



**The Corporation of the Township of Perth East**  
**2023 Annual Operations Report**  
**Shakespeare Water Pollution Control Plant**

3976B Galt Street  
Shakespeare, Ontario  
N0B 2P0

**March 8, 2024**



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**Ministry of the Environment, Conservation and Parks**

London Regional Office  
733 Exeter Road  
London, Ontario  
N6E 1L3

March 8, 2024

ATTN: Mr. Pierre Adrien, London District Manager

**Re: The Corporation of the Township of Perth East  
Shakespeare Water Pollution Control Plant, Annual Report 2023**

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Please find enclosed the Township of Perth East's Shakespeare Wastewater Treatment Facility Annual Operations Report for the year 2023. The report is prepared in accordance with the annual report criteria as part of the Certificate of Approval # 3152-7X2TW2, issued October 28, 2009 which contains the following:

- a) A summary and interpretation of all monitoring data and a comparison to the effluent limits outlined in condition 7, including an overview of the success and adequacy of the Works;
- b) A description of any operating problems encountered and corrective actions taken;
- c) A summary of all maintenance carried out on any major structure, equipment, apparatus, mechanism or thing forming part of the Works;
- d) A summary of any effluent quality assurance or control measures undertaken in the reporting period;
- e) A summary of the calibration and maintenance carried out on all effluent monitoring equipment;
- f) A description of efforts made and results achieved in meeting the Effluent Objectives of Condition 6;
- g) A tabulation of the volume of sludge generated in the reporting period, an outline of anticipated volumes to be generated in the next reporting period and a summary of the locations to where the sludge was disposed;
- h) A summary of any complaints received during the reporting period and any steps taken to address the complaints;
- i) A summary of all By-pass, spills or abnormal discharge events;
- j) Any other information the District Manager requires from time to time.

We trust that the information provided herein is satisfactory to the requirements of the above referenced Certificate of Approval. Should there be any questions or comments regarding the contents of this report, please feel free to contact the undersigned.

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## INTRODUCTION

The Shakespeare Water Pollution Control Plant (WPCP) is located at 3976B Galt Street in Shakespeare, ON. The WPCP operates under ECA number 3152-7X2TW2, and is rated as a Class 2 Facility. The plant is comprised of two continuous inflow extended aeration sequencing batch reactors. Raw wastewater flows from the village of Shakespeare are directed to the treatment plant via a gravity collection system. The raw sewage is processed through the plant in accordance with all applicable laws, certificates and regulations. Final effluent from the plant is treated by UV disinfection before discharging into the Shakespeare Drain and eventually the Thames River. The plant services a population of approximately 830 people.

The following is a list of the main treatment components:

- An inlet works consisting of a heavy bar screen (manual), and a raw sewage high lift station equipped with two (2) submersible pumps (operated alternately)
- Raw sewage equalization tank, equipped with two (2) submersible pumps (operated alternately)
- Two (2) continuous inflow extended aeration sequencing batch reactors (SBR) equipped with fine bubbling system, two (2) blowers (operated alternately), two (2) effluent decanters (one for each SBR) discharging into the effluent equalization tank, two (2) submersible waste pumps (one for each)
- One (1) 57.7m<sup>3</sup> effluent equalization tank, with two (2) submersible pumps (operated alternately)
- One (1) 1,000L Alum storage tote with chemical feed pumps, and standby alum totes
- One (1) tertiary sand filter
- One (1) UV disinfectant channel
- Grassed outlet channel
- One (1) 150kW standby diesel engine generator

The sewage works, including both the collection and treatment systems are owned and operated by the Township of Perth East.

The following information corresponds with the reporting parameters set forth under Subsection 6 of Section 10 of the aforementioned ECA (3152-7X2TW2).



### A) SUMMARY & INTERPRETATION OF MONITORING DATA

The following tables summarize the influent and effluent data relative to the limits and objectives provided in the C of A:

Table 1 - Effluent Quality Monitoring Data and Regulatory Compliance Parameters										
Year	Week	Month	CBOD <sub>5</sub> (mg/L)	Total Suspended Solids (mg/L)	Total Phosphorus (mg/L)	Total Ammonia Nitrogen (mg/L)	E.coli (CFU/100mL)	pH	Temperature °C	
			Limit: 10.0	Limit: 10.0	Limit: 0.3 (04/16 - 10/15)	Limit: 3.0	Limit: 100	Limit: 6.0 - 9.5		
			Objective: 5.0	Objective: 5.0	Limit: 0.5 (10/16 - 04/15)	Objective: 1.0	Objective: 80	Objective: 6.5 - 8.5		
					Objective: 0.25					
2023	1	January	5.9	8.8	0.4	3.0	8	8.0	8.7	
	2							7.8		
	3							7.7		
	4							7.9		
	5							8.0		
	6	February	2.9	4.0	0.2	0.7	0	7.5	7.9	
	7							7.8		
	8							7.8		
	9							7.8		
	10	March	2.8	4.5	0.3	0.3	1	7.7	10.6	
	11							7.6		
	12							7.6		
	13							7.8		
	14	April	1 - 15	3.5	7.0	0.2	1.5	14	8.1	8.8
	15								7.5	
	16		16 - 30			0.3			7.6	
	17	7.4								
	18	May	4.6	5.0	0.2	0.8	2	7.6	8.3	
	19							7.5		
	20							7.5		
	21							7.4		
	22	June	2.8	3.8	0.1	1.8	27	7.5	9.6	
	23							7.5		
	24							7.5		
	25							7.5		
	26	July	3.4	5.0	0.2	0.5	9	7.5	10.6	
	27							7.6		
	28							7.2		
	29							7.4		
	30	August	3.0	3.4	0.1	0.5	1	7.7	11.0	
	31							7.7		
	32							7.7		
	33							7.9		
	34	September	3.6	3.3	0.6	0.3	1	7.9	10.1	
	35							7.9		
	36							7.9		
	37							7.8		
	38	October	1 - 15	2.9	3.3	0.3	1.1	0	7.8	9.3
	39								7.8	
	40		16 - 30			0.3			7.7	
	41								7.7	
	42	November	5.3	8.3	0.3	1.1	1	7.8	7.8	
	43							7.7		
	44							7.7		
	45							7.7		
	46	December	2.4	3.0	0.2	0.2	63	7.7	9.4	
	47							7.8		
	48							7.7		
	49							7.7		
	50							7.8		
	51							8.0		
	52							7.5		



