Duffin Creek Water Pollution Control Plant

2018 Annual Performance Report

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International Organization for Standardization (ISO) 14001 Certification: CA05/3563/E

The Duffin Creek Water Pollution Control Plant (WPCP) Annual Performance Report provides staff, stakeholders and customers an overview of the performance of the Duffin Creek WPCP in 2018. 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 Duffin Creek WPCP is jointly owned by the Regional Municipality of Durham and the Regional Municipality of York and operated in accordance with the terms and conditions of the ECAs noted above. The plant is located in the City of Pickering and operated by the Regional Municipality of Durham. This MECP Class Four conventional activated sludge treatment plant is designed to treat wastewater at an average daily flow rate of 630,000 cubic metres per day (m^3/d) with a limit of 520,000 m^3/d as noted in the ECA for outfall capacity limitations. Duffin Creek WPCP is ISO 14001 certified.

Duffin Creek WPCP treats wastewater from the Town of Ajax and the City of Pickering service areas in the Regional Municipality of Durham as well as the following service areas in the Regional Municipality of York: Vaughan, King, Newmarket, Whitchurch-Stouffville, Aurora, East Gwillimbury, Richmond Hill, and Markham.

The Duffin Creek WPCP utilizes the following processes to treat wastewater;

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

Raw Influent Pumping

Wastewater collected through approximately 672 km of sanitary sewers in Ajax and Pickering is conveyed to the treatment plant by gravity and by the following sanitary sewage pumping stations

located in the collection system: Bayly St., Jodrel Rd., Toy Ave., Finch Av. and Liverpool Rd. Wastewater collected from the Regional Municipality of York is conveyed to the WPCP via the Primary Trunk Sewer and the twin South East Collectors which are part of the York Durham Sewage System (YDSS). The sanitary sewage from York Region accounted for an estimated 81.9% of the wastewater treated in 2018. The remaining 18.1% (estimated) was generated by the Town of Ajax and the City of Pickering in Durham Region. The combined flows enter a diversion chamber, which then splits the flow between Stages 1, 2 and 3 at the Duffin Creek WPCP. There are two Influent Pumping Stations (IPS) each with eight submersible pumps that direct the wastewater to the preliminary treatment process. From the IPS, the wastewater flows by gravity through the rest of the treatment processes.

Preliminary Treatment

Screening: Eight mechanically cleaned screens remove rags and large debris that could harm pumps and process equipment. Screenings are compacted for disposal to landfill.
Grit Removal: There are eight grit tanks equipped with coarse bubble diffusers to provide aeration in the grit removal process. Heavy suspended material such as sand and small stones (grit) is settled to the bottom of the tanks while lighter organic particles are kept in suspension and passed through the tanks for further treatment. The grit removed is dewatered for landfill disposal.

Primary Treatment

Fourteen primary clarifiers each equipped with a travelling bridge system utilize the physical process of sedimentation, which causes heavy particles to settle to the bottom of the tank as raw sludge and lighter particles to float to the surface as scum. The sludge, along with waste activated sludge from the secondary treatment process is collected by scraper blades, which push the sludge into hoppers. The sludge is then pumped to anaerobic digestion and/or dewatering holding tanks. The scum is collected by the travelling bridge and sent to the digesters.

Phosphorous Removal
Iron salts are added throughout the treatment process to aid in phosphorous and suspended solids removal. Chemical addition can be supplemented by polymer at various locations throughout the plant for enhanced treatment.

Secondary Treatment

Aeration Tank: There are fourteen aeration tanks each containing anoxic and aerobic zones. In the first part of the tank no oxygen is introduced (anoxic), this is for denitrification. The second part of the tank is where fine bubbled air is diffused into the wastewater (aerobic) to remove dissolved and suspended organics and nutrients from the wastewater. Biological activity is controlled to assimilate the organic material.
Secondary Clarifier: Twenty-two secondary clarifiers receive effluent from the aeration tanks where solids settle quickly as activated sludge leaving a clear effluent. A portion of the activated sludge

collected on the bottom of the clarifier is pumped back to the front of the aeration tanks and any excess activated sludge is 'wasted' to the primary clarifier to co-settle.

