Duffin Creek Water Pollution Control Plant

2017 Annual Performance Report

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Environmental Compliance Approval (ECA): 5531-9FJJT5 Dated March 3, 2014

Environmental Compliance Approval (Air): 1110-9AJP5C Dated September 13, 2013

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 2017. Further, this report fulfills the annual reporting requirements of the Ontario Ministry of the Environment and Climate Change (MOECC). 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 MOECC 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 outfall capacity limitations in the ECA. 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 654 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 South East Collector which are part of the York Durham Sewage System (YDSS). The sewage from the YDSS accounted for an estimated 81.9% of the wastewater treated in

2017. The remaining 18.1% (estimated) was generated by the Town of Ajax and the City of Pickering. 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: The sludges that are collected from the primary clarifiers are pumped into one of the four digesters, which overflow into two secondary digesters for thickening. Digested sludge is pumped to dewatering storage tanks and blended with raw sludge 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 2017.

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 64.1% of its approved capacity for this reporting period. The plant received a maximum daily flow of 732,972 m^3 on May 5, 2017.

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

The following challenges were successfully overcome though planning and communication.

- Spring 2017 - de-commissioned existing stage 1 and stage 2 detritors, which involved unwatering all channels/tanks and diverting flows, for ultimate demolition.
- May 2017 - commissioned Stage 1 and 2 IPS and associated Headworks, odour control system and chemical phosphorus removal system.
- June 2017 - as part of the Phosphorus Reduction Action Plan (PRAP) field study the plant transitioned from ferrous chloride to ferric chloride.
- September 2017 - Polymer addition to primary and secondary clarifiers associated with the PRAP study area – this involved; piping modifications, programming and recommissioning of the polymer building.
- Durham Region's energy conservation initiative – Duffin Creek WPCP curtails electrical loads throughout the plant as feasible during provincial peak electrical demand events.

c) Maintenance of major equipment

Major maintenance items in 2017 included:

Operations

- Replaced return activated sludge 600mm flow meter for secondary #5
- IPS pump inspection – remove and inspect all 16 submersible pumps (1 sent out for repair)
- Refurbished secondary polymer building including all pumps, mixers, make down units and dosing points
- Repaired broken diffusers on aeration tank #4, replaced submersible mixer and repaired mast
- Substation maintenance on TS-102 and TS-201
- Removal and rebuild of 4 digester mixers
- Replaced actuator on inlet gate to contact chamber 1
- Rebuilt Primary Scum collector #10 and #14
- Re-piped iron dosing locations as part of PRAP
- Replaced Secondary #18 chains

Dewatering

- Replaced hangar bearings on sludge cake distribution conveyor
- Replaced pipe lubrication lines
- Removed and replaced mechanical mixer in sludge tank #3
- Replaced 2 plug valves on sludge feed lines

Incineration

- Maintenance of digester boiler building
- Stack testing for #1 Incinerator
- Maintenance on hoisting devices.

d) 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 a comparable 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.

e) 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 February 1, 2017.
- All monitoring and laboratory equipment is calibrated and maintained according to manufacturer’s specifications.

f) Efforts made and results achieved in meeting effluent objectives

The objective for pH was exceeded twice on January 5th and 26th, resamples on each occasion showed pH values within acceptable limits. On December 12th and 13th a disruption in the nitrification process resulted in the exceedance of the pH objective in the final effluent. The objective for E.coli was exceeded for the months of May, June and July. The investigation which included flushing, disinfecting and CCTV of effluent lines produced no conclusive results. All results since have been well below objectives. Best efforts and process adjustments were and will continue to be applied to maintain results below objectives.

g) 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.

h) Summary of any complaints received during the reporting period

Odour complaint – On Dec. 12, 2017, an odour concern was received from a Pickering resident. The resident indicated that she lived beside Ontario Power Generation and could smell something she thought was from our facility. Staff logged complaint and verified the wind direction was blowing from the area of complaint towards Duffin Creek WPCP. Staff investigated and found no unusual odours at the plant and there were no major breakdowns of equipment during that time frame. Since the resident would not leave any contact information, we had no means of informing her of our findings. Notification of the concern was provided to the MOECC.

i) 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 2017.

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

No notice of modifications were submitted in 2017.

k) Extra Information

The fixed bed carbon adsorption units in the incineration complex were not usable. The MOECC was notified and investigations continued in 2017 in order to determine better operating conditions for the units.

The Regional Municipalities of Durham and York have undertaken a PRAP Study for the Duffin Creek WPCP. The purpose of the PRAP 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 effluent. The PRAP study will be complete in 2018, however field studies will continue for process optimization purposes.

Proposed Alterations, Extensions or Replacements

- Capital restoration plan for damaged sludge blending tank and biofilter works. Construction estimated to start last quarter 2018 (pending approvals)
- Stage 1 and 2 digester mixing improvements and motor control center replacements detailed design is estimated to commence in the third quarter of 2018.
- Detailed design is planned to commence March 2018 for replacement of incineration facility reactor 1 and 2.
- Facility phosphorous optimization trials continue through June 2018 as component of the Duffin Creek WPCP Outfall Class Environmental Assessment program.

