Township of Hornepayne

Water and Wastewater Treatment Plants

Energy Assessment - 2023 Annual Report

Prepared for the Township of Hornepayne

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STATEMENT OF CONFIDENTIALITY

OCWA's Energy Assessment of the
Township of Hornepayne's WTP &WWTP

VISION **MISSION** **VALUES**

VISION: Your Trusted Water Partner for Life.

MISSION: We provide clean water services for the health and sustainability of communities.

VALUES: Everything we do is guided by our belief in and commitment to:

- **Teamwork** – We bring together our local knowledge, skills and talents and collaborate with our clients to meet the needs of the communities we serve.
- **Reliability** – We provide essential services that meet or go beyond compliance standards and follow through on our commitments to each other and our clients.
- **Understanding** – We listen to each other, our clients and stakeholders to deliver total solutions.
- **Safety** – We make health, safety and wellness in our workplace and in the communities where we live and work, our number one priority.
- **Transparency** – We believe in communicating openly, honestly and authentically with each other, our clients and stakeholders.
- **Environment** – We protect the environment through innovative solutions that strengthen the health and sustainability of the communities we serve.
- **Diversity** – We embrace diverse perspectives and strive to create an equitable and inclusive environment where each of us feels respected and empowered to achieve our personal and professional goals.

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1. Objective

The purpose of this report is to provide an overall summary of the energy usage for 2023 at the Township of Hornepayne's (Town) Water Treatment Plants (WTPs) and Wastewater Treatment Plants (WWTPs).Energy assessment report aims to conduct an analysis of the facilities energy consumption and efficiency patterns for the year 2023 and compare it with process data to establish the relationship between energy, flow, biological oxygen demand (BOD) and other key process parameters.

This annual Hydro bill assessment (HBA) reports present an analysis of the energy consumption and efficiency patterns for the facility during a given year or quarter and develops the most recent key performance indicators (KPIs) for the facility. OCWA conducts a baseline and benchmark comparison of the facility's efficiencies and electricity consumption patterns to determine how the KPIs have evolved over time. The KPIs can then be used for recommendations and quantification of any energy efficiency activities.

This report is intended to inform key stakeholders at the Township of Hornepayne, the critical information required in order to understand energy usage at the facilities and plan for the next steps to reduce energy usage. The following facilities were assessed as part of the report.

Table 1-1 Township of Hornepayne's WTP &WWTP

Plant Name	Address	Account Number
Hornepayne Waste Water Treatment Plant	37 Honka Dr, Hornepayne	20023038 9115
Hornepayne Water Treatment Plant	100 Herbert Ave, Hornepayne	20023038 9519

2. Background

Energy plays a crucial role in the water treatment process, as it is required to perform various operations involved in treating and supplying the treated water. The energy requirements vary depending on the source and quality of the water, as well as the treatment techniques employed.

The Ontario water and wastewater treatment sectors are the largest municipal electricity consumers, representing more than a third of annual electricity consumption.

IESO stands for Independent Electricity System Operator, which is the organization responsible for managing the electricity system and ensuring the reliable operation of the electrical grid in Ontario, Canada. One key responsibility of IESO involves maintaining equilibrium between the electricity supply and demand in Ontario. This is achieved through the anticipation of electricity requirements at various times and the orchestration of electricity generation and distribution to align with the prevailing demand, ensuring a balanced energy system.

According to Energy Efficiency Solution- Water Treatment Plants and Pumping- IESO 2022 report the Ontario water treatment sectors are the largest municipal electricity consumers, representing more than a third of annual electricity consumption. This is based on an analysis of 340 Waste Water Treatment Plant, 423 Drinking Water Treatment Plant, 1246 Wastewater pumping station and 990 Drinking Water Pumping station across the province.

Annual electricity and natural gas consumption across all water treatment sectors in Ontario amounts to approximately 3.57 eTWh (with annual electricity consumption representing 2.88 TWh). Wastewater treatment plants (WWTPs) consume most of this energy (45%). This energy use may rise due to ever-more stringent treatment requirements; but these systems also have many opportunities to become more energy efficient, and even to generate renewable energy.

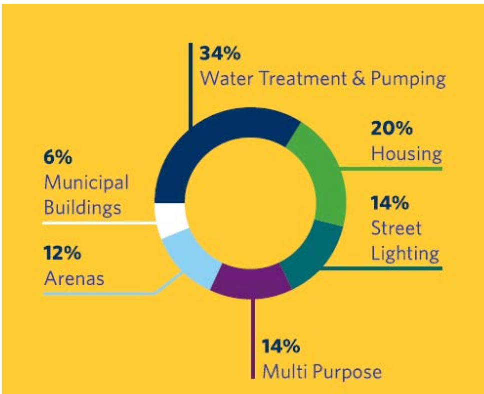

Figure 2-1 Municipal Energy Use by consumption in Ontario

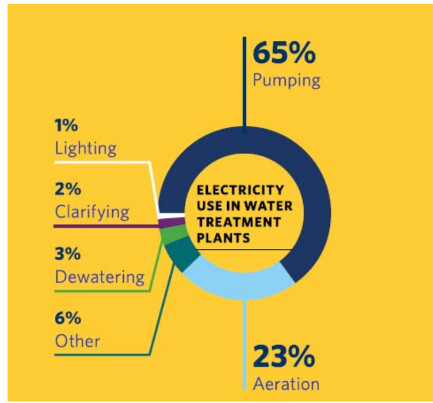

Figure 2-2 Breakdown of Energy Consumption by process in WTP

As depicted in Figure 2-1, water treatment and pumping stand out as the largest energy consumers in water treatment plants, constituting approximately 34% of municipal electricity usage in Ontario. Specifically, within WTPs, pumping alone consumes nearly 65% of the electricity, followed by aeration, which accounts for approximately 23%, Figure 2-2. This breakdown highlights the significant energy demands associated with water treatment processes, underscoring the importance of implementing energy-efficient practices and technologies to optimize resource utilization and minimize environmental impact.