Disinfection (chlorination/dechlorination)

Chlorine in the form of liquid sodium hypochlorite is metered into the effluent stream for pathogen control. Adequate contact time is provided by the chlorine contact chambers. Disinfected effluent is dechlorinated with a sodium bisulphite solution before being discharged to Lake Ontario through a 3.05 m diameter outfall pipe, approximately 1,100 m long with a 183 m long diffuser pipe.

Solids Management

Anaerobic Digestion: Some of the raw sludges that are collected from the primary clarifiers are pumped into one of the four primary digesters, which overflow into two secondary digesters for thickening. Digested sludge is pumped to dewatering storage tanks, where it is blended with additional raw sludge from the primary clarifiers before being dewatered. All solids produced are dewatered and incinerated on site.
Imported Sludge: Durham's Regional Biosolids Management Program imports sludges from facilities within the Regional of Municipality of York and the Regional Municipality of Durham.
Dewatering: Duffin Creek WPCP utilizes eight dewatering solid bowl centrifuges in order to separate the heavier material and the liquid supernatant (centrate). All dewatered solids (sludge cake) is sent to incineration. The centrate is pumped to the head of the plant where it combines with the influent to undergo treatment.

Incineration

There are four fluidized bed process trains, which through the combustion process burns the organic substances contained in the sludge cake and converts the cake into ash and flue gas. Steam boilers are utilized for waste heat recovery. All solids at Duffin Creek WPCP were incinerated during the reporting period.
The ash from the incineration process is sent to St. Mary's Cement in Bowmanville, Ontario for reuse. No land application or landfill of biosolids occurred in 2018.

Environmental Compliance Approval

Under Condition 10. (6) of ECA # 5531-9FJJT5 the Region of Durham 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 Duffin Creek WPCP effluent was determined to be compliant with the ECA approval limits during the reporting period.
- The plant operated at 65.99% of its approved capacity for this reporting period. The plant received a maximum daily flow of 787,719 m^3 on April 16, 2018.

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

The following challenges were successfully overcome though planning and communication.

- Phosphorous optimization field study continued in 2018, in which a portion of the plant operated under various optimization scenarios to assess opportunities for greater phosphorous removal.
- Stage 3 Substation Maintenance, 100% flow shift to Stages 1 and 2.
- Restored Stage 2 treatment trains November – December upon secondary 9-16 refurbishment completion.
- Test trains, as part of the phosphorous optimization field study transitioned to ferric sulfate as the coagulant chemical for phosphorous removal.
- Plant operations transitioned to an electronic logbook officially November 1st.
- Durham Region's energy conservation initiative – Duffin Creek WPCP curtails electrical loads throughout the plant as feasible during provincial peak electrical demand events. Effluent quality can potentially be adversely affected especially when energy curtailment occurs on consecutive days.

Major maintenance items in 2018 included:

Operations

- Replaced return activated sludge 600 mm flow meter for secondary 3.
- IPS pump inspection – remove and inspect all 16 submersible pumps (2 sent out for repair from Stage 3).
- Planned chain and flight maintenance for Secondary 17,18,19, 22.
- Repaired broken diffusers on aeration tank #4, replaced submersible mixer and repaired mast.
- Substation maintenance occurred on Dec. 4 and 5th on TS-201.
- Continue to have digester mixer failures, removal and repair of digester mixers.
- Replaced actuator on inlet gate to contact chamber 4 and aeration tank 5.
- Repair diffuser break on aeration 3.
- Replace seals on aeration header at aeration tank 3 and 8.
- Scheduled servicing on blowers 1-9.

Dewatering

- Sludge holding mixer mast repair.
- Sludge holding tank gate repair.
- West distribution conveyor repair.
- Schwing material cylinder replacement.

Incineration

Removed and replaced piping for two flash tanks.

