2018 Cayuga WWTP Annual Report

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1. Background

The Cayuga wastewater treatment plant (WWTP) is owned by Haldimand County and operated by Veolia Water. The WWTP operates under ECA # 0856-9QMSEL and has a nominal design flow of 1,200 m^3/d. The WWTP receives flow from the community of Cayuga via the Ouse St. pumping station. This station is equipped with an equalization tank to manage high flow events. The Cayuga WWTP is an oxidation ditch process with aerobic sludge digestion and storage and UV disinfection. Treated effluent is discharged to the Grand River. Biosolids from the facility are typically direct land applied or hauled to the Townsend biosolids storage lagoon for temporary storage prior to land application.

2. Per Capita Flows and Loadings

Table 1 – Cayuga Per Capita Flows and Loadings			
Parameter	**2017**	**2018**	
Population	1,713	1,713	
Average Daily Influent Flow (m^3/d)	800	797	
Peak Daily Influent Flow (m^3/d)	3,868	3,841	
Average Influent BOD_5 (mg/L)*	191	146	
Average Influent TSS (mg/L)	214	166	
Average Influent TKN (mg/L)	41	37	
Average Influent TP (mg/L)	5.2	4.6	
Per Capita Flows and Loadings			
Parameter	**2017**	**2018**	**Typical**
Per Capita Wastewater Flow (L/person/day)	467	465	350 – 500** 332***
Per Capita BOD_5 Loading (g/person/day)	89	68	80**
Per Capita TSS Loading (g/person/day)	100	77	90**
Per Capita TKN Loading (g/person/day)	19	17	13**
Ratios			
Peak Day / Annual Average Flow	4.8	4.8	2.0 – 3.0
Influent TSS/BOD_5	1.1	1.1	0.8 – 1.2
Influent TKN/BOD_5	0.2	0.3	0.1 – 0.2

Notes:
* Five day biochemical oxygen demand (BOD_5) measured in an unfiltered sample and includes carbonaceous and nitrogenous oxygen demand.
** Results are for typical residential wastewater and are identified in Metcalf and Eddy, Wastewater Treatment and Reuse (4th Edition).
*** Grand River Conservation Authority, "2017 Watershed Overview of Wastewater Treatment Plant Performance", July, 2018.

Comments:

- Average daily influent flows were similar in 2018 compared to 2017.
- Influent BOD_5, TKN and TP concentrations are lower than 2017 for unknown reasons. Sampling methodology should be reviewed to determine if it's an issue.
- Per capita flow of 465 L/person/d is within typical values but higher than the GRCA watershed average of 332 L/person/d.
- Per capita BOD and TSS loading are close to typical values.
- The TKN per capita loading is 31% higher than typical for unknown reasons.
- The peak day / annual average flow ratio of 4.8 is higher than typical values of 2.0-3.0. High precipitation or run-off events contribute to the higher than typical value.
- TSS/BOD_5 ratio is within the typical range and the TKN/BOD_5 ratio of 0.3 is slightly over the typical value of 0.1-0.2.

3. Performance

- **Effluent Concentration Compliance**

Table 2 is a summary of the effluent quality objectives and limits identified in the ECA # 0856-9QMSEL.

Table 2 – Summary of ECA Objectives and Limits for Effluent Quality

Parameter	Objectives (mg/L)	Limits (mg/L)	Loading Limits (kg/d)
$cBOD_5$	10	18	22
Total Suspended Solids (TSS)	15	18	22
Total Phosphorous (TP)	0.5	0.75	0.9
Total Ammonia Nitrogen (TAN) October 1 - May 31 June 1 - September 30		 4 2	 - -
E. Coli.	100 CFU/100mL	200 CFU/100mL	-
Total Chlorine Residual	Non-detectable	0.02	-
pH	6.5 - 9.0	6.0 - 9.5	-

Compliance for all concentration parameter limits identified in Table 2 (except E. Coli. and pH) are based on monthly averages of samples taken weekly. Loading parameters are based on annual averages of

samples taken. Compliance for E. Coli is based on a monthly Geometric Mean Density of all samples, while pH must be maintained within the range at all times. A summary of all monthly data is included in this report in Section 10. **Although total chlorine residual (TRC) is listed as an objective and limit, Cayuga WWTP utilizes UV disinfection so no data is reported for TRC.**

Haldimand County is also committed to achieving the Grand River Conservation Authority (GRCA) final effluent targets for total phosphorous (TP) and total ammonia nitrogen (TAN). The targets are shown for secondary treatment plants in Table 3 below.

