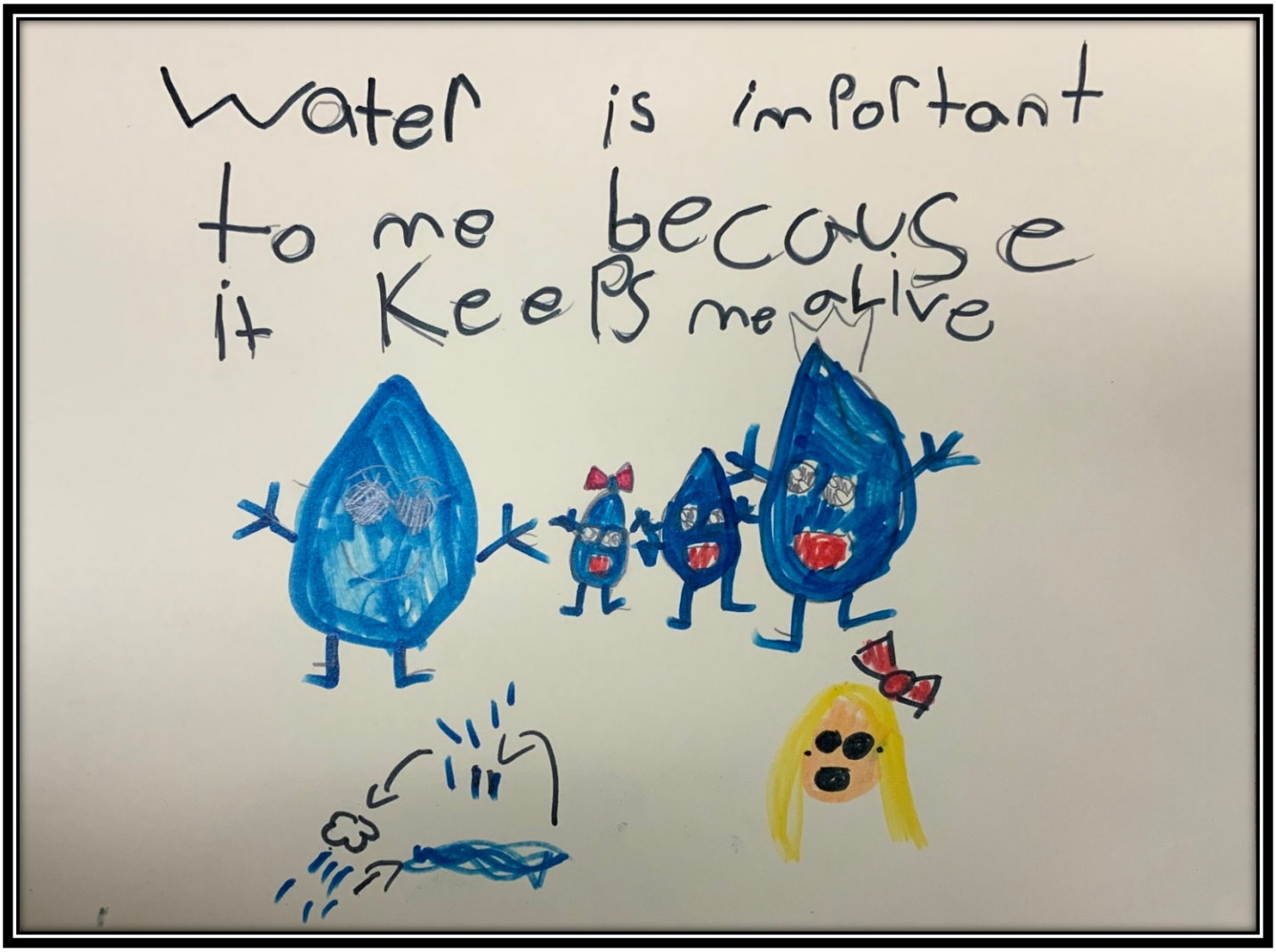
Newcastle Water Pollution Control Plant

2019 Annual Performance Report



The Regional Municipality of Durham
Newcastle Water Pollution Control Plant 2019 Annual Performance Report

Environmental Compliance Approval (ECA): 3-2189-87-946 Dated July 26, 1994
Amendments Dated;
June 21, 2006
May 10, 1998
June 11, 1996

Environmental Compliance Approval (Air): 8-3083-93-006 Dated March 22, 1993

The Newcastle Water Pollution Control Plant (WPCP) 2019 Annual Performance Report provides staff, stakeholders and customers a performance overview of the Newcastle WPCP. Further, this report fulfills the annual reporting requirements of the Ontario Ministry of the Environment, Conservation and Parks (MECP). This report demonstrates the commitment of ensuring that the WPCP continues to deliver wastewater services to our customers in an environmentally responsible manner.

