Duffin Creek Water Pollution Control Plant

2020 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
Environmental Compliance Approval (Air): 1110-9AJP5C Notice 1 Dated July 23, 2018
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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 2020. 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, located in the City of Pickering, is operated by The Regional Municipality of Durham. This MECP Class 4 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. The Duffin Creek WPCP is ISO 14001 certified.

The Duffin Creek WPCP treats wastewater for approximately 224,479 residents in the Town of Ajax and the City of Pickering in The Regional Municipality of Durham as well as 999,400 residents in The Regional Municipality of York, which includes Vaughan, King, Newmarket, Whitchurch-Stouffville, Aurora, East Gwillimbury, Richmond Hill, and Markham. The total population served by Duffin Creek WPCP is approximately 1,223,879.

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

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

Raw Influent Pumping

Wastewater collected through approximately 683 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 Ave. and Liverpool Rd. Wastewater collected from York Region is conveyed to the Water Pollution Control Plant (WPCP) via the Primary Trunk Sewer and the twin South East Collectors which are part of the York Durham Sewage System (YDSS). Wastewater from York Region accounted for 81.5% of the plant flow treated in 2020. The remaining sanitary sewage flow of 18.5% 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 in 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 cause 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 pumped to anaerobic digestion.

Phosphorus Removal

Iron salts are added throughout the treatment process to aid in phosphorus and suspended solids removal. Chemical addition can be supplemented by the addition of 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.
Secondary Clarifier: Twenty-two secondary clarifiers receive effluent from the aeration tanks where solids settle quickly as activated sludge leaving a clear effluent on top. 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 with primary sludge.

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: A portion of the raw sludge collected from the primary clarifiers is pumped into one of the four primary digester 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 York Region and Durham Region.
Dewatering: Duffin Creek Water Pollution Control Plant (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 off 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 the Duffin Creek Water Pollution Control Plant 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 2020 from this facility.

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 Water Pollution Control Plant (WPCP) effluent was determined to be compliant with the Environmental Compliance Approval limits during the reporting period,
- The plant operated at 66% of its approved capacity for this reporting period. The plant received a maximum daily flow of 1,095,382 m^3 on January 12, 2020.

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

The following challenges were successfully overcome though planning and communication.

- Foaming issues in Sludge Blend Tank #1 – Tank was dewatered and cleaned out,
- In April, the plant transitioned to ferric sulfate due to supply concerns. In June, the plant transitioned back to ferric chloride,
- A Request for Pandemic Related Temporary Relief (Alternative Arrangement) for Municipal Wastewater Systems was submitted to the Ministry of the Environment, Conservation and Parks on March 31, 2020. The request was made for relief of raw water monitoring and imported wastewater monitoring to assist in managing workload and for the health and safety of staff. The Director granted relief on April 29, 2020. Duffin Creek WPCP returned to normal sampling practices on May 4, 2020.

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

Operations

- Cleaned out primary digester #3,
- Inspected pumps in the influent pumping station,
- Replaced mixer for primary digester #4,
- Performed major repair to standby generator TS-201,
- Replaced drive sprockets, chains, wear shoes for secondary clarifier #21,
- Rebuilt cross collector chain and flights for primary clarifier #10,
- Replaced return activated sludge flow meter for secondary clarifier #1,
- Replaced grinder and motor for influent screen in east headworks,
- Replaced two butterfly values on stage 3 return activated sludge line,
- Restored blend tanks #1 and #2 and put back into service.

Dewatering

- Replaced feed screw, repaired starter and capacitor for Schwing pump 462.