Table 3: GRCA Secondary Treatment Targets for Effluent discharging into the Grand River

Parameter	Final Target (mg/L)
Total Effluent Phosphorous	0.30
Total Ammonia Nitrogen Summer Winter	 1.0 2.0

The monthly average concentrations for $cBOD_5$ compared against the objective and limit are shown in Figure 1.

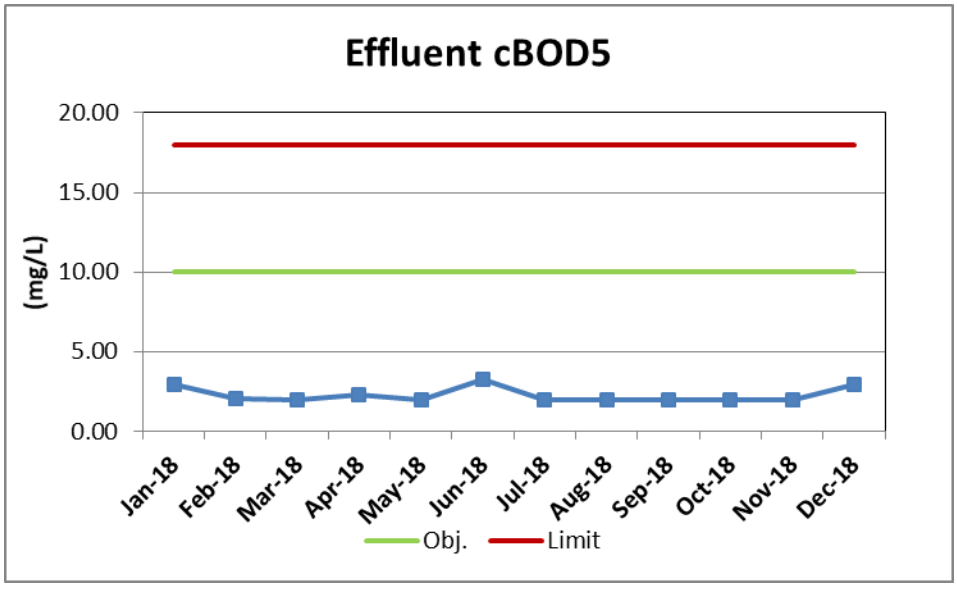

Figure 1 – Monthly Average Effluent $cBOD_5$ Compliance Graph

Comments:

- Monthly average effluent $cBOD_5$ met the compliance limit and objective in 2018.

The monthly average concentrations for TSS compared against the objective and limit are shown in Figure 2.