**Table 2 - Influent and Effluent Flow Data**

FLOW DATA (m <sup>3</sup> )							
Year	Month	EFFLUENT			INFLUENT		
		Average Daily Flow	Total Monthly Flow	Maximum Daily Flow	Average Daily Flow	Total Monthly Flow	Maximum Daily Flow
2023	January	204.77	6347.74	470.24	236.17	7321.29	651.57
	February	202.89	5680.78	447.05	230.19	6445.21	633.19
	March	228.08	7070.58	528.70	262.72	8144.30	682.22
	April	224.21	6726.28	621.06	255.66	7669.72	886.01
	May	211.66	6561.57	282.60	232.65	7212.00	358.12
	June	206.75	6202.55	318.72	224.89	6746.76	319.59
	July	215.55	6681.96	448.05	247.14	7661.41	562.66
	August	191.16	5926.07	242.43	205.87	6381.96	261.08
	September	173.47	5377.61	206.14	199.01	6157.55	267.24
	October	175.38	5436.86	214.17	204.28	6225.39	277.65
	November	180.50	5415.02	266.06	211.76	6352.77	324.38
	December	221.03	6851.99	391.97	267.70	8298.79	618.79

**Table 3 - Influent Quality Monitoring Data**

Year	Month	CBOD5 (mg/L)	Total Suspended Solids (mg/L)	Total Phosphorus (mg/L)	Total Kjeldahl Nitrogen (TKN)
2023	January	127	69.2	4.3	47.3
	February	172	84.4	4.9	52.1
	March	170	68.3	5.0	47.9
	April	93	37.8	3.2	29.3
	May	130	63.3	3.3	33.5
	June	165	98.0	4.5	41.8
	July	136	51.5	5.5	52.2
	August	182	155.0	5.5	48.0
	September	119	118.0	5.3	42.8
	October	214	162.0	5.9	53.0
	November	133	72.9	5.5	56.4
	December	147	146.0	3.9	33.7



**Table 4 - Monthly Average Annual Waste Loadings**

Year	WASTE LOADING				
	Month	CBOD <sub>5</sub> (kg/day)	Total Suspended Solids (kg/day)	Total Phosphorus (kg/day)	Total Ammonium Nitrogen (kg/day)
2023	January	30.0	16.3	1.0	11.2
	February	39.6	19.4	1.1	12.0
	March	44.7	17.9	1.3	12.6
	April	23.9	9.7	0.8	7.5
	May	30.2	14.7	0.8	7.8
	June	37.1	22.0	1.0	9.4
	July	33.6	12.7	1.3	12.9
	August	37.5	31.9	1.1	9.9
	September	23.7	23.5	1.1	8.5
	October	43.7	33.1	1.2	11.4
	November	28.2	15.4	1.2	11.9
	December	39.4	39.1	1.0	9.0

**Table 5 – Percent (%) Removal**

Year	Month	CBOD <sub>5</sub>	Total Suspended Solids	Total Phosphorus	Total Kjeldahl Nitrogen (TKN)
2023	January	95.33%	87.28%	91.25%	93.59%
	February	98.34%	95.29%	96.21%	98.69%
	March	98.37%	93.41%	94.29%	99.38%
	April	96.23%	81.42%	92.71%	94.93%
	May	96.48%	92.13%	93.40%	97.66%
	June	98.27%	96.15%	96.92%	95.60%
	July	97.49%	90.37%	97.16%	99.07%
	August	98.33%	97.84%	97.54%	98.98%
	September	96.98%	97.18%	88.53%	99.26%
	October	98.67%	97.98%	95.08%	97.85%
	November	96.03%	88.61%	93.67%	98.01%
	December	98.37%	97.98%	94.34%	98.52%



### I. Carbonaceous Biological Oxygen Demand (CBOD<sub>5</sub>)

Throughout the reporting period, the monthly average Carbonaceous Oxygen Demand concentration did not exceed the effluent limit of 10.0 mg/L. With the exception of the months of January and November, the effluent objective of 5mg/L was additionally achieved. The average for the reporting year was 3.6 mg/L, which indicates the treatment was effective for CBOD<sub>5</sub>. Figure 1 below details the CBOD<sub>5</sub> concentrations in relation to the compliance parameters and objectives.

