calibrated annually by a certified technician.

### Section 8: Non-Compliance with Licenses, Permits, Approvals and Orders

There were 2 instances of non-compliance in regard to regulatory requirements, both of which were planned shut downs for a water main for replacement. All residents were placed on a temporarily overland water main prior to shut down and work commencement. Residents remained on a precautionary boil water for the duration of work, until testing was complete and indicated the water was safe for use. All licensing permit and/or approval requirements were met during this reporting period. Furthermore, there were no orders or additional requirements issued to this system.

<b>2018 Reported Incident in accordance to subsection 18(1) of the Safe Drinking Water Act or</b>
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<b>Schedule 16 of O. Reg 170/03</b>					
<i>Incident Date</i>	<i>Parameter</i>	<i>Result</i>	<i>Unit of Measure</i>	<i>Corrective Action</i>	<i>Corrective Action Date</i>
20-Aug-2018	Low Pressure	< 20	psi	Preventative boil water due to watermain replacement. 5 residents effected. All testing and sampling performed as per procedure.	30-Aug-2018
23-Aug-2018	Low Pressure	< 20	psi	Preventative boil water due to watermain replacement. 9 residents effected. All testing and sampling performed as per procedure.	18-Sep-2018

**Section 9: Township of North Glengarry Endorsement of Summary Report**

A hard copy of the report was given to all members of the municipal council and all information was presented through the Committee of the Whole meeting held on February 20, 2019.

The report was also made available to the public through the Township of North Glengarry website or upon individual request at the Main office, located at 90 Main St South in Alexandria, or at the Public Works Office, located at 63 Kenyon St West in Alexandria

This report was accepted and endorsed by members of council and staff as presented. No outstanding issues or conflicts were presented during this time.

**Section 8: Contact**

All efforts have been made to provide accurate and up to date information in a relevant format. In the event that additional information is required please submit all verbal requests by phone at 613-525-3087; in writing by mail to 63 Kenyon St West. P.O. Box 700, Alexandria Ontario, K0C 1A0; or in writing by email to dean@northglengarry.ca

# Appendix A

2018 Alexandria Treated Flows (m<sup>3</sup>/day)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	1,446	2,048	1,706	1,832	1,760	1,625	1,310	1,785	1,960	1,404	2,390	1,643	
2	1,785	1,349	1,788	1,685	1,751	2,181	1,674	1,883	1,387	1,403	1,825	2,314	
3	1,713	2,558	1,674	1,615	1,729	1,853	2,453	1,851	1,803	2,127	1,260	2,189	
4	1,762	2,128	1,611	1,699	1,765	2,002	2,014	1,468	1,670	2,030	2,418	1,694	
5	1,659	1,854	1,632	1,734	2,003	1,759	2,007	1,647	1,937	1,653	1,872	2,022	
6	1,773	1,741	1,761	1,394	1,513	1,796	2,106	1,155	1,956	1,765	2,028	2,363	
7	1,719	1,581	1,773	1,885	1,791	1,932	2,043	1,843	1,777	1,709	1,896	1,952	
8	1,721	1,812	1,761	1,896	1,864	1,762	1,917	1,753	1,584	1,397	1,668	1,905	
9	1,798	1,265	1,054	1,911	1,722	2,138	2,024	2,318	1,659	1,661	1,665	1,795	
10	1,858	2,264	2,285	1,647	1,766	2,046	2,238	1,835	1,697	1,014	2,179	2,271	
11	1,714	1,740	1,554	1,864	1,376	1,894	2,223	1,691	1,521	2,566	1,817	2,320	
12	1,541	1,710	1,585	1,645	2,365	2,095	2,102	1,535	1,938	1,517	1,968	1,917	
13	2,223	1,605	1,553	1,137	1,653	1,959	1,961	2,001	1,754	1,619	2,181	2,048	
14	1,916	1,914	1,573	2,247	1,919	2,165	1,961	1,717	1,232	2,054	1,831	2,069	
15	1,845	1,529	1,756	1,729	1,887	1,401	2,104	1,737	1,616	1,147	1,911	2,305	
16	1,886	1,949	1,629	1,605	1,939	2,713	2,068	1,771	1,947	2,642	1,571	1,893	
17	1,764	1,665	1,814	1,563	1,898	1,795	1,902	1,696	2,088	1,607	2,402	2,032	
18	1,768	1,771	1,771	1,606	1,716	1,858	2,059	1,586	1,857	1,887	2,086	2,514	
19	1,217	1,680	1,719	1,875	1,871	2,051	1,879	1,906	1,763	1,514	1,765	1,778	
20	2,341	1,700	1,805	1,219	1,859	2,044	1,652	1,809	1,836	1,432	1,927	1,750	
21	1,850	1,718	1,770	2,444	1,587	1,993	2,169	1,674	1,436	2,242	1,842	2,296	
22	1,766	1,667	1,799	1,823	1,713	1,611	1,642	1,713	1,505	1,765	1,563	2,051	
23	1,964	1,641	1,035	1,691	1,975	2,253	2,093	1,844	2,366	1,842	2,277	2,125	
24	1,957	1,619	2,480	1,841	1,859	1,784	1,765	1,766	1,664	1,630	1,805	2,264	
25	1,953	1,876	2,242	1,903	1,563	2,034	1,732	1,293	1,788	1,947	1,834	1,620	
26	1,924	1,714	2,441	1,529	1,924	1,832	1,817	2,139	1,710	1,532	1,689	1,839	
27	1,972	1,818	1,762	1,667	1,725	1,946	1,909	1,902	1,877	1,696	2,062	2,286	
28	1,992	1,697	1,643	1,954	1,809	1,932	1,660	1,575	1,232	1,681	2,121	2,525	
29	1,990		1,729	1,463	1,919	1,935	1,550	2,065	2,232	2,055	2,029	2,569	
30	1,869		1,523	1,710	1,981	2,037	1,909	2,069	1,696	1,574	1,709	2,335	
31	2,077		1,786		1,952		1,877	1,443		1,431		1,928	
Minimum	1,217	1,265	1,035	1,137	1,376	1,401	1,310	1,155	1,232	1,014	1,260	1,620	1,014
Average	1,831	1,772	1,742	1,727	1,811	1,948	1,930	1,757	1,750	1,727	1,920	2,084	1,834
Maximum	2,341	2,558	2,480	2,444	2,365	2,713	2,453	2,318	2,366	2,642	2,418	2,569	2,713
Total	56,763	49,614	54,012	51,815	56,153	58,427	59,822	54,470	52,488	53,541	57,591	64,613	669,308

