APPENDIX A1:
TM 1 – Background and Existing Conditions

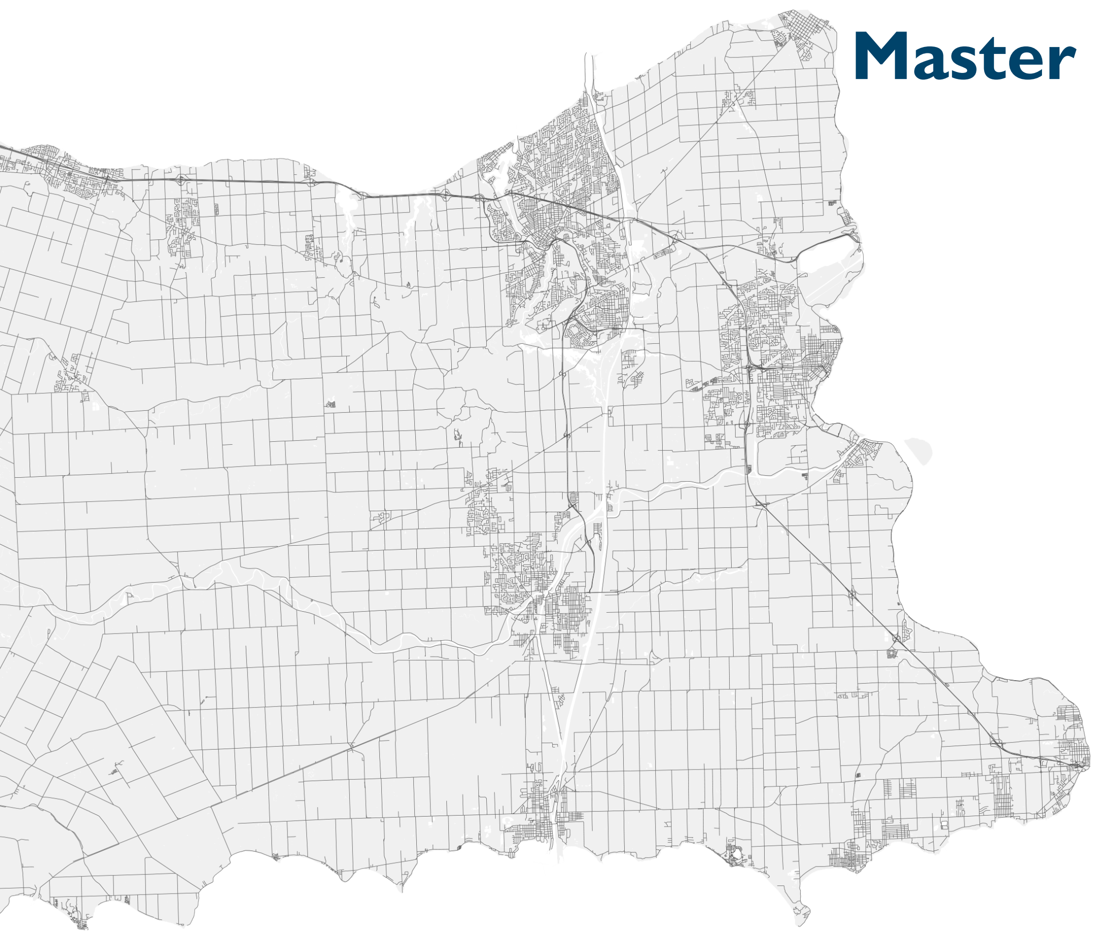
Niagara Region

Technical Memorandum 1

Background and Existing Conditions

2021 Biosolids Management Master Plan Update

August 5, 2022



GM BluePlan Engineering

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA

www.GMBluePlan.ca

Table of Contents

621143 – Niagara Biosolids Management Master Plan Update
Technical Memorandum 1 – Background and Existing Conditions

QA/QC - SIGN OFF SHEET

This report has been reviewed and approved by the undersigned.

Laurie Boyce, B.Sc., M.A.
Project Manager

Zhifei Hu, P.Eng.
Assistant Project Manager, Technical Lead

1.0 Introduction

1.1 Background and Purpose

In alignment with Niagara's Growth Management Strategy and under the legislative context of the Province's Place to Grow Plan and the Regional Policy Plan, growth in the Region of Niagara should occur in a sustainable manner addressing economic, social, and environmental considerations. The Region initiated the current Biosolids Management Master Plan (BMMP) Update to review the existing biosolids management strategy in light of these Provincial and Regional growth targets, to identify limitations, develop and evaluate alternative management strategies, and recommend a preferred strategy for implementation. The study will address of Phases 1 and 2 of the Municipal Engineers Association Class Environmental Assessment Master Planning Process, while meeting the goals and objectives of the Region.

The BMMP will be developed to:

- Meet future population growth needs to the year 2051,
- Consider future regulations,
- Educate stakeholders regarding the benefits of biosolids reuse,
- Address community expectations,
- Protect the environment,
- Provide greater flexibility, reliability and cost efficiency for biosolids management, and
- Provide a 'Made in Niagara' strategy that incorporate features unique to this area

1.2 Technical Memorandum Outline

This technical memorandum (TM) is organized into the following sections:

1. **Introduction:** This section describes the BMMP purpose and TM outline.
2. **Background and Existing Biosolids Management Program:** This section provides an overview of the existing biosolids and residuals management plan, and the social, cultural, and natural environment of the study area
3. **Third Party Contractors for Biosolids Management:** The roles and responsibilities of each third party contractor are described in this section.
4. **Review of the 2010 BMMP**: A review of the recommendations from the 2010 BMMP and their status are provided in Section 4.
5. **Wastewater Treatment and Biosolids Management**: The existing biosolids management practices at each WWTP, current performance and planned upgrades are described in this section.
6. **Water Treatment and Residuals Management**: The existing residuals management practices at each WTP, and quality and quality of residuals produced are described in this section.
7. **Garner Road Biosolids Facility**: The existing Garner Road Biosolids Facility, operations, and planned upgrades are described in this section.

8. **Biosolids and Residuals Management in Other Jurisdictions:** This section provides details on the assess current biosolids and residuals management practices in jurisdictions based on discussions with different municipalities.
9. **Summary and Next Steps:** The final section summaries the major findings and the next steps in the assessment process.

2 Background and Existing Biosolids and Residuals Management Program

The Region currently has a water and wastewater treatment system servicing 11 of their 12 area municipalities (Wainfleet is serviced by well and septic systems). The study area for this Master Plan encompasses the entire Region of Niagara, as biosolids products are applied on agricultural lands within Niagara, including Wainfleet, as illustrated in Figure 1.

Per the Region's Official Plan, which was adopted by Regional Council on June 23, 2022 under by-law 2002-47, the Region is planning to accommodate an additional population of over 200,000 people over the next 30 years for a total population of 694,000 by 2051.

The Niagara Region is situated between Lake Ontario, Lake Erie and the Niagara River, and contains the Niagara Escarpment, a limestone ridge that extends from Queenston at the Niagara River to Tobermory on the Bruce Peninsula. Portions of Niagara Region are designated areas under the Niagara Escarpment Plan, the Greenbelt Plan Natural Heritage System, and the Natural Heritage System for the Growth Plan as shown in Figure 2, with restrictions on development within these areas.

Niagara Region contains a unique microclimate suitable for cultivation of soft fruits and grapes, that support a winery industry unique to Ontario, which is shown as 'Specialty Crop Area' in Figure 1. In addition to agriculture, key industries within the Region include manufacturing, automotive and tourism.

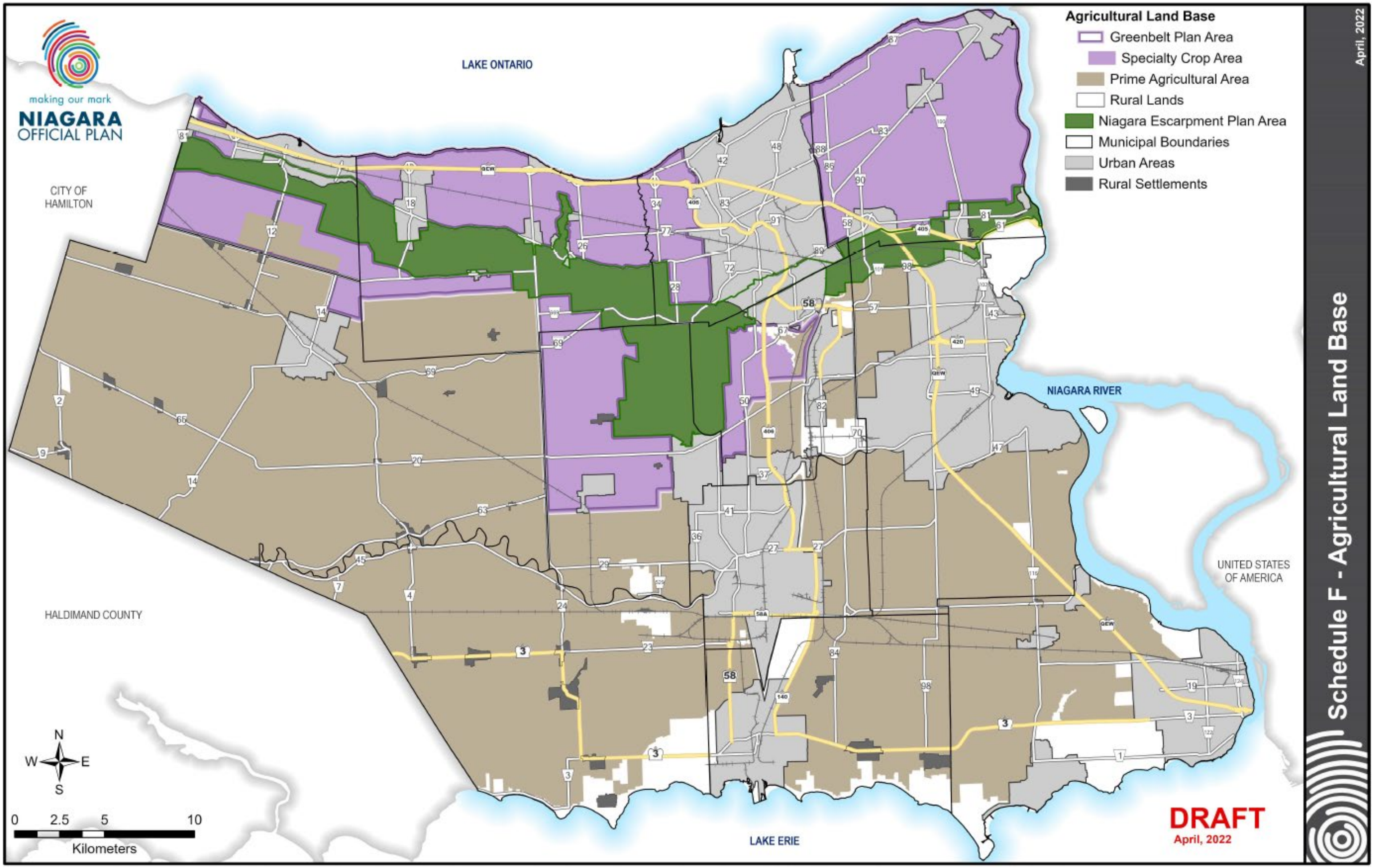


Figure 1 – Agricultural Land Base within Niagara Region (excerpt from Draft Regional Official Plan, April 2022)

