Courtice Water Pollution Control Plant

2023 Annual Performance Report

The Regional Municipality of Durham
Courtice Water Pollution Control Plant 2023 Annual Performance Report

Environmental Compliance Approval (ECA): 3393-68RLD4 Dated January 28, 2005
Amendment: Dated April 18, 2007
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The Courtice Water Pollution Control Plant (WPCP) 2023 Annual Performance Report provides staff, stakeholders and customers a performance overview of the Courtice 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 Courtice WPCP is located in the Municipality of Clarington (Courtice) 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 Courtice WPCP treats wastewater from the Oshawa and Courtice service areas in the Region. The Courtice WPCP receives most of its flow from the Harmony Creek catchment area via the Harmony Creek Sanitary Sewage Pumping Station (SSPS). The plant treats wastewater from approximately 146,268 residents or 72.2% of the total catchment population and the remaining 27.8% of the flow is treated at the Harmony Creek WPCP.
The Courtice WPCP is designed to treat wastewater at an average daily flow rate of 68,200 cubic metres per day (m^3/d) with a peak flow rate of 180,000 m^3/d. The plant is an MECP Class 4 conventional activated sludge treatment plant that utilizes the following processes to treat wastewater;

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

Raw Influent Pumping

Wastewater collected through approximately 658 kilometres of sanitary sewers in Oshawa and Courtice and is conveyed to the Harmony Creek SSPS located at the Harmony Creek WPCP. Approximately 72.2% of the Harmony Creek WPCP influent flow is diverted to the Harmony Creek

Sanitary Sewage Pumping Station (SSPS) and conveyed 6.4 kilometres in a 1,050-millimetre diameter forcemain to the Courtice Water Pollution Control Plant (WPCP).
In addition, a small service area in Courtice is serviced by gravity to the Courtice WPCP which includes the Durham York Energy Centre, and surrounding businesses and industries.

Preliminary Treatment

Screening: Two automatic, mechanically cleaned screens remove paper products and large material that could harm pumps and process equipment. Screenings removed in the process are compacted for landfill disposal.
Grit Removal: Heavy suspended material such as sand and small stones (grit) is removed in the two aerated grit tanks. 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 the process is dewatered and transported to landfill.

Primary Treatment

The two primary clarifiers utilize the physical process of sedimentation which allows the suspended material to settle to the bottom of the tank as sludge. This raw sludge, along with the excess activated sludge from the secondary treatment process is collected by a flight and chain mechanism which pushes the sludge into hoppers. The sludge is then pumped to the anaerobic digesters for further treatment. Any material floating on the surface of the clarifier is also removed to the digesters.

Phosphorus Removal

The phosphorus removal system lowers the total phosphorous level in the final effluent by adding a chemical coagulant, ferrous chloride, at various locations within the plant. In 2023, ferrous chloride was dosed only in the aeration tanks.

Secondary Treatment

Aeration Tank: The aeration tanks are comprised of two distinct zones. The first is an anoxic zone, where no oxygen is introduced. This allows for denitrification. Subsequently, the wastewater 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 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 clarifiers.

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 two chlorine contact chambers. Disinfected effluent is dechlorinated with a sodium bisulphite solution before being discharged through the 1,676-millimetre diameter outfall extending 770 metres into Lake Ontario.

Solids Management

Anaerobic Digestion: The raw sludge that is collected from the primary clarifiers is pumped into the anaerobic digesters where anaerobic bacteria reduce the volume of sludge. As a result of digestion, the plant produces biosolids, water, carbon dioxide, methane, and hydrogen sulphide.
The supernatant is returned to the head of the plant for further treatment and the digester gas is used to meet the heating requirements of the digesters and for heating areas of the treatment facility.
Sludge Management: All digested sludge produced at the Courtice Water Pollution Control Plant (WPCP) is pumped to the sludge holding facility. From there the treated sludge can be utilized on approved agricultural fields or be transferred to the Duffin Creek WPCP for incineration.

Environmental Compliance Approval (ECA)

Under Condition 10.(6) of ECA #3393-68RLD4 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 Courtice WPCP effluent was determined to be compliant with the ECA approval limits during the reporting period. The plant operated at 69.8% of its annual average rated flow capacity and received a maximum daily flow of 110,877 cubic metres per day (m^3/d) on February 10, 2023. See tables 3 and 4 for effluent results.