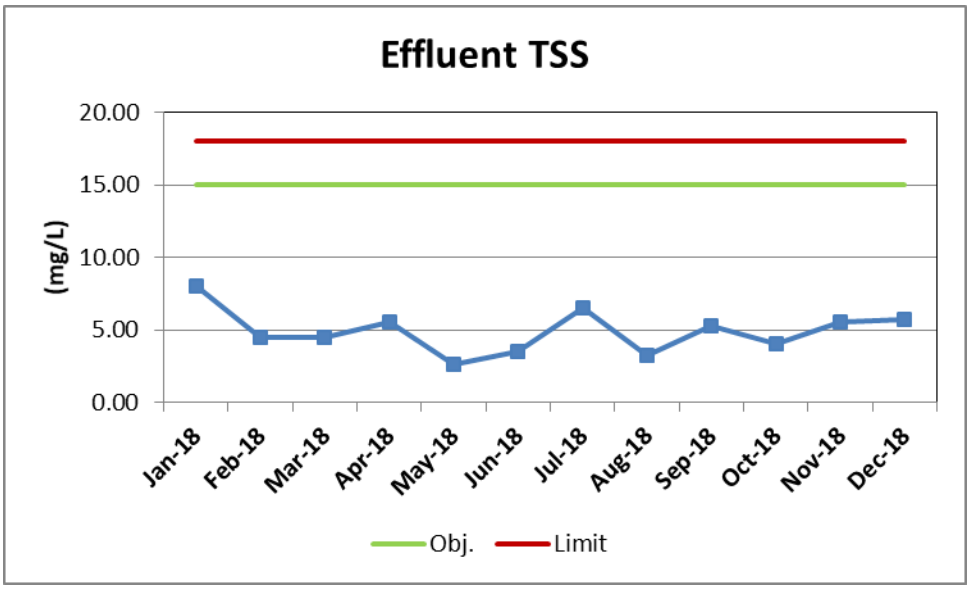

Figure 2 – Monthly Average Effluent TSS Compliance Graph

Comments:

- Monthly average effluent TSS met the compliance limit and objective in 2018;
- The effluent is essentially free of solids and visual observations indicate that the effluent is free of oils.

The monthly average concentrations for TP compared against the ECA objective and limit and GRCA interim and final targets are shown in Figure 3.

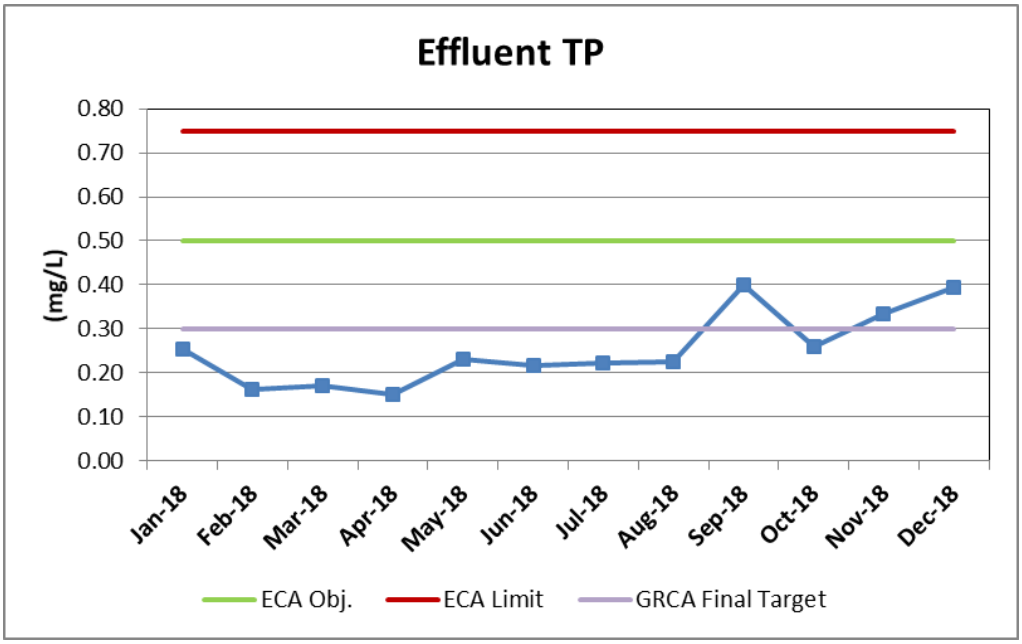

Figure 3 – Monthly Average Effluent TP Compliance Graph

Comments:

- Monthly average effluent TP met the ECA compliance objective and limit in all 12 months in 2018.
- The GRCA final target of 0.30 mg/L was achieved in 9 of 12 months.

The monthly average concentrations for total ammonia nitrogen compared against the ECA limits and GRCA interim and final targets are shown in Figure 4.