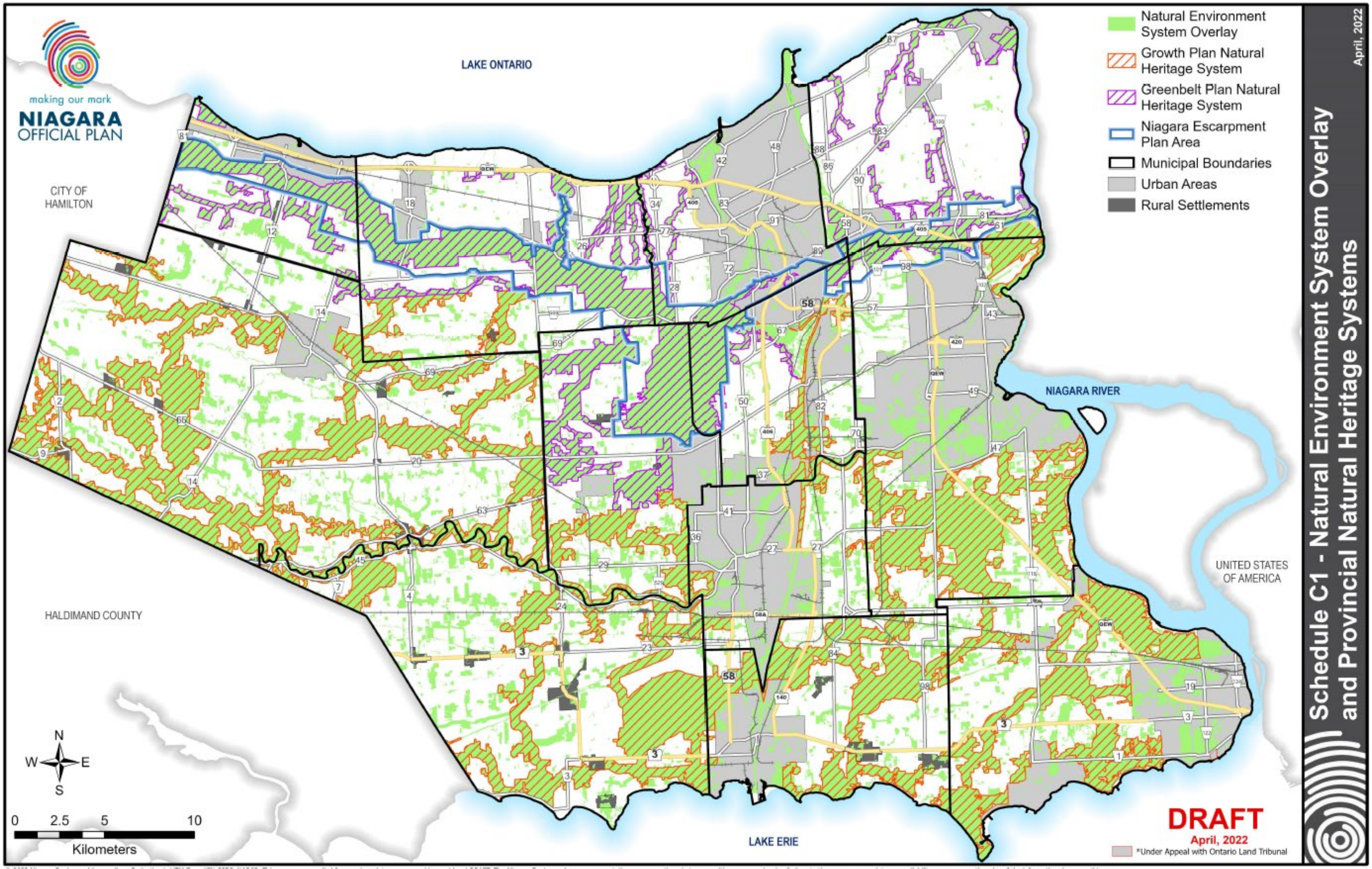


Figure 2 – Natural Environment Systems within Niagara Region (excerpt from Draft Regional Official Plan, April 2022)

There are 10 wastewater treatment plants (WWTP) plus the Stevensville/Douglastown Lagoon system. A Region is also completing a Schedule C Class Environmental Assessment (EA) for a new WWTP in South Niagara Falls to meet future needs. In addition, a Schedule B Class EA is being undertaken to develop a solution for servicing Queenston, which may involve the decommissioning of the Queenston WWTP and replacing it with a wastewater pumping station and forcemain to convey flows to the Niagara Falls system.

The Niagara Falls Stanley Avenue WWTP is currently the only plant that provides dewatering of biosolids; all other plants produce liquid biosolids. Dewatering is also planned at the new South Niagara Falls WWTP. Liquid biosolids from the WWTPs are trucked to the centralized Garner Road Biosolids and Dewatering Facility (Garner Road Facility). Historically, liquid biosolids have been trucked directly from the WWTPs to agricultural land based on available capacity and opportunities for land application, although in recent years all liquid biosolids have been first trucked to the Garner Road facility before land application. The wastewater treatment and biosolids facilities are shown in Figure 3.

There are 6 water treatment plants in Niagara Region, as shown in Figure 4. The residuals from the water treatment processes at the DeCew, Grimsby and Niagara Falls Water Treatment Plants (WTPs) are also transported to the Garner Road Facility to be mixed with Regional biosolids. The residuals from the remaining WTPs are conveyed to the WWTPs through the wastewater collection system.

The Garner Road facility provides storage for liquid biosolids and dewatering centrifuges. The liquid biosolids and WTP residuals received at the Garner Road Facility are blended and then either stored and trucked to be utilized directly on agricultural lands or dewatered and transported to the Walker Environmental biosolids processing facility (formerly N-VIRO Systems Canada) located in Thorold. Walker provides enhanced treatment of the Region biosolids, and markets and sells the final soil amendment product through licensed distributors.

Thomas Nutrient Solutions is responsible for managing Niagara's land application program and identifying and partnering with farmers for biosolids application to their agricultural land. They are also responsible for haulage, and lagoon Operation and Maintenance at the Garner Road facility. Thomas Nutrient maintains a Non-Agricultural Source Materials (NASM) plan for each agricultural end user and is responsible for acting in accordance with the Nutrient Management Act.

Our consulting team completed site visits of all 10 WWTPs, as well as the Garner Road and Walker Environmental Facilities on January 31 to February 2, 2022 to review existing conditions and discuss operations with Region staff.

An overview of the current biosolids and residuals management practices is illustrated in Figure 5.

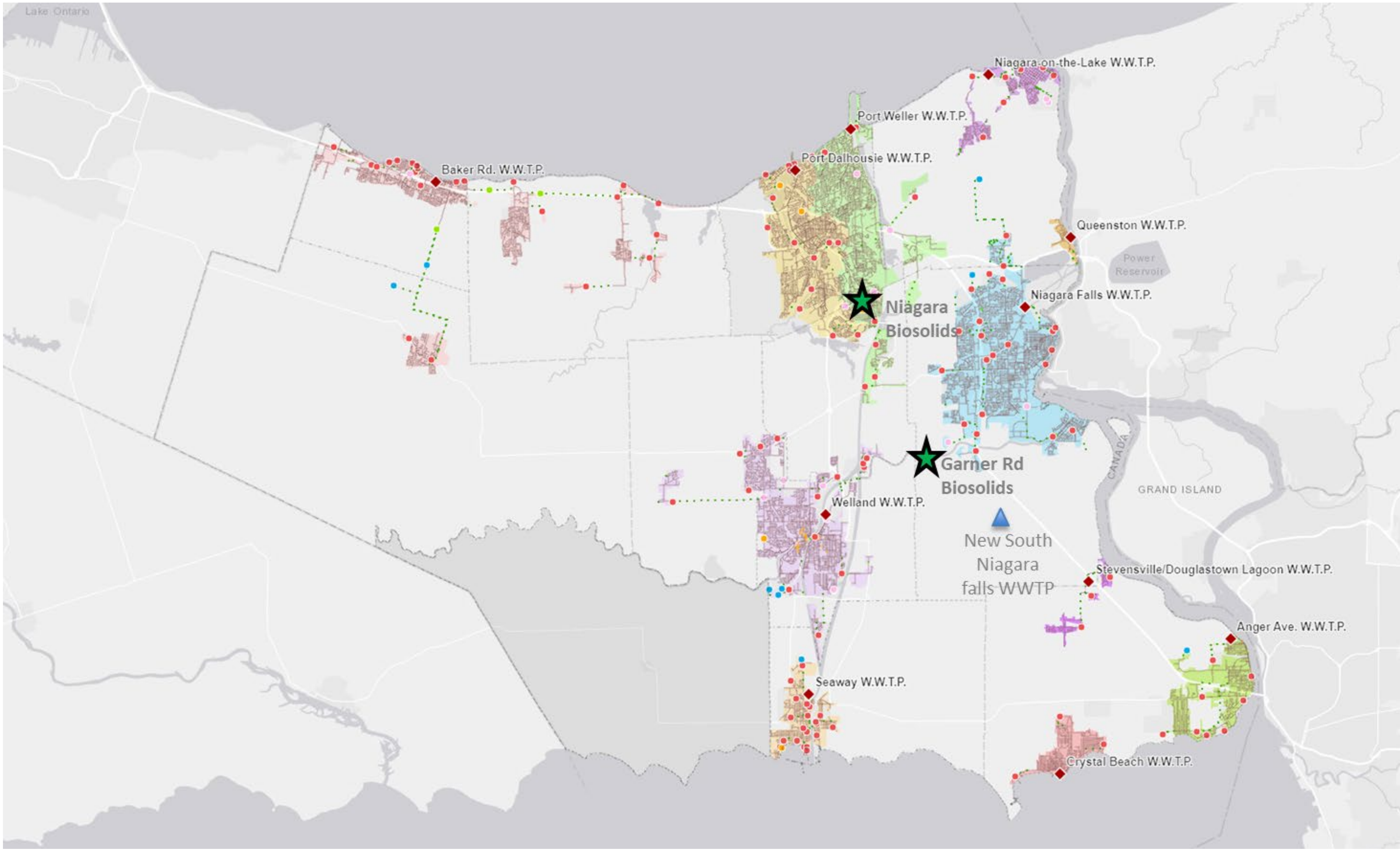


Figure 3: Existing and Planned Wastewater Treatment and Biosolids Facilities in Niagara Region