MOECC Inspection

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

Table 1 Raw Influent Flows

Month	York Region Plant Flow m^3	Durham Region Plant Flow m^3	Total Flow to Plant metered at the raw influent m^3	Average Daily Flow m^3/d	Maximum Daily Flow m^3/d
January	8,637,526	1,908,904	10,546,430	340,207	433,721
February	7,430,020	1,642,044	9,072,064	324,002	432,613
March	8,638,890	1,909,205	10,548,095	340,261	477,711
April	9,373,424	2,071,538	11,444,962	381,499	588,770
May	10,141,669	2,241,321	12,382,990	399,451	732,973
June	9,025,428	1,994,631	11,020,058	367,335	649,169
July	8,661,747	1,914,257	10,576,004	341,161	399,146
August	7,794,982	1,722,701	9,517,683	307,022	331,624
September	7,270,422	1,606,772	8,877,194	295,906	327,853
October	7,563,611	1,671,567	9,235,178	297,909	340,521
November	7,622,063	1,684,485	9,306,549	310,218	364,985
December	7,540,640	1,666,491	9,207,130	297,004	311,642
Total (%) *	99,700,422 (81.9%)	22,033,915 (18.1%)	121,734,338 (100%)		
Average *	8,308,369	1,836,160	10,144,528	333,498	
Minimum	7,270,422	1,606,772	8,877,194		
Maximum	10,141,669	2,241,321	12,382,990		732,973
ECA Limit				520,000	
ECA Objective					
Compliance Met				Yes	

*Note – total and average reflect rounding of decimal places

Table 2 Raw Influent Analyses

Month	BOD_5 average conc. mg/L	TSS average conc. mg/L	TP average conc. mg/L	TP average loading kg/d	TKN average conc. mg/L	TAN average conc. mg/L	pH	Temperature °C
January	197	265	5.7	1,939	45.17	32.1	7.2	13.1
February	183	284	6.0	1,944	45.54	30.3	7.3	13.1
March	183	316	7.0	2,382	48.22	28.9	7.2	12.7
April	175	283	5.8	2,213	41.00	26.1	7.2	14.1
May	176	311	5.5	2,197	41.13	26.3	7.2	15.1
June	196	316	5.7	2,094	44.56	26.5	7.3	17.2
July	202	296	6.0	2,047	42.83	26.6	7.4	19.2
August	223	329	7.5	2,303	52.44	32.6	7.3	19.8
September	225	360	6.8	2,012	50.08	29.7	7.4	19.9
October	202	359	6.7	1,996	49.00	29.9	7.2	18.0
November	234	395	7.0	2,172	49.39	28.6	7.2	16.0
December	225	328	6.5	1,931	51.60	31.9	7.2	12.5
Average	202	320	6.4	2,118	46.75	29.1	7.3	15.9
Minimum	175	265	5.5	1,931	41.00	26.1		
Maximum	234	395	7.5	2,382	52.44	32.6		
Sampling Frequency Requirement Met	Yes	Yes	Yes		Yes			

Table 3 Final Effluent Analyses

Month	$CBOD_5$ average conc. mg/L	TSS average conc. mg/L	TP average conc. mg/L	TP average loading kg/d	TAN average conc. mg/L summer	TAN average conc. mg/L winter
January	1.8	5.9	0.44	150		0.45
February	1.9	5.7	0.52	168		0.94
March	3.1	7.5	0.54	184		0.46
April	2.4	7.8	0.29	111		0.99
May	3.3	8.3	0.29	116	1.72	
June	2.6	8.3	0.43	158	2.21	
July	1.9	7.4	0.56	191	0.53	
August	1.8	8.2	0.47	144	0.97	
September	1.6	5.8	0.48	142	1.29	
October	2.4	8.6	0.48	143		0.58
November	1.5	7.0	0.31	96		0.33
December	2.4	7.8	0.35	104		0.74
Average	2.2	7.4	0.43	143	1.34	0.65
Minimum	1.5	5.7	0.29	96	0.53	0.33
Maximum	3.3	8.6	0.56	191	2.21	0.99
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

Table 3 Final Effluent Analyses continued

Month	Unionized Ammonia Nitrogen average conc. mg/L	TKN average conc. mg/L	Total Chlorine Residual average conc. mg/L	pH minimum	pH maximum	Temperature °C
January	0.0	1.41	0.00	6.2	7.3	13.6
February	0.0	1.96	0.00	6.5	7.2	13.3
March	0.0	1.63	0.00	6.5	7.1	13.1
April	0.0	2.09	0.00	6.7	7.3	15.2
May	0.0	3.13	0.00	6.5	7.4	16.1
June	0.0	3.43	0.00	6.6	7.3	18.8
July	0.0	1.67	0.00	6.6	7.5	20.9
August	0.0	2.13	0.00	6.7	7.3	21.5
September	0.0	2.25	0.00	6.6	7.3	21.1
October	0.0	1.82	0.00	6.6	7.1	19.5
November	0.0	1.40	0.00	6.6	7.3	17.4
December	0.0	1.97	0.00	6.4	7.3	15.7
Average	0.0	2.07	0.00			17.2
Minimum	0.0	1.40	0.00	6.2		
Maximum	0.0	3.43	0.00		7.5	
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	Number of Samples	Monthly Geometric Mean Density
January	21	8
February	19	50
March	23	59
April	19	78
May	24	128
June	34	138
July	26	102
August	22	33
September	19	30
October	21	30
November	21	37
December	19	25
ECA Limit	52	200
ECA Objective		100
Within Compliance		Yes
Sampling Frequency Requirement Met	Yes	