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# Appendix A

## 2018 Alexandria Raw Flows (m<sup>3</sup>/day)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	1,519	2,428	1,785	1,856	2,136	1,991	1,610	2,026	2,113	1,642	2,533	1,861	
2	2,121	1,874	2,010	1,862	1,845	2,411	1,857	2,475	1,616	1,954	1,960	2,524	
3	1,990	2,726	1,917	2,235	1,931	2,028	2,728	2,281	2,042	2,701	1,428	2,601	
4	2,279	2,481	1,823	1,878	2,230	2,348	2,325	1,600	1,989	2,203	2,729	1,966	
5	1,986	2,176	1,975	1,960	2,046	2,165	2,282	1,940	1,988	1,953	2,105	2,495	
6	2,137	1,983	1,947	1,788	1,744	2,033	2,477	1,361	2,210	2,203	2,180	2,448	
7	1,761	1,841	2,100	2,011	2,265	2,348	2,389	2,195	2,224	1,877	2,108	2,376	
8	1,941	2,390	2,021	2,225	2,034	2,126	2,091	2,454	2,023	1,623	2,216	2,118	
9	2,316	1,707	1,230	2,140	1,918	2,232	2,240	3,124	1,749	2,061	1,830	1,968	
10	2,394	2,625	2,451	1,989	1,953	2,260	2,575	2,235	1,939	2,061	2,373	2,807	
11	1,983	1,906	1,609	2,264	1,623	2,494	2,865	1,971	1,807	3,007	2,169	2,591	
12	1,768	1,950	2,002	1,874	2,534	2,212	2,507	1,802	2,562	1,583	2,220	2,294	
13	2,388	1,998	1,943	1,323	1,985	2,176	2,361	2,264	2,002	1,848	2,404	2,250	
14	2,314	2,248	1,974	2,553	2,355	2,904	2,167	2,182	1,436	2,342	2,135	2,584	
15	1,930	1,804	2,002	1,981	2,250	1,647	2,292	2,127	1,841	1,864	2,163	2,549	
16	2,262	2,510	1,942	1,985	2,315	2,957	2,306	2,275	2,415	2,776	2,026	2,067	
17	2,423	1,942	1,844	1,612	2,130	2,108	2,285	2,131	2,376	2,034	2,406	2,589	
18	2,183	2,076	2,144	1,840	2,053	2,263	2,468	1,689	2,226	2,198	2,324	2,718	
19	1,297	1,836	2,109	2,273	2,062	2,405	2,255	2,185	2,136	1,891	2,097	2,324	
20	2,559	2,043	2,198	1,950	1,934	2,432	1,983	2,237	2,066	1,524	2,454	1,995	
21	2,249	2,110	2,038	2,554	1,871	2,454	2,431	2,068	1,962	2,415	2,439	2,491	
22	2,133	1,760	2,129	1,981	2,086	1,825	1,921	2,117	1,592	2,272	1,673	2,644	
23	2,045	1,863	1,355	1,903	2,188	2,609	2,301	2,133	2,521	2,370	2,628	2,524	
24	2,303	1,784	2,687	2,197	2,393	2,018	2,099	2,094	1,943	1,897	2,047	2,463	
25	2,483	2,228	2,295	2,204	1,764	2,253	2,151	1,492	1,960	2,342	2,071	1,849	
26	2,203	2,167	2,879	1,926	2,170	2,196	2,030	2,428	2,126	1,713	1,931	2,006	
27	2,073	2,202	2,258	2,010	1,893	2,164	2,133	2,101	2,091	2,064	2,339	2,655	
28	2,365	2,323	1,872	1,979	2,275	2,447	1,896	1,800	1,286	1,733	2,550	2,718	
29	2,473		2,161	1,713	2,127	2,127	1,903	2,624	2,465	2,292	2,398	2,828	
30	2,302		1,816	2,009	2,071	2,438	2,201	2,136	2,015	1,813	1,965	2,672	
31	2,345		1,953		2,324		2,364	2,006		1,743		2,489	
Minimum	1,297	1,707	1,230	1,323	1,623	1,647	1,610	1,361	1,286	1,524	1,428	1,849	1,230
Average	2,146	2,106	2,015	2,003	2,081	2,269	2,242	2,115	2,024	2,064	2,197	2,402	2,139
Maximum	2,559	2,726	2,879	2,554	2,534	2,957	2,865	3,124	2,562	3,007	2,729	2,828	3,124
Total	66,524	58,980	62,470	60,075	64,506	68,068	69,492	65,555	60,721	63,998	65,901	74,462	780,753

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## Appendix C

### Comparison of the Average and Maximum Flow Rates for the Alexandria Drinking Water Treatment Plant