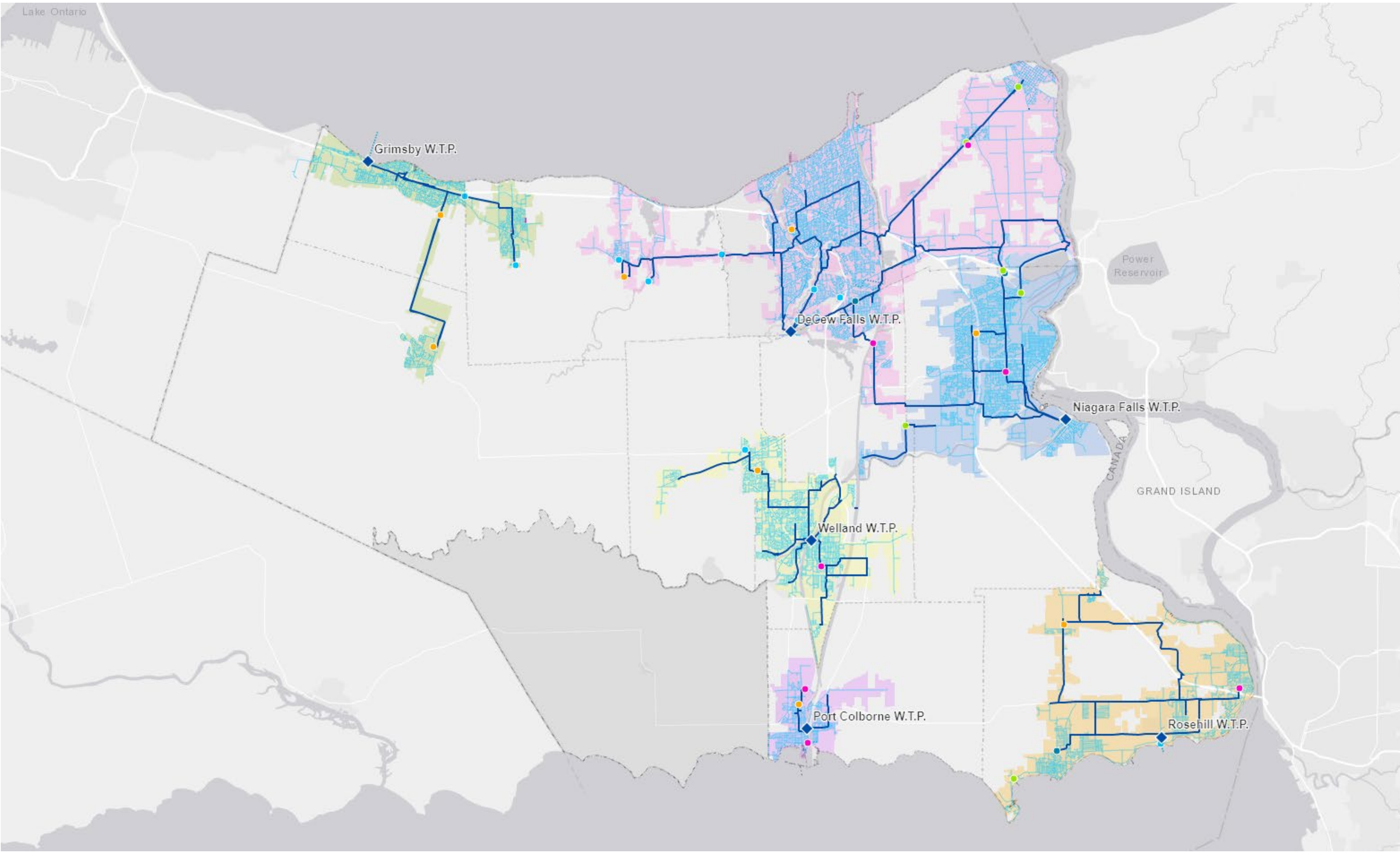


Figure 4: Existing Water Treatment Plants in Niagara Region

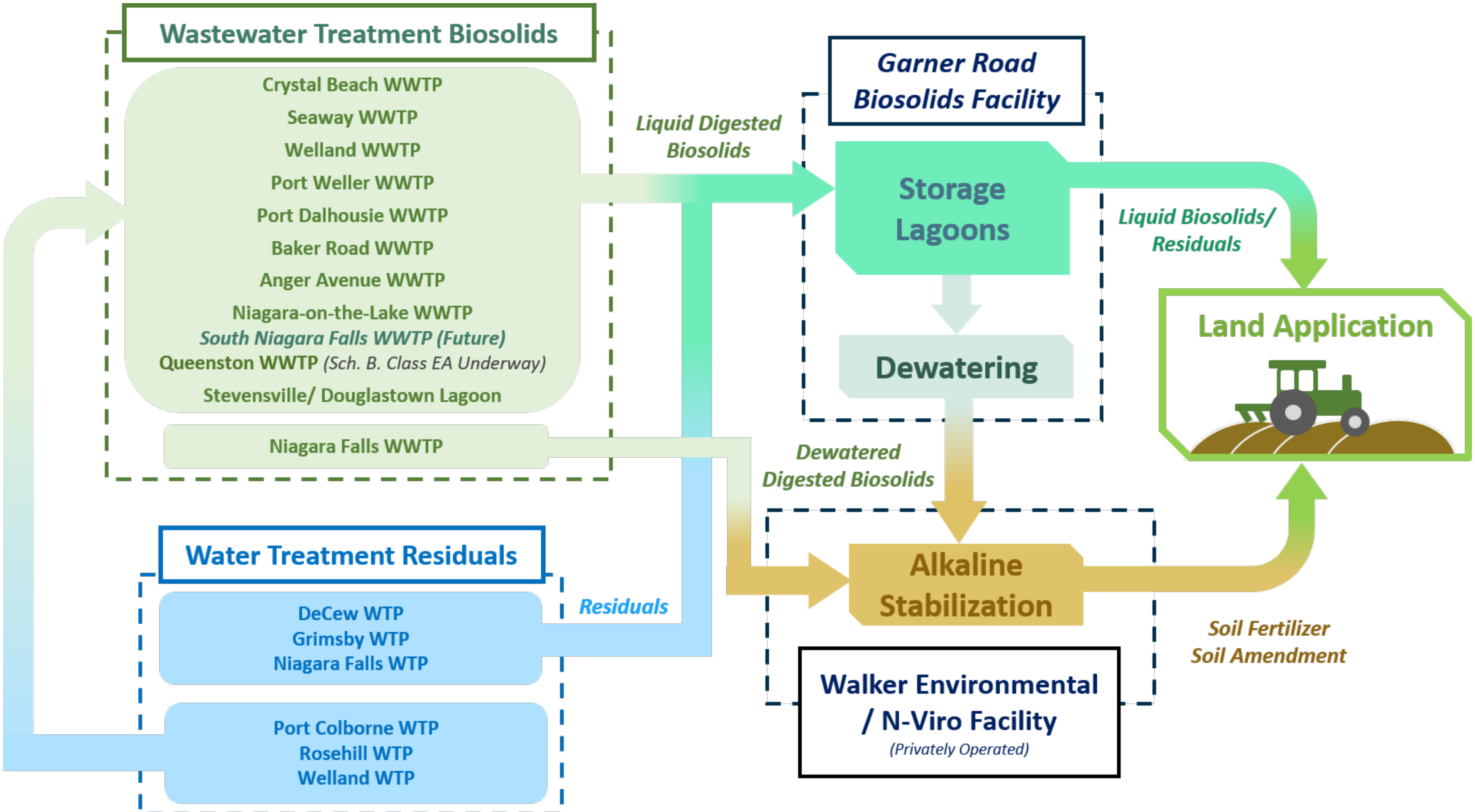


Figure 5: Overview of Current Biosolids and Residuals Management Practices in Niagara Region

3 Third Party Contractors for Biosolids Management

The Region has contracts with two third party contractors as part of their Biosolids Management Program: Walker Environmental and Thomas Nutrient Solutions.

3.1 Walker Environmental

The Region has contracted Walker Environmental (formerly N-Viro Systems Canada) to manage a portion of Region-generated biosolids since 2004. The Region's current contract with Walker Environmental (Walker) was executed on March 31, 2017 and expires after ten years (March 31, 2027) with the potential for renewal for an additional five years (March 31, 2032).

Walker's N-Viro processing facility has a total capacity of 10,000 dry tonnes, with 6,000 dry tonnes reserved for Niagara Region and the remaining 4,000 dry tonnes available for other suppliers. Before this additional 4000 dry tonne capacity is offered to other suppliers, Niagara Region is given first right of refusal. The contract guarantees that the Region will provide a minimum of 4,700 dry tonnes of biosolids per year, which is equivalent to approximately 50% of annual Region-generated biosolids. If this minimum volume is not provided, the Region must financially compensate Walker based on an agreed upon fee structure.

The Region must provide Walker Environmental with dewatered biosolids with solids content between 22 - 40%, which is treated through the N-Viro process to form a soil product with dry solids between 55 and 65%. Biosolids must also meet metal quality standards to allow for land application, with the Region responsible for routine testing. The Region must cover Walker's disposal costs for any Region-sourced biosolids that do not meet quality criteria.

Walker is responsible for hauling dewatered biosolids from sources within the Region. The Region currently dewaters at the Niagara Falls WWTP and Garner Road biosolids facility, which is then hauled to the Walker facility for processing. Once Walker has picked up the biosolids from the Region, the biosolids become the property of Walker, and Walker takes on all legal and regulatory responsibilities. Walker is responsible for arranging distribution and marketing of the product.

The Region pays Walker a tipping fee per tonne of dry solid, with a decreasing unit rate as the solid concentration increases. The rate is adjusted annually to account for inflation.

3.2 Thomas Nutrient Solutions

Thomas Nutrient Solutions has a current contract with Niagara Region executed on October 1, 2020 that expires December 31, 2024 with the possibility for an extension to December 31, 2026. Under this contract, Thomas Nutrient Solutions is responsible for the following hauling operations:

- Hauling liquid biosolids from all Region WWTPs and residuals from Decew, Grimsby and Niagara Falls WTPs to Garner Road Biosolids Facility
- Transferring biosolids and residuals between WWTPs and WTPs as required
- Hauling approximately 50% of liquid biosolids from the Garner Road Facility to various agricultural sites for land application
- Transferring supernatant from lagoon-stored liquid biosolids at the Garner Road Facility biosolids facility to sanitary sewer system if forcemain from Garner Road is not available.
- Directly hauling the dewatered biosolids from Niagara Falls, Port Weller, Port Dalhousie, Anger Ave and Welland WWTPs and land apply on an as-needed basis.

Thomas Nutrient Solutions is responsible for coordinating land application of biosolids and associated testing to meet quality requirements of NASM. They must secure 405 hectares of land for biosolids application each year, with an additional contingency area of 405 hectares. Thomas Nutrient Solutions is contracted to land apply up to 50% of the annual generated biosolids in the Region.

Currently supernatant, centrate and stormwater from the Garner Road Facility are pumped to the sewer via a forcemain. As a contingency measure, in the case where this forcemain is unavailable, Thomas Nutrient Solutions is responsible for hauling supernatant, centrate and stormwater directly to one of the Region's WWTPs or to the designated maintenance hole, MH13, located in the sewershed of Port Weller WWTP at 2 Niagara Stone Road, in Niagara-on-the-Lake.

In addition to their role as the biosolids hauler, Thomas Nutrient Solutions is also contracted to maintain the grounds and maintain site security at the Garner Road Biosolids Facility.

Thomas Nutrient Solutions must manage public complaints related to operation of the Garner Road Biosolids Facility, haulage of biosolid and residuals, and land application.

4 Review of 2010 Biosolids Management Master Plan

The basis for the existing biosolids program was developed under the 2010 Biosolids Management Master Plan (BMMP), with beneficial use and public understanding as major objectives. Key recommendations of the 2010 BMMP and implementation status are described in the table below.

Table 1. Recommendation of 2010 BMMP and Status of Implementation

RECOMMENDATION	STATUS OF IMPLEMENTATION
General	
Monitor future demand needs at Baker Road WWTP, and VSS destruction performance in digesters. Implement on-site dewatering at Baker Road to reduce hauling cost, and haul residuals from Grimsby WTP to Baker Rd WWTP for dewatering. Could be incorporated in future capital upgrades.	Grimsby WTP residuals are primarily hauled to the Garner Road Biosolids Facility, with occasional loads to the Baker Road WWTP. Residual volumes during clean-out periods are typically too high for the Baker Road WWTP to receive. Dewatering has not been implemented at the Baker Road WWTP to date. Capacity expansions are planned to begin design in 2023 to increase the rated capacity from 32 MLD to 48 MLD to address projected demands that could potentially incorporate dewatering.
Determine potential cost savings of increasing solids contents of biosolids at Region WWTPs without adding dewatering facilities.	Biosolids thickening upgrades are being considered at the Anger Ave WWTP as part of the digester replacement project scheduled for construction in 2025. The Region is also investigating portable dewatering units at Anger Ave and Baker Road WWTPs. Further, some WWTPs (Area 1 and 3) have implemented solids management practices which have reduced the volume produced for hauling.

RECOMMENDATION	STATUS OF IMPLEMENTATION
Track biosolids quality at WWTPs and Garner Road Biosolids Facility over time to determine trends towards exceedances and plan mitigation measures to ensure quality is maintained at 20% below most stringent regulatory requirements	Biosolids quality is being tracked at all WWTPs and at the Garner Road Biosolids Facility. Water residual quality is also being tracked for each facility that hauls out residuals (Decew Falls, Grimsby WTP and Niagara Falls WTP). A buffer of 20% is included in the tracking system with notification if the buffer is exceeded.
Determine potential cost savings of increasing land application rate from 8 to 22 dry tonne (dt) every 5 years if permitted based on NMA amendment that came into effect in 2011	Land application and conformance with NASM plan is currently the responsibility of third party contractors. Amendments to NMA that came into effect in 2011 require site specific review to determine land application rates, and a blanket application rate no longer applies.
Identify any residual contaminants that prevent implementation of 22 dt land application rate and potential source or process controls to improve residuals quality	See above.
Continue to monitor WWTP biosolids and Garner Road system performance with respect to ECAs and implement tracking data management system to predict and mitigate potential critical items prior to occurrence	The Region continues to monitor WWTP and Garner Road Biosolids Facility in accordance with ECA requirements, including recording biosolids quality and quantity data.
Request consolidated ECAs for facilities that do not currently have this, starting with Garner Road, to simplify compliance tracking	Garner Road has received consolidated ECA.

RECOMMENDATION	STATUS OF IMPLEMENTATION
Water Treatment Plants	
Implement residuals quality data collection program at WTPs and use to track any trends or quality target exceedances that may impact residuals management program	Hauled residuals quality from Niagara Falls, Decew and Grimsby WTPs are currently measured and documented. Frequency of sampling varies based on frequency of residual hauling. Weekly sewer samples are also taken from all WTPs. A similar buffer of 20% is applied in tracking system to manage residuals quality.
Review, assess and confirm residual quantities generated at WTPs	Hauled residuals quantities from Niagara Falls, Decew and Grimsby WTPs are currently tracked. Total sewer discharge volumes from other WTPs are also tracked for billing purposes.
Sewer Use By-Law Recommendations	
Consider lowering discharge limits in Regional sewer use by-law for copper, zinc, cadmium and possibly mercury to match CCME model sewer use by-law	In the 2014 Sewer Use By-Law Update mercury was reduced to match the CCME rates, while copper remained at 3 mg/L, selenium was reduced from 5 mg/L to 1 mg/L, and zinc was reduced from 5 mg/L to 3 mg/L. The existing By-law is currently under review including review of the potential to reduce copper, selenium and zinc levels further to match CCME.
Add discharge limit to persistent toxic organics after completing detailed sampling program and characterization	In the 2014 Sewer Use By-Law Update, the maximum limits for several contaminants were reduced slightly or modified to match the CCME suggested limits including limits for Dichlorobenzene (1,2-), Dichlorobenzene (1,4), Toluene, and Trichloroethylene (1,1,2,2-).