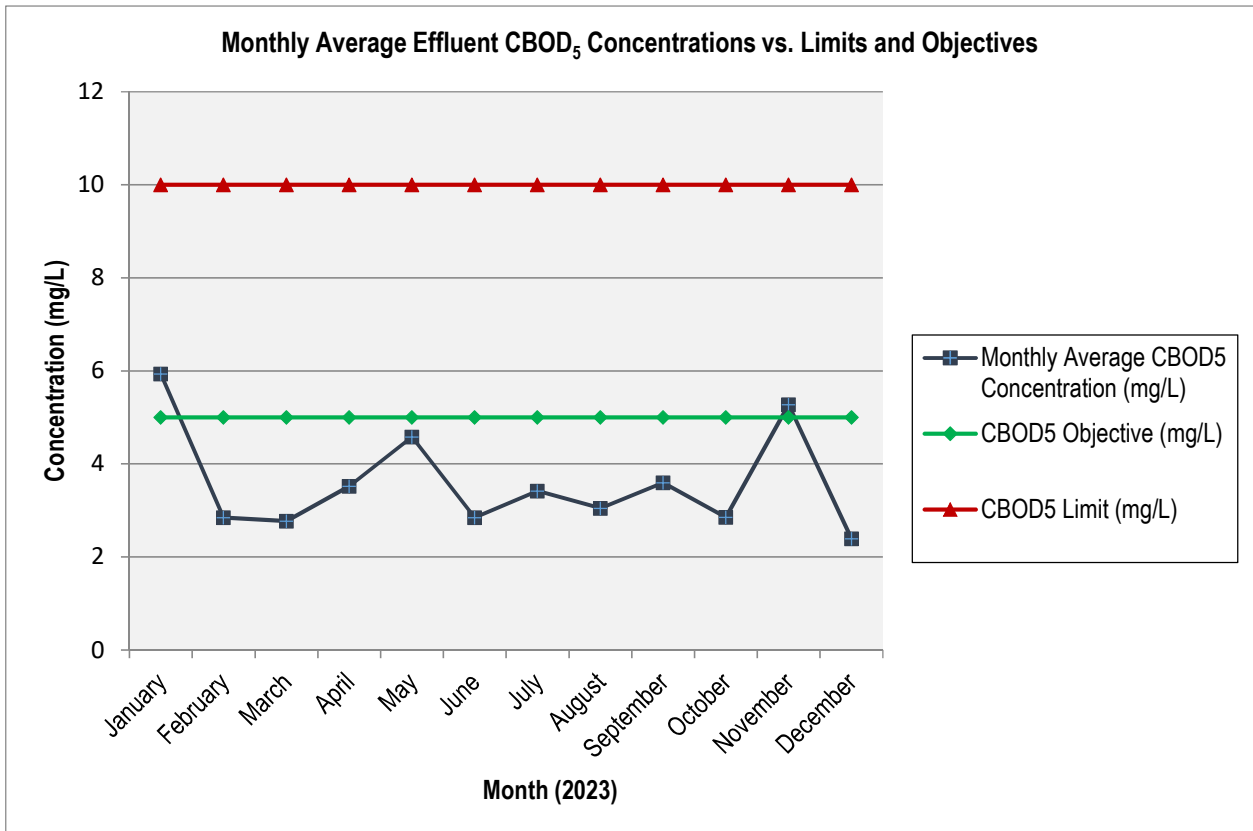


Figure 1 – Monthly Average Effluent CBOD<sub>5</sub> Concentration vs. CoA Limits & Objectives



## II. Total Suspended Solids (TSS)

Throughout the reporting period, the monthly average Total Suspended Solids concentration did not exceed the effluent limit of 10.0 mg/L. With the exception of the months of January, April and November, the effluent objective of 5mg/L was additionally achieved. The average for the reporting year was 4.9 mg/L, which indicates the treatment was generally effective for TSS. Figure 2 below illustrates the monthly effluent Total Suspended Solids concentrations in relation to the compliance parameter limits and objectives.