Table 5 Imported Wastewater Analyses and Septage Amounts

Month	BOD_5 average conc. mg/L	TSS average conc. mg/L	TKN average conc. mg/L	TP average conc. mg/L	York Septage Solids (dry tonnes)	Durham Septage Solids (dry tonnes)	Total Septage Solids (dry tonnes)
January	3,183	9,208	1,629.30	158.8	3.0	6.8	9.7
February	3,011	2,019	491.00	40.0	0.6	1.0	1.6
March	3,012	4,711	954.60	89.5	1.8	4.0	5.7
April	5,612	19,662	1,082.88	189.1	102.7	26.2	128.9
May	2,835	5,048	847.70	132.4	40.4	8.1	48.4
June	5,203	19,485	587.47	233.1	181.2	28.0	209.2
July	2,904	6,213	958.63	174.4	35.5	8.5	44.0
August	2,711	18,629	387.40	111.7	78.6	24.6	103.2
September	3,987	13,643	988.63	187.0	5.8	16.7	22.5
October	2,873	18,237	710.00	140.0	6.3	25.1	31.3
November	1,651	10,097	302.89	52.1	3.3	14.6	17.8
December	2,563	12,003	952.83	91.2	2.6	13.5	16.1
Total					461.7	176.9	638.7
Average	3,295	11,580	824.44	133.3	N/A	N/A	N/A
Sampling Requirement Frequency Met	Yes	Yes	Yes	Yes			

Table 6 Energy and Chemical Usage

Month	Ferrous Chloride kg	Ferric Chloride kg	Sodium Hypochlorite L	Sodium Bisulphite kg	Polymer kg	Hydro kWh	Natural Gas m^3
January	1,271,683		189,000	27,030		4,986,667	224,954
February	772,257		105,040	26,326		4,386,665	285,911
March	1,122,430		189,000	20,030		4,967,813	239,607
April	1,276,329		162,000	28,790		5,125,161	162,949
May	1,494,427		227,950	33,570		5,348,729	110,982
June	596,101	510,270	229,500	42,210		5,038,330	61,374
July		752,680	160,000	7,840		5,058,377	82,674
August		1,101,073	209,500	25,590		5,140,866	97,715
September		437,959	144,000	26,800		4,681,452	121,649
October		1,031,993	216,000	11,780		4,819,724	209,666
November		1,121,477	160,500	21,610	3,750	4,971,853	324,602
December		770,648	135,000	27,630	3,750	4,956,550	304,681
Total	6,533,227	5,726,100	2,127,490	329,206	7,500	59,482,186	2,226,764

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	2,315	512	2,826	103	283	386
February	2,229	493	2,722	100	174	274
March	2,782	615	3,396	102	463	565
April	2,521	557	3,079	95	246	341
May	3,276	724	4,000	122	107	229
June	2,708	598	3,306	108	325	433
July	2,486	549	3,035	100	257	357
August	2,323	513	2,836	100	141	241
September	2,501	553	3,054	79	66	145
October	2,420	535	2,955	68	187	255
November	2,355	521	2,876	101	382	483
December	2,202	487	3,164	91	436	527
Total	30,118	6,656	37,249	1,169	3,068	4,237

Table 8 Dewatering and Incineration Summary

Month	Average Feed Solids % TS	Average Sludge Cake % TS	Average Polymer Dosage kg/tonne	Total Sludge Output (dry tonnes)	Dewatered Sludge Incinerated (dry tonnes)	Ash Produced by Incineration (tonnes)
January	3.1	24.8	7.8	1,447	1,486	859
February	2.8	25.1	8.0	1,881	1,987	617
March	2.9	24.8	8.1	2,590	2,312	789
April	3.1	27.7	8.0	3,020	2,791	953
May	3.8	25.8	7.4	2,956	2,324	1,140
June	2.7	27.0	7.6	2,651	2,218	940
July	2.7	26.3	7.7	2,407	2,308	942
August	2.5	24.7	7.8	3,346	3,180	1,149
September	2.9	26.2	7.4	2,034	1,942	668
October	2.6	25.4	7.6	2,227	2,174	742
November	2.2	23.9	7.4	3,211	3,442	1,086
December	2.6	24.4	7.5	2,218	1,941	633
Total				29,988	28,105	10,518
Average	2.8	25.5	7.7	2,499	2,342	877