At different levels of treatment in the waste water treatment plant, energy is consumed for the process of treating raw water to meet effluent standards. At each stages of collection, pumps require electrical energy to operate, with the energy consumption dependent on the distance, elevation, and flow rate of the water being transported. During pre-treatment, processes may involve mechanical equipment like screens, clarifiers, and filters, which require energy to operate. In the case of wastewater plants, the highest energy consumption for WWTP is typically the secondary treatment process. Identifying the energy consumption associated with aeration and other processes involved is thus a key indicator to energy efficiency. In water treatment plants, during chemical treatment/ dosing, the systems require energy to mix, transport, and inject chemicals into the water. The energy consumption depends on the dosage rates and the type of chemical used. Additionally, energy is consumed by mixers during coagulation/flocculation, and during sludge removal operations (scrapers/rakes). Thus by analyzing energy consumption and integrating innovative energy efficient equipment, wastewater treatment plants can contribute to sustainable and environmentally friendly water management practices.

3. Hydro Rate Changes

Hornepayne WWTP is subject to Tiered energy pricing, meaning that the facility is billed based on a threshold usage plus any additional usage. The Ontario Energy Board (OEB) regulates the electricity rates for tiered customer. Under Tiered rates, customers are charged two rates for electricity: a lower rate for the electricity used up to a certain kWh, and a second, higher rate use above the lower rate maximum electricity used. The threshold usage also varies from season to season as can be seen in Figure 3-1.

In 2022, the government started to include “general service customers” in the price reduction program at the rate of 8.2 ¢ per kWh. This two-tiered pricing concept is reflected in Figure 3-1.

The lower tier pricing increased to 9.8 ¢ per kWh in February before it dropped to 8.7 ¢ per kWh in Nov. As for Higher tier price, January saw the lowest at 8.2 ¢ per kWh, till February at the rate of 11.5 ¢ per kWh. The price further lowered to 10.3 ¢ per kWh starting first of November with the introduction of seasonal price regulation. Table 3-1 shows that pricing for both lower and higher tiers was generally higher in 2023 compared to 2022.

Table 3-1 : 2021-2023 Tiered Pricing Distribution[3]

Effective date	Lower tier price (¢ per kWh)		Threshold for lower tier price (kWh per month)	Higher tier price (¢ per kWh)	
2023 (May 1 - October 31)	10.3	↑	600	12.5	↑
2023 - (November 1 - April 30)	10.3	↑	1000	12.5	↑
Nov 1, 2022	8.7	↓	600 (Summer) 1,000 (Winter)	10.3	↓
Feb 8, 2022	9.8	↑	1,000	11.5	↑
Jan 18, 2022	8.2	↓	1,000	8.2	↓
Nov 1, 2021	9.8	-	1,000	11.5	-
May 1, 2021	9.8	↓	600	11.5	↓
Feb 23, 2021	10.1	↑	1,000	11.8	↑
Jan 1, 2021	8.5		1,000	8.5	

Figure 3-1 : Historical Tiered Pricing Rates[1]

The Hornepayne WTP is subject to Time-of-Use (TOU) pricing. i.e., the facility is billed based on when electricity is used. Depending on the demand and time of the day the Time of Use price periods are classified into on peak, mid peak and off peak. The pricing and timing also varies depending on the season, Figure 3-2.

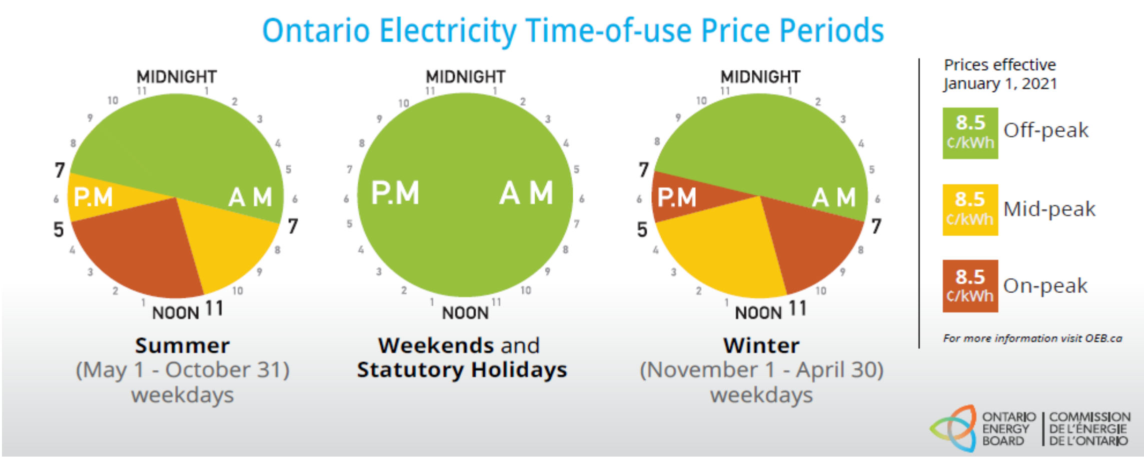

Figure 3-2 : Ontario Time-of-Use Pricing[2]

Depending on demand, the time of use is broadly classified into On –Peak, Mid –Peak and Off-Peak periods. Maximum demand occurs during On- peak, while Mid-peak is associated with moderate demands and least demand occurs during off peak periods.

[1] Ontario Energy Board, https://www.oeb.ca/rates-and-your-bill/electricity-rates/historical-electricity-rates

[2] Ontario Energy Board, https://www.oeb.ca/rates-and-your-bill/electricity-rates/managing-costs-time-use-rates

Table 3-2 : 2021-2023 Time of Use pricing distribution

Effective date	Off-Peak (¢ per kWh)	Mid-Peak (¢ per kWh)	On-Peak (¢ per kWh)
01-Nov-23	8.7	12.2	18.2
01-Nov-22	7.4	10.2	15.1
08-Feb-22	8.2	11.3	17
18-Jan-22	8.2	8.2	8.2
01-Nov-21	8.2	11.3	17
01-May-21	8.2	11.3	17
23-Feb-21	8.5	11.9	17.6
01-Jan-21	8.5	8.5	8.5

Figure 3-3 show that TOY rates increased gradually from May 2007 to November 2022. From approximately November 2016 to July 2017, the rates dropped significantly in anticipation of the province's *Fair Hydro Plan*. From July 2017 to May 2019, there has been very little fluctuation in the energy rates. The price of energy increased on November 1st 2019, followed by drastic decrease in March of 2020, and return to previous rates in November 2020 outlined in figure below.