RECOMMENDATION	STATUS OF IMPLEMENTATION
Require use of dental amalgam waste separators	Clause 5.4 was added to the 2014 Sewer Use By-law which requires installation of a dental waste amalgam separator where this substance is in use. This was already required under the *Dentistry Act, 1991*, S.O. 1991, c.24, but ensures the By-law is in alignment with this policy.
Include requirement for pollution prevention planning for industrial dischargers that contribute specific pollutants (i.e., metals of concern)	The Region's 2014 Sewer Use By-Law update generally reflects the MECP – Model Sewer Use By-Law. Pollution prevention plan requirement was intentionally omitted from the 2014 Sewer Use By-Law update due to very few dischargers with notable metal concentrations. The Region tracks high concentration dischargers to ensure enforcement of by-law. Through this Master Plan Update, the data on the existing industrial discharges to the sewer system will be reviewed and potential changes to the By-Law will be recommended such that Niagara maintains a high level of biosolids quality, now and in the future.
Determine source of industrial discharges containing high metals concentrations	See above.
Risk Mitigation Recommendations	
Review and update risk matrix and mitigate high to medium risks	The Region continues to monitor and mitigate high level risks. The risk register is formally updated on an annual basis as part of the Region's Quality Management System. As part of this Master Plan, the risk register is also being updated to continue to track and manage risks.

RECOMMENDATION	STATUS OF IMPLEMENTATION
Closely track Source Water Protection Planning requirements and any changes that may impact biosolids management	Implementation of the Source Water Protection Plan is a shared responsibility between the MECP, the Niagara Region and Local Municipalities and the Niagara Peninsula Conservation Authority (NPCA). Since 2006 when the Source Protection Committees were established under Ontario's Clean Water Act, Niagara has continued to work with its partners to track and adhere to Source Protection Planning requirements throughout Niagara, including meeting Nutrient Management Act with respect to biosolids land application and WWTP effluent meeting Provincial Water Quality Objectives (PWQO) of receiving water bodies.
Confirm third party contract has a Quality Management Plan in place	The current contract with Walker Environmental was executed in 2017 and requires Region and Walker to independently test dewatered material quality at agreed upon frequency to be used for basis of payment. Walker must also provide a monthly report with narrative on conditions, major events, tracking statistics on volumetric data, process control parameters.
Maintain communications with MECP and OMAFRA to stay up-to-date on other residuals programs that may consume available land application area	This is the responsibility of Thomas Nutrient Solution, including maintaining a sufficient land bank for biosolids application.

RECOMMENDATION	STATUS OF IMPLEMENTATION
Monitor land application contractor to ensure set-back distances and odour level are maintained as required	The Region has a contract with Thomas Nutrient Solutions, implemented in October 2020. Thomas Nutrient Solutions is responsible for maintaining a Non-Agricultural Source Material (NASM) Plan to ensure land application requirements per the Nutrient Management Act are met. The Region and MECP also conduct spot checks to ensure compliance. No issues reported to date.
Consider conducting total watershed management plan and integrating preferred biosolids management plan, in partnership with Conservation Authority	The NPCA takes an integrated watershed management (IWM) approach to manage activities on a watershed basis and protect the environment. Between 2003 and 2011, NPCA worked in partnership with the Region of Niagara to complete 12 plans for the Peninsula's 18 Watershed Planning areas. These plans are continually reviewed and updated to meet watershed management goals and objectives of protecting the health of the watershed.
Develop formal Contingency Plan, potentially in conjunction with Region's Emergency Plan	Niagara's general contingency approach is to have diversified end uses through land application (Thomas Nutrient Solutions) and additional stabilization (Walker Environmental). Third party vendors also have their own contingency plans for their operations.
Minimize storage of dewatered biosolids to reduce risk of odour events	Dewatered biosolids are produced only at Garner Road and Niagara Falls WWTP, and there is currently no dewatered cake storage at either facility. No current odour issues have been reported.

RECOMMENDATION	STATUS OF IMPLEMENTATION
Contingency Plan Recommendations	
Complete annual review of contingency plan for completeness	Contingency measures are in place; an overall contingency plan will also be developed under the current BMMP study.

5 Wastewater Treatment System and Biosolids Management – Existing System, Performance and Planned Upgrades

The Region has ten (10) WWTPs, all utilizing anaerobic digestion. Anaerobic digestion is a common practice used for the stabilization of wastewater solids. It must have enough residence time and mixing to allow for the destruction of volatile solids (VS). As per MECP Guidelines, a digester receiving primary sludge should achieve a VS destruction of 30-40%.

Hydrolysis is the limiting step in the anerobic digestion of municipal wastewater solids. Generally, this step is further constrained when digesting WAS compared to primary sludge due to the presence of cellular material protected by cell walls. The cell walls protect the cell contents so well that most of the cellular material is unavailable to anaerobic microbes in the digester. Therefore, WAS tends to have a much lower volatile solids reduction in anaerobic digestion than primary sludge.

It is common to see a VS reduction lower than 30% in anaerobic digesters of extended aeration plants, which only produce WAS and plants with co-digestion, which mix primary sludge and WAS.

Further process descriptions, treatment capacities and biosolids qualities and quantities for each facility are described in the following sections.

Pretreatment of WAS or thickened WAS by a process that induces cell lysis could be considered, to increase VS destruction and gas generation in the anaerobic digestion system.

5.1 Anger Avenue WWTP

The Anger Avenue WWTP was originally built in 1963 as a primary treatment facility and has undergone several upgrades since that time. The plant is operated under MECP ECA No. 0421-8LVJ3N issued on October 24, 2011. The current Anger Avenue WWTP is an extended aeration secondary treatment facility with a rated ADF capacity of 24,500 m^3/d. The plant receives wastewater generated in the urban area of the Town of Fort Erie and septage from the local haulers in the rural area of Fort Erie. All septage is combined with plant influent prior to the screening process.

The major liquid treatment processes include screening and aerated grit removal, aeration, secondary clarification, and effluent disinfection and de-chlorination prior to continuously discharging to the Niagara River. Ferric chloride is added to aeration tank effluent for phosphorus removal.

The plant is equipped with a stormwater treatment system to treat flows in excess of 49,000 m^3/d and up to 98,000 $m^{3/}$d, consisting of four stormwater tanks with provisions of a storm chlorine contact tank for sodium hypochlorite addition. After wet weather flows subside, any stormwater remaining in the four stormwater tanks is returned to the headworks to receive full treatment. Stormwater in excess of the stormwater tank storage volume will overflow the storm tanks and flow to the storm contact chamber where it will receive disinfection and dechlorination prior to discharge to the Niagara River via a separate storm outfall.

The current biosolids management system consists of WAS thickening, anaerobic digestion and on-site stabilized sludge storage.

WAS is thickened via a gravity belt thickener (GBT) in the GBT building, with thickened WAS (TWAS) being directed to two-stage anaerobic digesters for digestion. Filtrate is returned to the aeration tanks for further treatment. Biosolids are stored on-site in two biosolids storage tanks prior to haulage offsite.

Digester gas (biogas) produced during the anaerobic digestion process is directed to a waste gas burner and flared. Currently, the digester gas is not used at the plant.

5.1.1 Wastewater Flow

Table 2 summarizes historic flows to the Anger Avenue WWTP over the period from 2017 to 2021. The Anger Ave WWTP average raw wastewater flow during the review period was 14,203 m^3/d, approximately 58% of the rated capacity of 24,500 m^3/d.

Table 2: Historic Flow to the Anger Avenue WWTP (2017 – 2021)

PARAMETERS	INFLUENT FLOW (% OF RATED CAPACITY)	PEAK FACTOR
Rated ADF Capacity (m^3/d)	24,500	-
Rated Peak Flow Rate (m^3/d)	49,000	-
Historic ADF (m^3/d)	14,203	-
Historic PDF (m^3/d)	51,648	3.63
Historic Max Month (m^3/d)	20,731	1.46

5.1.2 Historical Biosolids Quantity and Quality (5-year average)

The biosolids removed from the Anger Avenue WWTP have a total solids content of 2.86%. Based on available data between 2017 and 2019, the digesters were able to achieve a VS destruction of 29%. This low VS destruction is typical of WAS only digestion and may have been exacerbated by challenges with digester heating and mixing. The quantity of biosolids hauled are provided in Figure 6.

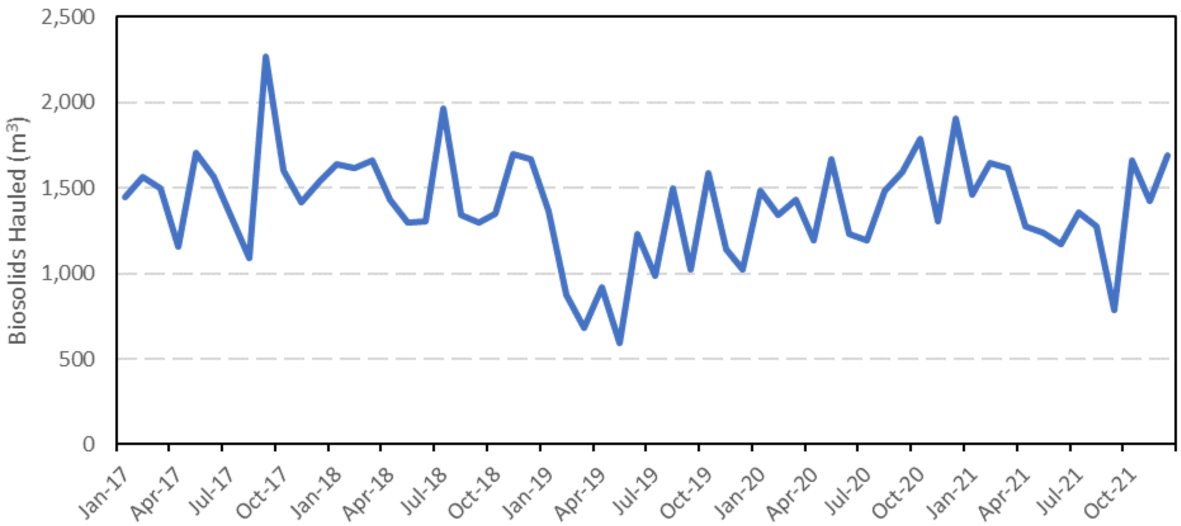


Figure 6 – Anger Avenue WWTP hauled sludge volumes

According to samples taken throughout the study period, the biosolids were also able to meet CM2 standards for land application, with results listed in Table 3.

Table 3: Comparison of Metal Content in Anger Ave WWTP Biosolids to Regulatory Limits for Land Application (2017-2021)

PARAMETER	2017-2021 AVERAGE (MG/KG)	CM2 (MG/KG)
Arsenic	8.72	170
Cadmium	2.34	34
Chromium	132.79	2,800
Cobalt	3.87	340
Copper	360.25	1,700
Lead	24.91	1,100
Mercury	0.20	11
Molybdenum	6.12	94
Nickel	30.97	420
Selenium	3.15	34
Zinc	456.57	4,200

5.1.3 Status of Planned Projects

Upgrades are planned for improved WAS equalization capacity, improved redundancy of gravity belt thickeners and upgraded digester tankage.

5.2 Baker Road WWTP

The Baker Road WWTP is a conventional activated sludge plant that provides treatment for wastewater generated from the Town of Grimsby. The plant is operated under MECP ECA No. 5755-AEFJVC issued on March 30, 2017. The plant has a rated ADF capacity of 31,280 m^3/d and peak flow rate of 62,600 m^3/d.

The major liquid treatment processes include screening, vortex grit removal, primary clarification, aeration, secondary clarification and chlorine disinfection and dechlorination. Ferric chloride is added at the inlet of the aeration tanks or at the primary clarifiers for phosphorus removal.

The existing biosolids management system consists of primary and secondary anaerobic digestion and sludge storage. WAS from the secondary clarifiers is returned to the primary clarifiers to co-thicken prior to being sent to the primary digester. The primary digester has a diameter of 27.4 m and holding capacity of 3,603 m^3 and is equipped with a fixed cover and gas mixing system. The gas mixing system includes two digester gas boosters to utilize produced digester gas. The primary digester is also equipped with two digested sludge recirculation pumps and sludge heat exchanger. The secondary digester also has a diameter of 27.4 m and holding capacity of 3,603 m^3 and is equipped with a floating cover. Digested sludge is sent to a 2,500 m^3 solids storage tank or pumped directly into a tanker truck before being hauled offsite. All digester gas that is not used for digester mixing and heating is used as boiler fuel, with any excess flared to atmosphere.

5.2.1 Wastewater Flow

Table 4 summarizes historic flows to the Baker Road WWTP over the period from 2019 to 2021. The Baker Road WWTP average raw wastewater flow during the review period was 19,346 m^3/d, approximately 62% of the rated capacity of 31,280 m^3/d.