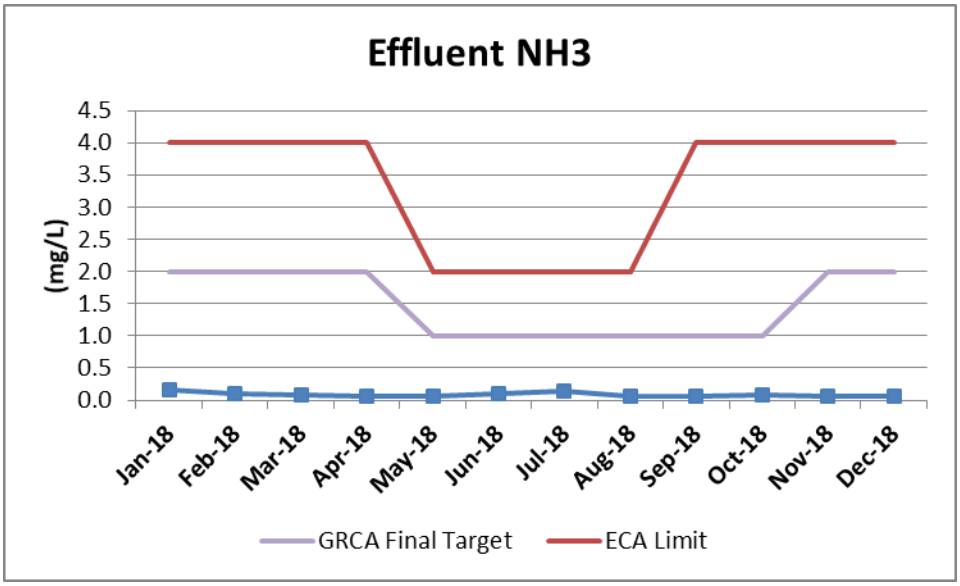

Figure 4 – Monthly Average Total Ammonia Nitrogen Compliance Graph

Comments

- Monthly average total ammonia nitrogen met the compliance limit in all 12 months;
- Operations met the final GRCA target of 2.0 mg/L (November – April) and 1.0 mg/L (November – April) for all 12 months.

The monthly geometric mean density for E. Coli compared against the limit and objective are shown in Figure 5.

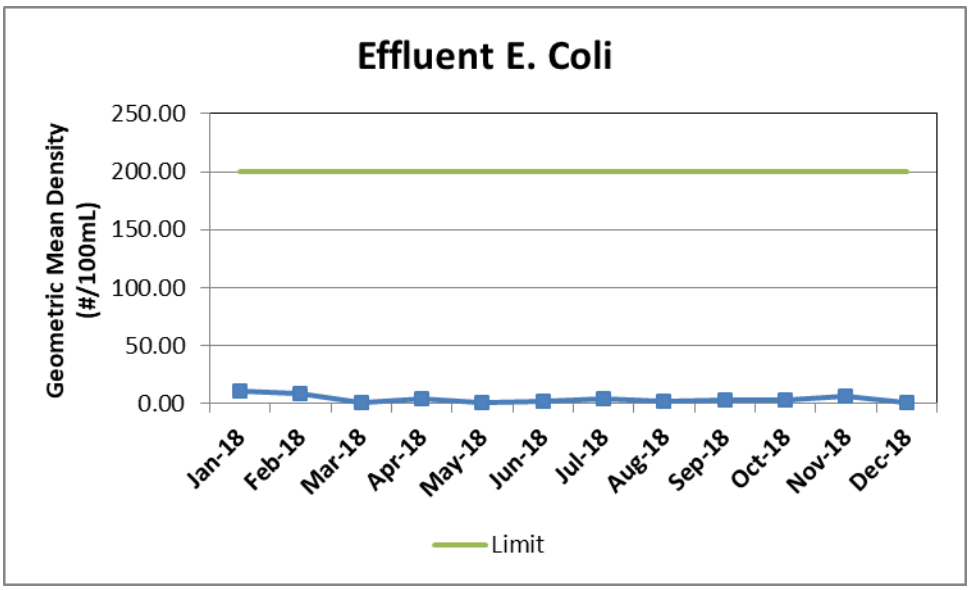

Figure 5 – Monthly Geometric Mean for E. Coli Compliance Graph

Comments:

- Monthly E. Coli Geometric Mean Density achieved the compliance limit and objective in all 12 months in 2018.

Effluent pH results compared against the compliance limits and objectives are shown in Figure 6.