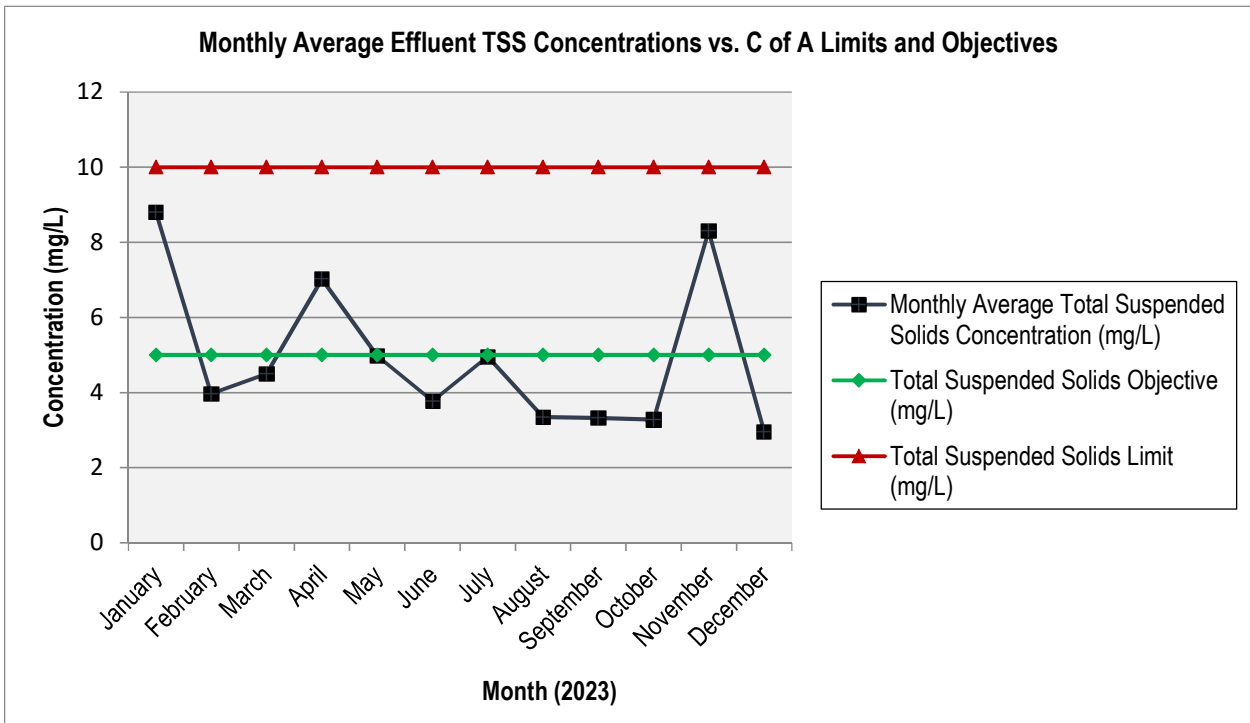


Figure 2 – Monthly Average Effluent TSS Concentration vs. CoA Limits & Objectives



### III. Total Phosphorus (TP)

Throughout the reporting period, the monthly average Total Phosphorus concentration generally did not exceed the effluent limit. Effluent limits for this parameter are seasonal in nature having a reduced limit of 0.3 mg/L between April 16<sup>th</sup> and November 15<sup>th</sup>, while being 0.5 mg/L otherwise. In the month of September the average concentration of TP did exceed the effluent limit, which staff feel can be attributed to the Programmable Logic Controller (PLC) changeover which occurred in August resulting in excessive sludge digester supernatant concentrations.

With the exception of the months of September, October and November, the effluent objective of 0.25 mg/L was achieved. The average for the reporting year was 0.27 mg/L, which indicates the treatment was generally effective for TP. Figure 3 below illustrates the monthly effluent Total Phosphorus concentrations in relation to the compliance parameter limits and objectives.

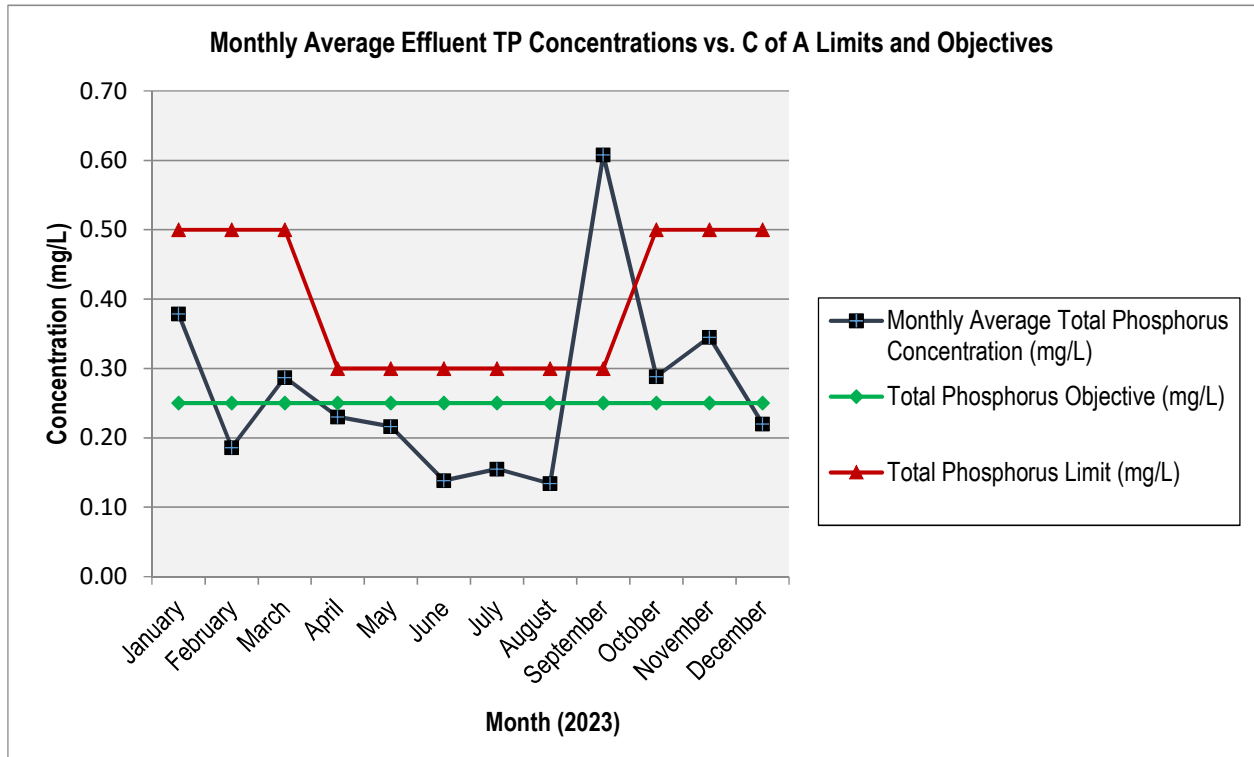


Figure 3 – Monthly Average Effluent TP Concentration vs. CoA Limits & Objectives



#### IV. Total Ammonia Nitrogen (TAN)

Throughout the reporting period, the monthly average Total Ammonia Nitrogen concentration did not exceed the effluent limit of 3.0 mg/L. In comparison to the effluent objective of 1.0 mg/L, the average monthly concentrations yielded variable results in terms of meeting the target. The months of January, April, June, October and November were over the objective concentration. The average for the reporting year however was 1.04 mg/L; slightly over the objective concentration, which indicates the treatment was generally effective for TAN. Figure 2 below illustrates the monthly effluent Total Suspended Solids concentrations in relation to the compliance parameter limits and objectives.