Table 4: Historic Flow to the Baker Road WWTP

PARAMETERS	INFLUENT FLOW (% OF RATED CAPACITY)	PEAK FACTOR
Rated ADF Capacity (m^3/d)	31,280	-
Rated Peak Flow Rate (m^3/d)	62,600	-
Historic ADF (m^3/d)	19,346	-
Historic PDF (m^3/d)	66,312	3.42
Historic Max Month (m^3/d)	30,635	1.58

5.2.2 Historical Biosolids Quantity and Quality (5-year average)

The biosolids removed from the Baker Road WWTP have a total solids content of 2.35%. The low total solids content may be a result of not using the sludge storage tank for additional settling prior to hauling offsite. Additionally, solids content may also be reduced by allowing sludge to co-thicken rather than using a designated sludge thickening process. The digesters were able to achieve a VS destruction of 42%. The quantity of biosolids hauled, in terms of volume and mass, respectively, are provided in Figures 7 and 8. With reference to Figure 7, the volume of biosolids hauled offsite was increased beginning in 2019 during the primary digester refurbishment. The digester was brough back into service in September 2021.

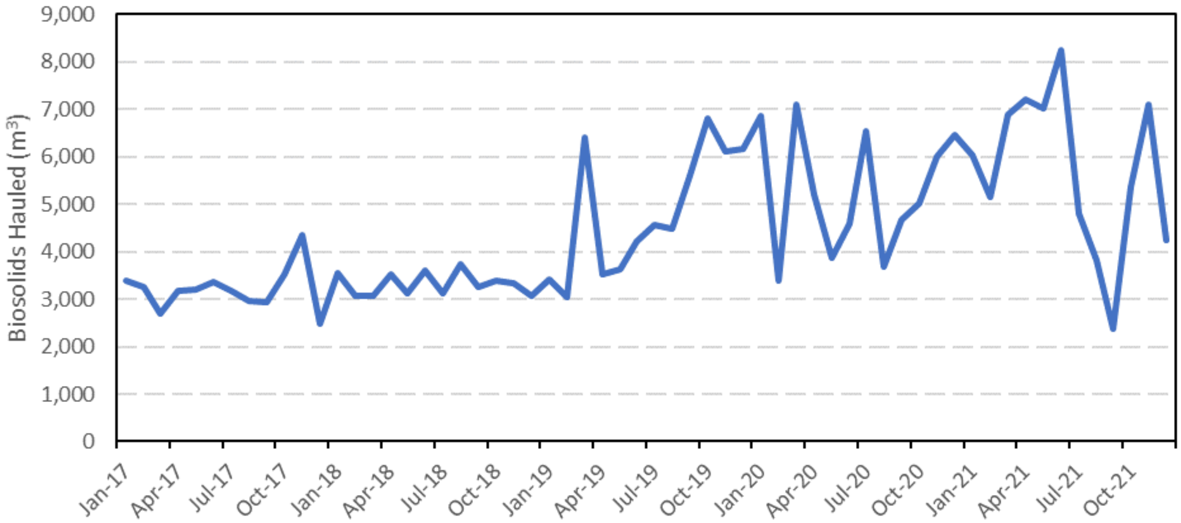


Figure 7 – Baker Road WWTP hauled sludge volume

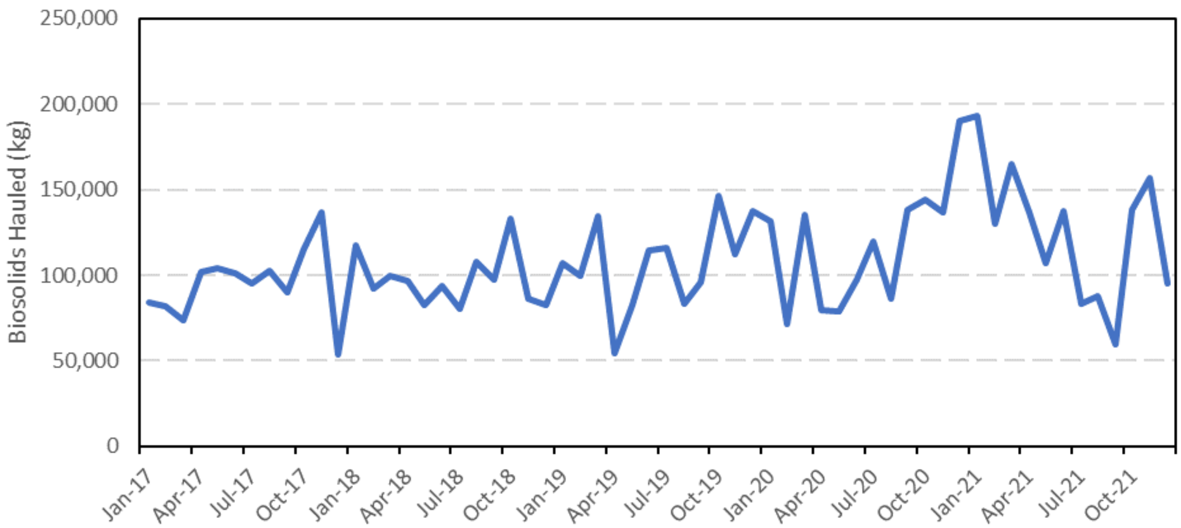


Figure 8 – Baker Road WWTP hauled sludge mass

According to samples taken throughout the study period, the biosolids were also able to meet CM2 standards for land application, with results listed in Table 5.

Table 5: Comparison of Metal Content in Baker Road WWTP Biosolids to Regulatory Limits for Land Application (2017-2021)

PARAMETER	2017-2021 AVERAGE (MG/KG)	CM2 (MG/KG)
Arsenic	5.74	170
Cadmium	1.01	34
Chromium	91.03	2,800
Cobalt	5.86	340
Copper	391.43	1,700
Lead	20.92	1,100
Mercury	0.19	11
Molybdenum	13.55	94
Nickel	30.04	420
Selenium	3.24	34
Zinc	970.95	4,200

5.2.3 Status of Planned Projects

There are no known projects planned for solids handling at this time. Design for an increase in plant capacity from 32 MLD to 48 MLD is expected to begin in 2023.

5.3 Crystal Beach WWTP

The Crystal Beach WWTP is an extended aeration plant that provides treatment for wastewater generated in the Town of Fort Erie. The plant is currently operated under MECP ECA No. 7162-8G5GVU issued on June 9, 2011. The Crystal Beach WWTP has a rated average day flow (ADF) capacity of 9,100 m^3/d and a peak flow capacity of 27,300 m^3/d.

The existing treatment processes include screening, grit removal, aeration, secondary clarification, and chlorine disinfection and dechlorination prior to discharge to Lake Erie. Ferric chloride is added upstream of the secondary clarifiers. Waste activated sludge (WAS) is sent to a gravity belt thickener prior to entering an anaerobic digester.

The current biosolids management system consists of WAS storage tanks, gravity belt thickener, and anaerobic digestion. The gravity belt thickener, complete with a sludge conditioning system consisting of polymer feed, in-line mixer and belt wash system receives WAS from the aeration tanks. Thickened sludge is then sent to the 599 m^3 primary digester (10 m diameter). The digester was originally equipped with a gas mixing system; however, it is currently only hydraulically mixed through the heat exchanger. There are two 123 m^3 mechanically aerated WAS holding tanks upstream of the gravity belt thickener; however, these tanks are currently not in use. All biogas is currently flared.

5.3.1 Wastewater Flow

Table 6 summarizes historic flows to the Crystal Beach WWTP from 2017 to 2021. The average raw wastewater flow during the review period was 5,459 m^3/d, approximately 60% of the rated capacity of 9,100 m^3/d.

Table 6: Historic Flow to the Crystal Beach WWTP (2017-2021)

PARAMETERS	INFLUENT FLOW (% OF RATED CAPACITY)	PEAK FACTOR
Rated ADF Capacity (m^3/d)	9,100	-
Rated Peak Flow Rate (m^3/d)	17,300	-
Historic ADF (m^3/d)	5,459	-
Historic PDF (m^3/d)	32,067	5.87
Historic Max Month (m^3/d)	9,483	1.74

5.3.2 Historical Biosolids Quantity and Quality (5-year average)

The biosolids removed from the Crystal Beach WWTP have a total solids content of 2.73%. The digester achieved a volatile solids (VS) destruction of 41%. The quantity of biosolids hauled, in terms of volume and mass, respectively, are provided in Figures 9 and 10.

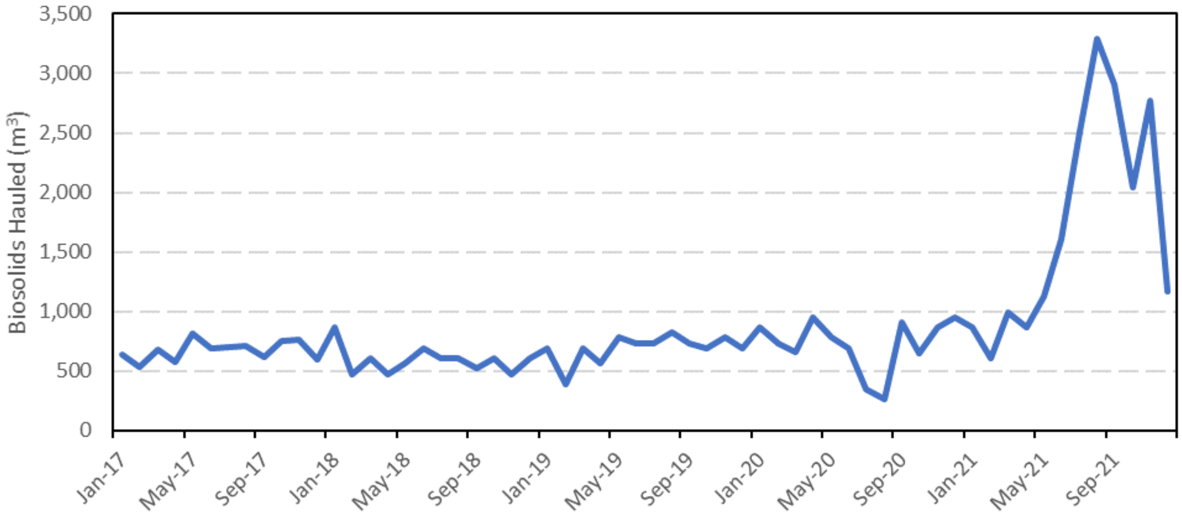


Figure 9 – Crystal Beach WWTP Biosolids volumes hauled.
Note Digester refurbishment in 2021.

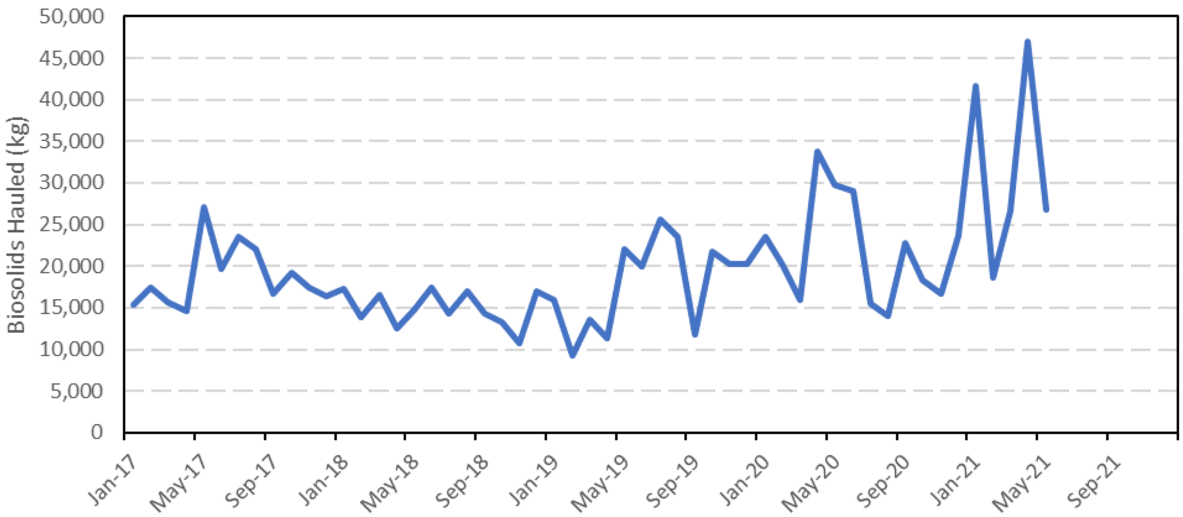


Figure 10 – Crystal Beach WWTP Biosolids mass hauled
Note Digester refurbishment in 2021, with digester brought back online in December 2021.