The Ontario government revised electricity prices to be set at the off-Peak price of 8.2 cents per kilowatt-hour, from January 18, 2022, for all Regulated Price Plan customers. The price further lowered to 7.4 cents per kilowatt-hour, from November 2022. Based on our analysis, it was found that the maximum energy consumption occurs at the facility during off- peak hours (about 61%). Meanwhile on peak and mid peak consumption at the facility are in similar range of 35,704 kWh and 36,880.9 kWh, i.e. 19% of total consumption respectively.

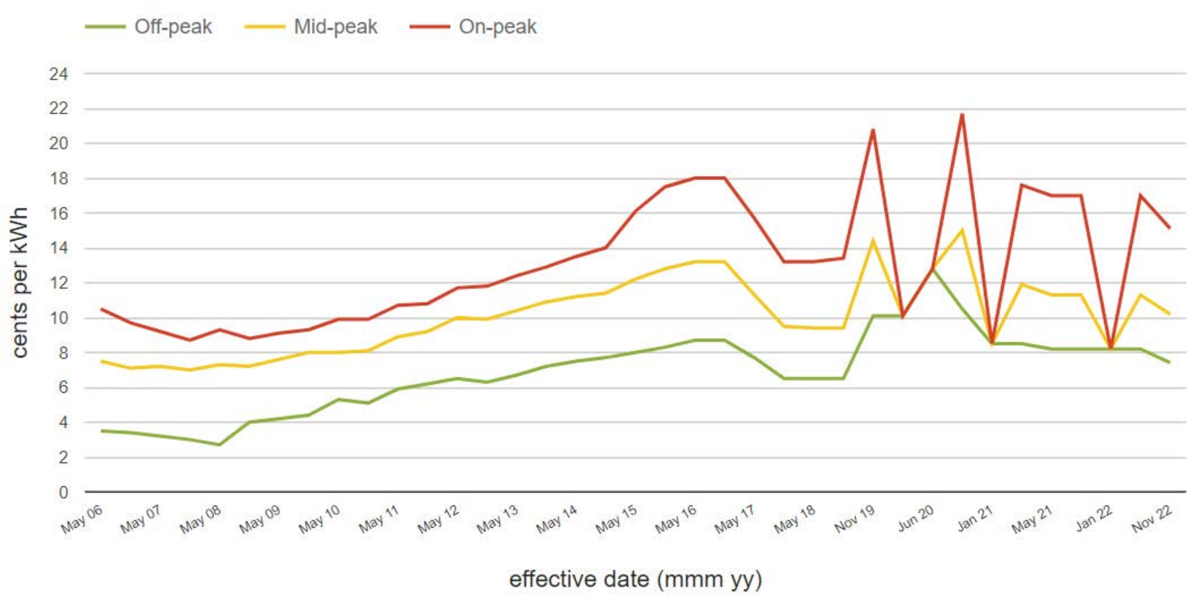

Figure 3-3 : Historical Time-of-Use Rates[3]

3 Ontario Energy Board, https://www.oeb.ca/rates-and-your-bill/electricity-rates/historical-electricity-rates

During 2023, the electricity used at the WTP during on-peak and mid-peak was about 18%, 20% and 55% of total h, with off-peak electricity costs (56%) making up a higher proportion of the total electricity costs and on-peak use and costs making up a significantly lower proportion of totals. As a general practice we recommend reducing consumption and operational activities at on-peak and mid-peak hours to the lowest extent possible, as this practice would help ensure that the cost is kept under control.

4. Hydro Bill Analysis

This Hydro Bill Analysis (HBA) was conducted for the Hornepayne WTP & WWTP for the year 2023. The assessment is based on hydro data extracted from the Festival Hydro online portal on January 19th and 22nd 2024 as well as process related data retrieved from OCWA's WISKI database. It seems like there was an issue with the invoice for the month of April, resulting in its cancellation. Due to this cancellation, the breakdown of on-peak, mid-peak, and off-peak charges for that month is unavailable.

The Hornepayne facilitates are billed based on both consumption (kWh) and demand (kW) under as mentioned previously. The facility's hydro bills consist not only of energy charges but also other supplementary charges such as distribution, debt retirement, transmission and global adjustment charges.

Table 4-1: Annual Results for Hornepayne WTP & WWTP 2023

Facility	Total Electricity Usage (kWh)	Total Electricity Cost ($)	Total Flow (m^3)	Average Blended Rate ($/kWh)	Pricing Type
Hornepayne WTP	176,418 kWh	$35,044	207,291	0.20	Time-of-Use
Hornepayne WWTP	267,480 kWh	$56,019	266,200	0.20	Tiered

The annual trends at the WTP is as follows:

- In 2023, the annual total cost was verified at $35,044, reflecting a 5% decrease compared to the annual cost in 2022 ($36,759). The energy cost was the highest during December 2023, reaching $3,324.
- The annual energy consumption (base energy) for 2023 has been confirmed at 176,418 kWh, marking a 6% decrease from the annual consumption of 186,401 kWh in 2022.
- The annual flow at the facility in 2023 reached 207,291 m^3, representing an 8% decrease from the annual flow recorded in 2022 (225,108 m^3). The maximum flow was recorded during October 2023 at 20,682 m^3.
- Notably, the average cost per kilowatt-hour ($/kWh) in 2023 and 2022 remained similar at $0.20 per kWh.

The annual trends at the WWTP is as follows:

- In 2023, the annual total cost was verified at $ 56,019, similar to annual cost in 2022 ($56,065). The energy cost was the highest during December 2023 similar to WTP, reaching $5,214.
- The annual energy consumption for 2023 has been confirmed at 267,480 kWh, marking 2% decrease from the annual consumption of 272700 kWh in 2022.
- The annual flow at the facility in 2023 reached, representing an 8% decrease from the annual flow recorded in 2022 (288,119 m^3). The maximum flow was recorded during May 2023 at 45,334 m^3.
- Notably, the average cost per kilowatt-hour ($/kWh) in 2023 and 2022 remained similar at $0.20 per kWh.

5. Energy Intensities

5.1 Hornepayne Water Treatment Plant (WTP)

The figure below presents the monthly distribution of energy consumption, flow and associated cost for the Hornepayne WTP.