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

Operating problems encountered and corrective actions taken in 2023 included:

- Thick scum and grease on the primary clarifiers travelled to the anoxic zone causing scum and foaming issues. A combination of both increased wasting and increased return activated sludge resolved the issue,

- Ferrous chloride lines routinely became plugged due to the quality of ferrous chloride received. The tanks were emptied and new product was requested. The chemical supplier has been contacted and is reviewing the quality of the product.

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 2023 included:

- Installed new final effluent chlorine analyzer,
- Replaced gasket on drain flange of sodium hypochlorite tank 1102,
- Replaced expansion joints on blowers 1102 and 1104,
- Installed new sump pump in sodium hypochlorite overflow pit,
- Replaced solenoids in all sump pumps in the chemical room,
- Replaced manifold, feed valve, inlet pipes, outlet pipes and fittings on sodium hypochlorite pump 102, subsequently replaced entire pump,
- Installed new vent on diesel generator fill station,
- Rebuilt blower 6104,
- Replaced dissolved oxygen probe 1403,
- Rebuilt biosolids transfer pump 3101,
- Installed new grit conveyor, screws, and liners,
- Installed new rags conveyor,
- Replaced mechanical seal on raw sludge pumps 1201 and 1202,
- De-watered, cleaned and repaired the three cells of primary 200:
    - repaired flights, chains and mounting links,
    - replaced chain in north cell,
    - replaced floor wear strips,
    - removal and cleaning of struvite and scale,
    - replaced torque overload on raw sewage pumps 201, 202, 203, and 204,
    - installed drive unit on south cell,
    - replaced or flipped wear shoes as needed,
    - installed new gearbox and torque limiter on cross-collector,
- Replaced check valve flappers on primary scum pumps 101 and 102,
- Replaced check valves on sodium hypochlorite pumps 101, 102 and 103,
- Installed missing strip on secondary 200,
- De-watered secondary 100 for repairs on south stub on main drive shaft; parts were incorrect, repairs to continue when parts are received,
- Installed new auto-grease canisters and rubber strips on bar screens,
- Replaced manifold and check valves on sodium hypochlorite pump 103,
- Repaired roof of headworks building,

- Replaced tee fitting on grit pump 4101,
- Replaced drive coupling and element on gas boosters 7101 & 7102,
- Replaced nitrogen regulator in gas booster room,
- Replaced feed valve on raw sludge pump 1102,
- Replaced biosolids actuators 5004 and 2028,
- Installed new liquid-crystal display (LCD) power boards for biosolids actuators 5004 and 4004,
- Replaced biosolids cell 2 valve 4004,
- Replaced cutter screen and blades on in-line digester grinder,
- Replaced programmable logic controller (PLC) input and output cards on raw sewage pump 1101,
- Repaired grab chain on decanting valve 5 in biosolids cell 1,
- Installed new hydroxyl generating units in headworks building.

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

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.

On-line instrumentation is verified by Water Pollution Control Plant (WPCP) operators using various field or lab test equipment.

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

Calibration of the effluent flow meter was conducted May 23, 2023.

Calibration of in-house lab equipment was conducted on July 12, 2023.

Calibration of the in-house lab pH meter was conducted regularly.

f) 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 and remain below the objectives specified in the ECA:

- The average daily rated flow capacity of 68,200 cubic metres per day (m^3/d) was not exceeded. The rated peak flow capacity of 180,000 m^3/d was not exceeded.
- The total phosphorus objective of 0.8 milligram per litre (mg/L) was exceeded in 61 out of 347 samples (17.6%). Poor quality ferrous chloride shipments contributed to higher total phosphorous levels. The chemical supplier has been contacted and is reviewing the quality of the product.
- The total suspended solids objective of 15.0 mg/L was exceeded in 3 out of 350 samples (0.9%).

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 Courtice Water Pollution Control Plant (WPCP) in 2023 was 80,052 cubic meters (m^3).

Outline of Anticipated Volumes to be Generated in the next Reporting Period;

Even with the increase in population on a year-to year basis, no significant changes to flows or processing are anticipated. Therefore, no significant changes in sludge generation are expected for the next year.