According to samples taken throughout the study period, the biosolids were also able to meet CM2 standards for land application as defined in the Nutrient Management Act, with results listed in Table 7.

Table 7: Comparison of Metal Content in Crystal Beach WWTP Biosolids to Regulatory Limits for Land Application (2017-2021)

PARAMETER	2017-2021 AVERAGE (MG/KG)	CM2 (MG/KG)
Arsenic	4.80	170
Cadmium	0.68	34
Chromium	48.24	2,800
Cobalt	3.10	340
Copper	330.60	1,700
Lead	21.84	1,100
Mercury	0.23	11
Molybdenum	5.02	94
Nickel	19.12	420
Selenium	2.99	34
Zinc	492.53	4,200

5.3.3 Status of Planned Projects

A digester rehabilitation project was completed in winter 2022, which was nearly completed during our site visit on January 31, 2022. There are no other known planned or on-going projects for the solids handling process. A feasibility study is currently underway to increase the plant capacity.

5.4 Niagara Falls WWTP

The Niagara Falls WWTP is a conventional activated sludge plant that provides treatment for wastewater generated from the City of Niagara Falls. The plant is operated under MECP ECA No. A-500-5110411564 issued on August 22, 2021. The plant has a rated ADF capacity of 68,300 m^3/d and peak flow capacity of 205,000 m^3/d.

The major liquid treatment processes include screening, grit removal, flocculation, primary clarification, rotating biological contactors, secondary clarification and chlorine disinfection and dechlorination.

The existing biosolids management system consists of a two-stage anerobic digester facility, sludge storage, and a sludge dewatering/handling facility that consists of mechanical sludge grinder and high-speed centrifuge. A shaftless conveyor system transfers sludge cakes from the sludge dewatering centrifuge to a truck to haul offsite. In 2019 the plant switched from co-thickening to using a flocculation tank with the addition of ferric chloride and polymer upstream of the primary clarifiers. Primary sludge and WAS are sent to one of two digesters, both having a diameter of 16.8 m and holding capacity of 3,400 m^3. The secondary digester has a diameter of 24.4 m and holding capacity of 3,825 m^3. Digested sludge is stored in a 1,700 m^3 sludge equalization tank prior to being sent to the sludge dewatering and handling facility.

All biogas at the plant is used as boiler fuel, with excess flared as production is not large or consistent enough to use as an alternative fuel.

5.4.1 Wastewater Flow

Table 8 summarizes historic flows to the Niagara Falls WWTP over the period from 2019 to 2021. The Niagara Falls WWTP average raw wastewater flow during the review period was 39,496 m^3/d, approximately 58% of the rated capacity of 68,300 m^3/d.

Table 8: Historic Flow to the Niagara Falls WWTP

PARAMETERS	INFLUENT FLOW (% OF RATED CAPACITY)	PEAK FACTOR
Rated ADF Capacity (m^3/d)	68,300	-
Rated Peak Flow Rate (m^3/d)	205,000	-
Historic ADF (m^3/d)	39,496	-
Historic PDF (m^3/d)	142,458	3.6
Historic Max Month (m^3/d)	55,085	1.36

5.4.2 Historical Biosolids Quantity and Quality (5-year average)

The biosolids removed from the Niagara Falls WWTP have a total solids content of 2.45%. The digesters were only able to achieve a VS destruction of 35%. One of the primary digesters was offline during the study period resulting in solids management challenges and significant quantity fluctuations.

According to samples taken throughout the study period, the biosolids were also able to meet CM2 standards for land application, with results listed in Table 9.

Table 9: Comparison of Metal Content in Niagara Falls WWTP Biosolids to Regulatory Limits for Land Application (2017-2021)

PARAMETER	2017-2021 AVERAGE (MG/KG)	CM2 (MG/KG)
Arsenic	5.53	170
Cadmium	0.64	34
Chromium	62.73	2,800
Cobalt	3.49	340
Copper	439.33	1,700
Lead	21.58	1,100
Mercury	0.15	11
Molybdenum	8.64	94
Nickel	16.65	420
Selenium	2.15	34
Zinc	503.71	4,200

5.4.3 Status of Planned Projects

The Niagara Falls WWTP is currently being upgraded from a Rotating Biological Contactors (RBCs) to Moving Bed Biofilm Reactors (MBBRs) for secondary treatment. Phase 2 of this project includes new primary digestion. Furthermore, a portion of wastewater currently received by Niagara Falls WWTP will be diverted to the proposed South Niagara Falls WWTP that is expected to be constructed within the next 10 years and will impact flows to the existing Niagara Falls WWTP.

5.5 Niagara-on-the-Lake WWTP

The Niagara-on-the-Lake (NOTL) WWTP is an extended aeration plant that provides treatment for wastewater generated from the Town of Niagara-on-the Lake. The plant is operated under MECP ECA No. 8314-9MHHJQ issued on September 10, 2014. The plant has a rated ADF capacity of 8,000 m^3/d and peak flow capacity of 34,700 m^3/d.

The major liquid treatment processes include screening, vortex grit removal, aeration, secondary clarification, and chlorine disinfection and dechlorination. Alum is added at the outlet of the aeration tanks for phosphorus removal.

The existing biosolids management system consists of sludge thickening, anaerobic digestion and biosolids storage. The NOTL WWTP has a gravity belt thickener that connects directly to a single anerobic digester with a fixed-roof and working volume of 1,500 m^3. The digester is heated using natural gas. Digested sludge is sent to the underground biosolids holding tank until it is hauled to the Garner Road Biosolids Facility. Sludge is hauled approximately once per day. If the digester is taken offline, there is also a provision to allow direct pumping of thickened sludge to the holding tank to be hauled to another plan for digestion. All biogas at the plant is currently flared.

5.5.1 Wastewater Flow

Table 10 summarizes historic flows to the Niagara-on-the-Lake (NOTL) WWTP over the period from 2019 to 2021. The NOTL WWTP average raw wastewater flow during the review period was 4,788 m^3/d, approximately 60% of the rated capacity of 8,000 m^3/d. Approximately 60-65% of winery waste in the Region is now sent to the NOTL WWTP and added at the headworks facility.

Table 10: Historic Flow to the NOTL WWTP (2019 – 2021)

PARAMETERS	INFLUENT FLOW (% OF RATED CAPACITY)	PEAK FACTOR
Rated ADF Capacity (m^3/d)	8,000	-
Rated Peak Flow Rate (m^3/d)	34,700	-
Historic ADF (m^3/d)	4,788	-
Historic PDF (m^3/d)	23,008	4.8
Historic Max Month (m^3/d)	6,210	1.30

5.5.2 Historical Biosolids Quantity and Quality (2-year average)

The biosolids removed from the NOTL WWTP have a total solids content of 2.22%. This solids content is low considering a gravity belt thickener is upstream of the digester, with an expected total solids range of 3-6%. The digester was only able to achieve a VS destruction of 24%. The low VS destruction is commonly seen in extended aeration plants. The quantity of biosolids hauled, in terms of volume and mass, respectively, are provided in Figures 11 and 12.

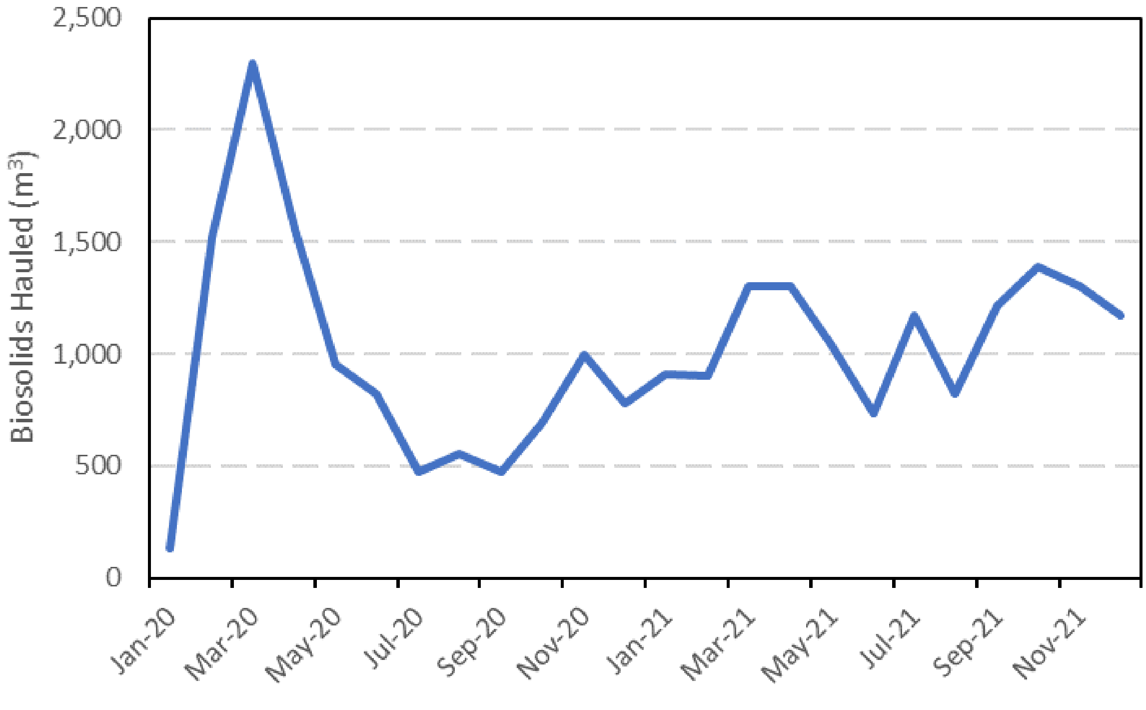


Figure 11 – Niagara on the Lake WWTP Biosolids volume hauled.
Note plant was commissioned in late 2019

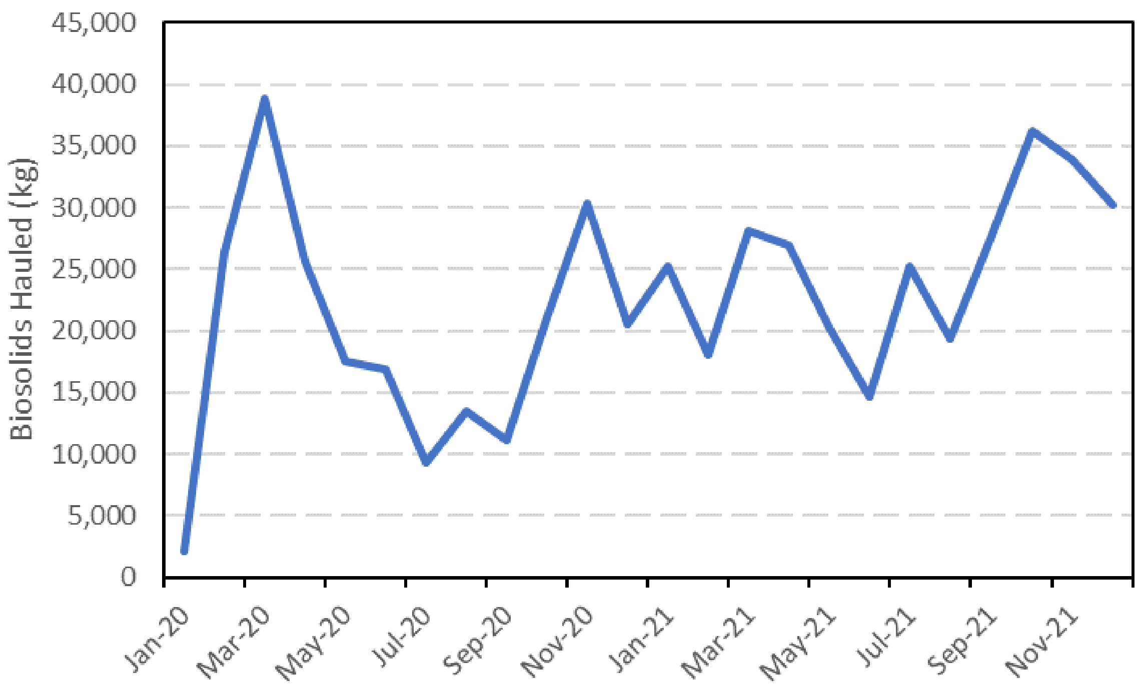


Figure 12 – Niagara on the Lake WWTP Biosolids volume hauled.
Note plant was commissioned in late 2019

According to samples taken throughout the study period, the biosolids were also able to meet CM2 standards for land application, with results listed in Table 11.