- Replacement of valve in digester boiler building.
- Major repairs of reactor 1.
- Stack testing for reactors 2 and 4.
- Reactor #3 induced draft blower fan repairs.

c) Summary of any effluent quality assurance or control measures

- In-house lab test results are compared to the results of the Regional Environmental Laboratory on comparable samples to determine the in-house accuracy. All results were found to be within an acceptable range.
- On-line instrumentation is verified by WPCP operators using various field or laboratory test equipment.
- Analytical balances are calibrated by Fisher Scientific Company Ltd.
- In-house lab equipment is calibrated by operations staff and various manufacturers.

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

- Plant flows are measured at the influent of this plant.
- All influent flow meters were calibrated on January 31, 2018.
- All monitoring and laboratory equipment is calibrated and maintained according to manufacturer's specifications.

e) Efforts made and results achieved in meeting effluent objectives

The objective for pH was exceeded twice on January 3 and 14 potentially due to a decline in alkalinity. On April 2, 3, June 3, 5, 6, 9 and September 2 the pH objective was also exceeded, upon resampling and recalibration each result was compliant. Best efforts and process adjustments were and will continue to be applied as the Region of Durham endeavours to maintain results below objectives.

f) An outline of anticipated volumes of sludge to be generated in the next reporting period.

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

g) Summary of any complaints received during the reporting period

Noise complaint – On February 25th, March 10th, October 23, 2018, noise concerns were received from an Ajax resident. The resident indicated that there was a persistent noise that he perceived to be emanating from the Duffin Creek WPCP, located approximately 1.6 kilometers (km) away. Each concern has been investigated and ambient noise readings have shown that Duffin Creek WPCP is not a significant source of noise at this location, nor

in the surrounding areas tested. Notifications and investigations of the concerns were provided to the MECP.

h) Summary of all by-passes, spill or abnormal discharge events

There is no mechanism for by-passing untreated wastewater at this facility. There are no anticipated by-passes planned for the next reporting period.

Spill or abnormal discharge event: There were no spills or abnormal discharge events in 2018.

i) Notice of modifications and any implementation of Limited Operational Flexibility

No notice of modifications were submitted in 2018.

j) Extra Information

The fixed bed carbon adsorption units in the incineration complex were not usable due to safety reasons. The MECP was notified and investigations continued in 2018 in order to determine better operating conditions for the units. Regional Staff are working to resolve this operating condition. To maintain operation of this essential process, the MECP issued Provincial Order Number 0328-AVYR75 which allows Duffin Creek WPCP to temporarily operate incinerators 3 and 4 without the carbon absorption units. Replacement Sorbent Polymer Composite (SPC) units are planned to be installed and operational by the end of 2020.

The Regional Municipalities of Durham and York have undertaken a Phosphorous Optimization Field Study at the Duffin Creek WPCP. The purpose of the field study is to identify a “phosphorous reduction action plan (strategy)” for reducing the amount of total phosphorous (TP) and soluble reactive phosphorous (SRP) in the Duffin Creek WPCP effluent. The field study was completed in September 2018, and the plant continues to operate with lower total Phosphorous targets.

The Duffin Creek WPCP continues to participate in the Independent Electricity System Operator’s (IESO) Industrial Conservation Initiative (ICI) by curtailing plant electricity demand during the highest periods of provincial electricity demand. In addition to ICI participation, the facility continues to participate in the Embedded Energy Manager (EEM) program to meet and exceed the targeted objective of 2000 MWh of avoided energy use per year.

Proposed Alterations, Extensions or Replacements

- Capital restoration plan for damaged sludge blending tank and biofilter works is planned. Contract awarded January 2019 with estimated completion late 2019.
- Stage 1 and 2 digester mixing improvements and motor control center replacements RFP estimated to commence in third quarter of 2019 due to project delays.