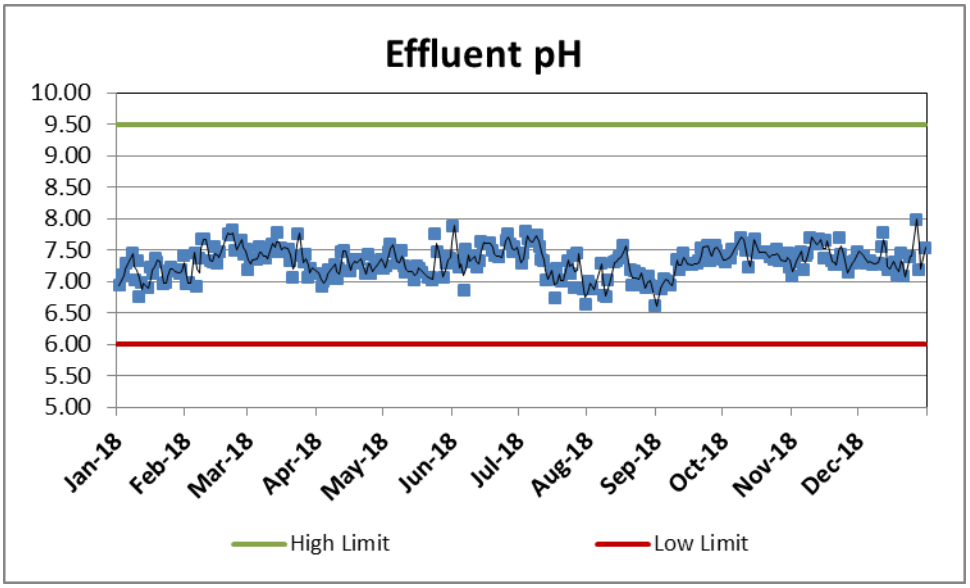

Figure 6 – Effluent pH Compliance Graph

Comments:

- The daily pH levels were within the limits and objectives for all days in 2018.

Monthly average plant flow compared against the design flow of 1,200 m^3/d is shown in Figure 7.

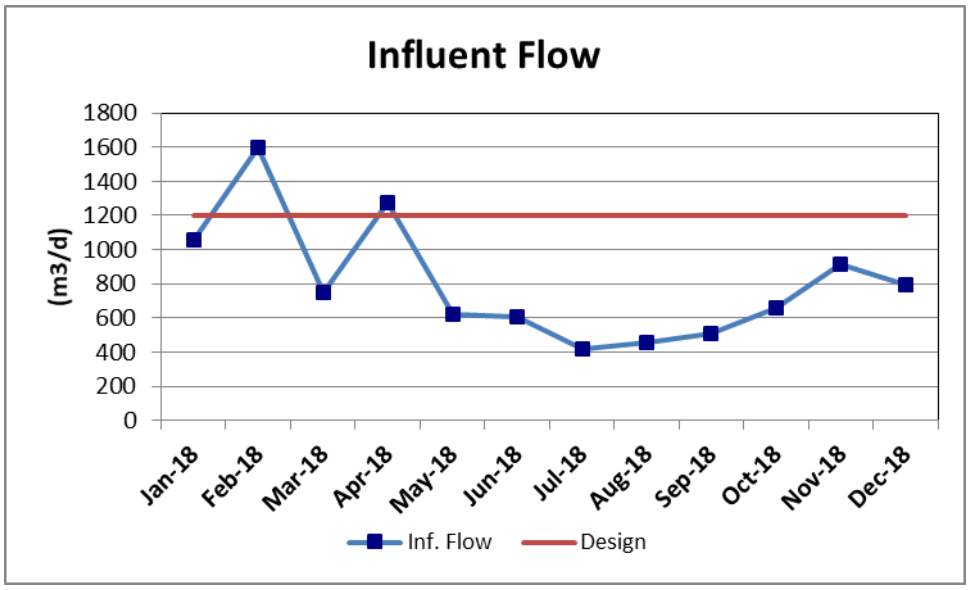

Figure 7 – Influent Flow Compliance Graph

Comments:

- The monthly average flows were below design for 10 of 12 months in 2018 but the annualized average day flow (cumulative total sewage flow to the sewage works during a calendar year divided by the number of days during which sewage was flowing to the sewage works that year) was 797 m^3/day which represents roughly 66% of design;
- Rain events caused high flows during February and April.