Table 11: Comparison of Metal Content in NOTL WWTP Biosolids to Regulatory Limits for Land Application (2017-2021)

PARAMETER	2017-2021 AVERAGE (MG/KG)	CM2 (MG/KG)
Arsenic	2.31	170
Cadmium	0.73	34
Chromium	13.72	2,800
Cobalt	1.59	340
Copper	345.43	1,700
Lead	8.03	1,100
Mercury	0.20	11
Molybdenum	5.75	94
Nickel	9.83	420
Selenium	2.84	34
Zinc	373.26	4,200

5.5.3 Status of Planned Projects

There are no known projects planned for solids handling at this time.

5.6 Port Dalhousie WWTP

The Port Dalhousie WWTP is a conventional activated sludge plant that provides treatment for wastewater generated from the City St. Catharines. The plant is operated under MECP ECA No. 8134-B8XS6U issued on June 9, 2019. The plant has a rated ADF capacity of 61,350 m^3/d and peak flow capacity of 122,700 m^3/d.

The major liquid treatment processes include screening, grit classifiers, primary clarification, aeration, secondary clarification, chemical phosphorus removal and chlorine disinfection and dechlorination. Ferric chloride is added at the outlet of the aeration tanks for phosphorus removal.

The existing biosolids management system consists of co-thickening and anaerobic primary and secondary digestion. WAS from the secondary clarifiers is returned to the primary clarifiers to co-thicken prior to being pumped to one of three primary anaerobic digesters. Primary digesters 1 and 2 each have a diameter of 18.2 m with a holding capacity of 1,800 m^3 and three mechanical draft tube sludge mixers. Digester 3 is an egg-shaped digester with a diameter of 14.2 m and holding capacity of 2,000 m^3, which has remained offline for the last three years. Each of the three digesters is equipped with two sludge recirculation pumps. The secondary digester has a diameter of 18.2 m with a holding capacity of 1,560 m^3.

A bulk sludge loading system consists of two 137 m^3 above ground tanks, equipped with a sludge loading arm. Biogas at the plant is currently used as boiler fuel to heat the digester, with excess quantities flared.

5.6.1 Wastewater Flow

Table 12 summarizes historic flows to the Port Dalhousie WWTP over the period from 2017 to 2021. The Port Dalhousie WWTP average raw wastewater flow during the review period was 34,490 m^3/d, approximately 56% of the rated capacity of 61,350 m^3/d.

Table 12: Historic Flow to the Port Dalhousie WWTP (2017 – 2021)

PARAMETERS	INFLUENT FLOW (% OF RATED CAPACITY)	PEAK FACTOR
Rated ADF Capacity (m^3/d)	61,350	-
Rated Peak Flow Rate (m^3/d)	122,700	-
Historic ADF (m^3/d)	34,490	-
Historic PDF (m^3/d)	128,544	2.60
Historic Max Month (m^3/d)	49,432	1.43

5.6.2 Historical Biosolids Quantity and Quality (5-year average)

The biosolids removed from the Port Dalhousie WWTP have a total solids content of 1.7%. The low total solids content is likely a result of the small secondary digester size that does not allow for supernating. Allowing sludge to co-thicken rather than using a designated sludge thickening process may also contribute to low solids concentrations. The digesters were able to achieve a VS destruction of 55%. The quantity of biosolids hauled, in terms of volume and mass, respectively, are provided in Figures 13 and 14.

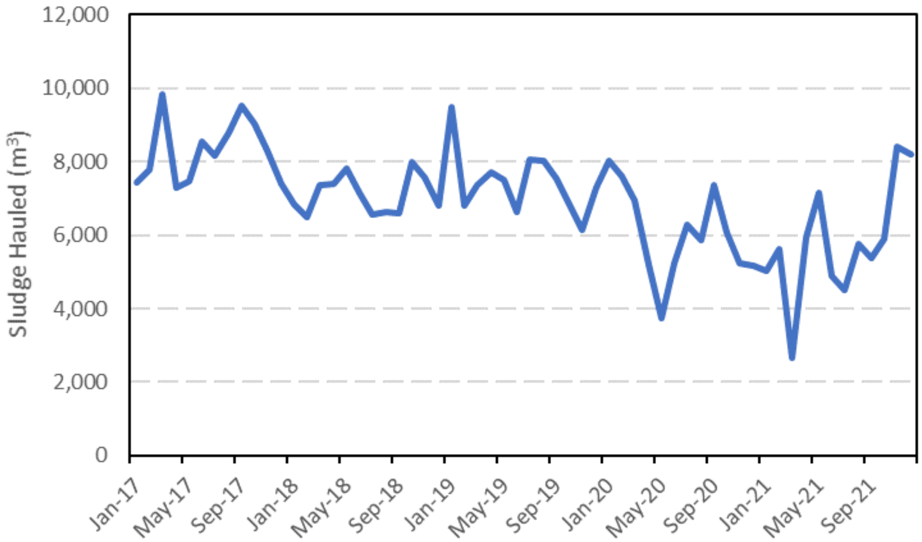


Figure 13 – Port Dalhousie WWTP Biosolids volume hauled

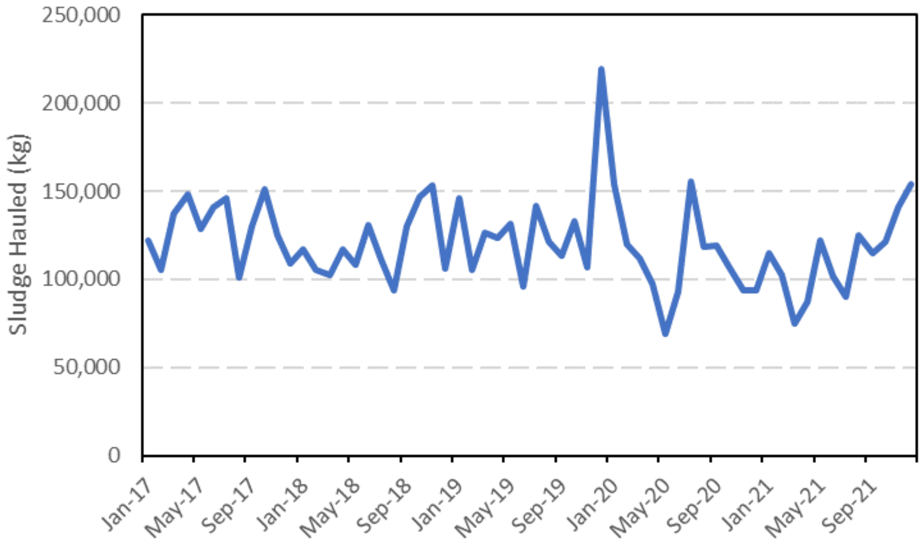


Figure 14 – Port Dalhousie WWTP Biosolids mass hauled

According to samples taken throughout the study period, the biosolids were also able to meet CM2 standards for land application, with results listed in Table 13.

Table 13: Comparison of Metal Content in Port Dalhousie WWTP Biosolids to Regulatory Limits for Land Application (2017-2021)

PARAMETER	2017-2021 AVERAGE (MG/KG)	CM2 (MG/KG)
Arsenic	4.23	170
Cadmium	1.01	34
Chromium	44.57	2,800
Cobalt	3.20	340
Copper	553.62	1,700
Lead	28.99	1,100
Mercury	0.26	11
Molybdenum	7.41	94
Nickel	23.25	420
Selenium	3.62	34
Zinc	663.84	4,200

5.6.3 Status of Planned Projects

A digester cleanout and flare upgrade are planned.

5.7 Port Weller WWTP

The Port Weller WWTP is a conventional activated sludge plant that provides treatment for wastewater generated from the City of St. Catharines. Port Weller also receives hauled wastewater discharged by Thomas Nutrient Solutions to upstream maintenance hole MH13 located at 2 Niagara Stone Road. MH13 receives sludge and centrate from Niagara Falls WWTP, sludge from Queenston WWTP, water treatment plant settling basin cleaning sludge, and other loads from WWTP as required. Supernatant and centrate from the Garner Road Facility are hauled to MH13 infrequently and generally only when the forcemain for waste streams from Garner Road is offline.

The plant is operated under MECP ECA No. 6014-9QMLZL issued on December 9, 2014. The plant has a rated ADF capacity of 56,180 m^3/d, a peak secondary treatment flow capacity of 112,360 m^3/d, and a peak primary treatment flow capacity of 136,200 m^3/d.

The existing unit treatment processes include screening, vortex grit removal, primary clarification, aeration, secondary clarification, and chlorine disinfection and dechlorination. Alum is added at the inlet of the primary and secondary clarifiers for phosphorus removal.

The current biosolids management system consists of co-thickening, and anaerobic primary and secondary digestion. WAS from the secondary clarifiers is returned to the primary clarifiers to co-thicken prior to being pumped to an anaerobic digester. The primary digester has a diameter of 24.4 m, with a holding capacity of 5,046 m^3, equipped with four draft tube type mixers. The secondary digester has a diameter of 27.4 m and holding capacity of 4,481 m^3.

The digesters are heated via boilers with excess biogas flared.

5.7.1 Wastewater Flow

Table 14 summarizes historic flows to the Port Weller WWTP over the period from 2017 to 2021. The Port Weller WWTP average raw wastewater flow during the review period was 35,702 m^3/d, approximately 63% of the rated capacity of 56,180 m^3/d.

Winery waste was previously fed directly to the digesters during the winery harvest season (Sept – Dec) when winery waste strength is highest; however, this led to a spike in gas production causing gas to blow out the top of the digester roof as the flare was unable to keep up. Lower strength winery waste still received at the headworks between January and August. The majority of winery waste produced in the Region was diverted to Niagara-on-the-Lake WWTP during the 2021 season.

Table 14: Historic Flow to the Port Weller WWTP (2017 – 2021)

PARAMETERS	INFLUENT FLOW (% OF RATED CAPACITY)	PEAK FACTOR
Rated ADF Capacity (m^3/d)	56,180	-
Rated Peak Flow Rate (m^3/d)	112,360	-
Historic ADF (m^3/d)	35,702	-
Historic PDF (m^3/d)	133,900	2.38
Historic Max Month (m^3/d)	50,893	1.43

5.7.2 Historical Biosolids Quantity and Quality (5-year average)

The biosolids removed from the Port Weller WWTP have a total solids content of 2.4%. The low total solids content is likely a result of allowing sludge to co-thicken rather than using a designated sludge thickening process. The digesters were able to achieve a VS destruction of 51%. The quantity of biosolids hauled, in terms of volume and mass, respectively, are provided in Figures 15 and 16.

During the study period Port Weller WWTP experienced high sludge blankets due to additional incoming sludge flows (i.e., Queenston WWTP sludge). Pumping rates from primary clarifiers were typically high to the digester, which may have contributed to lower solids content. Port Weller WWTP regularly recycles high volumes of supernate, which may also impact the settling in the primary clarifiers.