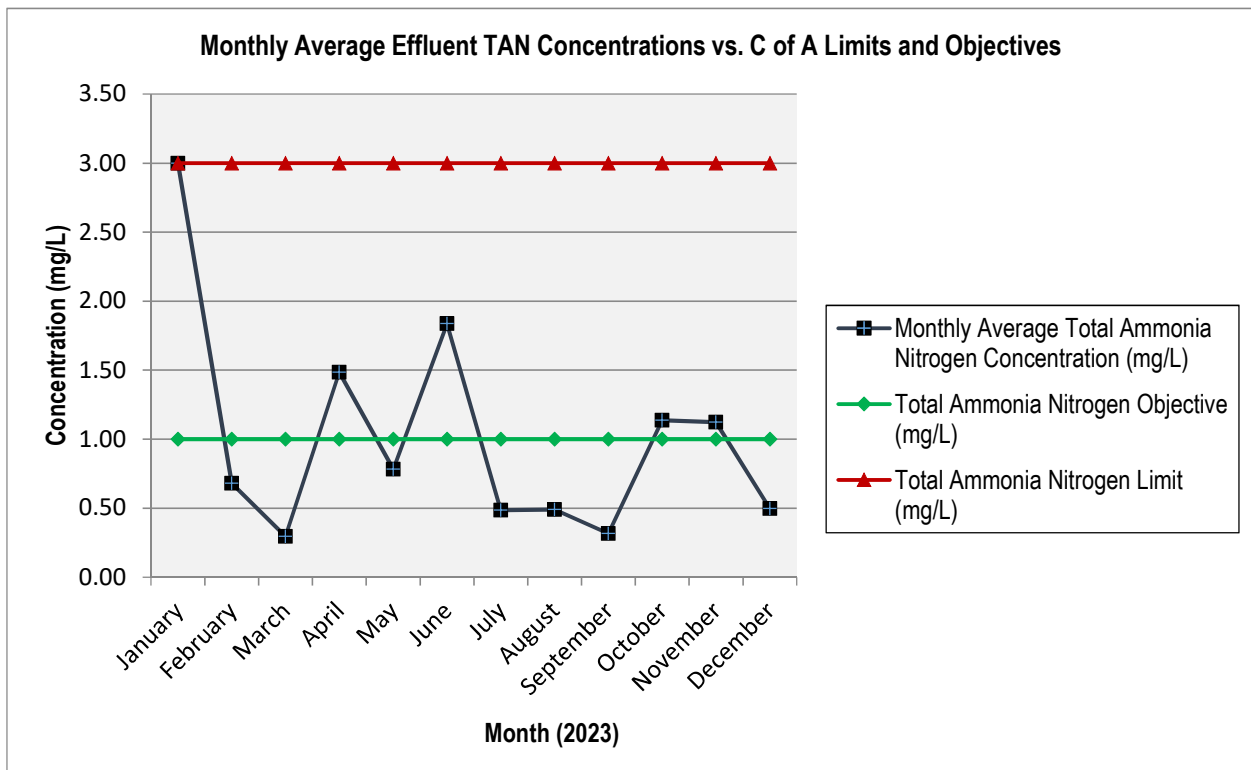
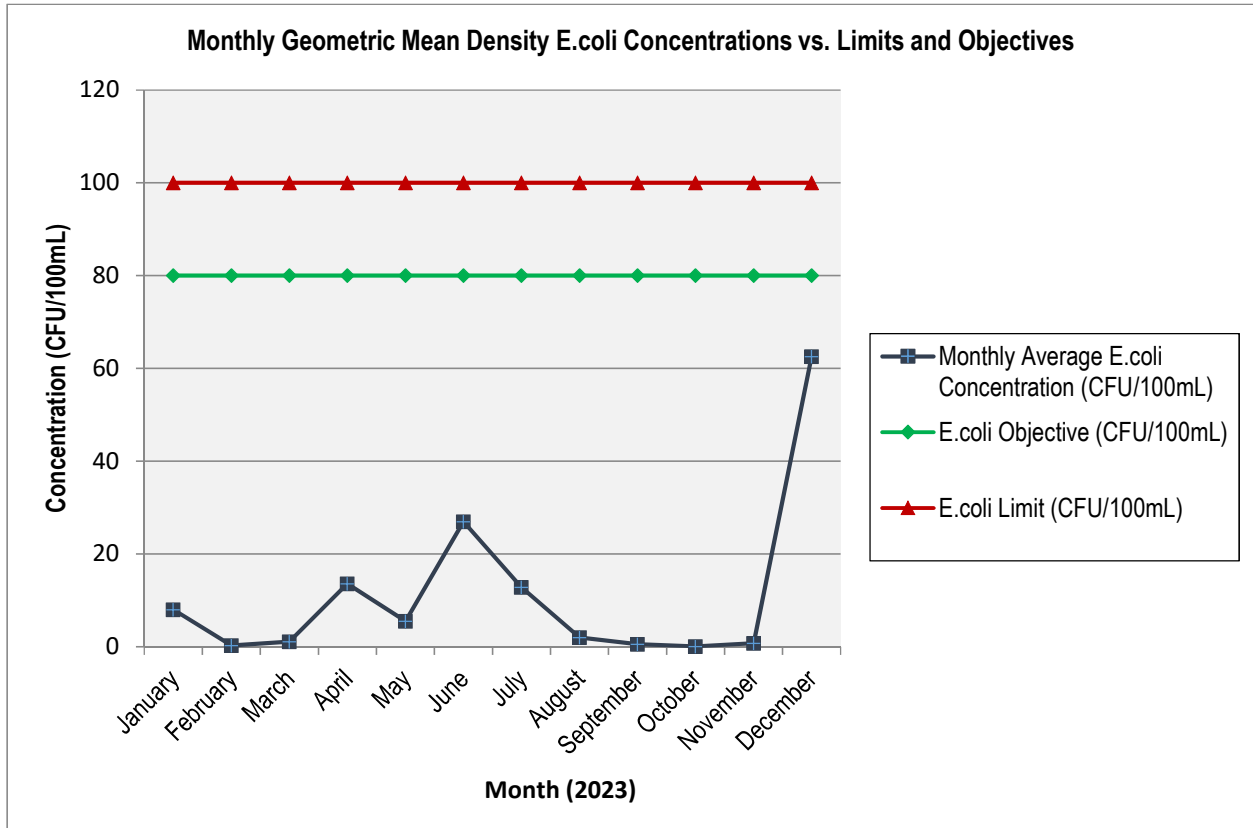