Summary of Locations to Where Sludge was Disposed;

Due to one of the digesters being out of service for maintenance, only primary digestion is occurring before the sludge is pumped to the sludge holding facility. The sludge produced at this facility was applied on agricultural fields as well as transferred to Duffin Creek WPCP for incineration.

Receiving facilities included:

Agricultural Fields – 45,388 m^3 or 56.7%

Duffin Creek WPCP – 34,664 m^3 or 43.3%

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

All complaints received from the public are administered and tracked through a central database. No complaints were received in 2023.

i) Summary of all By-pass, Spill or Abnormal Discharge;

There were no by-passes, spills, or abnormal discharges during the reporting period. There are no planned maintenance by-passes scheduled for the next reporting period.

j) Any other information the District Manager requires from time to time;

No additional information was requested.

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

This plant was last inspected by the MECP on June 22, 2017.

Table 1 Final Effluent Flows

Month	Total Flow to Plant* - cubic metre	Average Daily Flow cubic metre per day (m^3/d)	Maximum Daily Flow m^3/d
January	1,560,779	50,348	99,292
February	1,546,957	55,248	110,877
March	1,913,634	61,730	99,860
April	1,737,683	57,923	103,900
May	1,481,843	47,801	77,462
June	1,357,725	45,258	76,708
July	1,291,058	41,647	52,003
August	1,233,804	39,800	50,154
September	1,100,211	36,674	40,912
October	1,251,324	40,365	46,564
November	1,317,363	43,912	49,481
December	1,584,795	51,122	68,964
Total	17,377,470		
Average	1,448,123	47,610**	
Minimum	1,100,211		
Maximum	1,913,634		110,877
ECA Limit		68,200	180,000
Met Compliance		Yes	Yes

*Metered at the final effluent

**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 average conc. mg/L	Dissolved Reactive Phosphorus average conc. mg/L	Total Kjeldahl Nitrogen average conc. mg/L
January	202	377	4.1	1.61	39.02
February	191	281	4.0	1.62	35.98
March	194	355	3.6	1.43	33.84
April	174	401	3.3	1.53	31.85
May	219	331	3.7	1.69	36.26
June	199	329	4.6	2.19	40.57
July	233	312	5.9	2.43	48.16
August	219	305	5.7	2.50	47.59
September	224	318	5.8	2.66	51.69
October	263	398	5.9	2.70	54.35
November	302	464	5.9	2.85	51.17
December	220	311	4.8	2.38	42.70
Average	220	349	4.8	2.13	42.77
Minimum	174	281	3.3	1.43	31.85
Maximum	302	464	5.9	2.85	54.35
Sampling Frequency Requirement Met	Yes	Yes	Yes	Yes	Yes

Table 2 Raw Influent Analyses continued

Month	Total Ammonia Nitrogen average concentration (conc.) milligram per litre (mg/L)	Alkalinity average conc. mg/L	pH minimum	pH maximum	Temperature degree Celsius average
January	23.0	279	7.5	8.0	13.8
February	23.1	283	7.5	7.9	12.5
March	20.6	287	7.3	8.0	13.1
April	22.3	285	7.3	7.9	14.4
May	24.1	278	7.1	8.0	16.3
June	26.4	276	7.0	7.9	18.8
July	29.3	280	7.0	7.8	20.9
August	30.6	285	5.8	8.0	20.6
September	33.8	278	6.3	7.7	20.4
October	35.9	281	7.0	7.8	19.3
November	33.8	285	6.8	7.8	17.3
December	28.9	288	6.7	8.0	16.0
Average	27.7	282			17.0
Minimum	20.6	276	5.8		12.5
Maximum	35.9	288		8.0	20.9
Sampling Frequency Requirement Met	Yes	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 Ammonia Nitrogen average conc. mg/L winter	Total Ammonia Nitrogen average conc. mg/L summer
January	1.0	3.5	0.57	0.22	
February	1.4	3.3	0.52	0.29	
March	1.0	3.5	0.49	0.15	
April	1.0	3.3	0.63	0.20	
May	1.1	3.8	0.76		0.09
June	1.1	4.8	0.82		0.21
July	1.0	3.7	0.70		0.13
August	1.0	3.0	0.71		0.09
September	1.1	4.4	0.80		0.31
October	1.3	4.0	0.79		0.25
November	1.5	3.2	0.62	0.88	
December	2.5	16.8	0.83	0.83	
Average	1.2	4.8	0.69	0.43	0.18
Minimum	1.0	3.0	0.49	0.15	0.09
Maximum	2.5	16.8	0.83	0.88	0.31
ECA Limit	25	25	1.0	24	15
ECA Objective	15	15	0.8	12	8
Within Compliance	Yes	Yes	Yes	Yes	Yes
Sampling Frequency Requirement Met	Yes	Yes	Yes	Yes	Yes