Incineration

- Installed new flange tube for train #2,
- Tightened packing on heat exchangers #3 and #4,
- Replaced effluent piping and fittings for ash slurry tank #3,

- Replaced welded valves for superheater drains for waste heat boiler #3 and #4,
- Replaced gravel and sand for reactor #4,
- Installed new bearing on induced draft fan #3 and was realigned,
- Recertified large safety valve,
- Repaired auxiliary boiler #2,
- Refractory work performed on reactor #1 and #2,
- Installed manual gas reset switch for digester boilers,
- Installed oxygen sensor for digester boiler #1,
- Connected reverse osmosis buffer tank level to Supervisory Control and Data Acquisition display,
- Rebuilt condenser injector steam controllers for reactor #1 and #2,
- Replaced the circulating pump for auxiliary boiler,
- Tested steam safety valves,
- Changed gas bottle composition for continuous emissions monitoring system.

d) Summary of any effluent quality assurance or control measures:

- In-house laboratory (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 Water Pollution Control Plant operators using various field or lab test equipment,
- Analytical balances are calibrated by Fisher Scientific Company Ltd,
- In-house lab equipment was calibrated by operations staff and various manufacturers.

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 January 20,
- All monitoring and laboratory equipment was calibrated and maintained according to manufacturer's specifications.

f) Description of efforts made and results achieved in meeting effluent objectives:

- The annual average daily flow did not exceed the rated capacity of 520,000 m^3/d,
- The final effluent chlorine residual objective was exceeded in June due to low plant flows and the resulted loss of flow to disinfection chemical dosing pumps on Stage 1 and 2. Pump minimum speed was reprogrammed to rectify the problem,
- The final effluent pH objective fell below 6.5 on December 22. It was the result of Influent Pumping Station (IPS) flushing sequences delivering surge flows downstream. Influent pH was normal and effluent pH came back into range quickly. Data monitoring dashboards have been created to observe the effects of IPS flushing on effluent pH going forward.

g) Tabulation of the volume of sludge generated, an outline of anticipated volumes of sludge to be generated in the next reporting period and a summary of the locations where the sludge is disposed:

Refer to Table 7.

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

All sludge generated at Duffin Creek Water Pollution Control Plant is incinerated.

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

On January 10, 2020, a noise complaint was investigated and was a result of sand removal from Reactor 4 within the incineration facility using a vacuum truck. The vacuum truck was relocated to reduce the noise emanating from the plant to an acceptable level. Work was completed January 17th and any future work performed will take the situation into consideration.

On May 20 and May 26, 2020, a noise concern was raised from residents. Upon investigation it was determined that the noise was from the Induced Draft Fans on Incineration Reactors #3 and #4. This issue will be rectified as noise reduction features will be added to the Induced Draft Fans.

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:

On January 11, 2020, a spill occurred due to significant precipitation which resulted in extremely high influent flow. This resulted in an overflow of partially treated wastewater from the chlorine contact chambers and secondary clarifiers. Due to the nature of the extreme weather event, no changes to operational procedures would have prevented the spill.

On July 1, 2020, a spill of diluted digested sludge occurred due to opening a valve located on Primary Digester #3 access hatch in preparation for digester cleaning. One thousand litres was estimated to have entered the on-site storm catch basin. No significant environmental impacts were observed at the stormwater outfall to the lake. Corrective measures including work instructions and training were completed to mitigate a re-occurrence.

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

No notice of modifications was submitted in 2020.

k) Additional information required by Ministry of the Environment, Conservation and Parks (MECP) Water Supervisor:

The fixed bed carbon adsorption units in the incineration complex were not usable due to safety reasons. 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 instructed Duffin Creek Water Pollution Control Plant to temporarily operate incinerators 3 and 4 without the carbon absorption units. Replacement Sorbent Polymer Composite (SPC) units are being installed and should be operational by 2021 for reactor 3 and 2022 for reactor 4.

Proposed Alterations, Extensions or Replacements

- Digestion mixing and motor control center improvements. Detailed engineering designs are complete. Construction estimated to commence at the end of 2021,
- Replacement of incineration units #1 and #2. Detailed design completion is targeted for the 3rd quarter of 2021,
- Enhanced phosphorus removal and outfall upgrades. Detailed design completed in February 2021. Construction expected to commence November 2021,
- Stage 3 rehabilitation and retrofit work request for proposal for engineering services to be issued July 2021,
- Stage 1 and 2 blower building control system hardware replacement. Construction to begin July 2021.

Ministry of the Environment, Conservation and Parks (MECP) Inspection

This plant was last inspected by the MECP on February 12, 2015.