- Replacement of incineration facility reactor 1 and 2 is planned. Detailed design on-going and is to be completed end of 2020.
- Facility phosphorous optimization trials continued through September 2018 as a component of the Duffin Creek WPCP Outfall Class Environmental Assessment program. Facility phosphorous optimization trails completed.
- Reactor 3 and 4 enhanced mercury removal replacement and retrofit works. Detailed design of replacement SPC units initiated in first quarter of 2019 with construction planned to start at the end of 2019 and completion by the end of 2020.

MECP Inspection

This plant was last inspected by the MECP on February 12, 2015. No compliance items were identified in the report.

Table 1 Raw Influent Flows

Month	York Region Plant Flow cubic metre (m^3)	Durham Region Plant Flow m^3	Total Flow to Plant metered at the raw influent m^3	Average Daily Flow cubic metre per day (m^3/d)	Maximum Daily Flow m^3/d
January	8,155,103	1,802,288	9,957,391	321,206	473,208
February	7,691,792	1,699,896	9,391,688	335,417	497,000
March	8,311,226	1,836,791	10,148,017	327,355	363,622
April	10,820,300	2,391,300	13,211,600	440,387	787,719
May	8,855,591	1,957,096	10,812,688	348,796	407,743
June	7,952,723	1,757,561	9,710,284	323,676	348,588
July	8,157,043	1,802,716	9,959,759	321,283	368,361
August	8,911,554	1,969,464	10,881,019	351,001	422,489
September	7,863,455	1,737,833	9,601,288	320,043	349,450
October	8,106,326	1,791,508	9,897,835	319,285	352,701
November	8,891,145	1,964,954	10,856,099	361,870	509,727
December	8,865,945	1,959,385	10,825,330	349,204	399,143
Total (%) *	102,582,204 (81.9%)	22,670,792 (18.1%)	125,252,996 (100%)		
Average *	8,548,517	1,889,233	10,437,750	343,159	
Minimum	7,691,792	1,699,896	9,391,688		
Maximum	10,820,300	2,391,300	13,211,600		787,719
ECA Limit				520,000	
ECA Objective					
Compliance Met				Yes	

*Note – total and average reflect rounding of decimal places

Table 2 Raw Influent Analyses

Month	Biochemical Oxygen Demand average concentration (conc.) milligram per litre (mg/L)	Total Suspended Solids average conc. mg/L	Total Phosphorous (TP) average conc. mg/L	TP average loading kilogram per day	Total Kjeldahl Nitrogen average conc. mg/L	Total Ammonia Nitrogen average conc. mg/L	pH	Temperature Degree Celcius
January	236	330	6.2	1,975	48.60	28.7	7.3	11.1
February	239	369	6.3	2,113	50.50	30.1	7.3	10.5
March	214	312	6.3	2,046	51.30	30.4	7.2	11.7
April	157	243	4.5	1,986	34.32	17.9	7.5	11.8
May	236	364	6.4	2,225	48.00	25.7	7.3	15.7
June	254	429	7.3	2,360	53.30	27.8	7.1	17.7
July	257	415	7.0	2,239	55.20	30.4	7.2	19.8
August	198	393	6.5	2,271	45.50	26.6	7.2	21.0
September	234	402	6.7	2,144	48.90	30.9	7.2	20.3
October	301	413	6.9	2,190	51.70	28.4	7.8	15.6
November	175	319	5.8	2,099	43.46	25.1	7.3	14.8
December	208	318	5.7	1,990	45.44	26.5	7.2	13.3
Average	226	359	6.3	2,137	48.02	27.4	7.3	15.3
Minimum	157	243	4.5	1,975	34.32	17.9		
Maximum	301	429	7.3	2,360	55.20	30.9		
Sampling Frequency Requirement Met	Yes	Yes	Yes		Yes			