Table 3 Final Effluent Analyses continued

Month	Dissolved Reactive Phosphorus average concentration (conc.) milligram per litre (mg/L)	Unionized Ammonia Nitrogen average conc. mg/L	Nitrate Nitrogen average conc. mg/L	Alkalinity average conc. mg/L
January	0.46	0.0	19.66	108
February	0.44	0.0	21.21	116
March	0.40	0.0	18.96	136
April	0.54	0.0	20.19	131
May	0.64	0.0	19.41	120
June	0.69	0.0	20.49	87
July	0.60	0.0	18.87	92
August	0.64	0.0	19.60	80
September	0.63	0.0	21.10	53
October	0.69	0.0	20.57	65
November	0.53	0.0	17.98	87
December	0.56	0.0	17.24	100
Average	0.57	0.0	19.61	98
Minimum	0.40	0.0	17.24	53
Maximum	0.69	0.0	21.21	136
ECA Limit		0.2		
ECA Objective		0.1		
Within Compliance		Yes		
Sampling Frequency Requirement Met	Yes	Yes	Yes	Yes

Table 3 Final Effluent Analyses continued

Month	Total Chlorine Residual average concentration (conc.) milligram per litre (mg/L)	pH minimum	pH maximum	Temperature degree Celsius average
January	0.00	6.6	7.2	13.0
February	0.00	6.9	7.0	12.5
March	0.00	6.6	7.2	12.7
April	0.00	6.7	7.2	14.6
May	0.00	6.6	7.3	16.9
June	0.00	6.5	7.2	19.3
July	0.00	6.7	7.7	21.3
August	0.00	6.6	7.1	21.3
September	0.00	6.6	7.0	20.9
October	0.00	6.7	7.2	19.3
November	0.00	6.7	7.5	16.5
December	0.00	6.7	7.6	15.6
Average	0.00			17.0
Minimum	0.00	6.5		12.5
Maximum	0.00		7.7	21.3
ECA Limit		6.0	9.5	
ECA Objective		6.5	9.0	
Within Compliance		Yes	Yes	
Sampling Frequency Requirement Met	Yes	Yes	Yes	Yes

Table 4 *Escherichia coli* Sampling

Month	Number of Samples	Monthly Geometric Mean Density
January	9	32
February	8	16
March	9	5
April	8	13
May	9	32
June	9	17
July	8	32
August	10	13
September	8	12
October	9	129
November	9	12
December	8	20
ECA Objective		200
Sampling Frequency Requirement Met	Yes	

Table 5 Energy and Chemical Usage

Month	Total Flow to Plant - metered at the final effluent cubic metre (m^3)	Ferrous Chloride Litres (L)	Sodium Hypochlorite kilograms as chlorine	Sodium Bisulphite L	Hydro kilowatt hours	Natural Gas m^3
January	1,560,779	68,170	3,625.7	9,151	619,186	36,113
February	1,546,957	65,551	3,375.0	8,815	565,659	49,875
March	1,913,634	63,057	3,918.1	10,743	626,225	52,952
April	1,737,683	62,529	3,696.8	10,633	602,663	36,446
May	1,481,843	75,670	4,283.2	11,791	677,840	15,791
June	1,357,725	105,101	3,586.9	10,113	674,963	2,457
July	1,291,058	82,723	3,654.2	10,490	673,983	2,896
August	1,233,804	95,913	3,409.7	9,169	669,135	4,589
September	1,100,211	117,469	3,128.3	8,246	679,546	2,241
October	1,251,324	87,022	3,667.1	9,173	683,668	12,291
November	1,317,657	81,565	3,477.8	9,743	677,973	30,398
December	1,584,795	72,486	5,907.2	11,958	744,200	25,721
Total	17,377,470	977,256	45,730	120,025	7,895,040	271,770