Water Pollution Control Plant Process Description

General

The Newcastle WPCP is located in the Municipality of Clarington (Newcastle) and is owned and operated by the Regional Municipality of Durham (Region). The plant is operated according to the terms and conditions of the ECAs.

The plant treats wastewater from the Newcastle service area in the Region, servicing approximately 11,410 residents.

The Newcastle WPCP is designed to treat wastewater at an average flow rate of 4,086 cubic metres per day (m^3/d) with a peak flow rate of 12,300 m^3/d. The plant is an MECP Class 3 conventional activated sludge treatment plant that utilizes the following processes to treat wastewater:

- raw influent pumping,
- preliminary treatment,
- primary treatment,
- secondary treatment,
- phosphorus removal,
- disinfection (chlorination/dechlorination), and
- solids treatment.

Raw Influent Pumping

Wastewater collected through approximately 40 kilometres of sanitary sewers in Newcastle is conveyed to the Newcastle WPCP by gravity and by two sanitary sewage pumping stations located in the collection system.

Preliminary Treatment

Screening: One automatic, mechanically cleaned screen and one emergency manual screen remove paper products and large material that could harm pumps and process equipment. Screenings removed in this process are transported to landfill.
Grit Removal: Heavy suspended material such as sand and small stones (grit) is removed in the aerated grit tank. The velocity of the wastewater rolling in the tanks is controlled by the quantity of air added to produce conditions that allow heavy grit material to settle, while keeping the lighter organic material in suspension to proceed to the next process tank. The grit removed in this process is dewatered and transported to landfill.

Primary Treatment

The primary clarifier utilizes the physical process of sedimentation which allows suspended material to settle to the bottom of the tank as sludge. This raw sludge, along with excess activated sludge from the secondary treatment process is collected by a sweep arm mechanism which pushes the sludge into a hopper. The sludge is then pumped to the sludge holding tank for transportation to the Courtice WPCP or the Port Darlington WPCP. Any material floating on the surface of the clarifier is also removed to the sludge holding tank.

Secondary Treatment

Aeration Tanks: The two aeration tanks are each comprised of two distinct sections. The first section is an anoxic zone, where no oxygen is introduced and allows for denitrification. Subsequently, the flow leaves the anoxic zone and enters the aerated zone where fine bubbled air is diffused into the wastewater to assist bacteria in removing dissolved and suspended organics, and nutrients.
Secondary Clarifier: The effluent from the aeration tanks is directed to the two secondary clarifiers where the solids settle quickly to the bottom as activated sludge leaving clear supernatant. A portion of the activated sludge collected on the bottom of the clarifier is pumped back to the head of the aeration tanks and the excess activated sludge is wasted to the primary clarifier.

Phosphorus Removal

The phosphorous removal system lowers the total phosphorous level in the final effluent by adding a chemical coagulant, aluminum sulphate, into various locations within the plant.

Disinfection (chlorination/dechlorination)

Chlorine in the form of liquid sodium hypochlorite is metered into the secondary effluent stream for pathogen control. Adequate contact time is provided by the single chlorine contact chamber. Disinfected effluent is dechlorinated with a sodium bisulphite solution before being discharged through a 900 millimetre (mm) diameter outfall extending 130 metres (m) to a 600 mm diameter pipe which extends 800 m into Lake Ontario.

Sludge Management: All sludge produced at the Newcastle WPCP is stored in a sludge holding tank. The sludge is shipped to the Courtice WPCP or the Port Darlington WPCP for anaerobic digestion.

Environmental Compliance Approval

Under Condition 17.(1) of ECA #3-2189-87-946 the Region must produce an annual performance report that contains the following information:

a) Summary and interpretation of all monitoring data and a comparison to the effluent limits;

The raw wastewater flowing into the plant is analyzed for its chemical and physical composition. Monitoring of the raw wastewater is performed in accordance with the conditions in the ECA. Table 2 summarizes the raw wastewater characteristics during the reporting period.