Figure 4 – Monthly Average Effluent TAN Concentration vs. CoA Limits & Objectives



**V. E.coli**

Throughout the reporting period, the monthly geometric mean density E.coli concentration did not exceed the effluent limit of 100 CFU/100mL and further met the objective of 80 CFU/100mL in all months of the year. The geometric mean density for the reporting year was 2 CFU/100mL, which indicates the treatment was very effective for E.coli. Figure 5 below details the E.coli concentrations in relation to the compliance parameter limits and objectives.



**Figure 5 – Geometric Mean Density E.coli Concentration vs. CoA Limits & Objectives**



## VI. pH

Throughout the reporting period, the pH of the effluent was tested weekly and remained within the effluent limits between 6.0 and 9.5 and further remained within the objective range between 6.5 and 8.5 every week of the year indicating the wastewater maintained a relatively neutral pH range, ensuring biological treatment can be successful. Figure 6 below captures the weekly pH concentrations in relation to the compliance parameter limits and objectives.

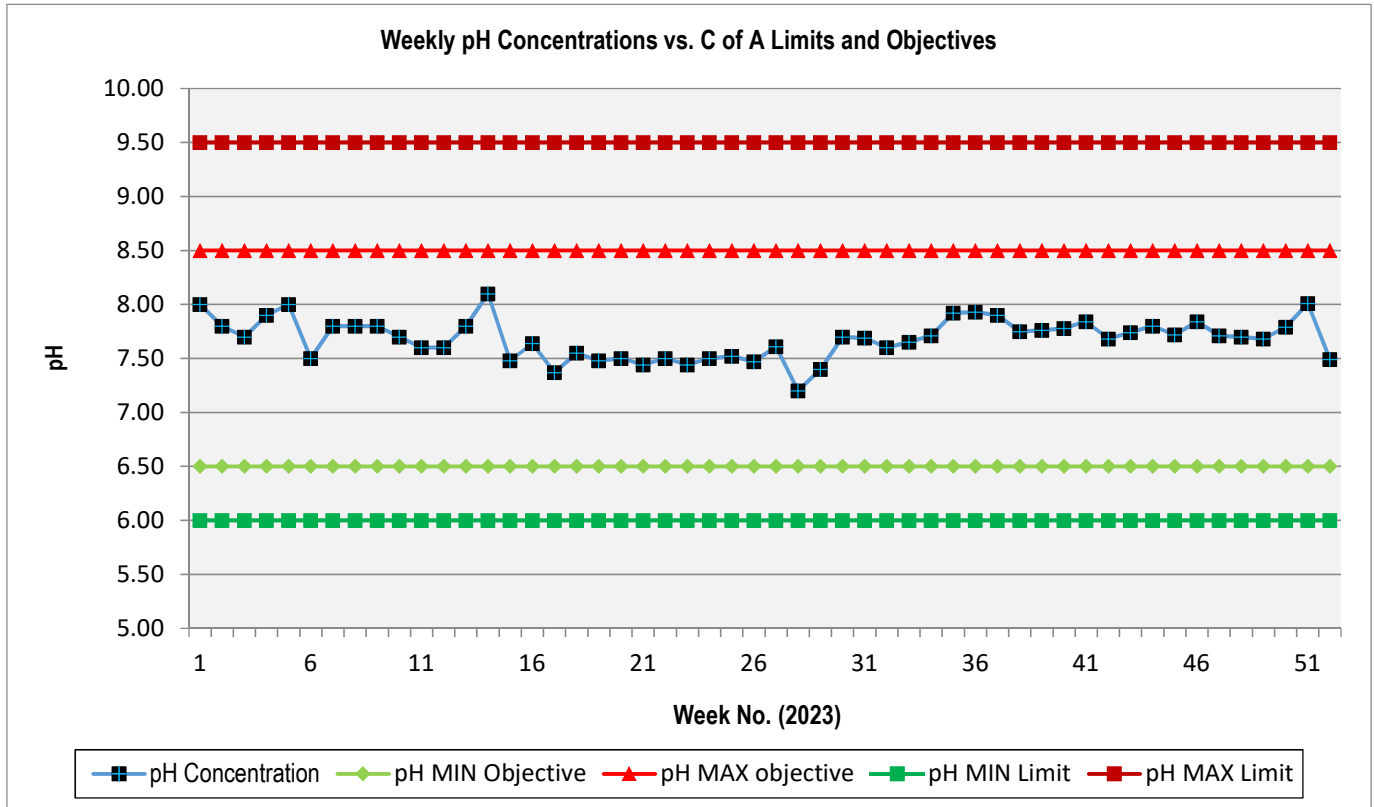


Figure 6 – Weekly pH Concentration vs. CoA Limits & Objectives

## VII. Overall Treatment Efficacy

The overall efficacy of the treatment facility can be demonstrated through a comparison of influent and effluent compositions. As outlined in Table 5, the Shakespeare WPCP was able to achieve an average annual removal of 97.4% for CBOD5, 93.0% for Total Suspended Solids (TSS), 94.3% for Total Phosphorus (TP) and 98.5% removal of Total Kjeldahl Nitrogen (TKN). Further, as referenced in Section A (V.), E.coli was calculated to have an effluent geometric mean density of 2 CFU/100mL for the year which is indicative of a well operating filter and disinfection system. The plant effluent was additionally free of floating and settleable solids and there were no signs of oils, discoloration or foam.