Effluent Loading Compliance

A summary of the annual average effluent loading compliance is displayed in Table 4.

Table 4 – Summary of Annual Average Effluent Loading Compliance		
Parameter	**Annual Average Loading**	**Annual Average Loading Limit**
$cBOD_5$ Loading	1.8 kg/d	22 kg/d
TSS Loading	4.1 kg/d	22 kg/d
TP Loading	0.2 kg/d	0.9 kg/d

Comments:

- The annual average loading for $cBOD_5$, TSS and TP met ECA loading limits in 2018.

4. Non-Regulated Effluent Sampling

The daily effluent temperature results are displayed in Figure 8.

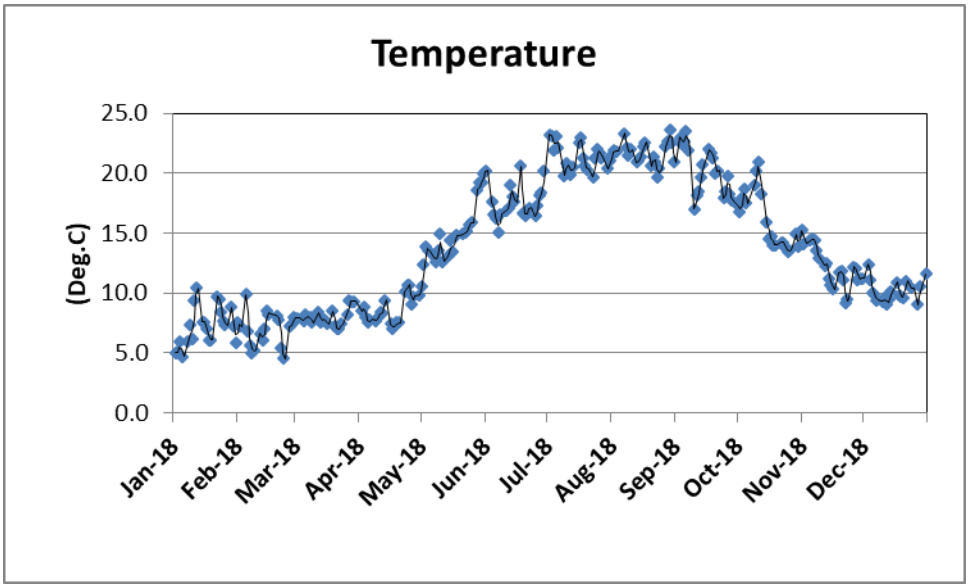

Figure 8 - Effluent Temperature Results

Comments:

- Water temperature ranged from approximately 4.5°C in February to 23.6°C in August;

5. Operational Issues

- High river levels in February and April resulted in direct river inflow to the collection system via the raw sewage overflow outfall pipe located adjacent to the Ouse Street pumping station. A new back-flow preventer was installed in the overflow outfall pipe to correct this problem.

6. Sludge Generation

- **Sludge Production**

Reported sludge being removed from the treatment plant is compared to projected sludge that Cayuga would be expected to produce. If the difference between the two sludge masses (kg/d) is within ± 15%, then the sludge data is probably accurate. The sludge accountability is reported in Table 6. See appendix 1 for sludge accountability calculations.

Table 6 – Summary of Sludge Accountability

Reported Sludge (kg/d)		Projected Sludge (kg/d)		Accountability
Intentional Wasting	114	Biological Sludge	74	-31%
Unintentional Wasting	4	Chemical Sludge	16	
Total Reported Sludge	118	Total Projected Sludge	90	

Comments:

- The sludge accountability did not close within ± 15%;
- Projected sludge was 31% lower than reported sludge;
- Accountability shows the data collected may not accurately reflect the true performance of the facility;
- Inaccurate WAS concentration measurements probably contributed most significantly to the percent non-accountability. A new procedure to turn off RAS pump during the wasting period was started in 2018 to send thicker sludge to the digester. Operations are working on collecting a representative wasted sludge concentration for this new procedure.

Sludge Removal

Table 7 identifies a monthly summary of the volume of sludge removed from the digesters at the Cayuga WWTP.