The Newcastle WPCP effluent was determined to be compliant with the ECA approval limits during the reporting period. The plant operated at an average of 77% of its annual average rated flow capacity and received a maximum daily flow of 7,662 m^3/d on April 27, 2019. See tables 3 and 4 for effluent results.

b) Description of any operating problems encountered and corrective actions taken;

In July of 2019 the lower spring arms in secondary clarifier #1 malfunctioned, causing sludge bulking and the subsequent carryover of solids into the chlorine contact chamber. This resulted in elevated total suspended solids in the final effluent. Flow was diverted to secondary clarifier #2 and the springs were replaced on the lower spring arms in secondary clarifier #1.

c) Summary of all maintenance carried out on any major structure, equipment, apparatus, mechanism or thing forming part of the Works;

Major maintenance items in 2019 included:

- replaced variable-frequency drive on raw sludge pump #2,
- rebuilt grit blower #2,
- replaced motor in primary clarifier,
- replaced rubber on squeegee blades in primary clarifier, and
- replaced springs on lower spring arms in secondary clarifier #1.

d) Summary of any effluent quality assurance or control measures undertaken in the reporting period;

- In-house lab test results are compared to the results of the Regional Environmental Laboratory on comparable samples to determine the in-house accuracy. Elevated in-house nitrate results in July and August was due to the use of a faulty reagent. All other results were found to be within a comparable range.

- Online instrumentation is verified by WPCP operators using field or laboratory test equipment.

e) Summary of the calibration and maintenance carried out on all effluent monitoring equipment;

- Calibration of the raw influent flow meter was conducted on October 8.
- Calibration of in-house lab equipment was conducted on July 23.
- Calibration of the in-house lab pH meter was conducted regularly.

f) A description of efforts made and results achieved in meeting the Effluent Objectives;

The Region continually strives to achieve the best effluent quality at all times, remaining below the ECA compliance limits.

- The average daily rated flow capacity of 4,086m^3/d was not exceeded. The maximum rated flow rate of 12,300 m^3/d was not exceeded.
- The total chlorine residual monthly average objective was exceeded on three of 12 occasions (25%). Sodium bisulphite dosing is monitored and increased as necessary to ensure low total chlorine residual.

Best efforts will continue to be applied to maintain results below the objectives.

g) Biosolids Production;

Tabulation of Volume of Sludge Generated:

The volume of sludge removed from Newcastle WPCP in 2019 was 7,709 cubic metres (m^3) at an average concentration of 3.3% total solids. See table 5 Sludge Quality and Disposal.

Outline of anticipated volumes to be generated in the next reporting period;

There is no increase of sludge volume expected in the next reporting period.

Summary of locations to where sludge was disposed;

The plant sludge volume of 7,621 m^3 (99%) was hauled to the Port Darlington WPCP and 88 m^3 (1%) was shipped to the Courtice WPCP for anaerobic digestion.

h) Summary of any complaints received during the reporting period and any steps taken to address the complaints;

A summary of complaints received from the public is administered through a central database. Noise complaint – On October 30th noise concerns were received from a Newcastle resident. The resident reported a consistent low frequency hum thought to be emanating from the Newcastle WPCP, located approximately 350 m away. The concern was investigated and ambient noise readings have shown that the Newcastle WPCP is not a significant source of the noise.

i) A summary of all By-pass, Spills or Abnormal Discharge events;

MECP approved by-passes of the chlorine contact chamber were conducted on April 10 and November 13 for cleaning. The MECP York Durham District Office supervisor was notified once the by-pass was complete.

There were no spills during the reporting period.

j) Proposed Alterations, Extensions or Replacements;

The Region is investigating innovative ways to upgrade the plant. The plant upgrade is scheduled to begin in Spring 2022 and will involve refurbishing and/or replacing components of the WPCP to increase optimization, including sewage sludge pumps, collection mechanisms, chemical feed systems and more. Sustainability will be addressed throughout the project by using more efficient equipment including blowers and aeration system controls that will reduce power consumption of the aeration system by approximately 10 to 20 per cent.

k) Information Required by Ministry of the Environment, Conservation and Parks (MECP) Water Supervisor;

Table 7 provides a bacterial analysis of the Newcastle Water Supply Plant raw water for 2019.

MECP Inspection

This plant was last inspected by the MECP on November 16, 2017.