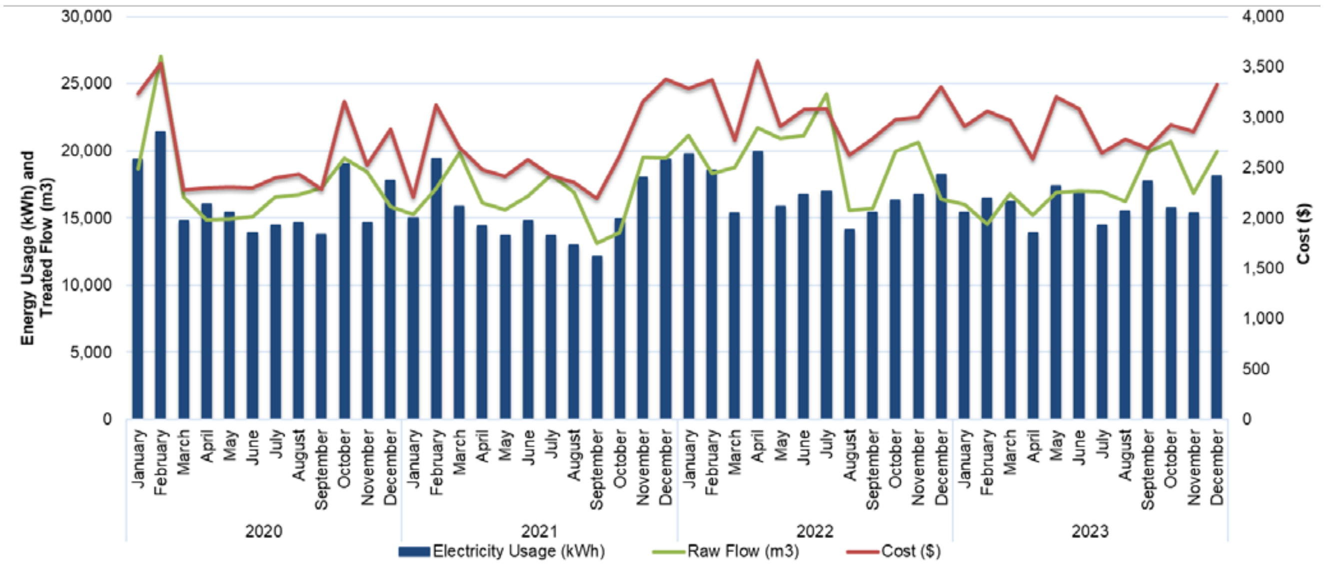

Figure 5-1 Monthly Energy Cost and Energy Consumption for Hornepayne WTP (2020- 2023)

- As can be observed in the Figure 5-1 and Table 5-1 the monthly cost and energy consumption had changed in 2023 when compared to the quarters of previous years. Hornepayne WTP has an average monthly consumption of approximately 14,702 kWh for 2023 with monthly costs varying from about $3,324 to $ 2,588. The highest energy use month was December of 2023, where the plant consumed 16,536 kWh of energy. The lowest energy use month was April of 2023, where the plant consumed $12,675 kWh of energy. The highest cost per month was also December of 2023 at $3,324 while the lowest cost per month was April of 2023 at $2,588, both aligning with the lowest and highest energy consumption.
- Analyzing the raw flow patterns for 2023, we observed a decrease in flow during Q1, Q2, and Q3 by 19%, 23%, and 4% respectively. However, Q4 experienced a slight increase in

flow by 1%. Overall, there was a reduction of raw water for treatment by 12% at Hornepayne WTP.

- Quarterly electricity usage is slightly higher (3%) during the third quarters of 2023 in comparison to previous years. The electricity usage across all other quarters witnessed a decrease in 2023 compared to 2022. Q1& Q2 of 2023 accounted to 43,873 kWh and 44,053 kWh respectively indicating 11% & 8% decrease in energy consumption compared to 2022. The possible reasons for this increase includes better operational practices and the reduced flow due to precipitation.

The following table summarizes the trends in raw flow, consumption, demand and costs for all quarters of 2020 to Dec 2023. The percentage change indicates the change in value since the corresponding quarter from the previous year.

Table 5-1 Comparison of Process and Electricity Parameters at Hornepayne WTP

Year	Quarter	Total Energy Usage (kWh)		Total Raw Flow (m^3)		Total cost ($)		Average Volumetric Energy Intensity (kWh/m^3)	
2020	Q1	50,750	-	62,216	-	9,047	-	0.82	-
	Q2	41,346	-	44,920	-	6,908	-	0.92	-
	Q3	39,195	-	50,528	-	7,112	-	0.78	-
	Q4	47,001	-	53,777	-	8,570	-	0.87	-
2021	Q1	45,907	↓	52,325	↓	8,031	↓	0.88	↑
	Q2	39,159	↓	48,391	↑	7,474	↑	0.81	↓
	Q3	35,459	↓	48,291	↓	6,962	↓	0.73	↓
	Q4	47,758	↑	52,843	↓	9,145	↑	0.90	↑
2022	Q1	49,028	↑	58,296	↑	9,438	↑	0.84	↓
	Q2	48,018	↑	63,758	↑	9,541	↑	0.75	↓
	Q3	42,481	↑	55,530	↑	8,502	↑	0.86	↑
	Q4	46,874	↓	57,035	↑	9,277	↑	0.82	↓
2023	Q1	43,873	↓	47,402	↓	8,942	↓	0.93	↑
	Q2	44,053	↓	49,193	↓	8,870	↓	0.90	↑
	Q3	43,550	↑	53,171	↓	8,122	↓	0.82	↓
	Q4	44,942	↓	57,525	↑	9,110	↓	0.78	↓

The volumetric energy intensity, representing the average energy expenditure for treating one cubic meter of water, has increased from 0.88 kWh/m^3 in 2022 to 0.94 kWh/m^3 in 2023 at the plant. This reflects a 7% rise in the annual average volumetric energy compared to the previous year. Upon closer examination of individual quarters, the Volumetric Energy Intensity (VEI) for water treatment peaked in Q1, with an average of 0.93 kWh/m^3 treated, followed by Q1 with an average of 0.90 kWh/m^3 treated. While registering its lowest values in Q4 at 0.78 kWh/m3 treated. In Q3 and Q4 of 2023, there was a 5% decrease in VEI compared to the previous year.Furthermore, there has been a decrease in the flow at the facility, lowering from an annual total of 234,619 m^3 in 2022 to 207,291 m^3 in 2023.