### VIII. Influent & Effluent Flows

Table 2 above captures influent and effluent flows over the reporting period including average daily flow, total monthly flow and maximum daily flow. In review, the average daily raw sewage influent flow for the Shakespeare WPCP over the reporting period was calculated to be 231.50 m<sup>3</sup>/day. This average represents approximately 70% of the plants rated capacity of 329 m<sup>3</sup> average daily flow. As mentioned in the 2022 Annual Operations Report, both flow meters were set to be replaced in 2023; however, meter replacement was pushed to 2024 due to supply issues. At the time of writing of this report, the flow meters have been purchased and delivered to the facility with installation scheduled in the near term.

The maximum daily influent flow over this reporting period occurred on April 2, 2023, with a total of 886.01 m<sup>3</sup> which occurred following a high intensity rain event prior. Operational staff continue to monitor influent flows in order to determine the viability of an inflow and infiltration study. Upon installation of the new raw influent flow meters, staff will be able to better understand the flow tendencies.

Figure 7 below shows the monthly average influent flow versus the plants rated capacity and peak design flow for the 2023 reporting period.

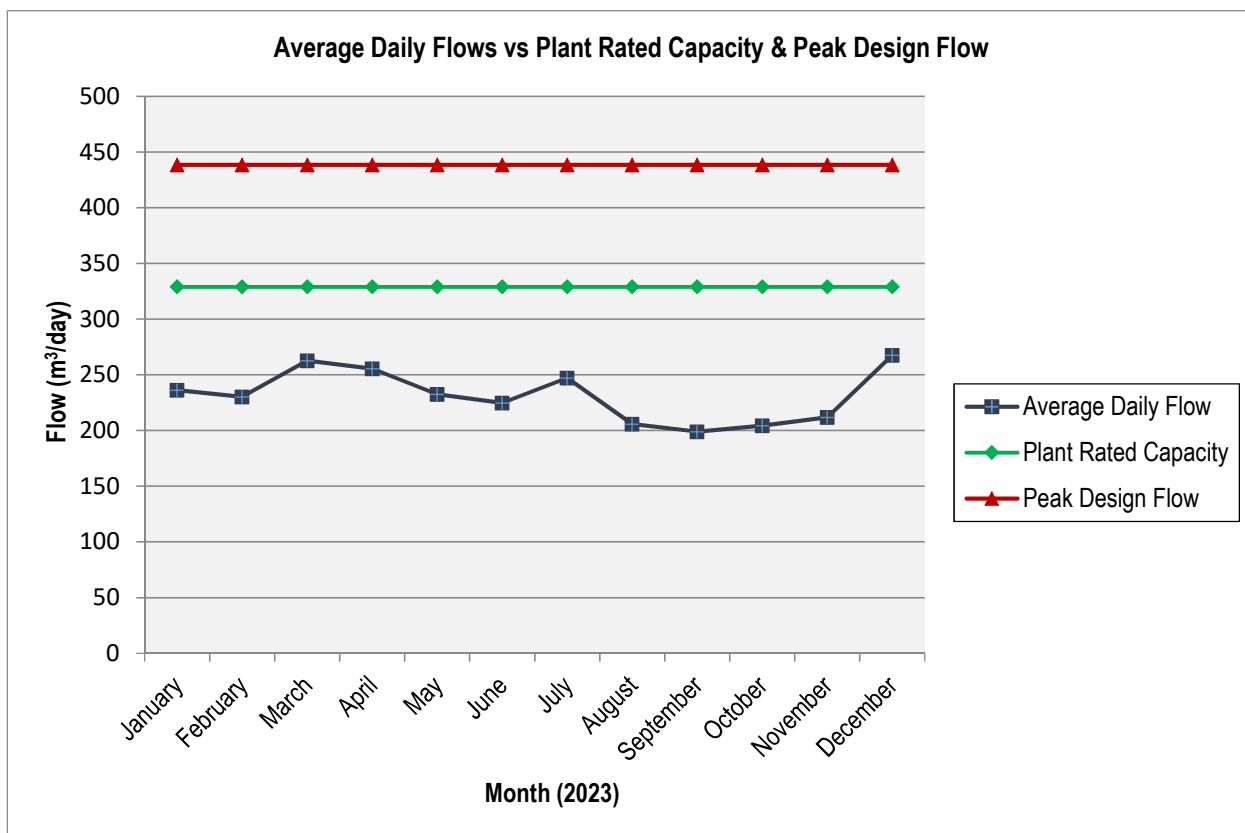


Figure 7 – Average Daily Flows vs Plant Rated & Peak Capacities



## **B) OPERATING PROBLEMS & CORRECTIVE ACTION**

The Township of Perth East operating staff has made every effort to ensure that this wastewater treatment facility operates in accordance with all applicable laws, certificates and regulations. Plant operations were continually monitored and modified in order to improve the treatment process as the nature of the raw sewage changes and the influent flows fluctuate. In the reporting year, operating problems were minimal outside of the challenges faced through replacement of the sand filter media.