Table 1 Raw Influent Flows

Month	Total Flow to Plant -metered at the raw influent cubic metre	Average Day Flow cubic metre per day (m^3/d)	Maximum Day Flow m^3/d
January	97,608	3,149	4,198
February	76,462	2,731	3,388
March	92,613	2,988	4,947
April	134,933	4,498	7,662
May	129,416	4,175	6,537
June	95,694	3,190	4,926
July	89,630	2,891	7,310
August	82,039	2,646	3,443
September	76,289	2,543	2,993
October	81,470	2,628	4,505
November	93,610	3,120	4,725
December	103,009	3,323	4,690
Total	1,152,773		
Average	96,064	3,158*	
Minimum	76,289		
Maximum	134,933		7,662
ECA Limit		4,086	12,300
Met Compliance		Yes	Yes

*Annual Average Daily Flow

Table 2 Raw Influent Analyses

Month	Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) average (avg.) concentration (conc.) milligram per litre (mg/L)	$CBOD_5$ loading kilogram per day (kg/d)	Biochemical Oxygen Demand avg. conc. mg/L	Total Suspended Solids (TSS) avg. conc. mg/L	TSS loading kg/d
January	137	430	179	187	590
February	124	339	164	227	620
March	137	409	172	180	539
April	79	356	124	137	614
May	99	412	124	138	577
June	105	334	131	170	544
July	114	328	145	191	553
August	116	307	163	205	543
September	114	290	153	200	510
October	132	346	168	166	437
November	99	308	148	241	752
December	105	350	144	184	612
Average	113	358	151	186	587
Minimum	79	290	124	137	437
Maximum	137	430	179	241	752

Table 2 Raw Influent Analyses continued

Month	Total Kjeldahl Nitrogen average (avg.) concentration (conc.) milligram per litre (mg/L)	Total Ammonia Nitrogen avg. conc. mg/L	pH minimum	pH maximum	Total Phosphorous (TP) avg. conc. mg/L	TP loading kilograms per day
January	36.14	23.5	7.2	8.2	4.5	14
February	37.70	26.6	7.3	7.9	4.8	13
March	36.63	23.1	7.2	8.0	4.2	13
April	25.82	15.9	6.5	7.9	3.3	15
May	38.58	19.1	7.1	7.9	3.8	16
June	35.70	23.5	6.8	8.1	4.5	14
July	38.36	26.0	6.9	8.0	4.4	13
August	41.03	27.4	6.3	7.8	4.9	13
September	43.78	28.5	6.6	7.9	5.1	13
October	44.72	26.8	6.9	7.9	5.0	13
November	36.50	22.8	6.4	8.3	4.5	14
December	35.80	23.9	6.6	8.1	4.2	14
Average	37.56	23.9			4.4	14
Minimum	25.82	15.9	6.3		3.3	13
Maximum	44.72	28.5		8.3	5.1	16

Table 3 Final Effluent Analyses

Month	Carbonaceous Biochemical Oxygen Demand (CBOD5) average (avg.) concentration (conc.) milligram per litre (mg/L)	CBOD5 loading kilogram per day (kg/d)	Total Suspended Solids (TSS) avg. conc. mg/L	TSS loading kg/d	Total Phosphorous (TP) avg. conc. mg/L	TP loading kilograms per day	Total Ammonia Nitrogen (TAN) avg. conc. mg/L summer	TAN avg. conc. mg/L winter
January	2.4	7	6.6	21	0.23	1		0.89
February	2.8	8	6.9	19	0.21	1		5.56
March	2.4	7	6.3	19	0.18	1		2.69
April	2.0	9	5.2	24	0.24	1	0.45	
May	2.0	8	6.8	28	0.38	2	0.04	
June	2.3	7	6.9	22	0.27	1	0.10	
July	3.7	11	14.7	42	0.47	1	0.71	
August	2.0	5	4.5	12	0.11	0	0.06	
September	2.1	5	6.0	15	0.19	0	0.16	
October	1.7	5	4.8	13	0.16	0	0.71	
November	2.4	7	8.2	26	0.22	1	0.80	
December	3.1	10	7.8	26	0.24	1		3.64
Average	2.4	8	7.1	22	0.24	1	0.38	3.19
Minimum	1.7	5	4.5	12	0.11	0	0.04	0.89
Maximum	3.7	11	14.7	42	0.47	2	0.80	5.56
ECA Limit	25.0	102	25.0	102			15	20
ECA Objective	15.0	61.29	15.0	61.29	1.0	4.1	10	15
Within Compliance	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Sampling Frequency Requirement Met	Yes		Yes		Yes		Yes	Yes