5.2 Hornepayne Waste Water Treatment Plant (WWTP)

The Hornepayne WWTP process consists of head works, aeration for biological treatment, secondary clarifiers for settling, and a chlorination system for disinfection. The Hornepayne waste water treatment plant facility is located 37 Honka Dr., with effluent received by the Effluent Receiver, Little Jackfish River. The major processes at the facility consist of Extended Aeration and Carrousel-type treatment systems. A UV system was proposed for the facility; however, that idea has been cancelled and the municipality is looking into other options. Raw water and effluent from the facility are metered using flow meters. The Hornepayne WWTP currently operates under Environmental Compliance Approval Number 7840-C7RRSS, with a rated capacity of 1,364 m3/d. The quarterly flow, treated loading, and hydro bill analysis for the Hornepayne WWTP is summarized in Table 5.2-1. The treated loadings assessed include the biological oxygen demand (BOD), total Kjeldahl nitrogen (TKN), and total phosphorus (TP) loadings.

Table 5-2 : Quarterly Flow, Load and Energy Consumption Data at Hornepayne WWTP (2020 –2023)

Year	Quarter	Total Flow (m^3)	Total BOD Treated (kg)	Total TKN Treated (kg)	Total TP Treated (kg)	Total Electricity Usage (kWh)	Total Electricity Cost ($)	Average Blended Rate ($/kWh)
2020	Q1	36,079	3,059	507	53.1	61,020	11,585	0.19
	Q2	101,694	3,638	1,043	82.1	66,960	12,709	0.19
	Q3	57,185	7,014	1,373	166.7	55,440	10,533	0.19
	Q4	60,320	3,354	813	58.7	74,700	13,923	0.19
2021	Q1	37,521	3,030	757	76.4	66,240	11,893	0.18
	Q2	78,245	3,870	993	84.9	64,620	12,595	0.19
	Q3	57,630	4,343	858	132.5	55,440	10,930	0.20
	Q4	55,335	2,498	1,219	58.6	72,180	14,533	0.20
2022	Q1	38,981	3,608	765	76.3	72,360	14,427	0.20
	Q2	100,729	1,938	821	69.2	67,320	14,017	0.21
	Q3	77,084	3,775	546	69.3	61,920	12,898	0.21
	Q4	71,325	6,124	425	9.6	71,100	14,723	0.21
2023	Q1	33,181	2,014	284	16.4	69,120	14,447	0.21
	Q2	108,923	3,745	783	9.6	67,140	14,014	0.21
	Q3	56,209	2,337	451	22.5	64,260	13,292	0.21
	Q4	67,887	2,208	517	28.75	66,960	14,265	0.21

For the Township's WWTP, four KPIs (one primary and three secondary) were identified:

1. Volumetric Energy Intensity (kWh per volume raw sewage)
2. Biological Energy Intensity (kWh per kg biological oxygen demand (BOD) treated)
3. Nitrogen Energy Intensity (kWh per kg TAN treated)
4. Phosphorus Energy Intensity (kWh per total phosphorus (TP) treated)

For WWTPs, the most important KPI is expressed as the energy used per mass of treated pollutant, or kWh per kg of BOD treated (biological energy intensity). The phosphorus energy intensity is the energy required to remove Total Phosphorus (TP) from the influent raw sewage to the final effluent. Likewise, the nitrogen energy intensity corresponds to the amount of energy required to remove Total Kjeldahl Nitrogen (TKN) from the influent raw sewage. The nitrogen load (i.e. TKN and TAN) to a plant is primarily treated in the aeration process and has the largest impact on the oxygen demand to treat the incoming sewage. Nitrogen removal from sewage has a greater oxygen demand on a per kg basis than BOD. Table 5 -3 shows the trend in quarterly KPIs at the Hornepayne WWTP from 2020 to 2023.

Table 5-3: Hornepayne WWTP Quarterly KPIs (2020 –2023)

Year	Quarter	Volumetric Energy Intensity (kWh/m^3)	Biological Energy Intensity (kWh/kg)	Nitrogen Energy Intensity (kWh/kg)	Phosphorus Energy Intensity (kWh/kg)
2020	Q1	1.69	19.95	120.24	1,149
	Q2	0.66	18.40	64.18	816
	Q3	0.97	7.90	40.36	333
	Q4	1.24	22.27	91.84	1,273
2021	Q1	1.77	21.86	87.54	867
	Q2	0.83	16.70	65.07	761
	Q3	0.96	12.76	64.59	418
	Q4	1.30	28.89	59.22	1,232
2022	Q1	1.86	20.06	94.64	949
	Q2	0.67	34.74	81.99	973
	Q3	0.80	16.40	113.43	893
	Q4	1.00	11.61	167.30	7,388
2023	Q1	2.08	34.33	243.25	4,227
	Q2	0.62	17.93	85.80	7,011
	Q3	1.14	27.50	142.56	2,855
	Q4	0.99	30.32	129.51	2,329

The trends for all energy intensities at WWTPs typically show that there is an inverse relationship between the raw flow or the mass of treated pollutant and the corresponding energy intensity. This trend can be observed in the figure below which shows that as flow increases, the amount of energy required to treat each m^3 of sewage decreases. While raw flow often peaks in the spring and fall months at the WWTP, volumetric energy intensity drops, Figure 5-2.