The largest operating issue at the Shakespeare WPCP continues to be that of high flow events as a result of precipitation and/or melt events. In response to these events, the treatment plant is subject to influent flows which place the sequencing batch reactors into “Storm Mode”, which in turn reduces the treatment timelines and ultimately treatment effectiveness. Through the update of the Township’s Water/ Wastewater Master Plan occurring in 2024, the consultant and staff will examine the urgency around conducting an inflow & infiltration (I&I) study and the potential implications of such.

## **C) MAINTENANCE SUMMARY**

The following is a list of the maintenance activities carried out during this reporting period on any of the plants major structures, equipment, apparatus, or mechanisms which form the integral parts of the treatment process.

- Monthly inspection carried out on backup generator; weekly checks
- Routine service of blowers
- Alum pump foot valves cleaned and serviced
- Primary alum injectors cleaned and serviced
- PLC replaced, SCADA updated
- UV light cleaned, ballast replaced
- Routine greasing of components
- Changed blower air in-take filters
- Sand filter media replaced
- Sand filter air lift piping replaced
- Generator inspected and load tested by T&T Power Group
- Raw sewage pumps pulled and cleaned
- Raw sewage tanks cleaned by vacuum truck
- Replaced air compressor for sand filter, ran new air lines



## D) EFFLUENT QUALITY ASSURANCE

All samples are collected and tested as per the requirements of the Certificate of Approval.

All collected samples were delivered to ALS Global in Waterloo a CAEAL accredited laboratory. The lab is responsible for performing the quality assurance and control checks.

Effluent quality monitoring is achieved by both composite and grab samples taken weekly as outlined within the plants operational Certificate of Approval. Samples are collected by an automatic composite sampler over a twenty-four hour period, as well as a grab sample tested for E.coli. Weekly grab samples are collected and tested in house for pH and temperature.

For the purpose of influent quality monitoring, monthly composite samples are collected and sent to the lab for testing. Raw sewage samples are tested for CBOD<sub>5</sub>, total suspended solids, total phosphorus and total Kjeldahl nitrogen. Settling tests and TSS are also performed on each of the basins in order to better interpret the state of the activated sludge during checks and better assess the expected performance.

## E) CALIBRATION OF EFFLUENT MONITORING EQUIPMENT

Annual calibrations of influent and effluent flow meters for the year 2023 were conducted by SCG Flowmetrix. Calibrations were completed on all meters on May 18, 2023. Calibration of the dissolved oxygen (DO) probes, TSS probes, temperature and pH meters are performed in-house according to manufacturer's instructions.

## F) EFFORTS MADE IN ACHIEVING EFFLUENT OBJECTIVES

Throughout the reporting period the effluent objectives were met as follows:

EFFLUENT PARAMETER	EFFLUENT OBJECTIVE
Carbonaceous Biological Oxygen Demand (CBOD <sub>5</sub> )	Achieved 10 out of 12 months
Total Suspended Solids (TSS)	Achieved 9 out of 12 months
Total Phosphorus (TP)	Achieved 7 out of 12 months
Total Ammonia Nitrogen (TAN)	Achieved 7 out of 12 months
E.coli	Achieved 12 out of 12 months
pH	Achieved 12 out of 12 months

Over the reporting period, operational staff made every effort to meet effluent objectives. In 2023, the sand filter media was replaced in order to improve treatment efficacy. Additionally, the sand filter air compressor and air return piping was replaced to improve the filtration process. Looking ahead staff have been working with the SCADA contractor to implement improved programming around the sludge digester supernatant return. Optimizing the aeration cycling of the sludge will assist in the overall efficacy of the treatment by improving the sludge thickening process and reduce the loading associated with the supernatant.



## **G) SLUDGE GENERATION**

Approximately 306m<sup>3</sup> of sludge was removed from the plant in 2023 which is a reduction by nearly 22% when compared to 2022 and approximately 42% reduction since 2021. This equates to a total volume of sludge removed from the plant since the initial treatment operations began in November 2010 of approximately 5280m<sup>3</sup>.

The generated sludge is transferred to the Township of Perth East's Milverton WPCP (aerated lagoon facility) at Lot 5 Concession 3 Mill Street West, Township of Perth East, Mornington Ward; Certificate of Approval #6264-6EEP9N. The sludge is analyzed annually for the set parameters for not utilized sludge. It is expected that the amount of sludge generated in 2024 will be similar to the volume disposed of in 2023.

## **H) COMPLAINTS**

There were no complaints received regarding the overall operation of the Shakespeare WWTP and collection system during the reporting period.

## **I) BY-PASSES, SPILLS & ABNORMAL DISCHARGE**

Over the reporting period, there was one planned by-pass event in order to perform the media replacement on the sand filter. This by-pass is considered partial as all other processes in the treatment system remained in operation. The planned event saw a total of 365 cubic meters (m<sup>3</sup>) bypass the sand filter.

No other by-passes, spills or abnormal discharge events occurred over the reporting period.

## **J) ADDITIONAL INFORMATION**

The District Manager did not request any additional information over the reporting period.