Table 3 Final Effluent Analyses continued

Month	Unionized Ammonia average (avg.) concentration (conc.) milligram per litre (mg/L)	Total Kjeldahl Nitrogen avg. conc. mg/L	Total Chlorine Residual avg. conc. mg/L	Nitrate plus Nitrite avg. conc. mg/L	pH minimum	pH maximum	Temperature Degree Celsius avg.
January	0.00	2.07	0.00	13.2	6.4	6.9	10
February	0.01	7.26	0.00	11.8	6.6	7.1	10
March	0.00	4.56	0.00	12.4	6.5	7.1	9
April	0.00	1.27	0.00	10.5	6.7	7.3	10
May	0.00	0.87	0.00	11.1	6.8	7.1	13
June	0.00	1.41	0.00	13.1	6.5	7.4	16
July	0.00	2.61	0.00	13.2	6.1	7.5	19
August	0.00	1.22	0.00	15.7	5.9	7.0	20
September	0.00	1.54	0.00	17.1	6.3	7.0	20
October	0.00	1.92	0.01	15.6	6.2	6.9	19
November	0.00	3.04	0.01	12.3	6.2	7.1	16
December	0.01	6.77	0.01	10.5	6.2	7.0	14
Average	0.00	2.88	0.00	13.0			15
Minimum	0.00	0.87	0.00	10.5	5.9		9
Maximum	0.01	7.26	0.01	17.1		7.5	20
ECA Limit			0.04				
ECA Objective			0				
Within Compliance			Yes				
Sampling Frequency Requirement Met		Yes	Yes	Yes	Yes	Yes	Yes

Table 4(a) *Escherichia coli* Sampling

Month	Number of Samples	Monthly Geometric Mean Density
January	5	2
February	4	1
March	4	1
April	5	13
May	4	16
June	4	19
July	5	91
August	4	9
September	4	10
October	5	15
November	4	80
December	5	8
ECA Limit		
ECA Objective		200
Within Compliance		Yes
Sampling Frequency Requirement Met	Yes	

Table 4(b) Summary of Faecal Streptococcus and Total Coliform Monitoring

Month	Number of Samples	Faecal Streptococcus Monthly Geometric Mean Density	Total Coliform Monthly Geometric Mean Density
January	2	2	15
February	2	2	7
March	2	1	95
April	2	45	590
May	2	34	132
June	2	52	1,625
July	2	314	2,775
August	2	20	130
September	2	13	151
October	2	25	184
November	2	534	2,611
December	2	15	72
Sampling Frequency Requirement Met	Yes		

Table 5 Sludge Quality and Disposal

Month	Average Sludge Total Solids Percentage	Total Volume Removed cubic metre (m^3)	Total Volume Hauled to Courtice WPCP (m^3)	Total Volume Hauled to Port Darlington WPCP (m^3)
January	3.26	616	0	616
February	2.93	555	0	555
March	3.94	572	0	572
April	3.45	572	0	572
May	4.07	616	0	616
June	4.13	528	0	528
July	2.93	748	0	748
August	2.76	690	0	690
September	3.07	660	88	572
October	3.77	660	0	660
November	2.87	704	0	704
December	2.75	788	0	788
Total		7,709	88	7,621
Average	3.33	642		

Table 6 Energy and Chemical Usage

Month	Total Plant Flow cubic metre	Aluminum Sulphate litre	Sodium Hypochlorite kilograms as chlorine	Sodium Bisulphite litre	Hydro kilowatt hour	Natural Gas cubic metre
January	97,608	8,057	376	2,964	89,520	18,754
February	76,462	7,017	181	2,636	81,840	16,308
March	92,613	7,989	220	3,919	88,080	20,260
April	134,933	7,144	389	1,428	97,680	6,990
May	129,416	7,298	457	1,836	88,080	9,484
June	95,694	7,387	407	1,592	80,400	1,489
July	89,630	8,200	567	2,152	91,920	1,486
August	82,039	8,424	612	2,400	88,800	211
September	76,289	7,865	418	2,468	94,080	188
October	81,470	8,303	324	2,666	89,520	10,258
November	93,610	7,344	402	2,875	91,440	6,645
December	103,009	8,353	465	2,719	110,640	14,694
Total	1,152,773	93,382	4,819	29,656	1,092,000	106,767

Table 7 Summary of the Raw Water Bacteriological Analyses at the Newcastle Water Supply Plant

Month	*Escherichia coli* (*E. coli*) number of samples	*E. coli* Colony Forming Units per 100 millilitres (CFU/100ml) Results Range	Total Coliform number of samples	Total Coliform CFU/100ml Results Range
January	18	Non-Detect (ND)-2	18	ND-99
February	15	ND-5	15	ND-1400
March	16	ND-1	16	ND- 50
April	17	ND-1	17	ND-56
May	17	ND-4	17	ND-91
June	16	ND	16	ND-9
July	18	ND-1	18	ND-9
August	16	ND-3	16	ND-96
September	16	ND-3	16	ND-54
October	18	ND-7	18	ND-36
November	15	ND-3	15	ND-17
December	15	ND-2	15	ND-57