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	10,654,601	2,595,950	13,250,551	427,437	1,095,382
February	8,222,247	1,937,288	10,159,535	350,329	374,413
March	9,867,388	2,370,585	12,237,973	394,773	510,400
April	8,444,211	2,110,377	10,554,588	351,820	388,532
May	8,448,091	1,908,150	10,356,241	334,072	352,420
June	7,965,602	1,737,416	9,703,018	323,434	363,280
July	7,924,196	1,757,593	9,681,789	312,316	332,322
August	8,267,449	1,757,352	10,024,801	323,381	379,481
September	7,793,924	1,640,592	9,434,516	314,484	339,181
October	8,136,299	1,740,950	9,877,250	318,621	332,869
November	7,903,619	1,710,249	9,613,868	320,462	387,813
December	8,833,464	1,970,631	10,804,094	348,519	385,296
Total (%) *	102,461,091 (81.5%)	23,237,133 (18.5%)	125,698,224 (100%)		
Average *	8,538,424	1,936,428	10,474,852	343,438**	
Minimum	7,793,924	1,640,592	9,434,516		
Maximum	10,654,601	2,595,950	13,250,551	N/A	1,095,382
ECA Limit				520,000	
Compliance Met				Yes	

*Total and average reflect rounding of decimal places

**Annual average daily flow

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 Phosphorus (TP) average conc. mg/L	Total Kjeldahl Nitrogen average conc. mg/L
January	159	245	4.9	37.11
February	186	283	5.5	42.75
March	149	247	5.0	39.09
April	197	348	6.4	48.88
May	190	301	6.4	51.13
June	179	295	6.2	50.23
July	170	300	6.3	48.29
August	184	282	6.2	44.01
September	204	312	6.4	48.96
October	203	301	6.6	49.42
November	201	308	6.3	48.31
December	195	286	5.8	42.40
Average	185	292	6.0	45.88
Minimum	149	245	4.9	37.11
Maximum	204	348	6.6	51.13
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 Phosphorus average conc. mg/L	Total Phosphorus average loading kilogram per day – year to date	Total Ammonia Nitrogen average conc. mg/L winter	Total Ammonia Nitrogen average conc. mg/L summer
January	1.5	4.8	0.19	81	0.27	
February	1.1	4.0	0.20	76	0.11	
March	1.0	4.1	0.17	73	0.14	
April	1.7	5.6	0.30	82	0.14	
May	1.5	5.4	0.29	86		0.23
June	1.1	5.3	0.32	89		1.14
July	1.2	5.8	0.32	91		1.64
August	1.0	4.5	0.28	91		0.54
September	1.1	4.3	0.32	92		0.45
October	1.0	3.8	0.30	93		0.17
November	1.0	3.9	0.29	93	0.25	
December	1.2	4.4	0.22	92	0.28	
Average	1.2	4.7	0.27	92	0.20	0.70
Minimum	1.0	3.8	0.17	73	0.11	0.17
Maximum	1.7	5.8	0.32	93	0.28	1.64
ECA Limit	25.0	25.0	0.8	311	10.0	6.0
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 concentration (conc.) milligram per litre (mg/L)	Total Chlorine Residual average conc. mg/L	pH minimum	pH maximum	Temperature Degree Celsius
January	0.0	0.00	6.8	8.0	13.8
February	0.0	0.00	6.9	7.2	13.6
March	0.0	0.00	6.7	7.2	14.3
April	0.0	0.00	6.5	7.2	14.9
May	0.0	0.00	6.5	7.2	17.4
June	0.0	0.01	6.5	7.3	19.2
July	0.0	0.00	6.5	7.1	21.5
August	0.0	0.00	6.5	7.1	21.0
September	0.0	0.00	6.7	7.2	20.0
October	0.0	0.00	6.6	7.0	18.5
November	0.0	0.00	6.5	6.8	17.5
December	0.0	0.00	6.4	7.5	16.2
Average	0.0	0.00			17.3
Minimum	0.0	0.00	6.4		13.6
Maximum	0.0	0.01		8.0	21.5
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	Monthly Geometric Mean Density	Number of Samples
January	53	22
February	21	19
March	45	18
April	33	11
May	50	13
June	29	21
July	50	21
August	15	20
September	19	21
October	28	21
November	13	20
December	15	21
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 Phosphorus average conc. mg/L	York Septage Solids dry tonnes	Durham Septage Solids dry tonnes	Total Septage Solids dry tonnes
January	3,396	5,331	1,484.48	215.8	3.7	8.5	12.3
February	2,410	4,984	1,452.62	97.5	2.8	3.8	6.6
March	1,372	3,887	429.17	96.3	4.4	4.2	8.6
April	3,503	3,444	1,531.60	113.7	3.5	3.7	7.2
May	4,798	3,412	2,925.20	218.4	3.0	4.5	7.5
June	6,932	7,412	3,149.33	253.5	7.2	9.6	16.8
July	4,704	5,763	2,360.44	179.3	8.4	7.8	16.2
August	1,877	1,715	978.60	90.6	0.6	1.2	1.8
September	3,074	4,379	1,421.40	172.9	3.7	5.7	9.5
October	3,701	5,766	2,138.00	147.5	3.2	11.1	14.3
November	4,396	7,945	1,885.75	227.5	6.6	10.7	17.3
December	1,522	5,046	743.82	79.3	5.9	5.7	11.6
Total					53.1	76.4	129.6
Average	3,474	4,924	1,708.37	157.7			
Sampling Requirement Frequency Met	Yes	Yes	Yes	Yes			