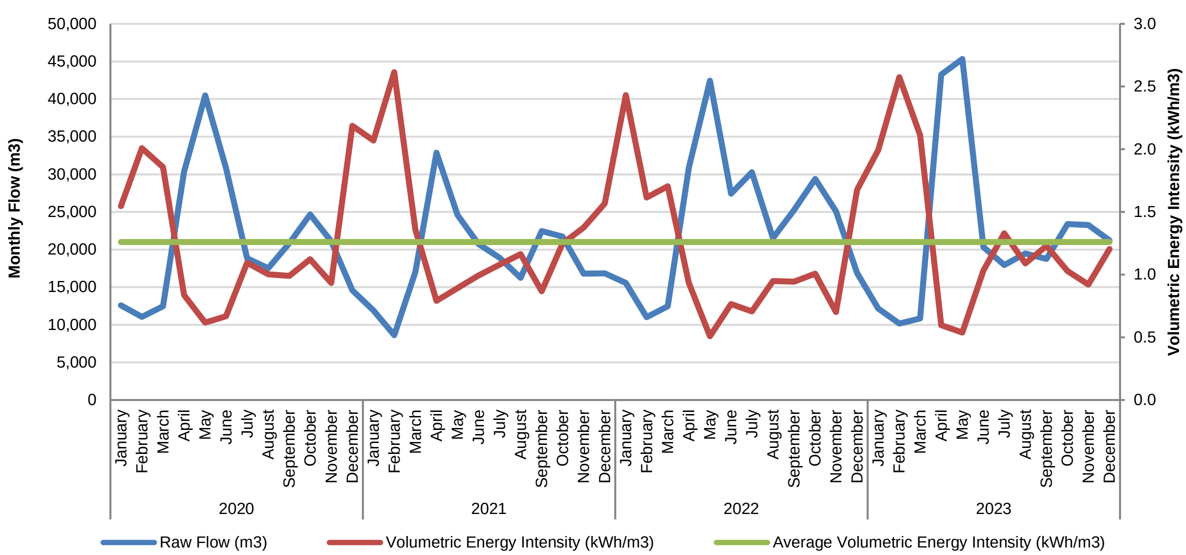

Figure 5-2 : Volumetric Energy Intensity at the Hornepayne WWTP (2020 –2023)

Usually any assessment of the treatment facility begins with the comparison of flow volumes against the used energy, followed by investigation of the additional factors such as influent concentrations for wastewater plants.

The volumetric energy intensity, representing the average energy expenditure for treating one cubic meter of water, has increased from 1.16 kWh/m^3 in 2022 to 1.30 kWh/m^3 in 2023 at the plant. This reflects a 12% rise in the annual average volumetric energy compared to the previous year. Upon closer examination of individual quarters, the Volumetric Energy Intensity (VEI) for water treatment peaked in Q1, with an average of 2.23 kWh/m3 treated. This trend of higher consumption in winter is typical at the plant, while registering its lowest values in Q2 at 0.72 kWh/m3 treated. In Q1 of 2023, there was a 16% increase in VEI compared to the previous year.Furthermore, there has been a decrease in the flow at the facility, lowering from an annual total of 288,119 m^3 in 2022 to 266,200 m^3 in 2023.

For WWTPs, perhaps the most important KPI is expressed as the energy used per mass of treated pollutant, or kWh per kg of BOD treated (referred to as Biological energy intensity). As with the flow and volumetric energy intensity, there is an inverse relationship between the average BOD treated and the biological energy intensity. As shown in Figure 5-3 as the BOD load increases, the biological energy intensity decreases and vice versa. Therefore, as expected, most of the months with the large spikes in BOD loads correspond to the months with the lowest biological energy intensity.

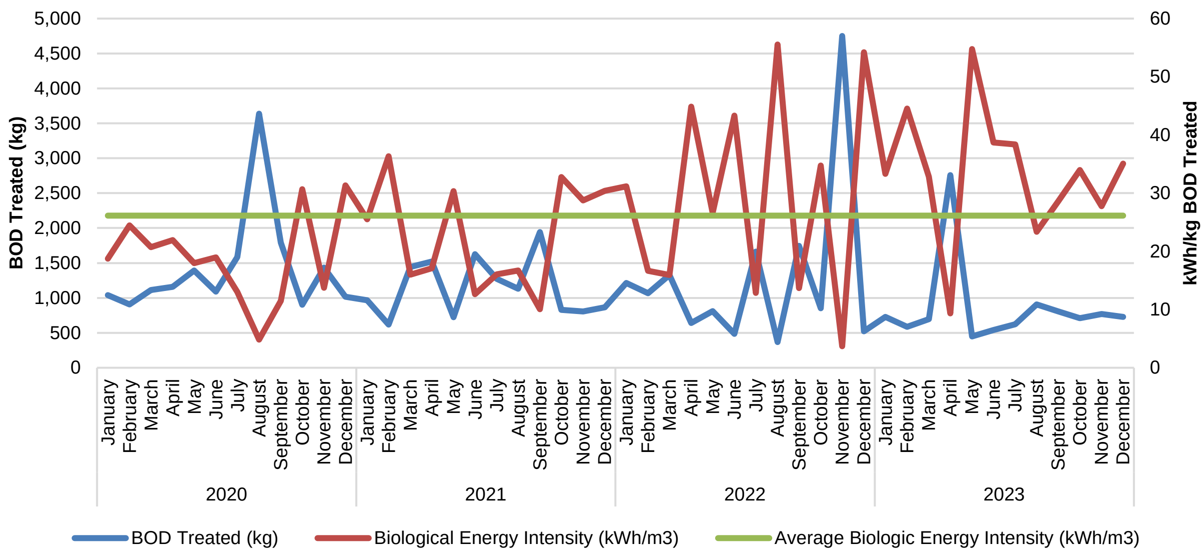

Figure 5-3 : BOD loading vs Biological Energy Intensity at the Hornepayne WWTP (2020 –2023)

The biological intensity or the average energy expenditure for BOD treatment has witnessed a notable increase at the plant in 2023. In 2022, the annual average Biological Energy intensity stood at 27.75 kWh/kg BOD treated, contrasting with the elevated figure of 31.7 kWh/kg BOD Treated recorded in 2023, reflecting an increase of 14%.

In April 2023, there was a notable increase in the BOD load, reaching 2,756 kg BOD treated, compared to previous Aprils. This contributed to a decrease in biological energy intensity, which was recorded at 8.82 kWh/kg BOD treated in Q2 2023, contrasting with Q2 2022. Given the variability in BOD, optimizing aeration operations to closely align with influent loads presents opportunities for improvement. May exhibited the highest biological energy intensity, reaching 51.56 kWh/kg BOD treated. This coincided with the period of lowest BOD treated and highest flow received throughout the year.

As can be seen in Figure 5-4 the nitrogen energy intensity or the average energy expenditure for nitrogen treatment has have significantly increased in 2023 when comparing to 2022. In 2022, the annual average nitrogen energy intensity stood at 129.17 kWh/kg TKN Treated, compared with average of 176.79 kWh/kg TKN Treated in 2023, an increase of 37%. Examining individual quarters, the energy demand for Nitrogen removal peaked in Q1 at an average of 259 kWh/kg TKN Treated, while reaching its lowest in Q4 at 130 kWh/kg TKN Treated.
February exhibited the highest nitrogen energy intensity, reaching 361 kWh/kg Nitrogen treated, while the lowest consumption of energy occurred during April. This coincided with the period of highest Nitrogen treated throughout the year.