Table 3 Final Effluent Analyses

Month	Carbonaceous Biochemical Oxygen Demand average concentration (conc.) milligram per litre (mg/L)	Total Suspended Solids average conc. mg/L	Total Phosphorous average conc. mg/L	Total Phosphorous average loading kilogram per day	Total Ammonia Nitrogen average conc. mg/L summer	Total Ammonia Nitrogen average conc. mg/L winter
January	2.1	8.4	0.31	100	N/A	1.57
February	2.5	8.7	0.30	101	N/A	0.89
March	2.7	6.8	0.28	92	N/A	0.90
April	3.5	8.2	0.26	115	N/A	0.64
May	2.2	6.0	0.28	98	0.74	N/A
June	2.4	7.1	0.39	126	0.28	N/A
July	1.8	7.1	0.34	109	1.57	N/A
August	2.4	11.3	0.38	133	1.12	N/A
September	1.0	6.2	0.34	109	0.26	N/A
October	1.8	6.8	0.37	118	N/A	0.27
November	2.4	8.2	0.32	116	N/A	0.15
December	3.1	10.1	0.38	133	N/A	1.54
Average	2.3	7.9	0.33	112	0.79	0.85
Minimum	1.0	6.0	0.26	92	0.26	0.15
Maximum	3.5	11.3	0.39	133	1.57	1.57
ECA Limit	25.0	25.0	0.8	311	6.0	10.0
ECA Objective	15.0	15.0	0.6		5.0	5.0
Within Compliance	Yes	Yes	Yes	Yes	Yes	Yes
Sampling Requirement Frequency Met	Yes	Yes	Yes	Yes	Yes	Yes

Table 3 Final Effluent Analyses continued

Month	Unionized Ammonia Nitrogen average concentration (conc.) milligram per litre (mg/L)	Total Kjeldahl Nitrogen average conc. mg/L	Total Chlorine Residual average conc. mg/L	pH minimum	pH maximum	Temperature Degree Celcius
January	0.0	2.79	0.00	6.3	7.5	13.8
February	0.0	2.21	0.00	6.6	7.2	14.2
March	0.0	2.19	0.00	6.6	7.7	14.1
April	0.0	1.74	0.00	6.4	8.0	14.3
May	0.0	1.95	0.00	6.5	7.7	17.2
June	0.0	1.60	0.00	6.3	7.7	19.0
July	0.0	2.79	0.00	6.7	7.1	21.1
August	0.0	2.25	0.00	6.5	7.2	21.8
September	0.0	1.53	0.00	6.4	7.3	21.2
October	0.0	1.53	0.00	6.5	7.3	18.7
November	0.0	1.37	0.00	6.6	7.4	16.7
December	0.0	2.79	0.00	6.5	7.6	15.6
Average	0.0	2.06	0.00			17.3
Minimum	0.0	1.37	0.00	6.3		
Maximum	0.0	2.79	0.00		8.0	
ECA Limit	0.2		0.02	6.0	9.5	
ECA Objective	0.1		Non-detectable	6.5	8.5	
Within Compliance	Yes		Yes	Yes	Yes	
Sampling Frequency Requirement Met	Yes		Yes	Yes	Yes	Yes

Table 4 Escherichia Coliform Sampling

Month	Monthly Geometric Mean Density	Number of Samples
January	16	22
February	18	19
March	24	21
April	56	20
May	47	22
June	52	20
July	16	21
August	42	22
September	39	19
October	41	21
November	97	21
December	91	19
ECA Limit	200	52
ECA Objective	100	
Within Compliance	Yes	
Sampling Frequency Requirement Met		Yes