Table 6 Energy and Chemical Usage

Month	Iron Salt Litre (L)	Sodium Hypochlorite kilogram as chlorine	Sodium Bisulphite L	Anionic Polymer kilogram*	Hydro kilowatt hour	Natural Gas cubic metre
January	627,939	25,174	30,036	6,000	5,439,069	299,946
February	545,882	20,109	19,933		4,763,092	317,562
March	614,188	23,779	18,514	9,750	5,449,599	242,965
April	603,666	20,452	17,178		4,978,778	171,949
May	645,910	19,946	16,232		5,531,557	31,703
June	619,023	18,429	17,324	9,750	5,322,001	44,147
July	714,932	17,254	16,113		5,746,638	117,902
August	768,266	19,237	18,527		5,505,563	50,257
September	753,635	18,328	16,457	9,000	5,069,349	157,716
October	759,980	18,861	17,433		5,267,498	281,873
November	693,715	18,630	17,390		4,925,064	207,919
December	734,147	19,310	18,370		5,348,777	425,426
Total	8,081,283	239,508	223,507	34,500	63,346,985	2,349,365

*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	2,610	636	3,246	98	497	595
February	2,327	548	2,875	113	633	746
March	2,437	586	3,023	74	661	735
April	2,939	734	3,673	93	498	592
May	2,543	574	3,117	111	112	223
June	2,350	513	2,862	82	272	354
July	2,377	527	2,905	65	212	277
August	2,331	496	2,827	50	153	203
September	2,432	512	2,944	72	165	237
October	2,449	524	2,973	89	271	360
November	2,434	527	2,961	92	323	415
December	2,526	564	3,090		500	500
Total	29,756	6,740	36,496	940	4,298	5,237

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	3.0	25.53	7.3	3,488	2,801	1,159
February	2.8	25.02	7.4	2,956	2,232	838
March	2.7	24.60	7.9	3,463	2,722	972
April	2.7	24.03	7.8	2,350	1,861	647
May	2.2	24.56	7.7	3,237	2,821	809
June	2.1	25.42	7.1	2,257	1,894	600
July	2.0	25.14	7.7	3,103	2,433	1,088
August	2.4	26.05	7.8	2,536	2,003	880
September	2.1	28.16	7.5	2,256	1,805	849
October	1.9	25.53	8.3	2,980	2,578	1,099
November	1.9	24.68	8.2	2,195	1,762	748
December	2.2	25.50	8.4	3,015	2,582	900
Average	2.3	25.35	7.8	2,820	2,291	882
Total				33,836	27,494	10,589