	Table 7 – Monthly Summary of Sludge Removed							
Month	**Sludge Volume Removed to Townsend (m^3)**		**Sludge Volume Removed for Land Application (m3)**		**Concentration (mg/L)**		**Hauled Sludge Generated (kg)**	
	2017	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
January								
February								
March								
April								
May		90		585		23,895		16,129
June			91		26,000		2,366	
July			628		25,500		16,014	
August	135				20,000		2,700	
September				180		33,330		5,999
October			223		17,000		3,791	
November								
December								
Total	**1,077**	**90**	**942**	**765**			**24,871**	**22,128**

Comments:

- The volume of biosolids removed in 2018 of 855 m^3 was 987 m^3 less than the volume hauled in 2017 of 1,842 m^3.
- The mass of solids removed in 2018 of 22,128 kg was 2,743 kg more than in 2017 (24,871 kg).
- Differences in solids removal between 2017 and 2018 is a result of changes in wasting methodologies.
- In 2019 it is estimated that the mass of sludge removed will be comparable to 2018.

7. Biosolids Removal

- Biosolids were applied to land in May and September at the following sites: HN1315 and HN1316.

8. Facility Activities in 2018

- A new backflow prevention device was installed in the raw sewage bypass outfall pipe at the river;
- A new waste activated sludge (WAS) flow meter was installed;
- Completed a 12 month special study on achieving and sustaining the GRCA effluent total phosphorous final target of 0.30 mg/L;
- Participated in What Makes our Community Work by teaching grade 7 and 8 students about wastewater treatment at the Cayuga WWTP.

9. Planned Activities for 2019

- The existing return activated sludge (RAS) pumps will be rebuilt;
- The sludge digester and holding tank will be cleaned-out and inspected.

10. Bypasses, Spills and Overflows

- Table 8 is a summary of all bypass and overflow events at the Cayuga WWTP in 2018.

Table 8 – Summary of Bypass Events

Date(s)	Duration (hours)	Volume Bypassed (m^3)	Reason	Process Bypassed
February 20, 2018	125	9,000	High Flows	Raw (Overflow)
April 16, 2018	21	1,512	High Flows	Raw (Overflow)

Comments:

- Event in February was an overflow caused by high water levels in the Grand River flowing back into the pump station and collection system. Wet weather events caused the Grand River levels to increase.
- Event in April was caused by high water levels in the Grand River flowing back into the pump station and collection system. Wet weather events caused the Grand River levels to increase.

11. Public Complaints

- There were no reported complaints in 2018.

12. Monthly Average Effluent Data Summary

- Table 9 displays a summary of all monthly average effluent data.

13. Calibration Reports

- See attached.

14. Maintenance Activities

Routine preventative maintenance was performed on various plant and pumping station equipment during the reporting period. This includes tasks such as:

- the lubrication of applicable bearings and/or gearboxes on various equipment;
- the removal, inspection and servicing of numerous submersible pumps;
- the inspection and servicing of chemical feed systems;
- the inspection and servicing of the ultraviolet disinfection system;
- the inspection and servicing of various HVAC systems;
- the inspection, testing and servicing of various back-up generator systems;
- See attached for the complete annual maintenance report.