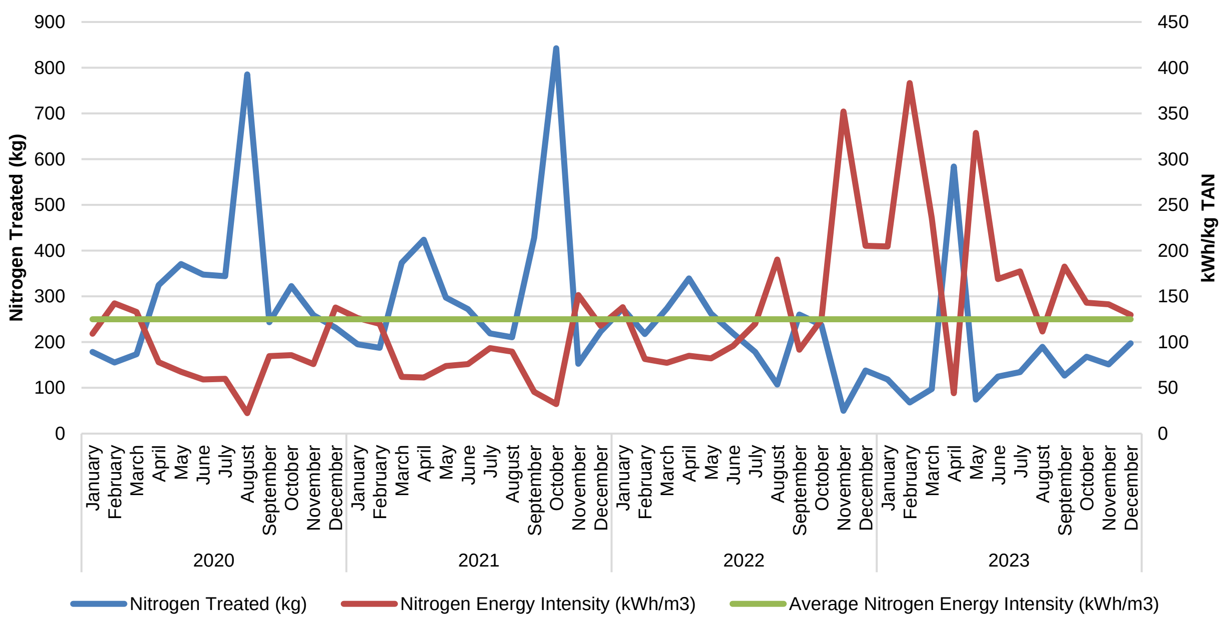

Figure 5-4 : Nitrogen loading vs Nitrogen Energy Intensity at the Hornepayne WWTP (2020 –2023)

Likewise, the phosphorus energy intensity is the energy required to remove Total Phosphorus (TP) from the influent raw sewage to the final effluent. Figure 5-5 shows the amount of phosphorous treated vs the phosphorus energy intensities at Hornepayne WWTP. Unlike the BOD and Nitrogen energy intensities, the phosphorus energy intensity does not impact the aeration process as it is driven by chemical addition. However, the treatment process as a whole plays a part in aiding phosphorus removal by mixing, settling and removal of phosphorus.

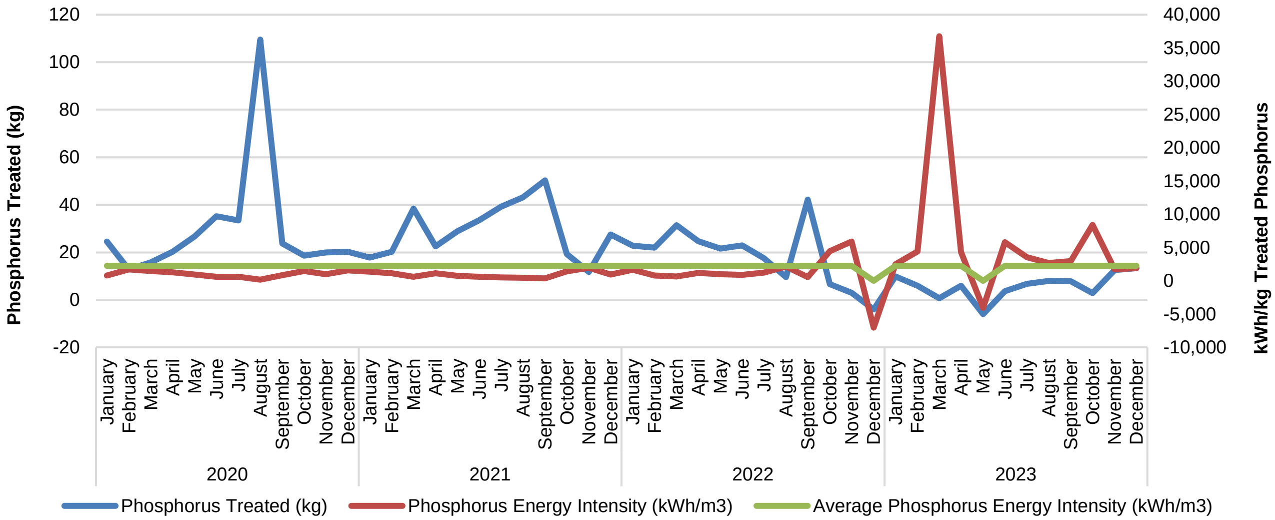

Figure 5-5: Phosphorous loading vs Phosphorous Energy Intensity at the Hornepayne WWTP (2020 –2023)

The phosphorus energy intensity, or the average energy expenditure for nitrogen treatment, has significantly increased in 2023 to 6,583 kWh/kg treated when compared to 2,293 kWh/kg treated in 2022. In 2022, the annual average phosphorus energy load treated stood at 19 kWh/kg phosphorus treated, compared to an average of 16 kWh/kg phosphorus treated in 2023, representing a decrease of 15%. Examining individual quarters, the energy for phosphorus removal peaked in Q1 at an average of 14,545 kWh/kg P treated, while reaching its lowest in Q2 at 4,727 kWh/kg P treated. The amount of phosphorous treated at the facility has declined significantly in 2023. The average influent phosphorus loading was only 1.47 mg/l in 2023, marking a significant decrease compared to previous years. Additionally, the effluent removal rate was lower in 2023 compared to previous years.