Table 5 Imported Wastewater Analyses and Septage Amounts

Month	Biochemical Oxygen Demand average concentration (conc.) milligram per litre (mg/L)	Total Suspended Solids average conc. mg/L	Total Kjeldahl Nitrogen average conc mg/L	Total Phosphorous average conc. mg/L	York Septage Solids dry tonnes	Durham Septage Solids dry tonnes	Total Septage Solids dry tonnes
January	2099	5537	695.79	99.9	1.2	7.3	8.5
February	1494	3460	642.50	79.2	0.6	1.9	2.5
March	1902	5186	1293.44	95.1	1.3	7.9	9.3
April	6217	17186	1402.00	135.1	5.4	16.6	21.9
May	1718	3241	655.84	88.6	1.2	5.0	6.3
June	2638	2397	1125.00	93.4	1.0	11.1	12.1
July	2028	6045	1565.00	154.0	2.3	9.0	11.3
August	6398	8502	822.00	121.0	3.7	13.8	17.6
September	3009	14380	954.00	173.0	4.9	15.9	20.8
October	1417	6091	511.56	108.3	1.5	9.2	10.7
November	3103	9514	1349.59	228.0	4.7	15.9	20.6
December	3154	3966	1179.56	86.9	3.2	4.2	7.4
Total					31.1	117.7	148.9
Average	2931	7125	1016.36	121.9			
Sampling Requirement Frequency Met	Yes	Yes	Yes	Yes			

Table 6 Energy and Chemical Usage

Month	Ferric Chloride Litre (L)	Sodium Hypochlorite L	Sodium Bisulphite L	Anionic Polymer kilogram*	Hydro kilowatt hour	Natural Gas cubic metre
January	650,902	149,465	17,784	(N/A)	5,090,773	486,184
February	516,222	163,465	17,802	3750	4,718,689	479,899
March	559,848	186,255	20,181	6000	5,288,204	484,139
April	637,442	271,479	30,631	4500	5,111,044	490,938
May	565,513	223,906	22,345		5,310,768	334,352
June	586,804	178,000	19,867	6000	5,241,231	108,626
July	664,088	160,692	22,265	6000	5,178,051	120,885
August	774,302	168,076	23,613	6000	5,757,072	13,086
September	658,349	163,485	22,607		5,025,346	90,334
October	704,823	166,675	21,745		5,149,417	314,085
November	696,865	180,548	24,507		4,698,718	397,069
December	667,546	195,879	29,109		5,399,940	411,206
Total	7,682,706	2,207,925	272,456	32,250	61,969,253	3,730,803

*based on amount purchased

Table 7 Summary of Sludge Produced and Imported

Month	Sludge produced from York Influent Solids dry tonnes	Sludge produced from Durham Influent Solids dry tonnes	Total Sludge produced from all Influent Solids dry tonnes	York Imported Solids dry tonnes	Durham Imported Solids dry tonnes	Total Imported Solids dry tonnes
January	2,691	595	3,286	135	391	526
February	2,838	627	3,466	137	288	425
March	2,593	573	3,166	134	484	618
April	2,629	581	3,210	139	529	668
May	3,223	712	3,936	126	537	663
June	3,412	754	4,166	128	299	427
July	3,385	748	4,133	137	364	501
August	3,502	774	4,276	136	488	624
September	3,161	699	3,860	116	502	618
October	3,348	740	4,088	142	546	688
November	2,836	627	3,463	129	465	594
December	2,819	623	3,442	116	339	455
Total	36,439	8,053	44,492	1,575	5,231	6,806

Table 8 Dewatering and Incineration Summary

Month	Average Feed Solids percent (%) Total Solids (TS)	Average Sludge Cake % TS	Average Polymer Dosage kilogram per tonne	Total Sludge Output dry tonnes	Dewatered Sludge Incinerated dry tonnes	Ash Produced by Incineration tonnes
January	2.8	23.5	7.2	2,532	2,393	759
February	2.7	22.4	8.0	2,067	2,254	681
March	2.9	25.3	8.1	3,543	3,323	1,058
April	3.6	26.6	8.0	3,084	2,864	933
May	3.3	26.8	8.1	2,656	2,434	824
June	2.8	26.5	7.7	3,048	2,679	889
July	2.7	26.6	7.4	2,109	1,820	690
August	2.6	24.7	7.4	3,095	2,620	1,057
September	2.8	26.5	7.5	2,670	2,319	841
October	2.6	25.6	7.4	2,829	2,446	948
November	2.9	25.4	7.4	2,306	2,292	748
December	2.8	24.0	7.3	2,914	2,530	842
Average	2.9	25.3	7.6	2,738	2,498	856
Total				32,852	29,975	10,271