Table 9 – Summary of Monthly Average Effluent Data																		
	Plant Flow	CBOD	Target CBOD Limit	ECA CBOD Limit	CBOD Loading	ECA CBOD Load Limit	TSS	Target TSS Limit	ECA TSS Limit	TSS Loading	ECA TSS Load Limit	Phosphorous	Target TP Limit	ECA TP Limit	Phosphorous Loading	ECA TP Load Limit	E. Coli	ECA E. Coli Limit
Month	(m^3/d)	(mg/L)	(mg/L)	(mg/L)	(kg)	(kg)	(mg/L)	(mg/L)	(mg/L)	(kg)	(kg)	(mg/L)	(mg/L)	(mg/L)	(kg)	(kg)	#/100m	#/100ml
Jan-16	1060	3	18.0	25.0	3.1	22.0	8	18.0	25.0	9.4	22.0	0.25	0.75	1.00	0.29	0.9	10	200
Feb-16	1596	2	18.0	25.0	3.3	22.0	5	18.0	25.0	16.0	22.0	0.16	0.75	1.00	0.43	0.9	9	200
Mar-16	748	2	18.0	25.0	1.5	22.0	5	18.0	25.0	5.2	22.0	0.17	0.75	1.00	0.22	0.9	1	200
Apr-16	1276	2	18.0	25.0	2.9	22.0	6	18.0	25.0	8.9	22.0	0.15	0.75	1.00	0.33	0.9	4	200
May-16	620	2	18.0	25.0	1.2	22.0	3	18.0	25.0	3.1	22.0	0.23	0.75	1.00	0.17	0.9	1	200
Jun-16	606	3	18.0	25.0	2.0	22.0	4	18.0	25.0	3.3	22.0	0.22	0.75	1.00	0.17	0.9	1	200
Jul-16	418	2	18.0	25.0	0.8	22.0	7	18.0	25.0	3.1	22.0	0.22	0.75	1.00	0.12	0.9	4	200
Aug-16	456	2	18.0	25.0	0.9	22.0	3	18.0	25.0	2.8	22.0	0.23	0.75	1.00	0.11	0.9	2	200
Sep-16	506	2	18.0	25.0	1.0	22.0	5	18.0	25.0	3.6	22.0	0.40	0.75	1.00	0.14	0.9	3	200
Oct-16	657	2	18.0	25.0	1.3	22.0	4	18.0	25.0	5.6	22.0	0.26	0.75	1.00	0.19	0.9	3	200
Nov-16	912	2	18.0	25.0	1.8	22.0	6	18.0	25.0	8.9	22.0	0.34	0.75	1.00	0.30	0.9	7	200
Dec-16	792	3	18.0	25.0	2.3	22.0	6	18.0	25.0	6.8	22.0	0.39	0.75	1.00	0.27	0.9	1	200
Average	815	2			1.8		5			6.4		0.25			0.23		4.0	

Appendix #1 - Cayuga WWTP Sludge Accountability 2018

Influent Flow = 797 m^3/d	Effluent TSS = 0.0050 kg/m^3
Influent BOD = 0.146 kg/m^3	Effluent cBOD = 0.0020 kg/m^3
Sludge Production Ratio = 0.65 – EA (0.70 – CAS)	SAX Dosage = 0.0207 m^3/d
WAS Flow = 6.2 m^3/d	WAS Concentration = 18.301 kg/m^3
Density of SAX = 1470 kg/m^3	% Aluminum in SAX = 10.7 %
Sodium aluminate Sludge Production Ratio = 4.79	

Projected Sludge

Biological Sludge = Influent Flow * (Influent BOD – Effluent BOD) * SPR

Biological Sludge = 791 m^3/d * (0.146 kg/m^3 – 0.0020 kg/m^3) * 0.65

Biological Sludge = 74.0 kg/d

Chemical Sludge = SAX Dosage * SAX Density * % Aluminum * SPR

Chemical Sludge = 0.0207 m^3/d * 1470 kg/m^3 * 0.107 * 4.79

Chemical Sludge = 15.6 kg/d

Total Projected Sludge = Biological Sludge + Chemical Sludge

Total Projected Sludge = 74.0 kg/d + 15.6 kg/d

Total Projected Sludge = 89.5 kg/d

Reported Sludge

Intentional Wasting = WAS Flow * WAS Concentration

Intentional Wasting = 6.2 m^3/d * 18.301 kg/m^3

Intentional Wasting = 113.5 kg/d

Unintentional Wasting = Influent Flow * Effluent TSS

Unintentional Wasting = 797 m^3/d * 0.0050 kg/m^3

Unintentional Wasting = 4.0 kg/d

Total Reported Sludge = Intentional Wasting + Unintentional Wasting

Total Reported Sludge = 113.5 kg/d + 4.0 kg/d

Total Reported Sludge = 117.5 kg/d

Sludge Accountability Calculations

$$\text{Sludge Accountability} = \frac{(\text{Projected Sludge} - \text{Reported Sludge})}{\text{Projected Sludge}} * 100$$

$$\text{Sludge Accountability} = \frac{(89.5 \text{ kg/d} - 117.5 \text{ kg/d})}{89.5 \text{ kg/d}} * 100$$

Sludge Accountability = -31.3%