Following consultation with operations, potential causes recommended include infiltration due to spring snow melting in April, May, and June, potentially leading to reduced retention time from increased daily flows. Regarding intensity the increase from 2022 to 2023, could be attributed to differences in spring melting amounts between the years. This time frame is where we suspect most of the process efficiency losses occur, except perhaps for a wet fall when flows are relatively stable for most of the year.

6. Energy Intensity Benchmarking

Energy performance is evaluated using KPIs and electricity usage for the period of study and comparing the KPIs across facilities. This way, facility energy efficiency can be evaluated and compared. It is essential from a benchmarking perspective that we compare the KPIs with similar plants across the industry, as typically larger plants are more energy efficient. Table 6-1 and Table 6-2 present a comparison of volumetric energy intensities for OCWA operated WTPs and WWTPs, respectively.

Table 6-1 : Volumetric Energy Intensity Comparison for WTPs

Category/Facility	Rated Capacity (m^3/d)	Volumetric Energy Intensity (kWh/m^3)
Ontario - Water Distribution	-	0.17
Deep River DWS	13,638	0.42
Hornepayne WTP	**1,800**	**0.94**
Lion’s Head DWS	1,351	1.17
Temagami South WTP	950	1.55
Emo WTP	950	1.58
Beardmore WTP	752	5.7
Nakina WTP	-	5.5

Table 6-2: Volumetric Energy Intensity Comparison for WWTPs

Category/Facility	Facility Type	Rated Capacity (m^3/d)	Volumetric Energy Intensity (kWh/m^3)
Renfrew WPCP	Extended Aeration	9,500	0.52
Paris WPCP	Extended Aeration	7,056	1.54
Angus WPCP	Extended Aeration	5,511	1.19
Shelburne WPCP	Extended Aeration	2,500	1.65
Hornepayne WWTP	**Extended Aeration**	**1,364**	**1.30**

As seen in Table 6-1 , Hornepayne WTP has a volumetric energy intensity of 0.94 kWh/m^3, lower than much of the facilities analyzed. It must be noted that based on the energy consumption profile, the Township’s WTP has a low volumetric energy intensity compared to other facilities examined. This is expected, as the rated capacity for Hornepayne WTP is higher than other facilities.

The Hornepayne WWTP volumetric energy intensity of 1.30 kWh/m^3 is also comparable to other extended aeration facilities, as seen in Table 6-2. Despite having the lowest rated capacity, the volumetric energy intensity is lower than some larger facilities (e.g., Paris WPCP and Shelburne WPCP).

7. Recommendations

OCWA recommends the Township to further explore the opportunities to optimize energy usage at both facilities. OCWA operations and support services will work with the Town (as requested) on any equipment upgrades and operational and process optimization activities. Detailed study might be required to evaluate the Return of Investment for the recommendations below.

Based on the 2023 Capital maintenance plan, there is plans for leak detection for the water distribution system during this year. This could also provide potential energy and cost savings by identifying and repairing any leaks in the distribution system. This may help improve the volumetric energy intensity of Hornepayne WTP as less water will be required to be pumped after resolving the leak associated.

Additionally, improving the energy efficiency of the aeration system of Hornepayne WWTP can offer significant energy cost savings, especially due to the variability of the influent BOD and TAN concentrations. Adjusting the aeration control strategy can capture energy savings by preventing over-aeration. Furthermore, future capital upgrades to the aeration system may be explored to improve efficiency and lower energy costs. Currently the facility uses coarse bubble diffusers, which provide less efficient aeration than fine bubble diffusers. Using an energy efficient turbo blower may also provide more energy savings as well. More information and studies can also be provided by the OCWA engineering team.

The Township of Hornepayne can also make use of various incentives such as the Save on Energy Retrofit programs available for these upgrades. Changes to the Save on Energy program came into effect in May 2023, adding a new custom stream for the Retrofit program. Applicants are now able to submit Retrofit applications for custom measures and are no longer limited by the listed prescriptive measures. This will permit more non-standard projects to benefit from more energy-efficiency measures that are more reflective of actual operating conditions, and to capture more savings. An increased incentive rate will be available of $1,200/kW or $0.13/kWh, whichever is greater. Switching to more energy efficient indoor lighting alternatives can also help reduce energy use at the Hornepayne facilities. The rate for both lighting and non-lighting projects will be the same, while incentives continue to be capped at 50% of the total eligible project costs[4].

The Peak Perks program also offers Ontarians incentives for enrolling and maintaining membership in the program. Participants with a smart thermostat can enroll by agreeing to adjustments between 2-4°C during peak energy demand periods from June to September. This may occur up to 10 times per year, up to 3 hours per period. $75 is granted for enrolling in the program, with $20 also granted each year a participant remains enrolled.[5]

As part of the Canada Greener Homes Initiative, incentives are available for more efficient heating and cooling equipment. Up to $5,000 is available when installing a new heat pump for space and water heating/cooling. The heat pumps may be either air-source or ground-source, which must be on a list of eligible products that meet Energy Efficiency Regulations. Additionally, heat pumps will provide energy savings for both heating and cooling, operating more efficiently than furnaces

[4] https://saveonenergy.ca/en/News-and-Updates/May-2023-Retrofit-program-update
[5] https://saveonenergy.ca/For-Your-Home/Peak-Perks

and air conditioners. With the incentive and reduced operational costs, heat pumps may be an attractive investment for the Township of Hornepayne.[6]

OCWA can assist the township of Hornepayne with future applications for the Ontario Community Infrastructure Fund. The facility is also eligible to apply for the funding to receive the minimum grant of $100,000 per year (associated with LSB). This funding is provided for Capital expenditures on core infrastructure projects that are part of asset management plan.

OCWA can also assist the Township of Hornepayne in with the incentive applications process that require and Measurement and Verification (M&V) procedures such as the new custom retrofit, EPP, and deep retrofit IESO programs to ensure the projected energy savings as a result of any equipment upgrades, operational and process optimization activities within water and wastewater facilities OCWA operates. OCWA can provide energy walkthroughs followed by process review and optimization, which are expected to increase both process and energy efficiencies for these plants.

[6]https://natural-resources.canada.ca/energy-efficiency/homes/canada-greener-homes-initiative/canada-greener-homes-grant/greener-homes-grant-ontario/24835