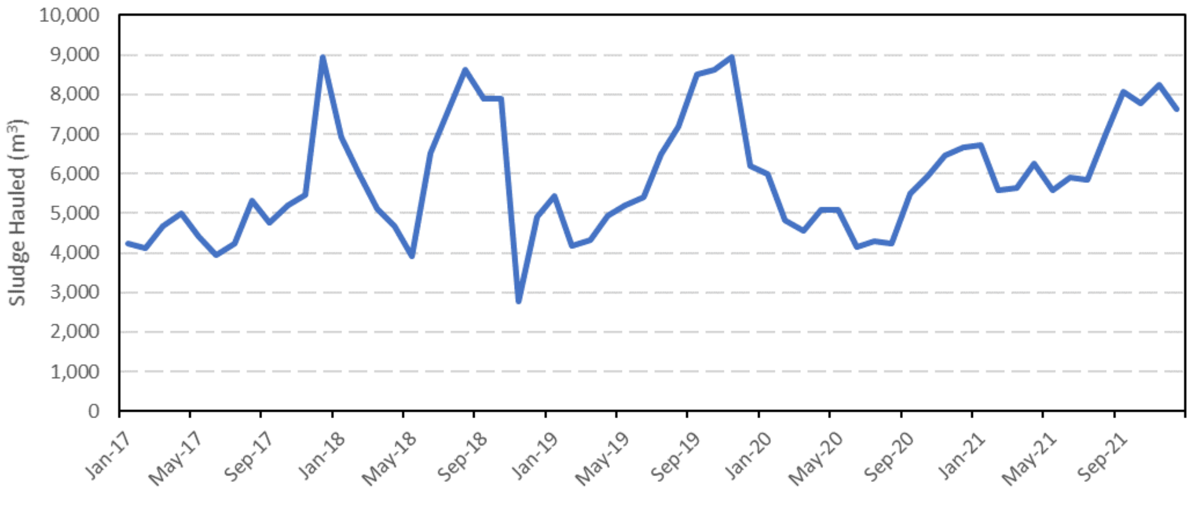


Figure 15 – Port Weller WWTP Biosolids volume hauled

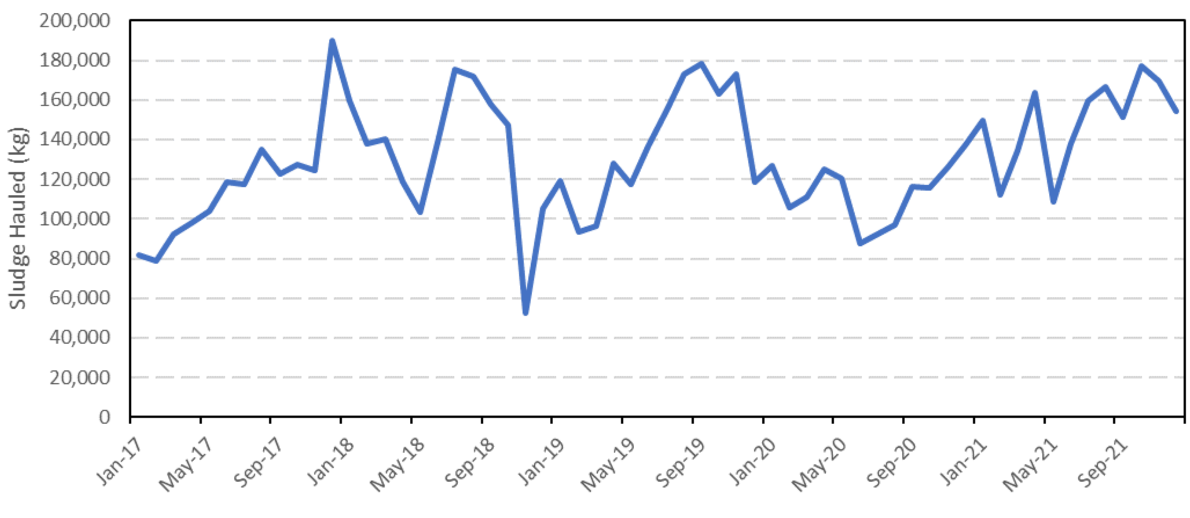


Figure 16 – Port Weller WWTP Biosolids mass hauled

According to samples taken throughout the study period, the biosolids were also able to meet CM2 standards for land application, with results listed in Table 15.

Table 15: Comparison of Metal Content in Port Weller WWTP Biosolids to Regulatory Limits for Land Application (2017-2021)

PARAMETER	2017-2021 AVERAGE (MG/KG)	CM2 (MG/KG)
Arsenic	5.19	170
Cadmium	0.92	34
Chromium	32.53	2,800
Cobalt	3.05	340
Copper	597.27	1,700
Lead	21.79	1,100
Mercury	0.26	11
Molybdenum	6.32	94
Nickel	16.89	420
Selenium	3.04	34
Zinc	720.63	4,200

5.7.3 Status of Planned Projects

The design of a winery waste receiving station with equalization storage tank is currently underway, with construction planned for 2023. This will allow better control of winery waste sent to the digesters and could increase biogas production. A digester upgrade is planned in the longer term.

5.8 Queenston WWTP

The Queenston WWTP is located at 5 River Frontage Road in the Town of Niagara-on-the-Lake, on property owned by and leased from the Niagara Parks Commission. The facility sits at the base of the Niagara Escarpment, on the west bank of the Niagara River. The WWTP is owned and operated by the Region of Niagara under ECA #0371-93YM2L issued February 22, 2013.

The Queenston WWTP is a modified extended aeration package plant consisting of grit and screenings removal, a bioreactor consisting of an anoxic selector and aeration tank, chemical phosphorus removal, and final settling. Effluent is seasonally disinfected using a chlorination/dechlorination system, prior to discharge to the Niagara River. The sludge from the wastewater treatment is stored on-site in an aerated holding tank prior to offsite haulage, typically to MH13 in the Port Weller catchment for further digestion and treatment.

The WWTP has a rated capacity of 500 m^3/day for average daily flow rate and a peak design flow rate of 1,700 m^3/day. The facility operates under the Amended Environmental Compliance Approval (ECA) number 0371-93YM2L dated February 22, 2013.

5.8.1 Wastewater Flows

Table 16 summarizes historic flows to the Queenston WWTP from 2017 to 2021. The average raw wastewater flow during the review period was 226 m^3/d, approximately 45% of the rated capacity of 500 m^3/d.

Table 16: Historic Flow to the Queenston WWTP (2017-2021)

PARAMETERS	INFLUENT FLOW (% OF RATED CAPACITY)	PEAK FACTOR
Rated ADF Capacity (m^3/d)	500	-
Rated Peak Flow Rate (m^3/d)	1,700	-
Historic ADF (m^3/d)	226	-
Historic PDF (m^3/d)	1,837	8.1
Historic Max Month (m^3/d)	577	2.5

5.8.2 Historical Biosolids Quantity (5-year average)

The biosolids removed from the Queenston WWTP have a total solids content of 0.7%. The digester achieved a volatile solids (VS) destruction of 31%. The quantity of biosolids hauled, in terms of volume and mass, respectively, are provided in Figures 17 and 18. Biosolids from Queenston WWTP are typically hauled to MH13 in the Port Weller WWTP catchment.

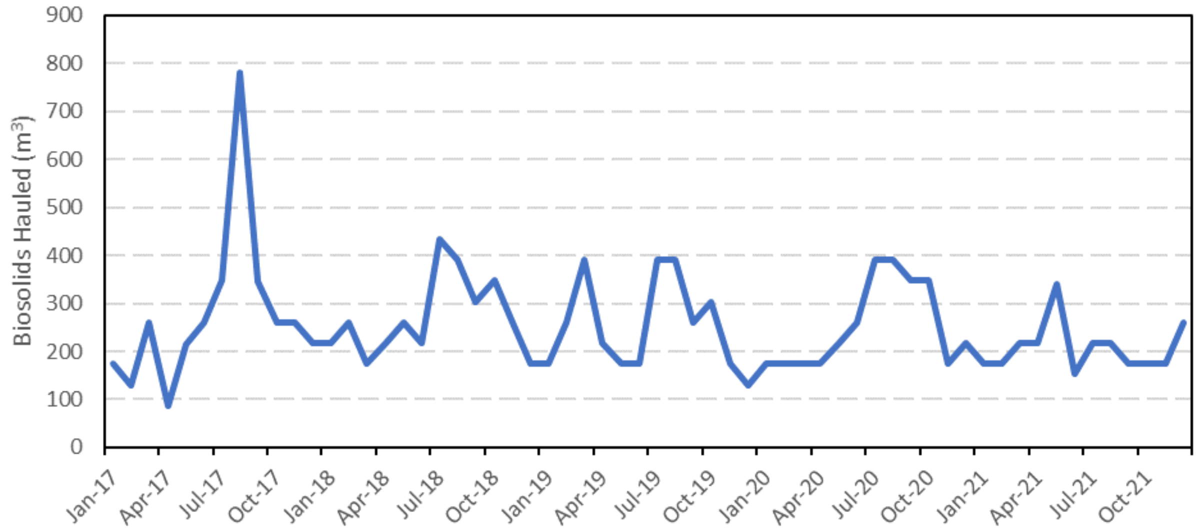


Figure 17 – Queenston WWTP Biosolids volumes hauled.

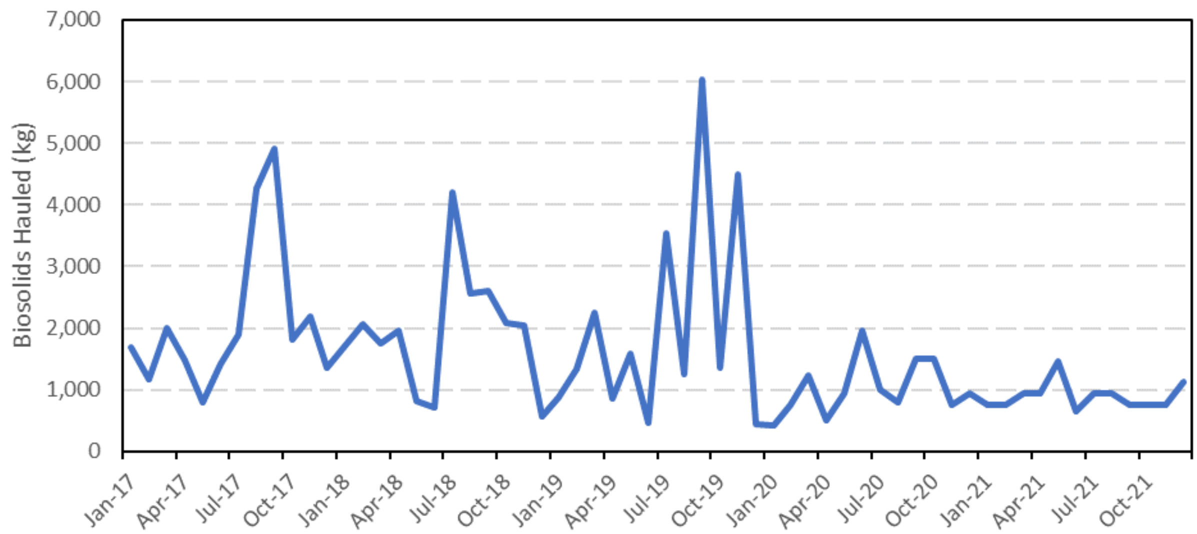


Figure 18 – Queenston WWTP Biosolids mass hauled

As Queenston WWTP produces undigested sludge that is digested at other Region facilities, quality data of the sludge is less relevant, as it will not be directly land applied.

5.8.3 Status of Planned Projects

The Region is currently undertaking a Schedule B Class EA to determine the future of the Queenston WWTP, and if it should be upgraded based on State-of-Good Repair requirements, or be replaced with a sewage pumping station and forcemain to convey flows to the Niagara Falls WWTP system.

5.9 Seaway WWTP

The Seaway WWTP is a conventional activated sludge plant that provides treatment for wastewater generated in the City of Port Colborne. The plant is operated under MECP ECA No. 8325-AWPRYR issued on June 13, 2018. The plant has a rated ADF capacity of 19,600 m^3/d. It was built in 1981 to replace the aging East Side and West Side WWTPs which serviced their respective catchments on either side of the canal.

The major liquid treatment processes include screening, grit classifiers, primary clarification, aeration, secondary clarification, chemical phosphorus removal and chlorine disinfection and dechlorination. Ferric chloride is added at the outlet of the aeration tanks for phosphorus removal.

The current biosolids management system consists of co-thickening, anaerobic digestion, and sludge storage. The WAS from the secondary clarifiers is returned to the primary clarifiers to co-thicken prior to being pumped to one of two primary anaerobic digesters. Each digester has a diameter of 12.2 m and working volume of 960 m^3. One is equipped with mechanical draft tube sludge mixers and a sludge recirculation pump, while the other digester is equipped with only a recirculation pump. Currently the digester with the mechanical draft tube mixers is offline and requires structural repair. This leaves only one digester in operation that relies solely on a sludge recirculation pump for mixing. Digested sludge is pumped to a 163 m^3 sludge holding tank, where it is held until it is hauled to the Garner Road Biosolids Facility. All biogas at the plant is currently used as boiler fuel, with excess quantities flared.

5.9.1 Wastewater Flow

Table 17 summarizes historic flows to the Seaway WWTP over the period from 2017 to 2021. The Seaway WWTP average raw wastewater flow during the review period was 5,819 m^3/d, approximately 30% of the rated capacity of 19,600 m^3/d.

Table 17: Historic Flow to the Seaway WWTP (2017 – 2021)

PARAMETERS	INFLUENT FLOW (% OF RATED CAPACITY)	PEAK FACTOR
Rated ADF Capacity (m^3/d)	19,600	-
Rated Peak Flow Rate (m^3/d)	-	-
Historic ADF (m^3/d)	5,819	-
Historic PDF (m^3/d)	24,910	4.28
Historic Max Month (m^3/d)	8,109	1.39

5.9.2 Historical Biosolids Quantity and Quality (5-year average)

The biosolids removed from the Seaway WWTP have a total solids content of 1.74%, which is considered low for digested sludge. This is likely a result of allowing WAS to co-thicken with primary sludge in the primary clarifiers rather than using a designated sludge thickening process. The digesters were able to achieve a VS destruction of 53%. The quantity of biosolids hauled, in terms of volume and mass, respectively, are provided in Figures 19 and 20.

The Seaway WWTP digesters are small for a conventional activated sludge plant, as the plant was converted from an extended aeration plant that used a gravity belt for thickening. A project for a new digester was cancelled but was part of the original upgrades when primary clarifiers were installed. The digesters also have no means to remove supernatant.

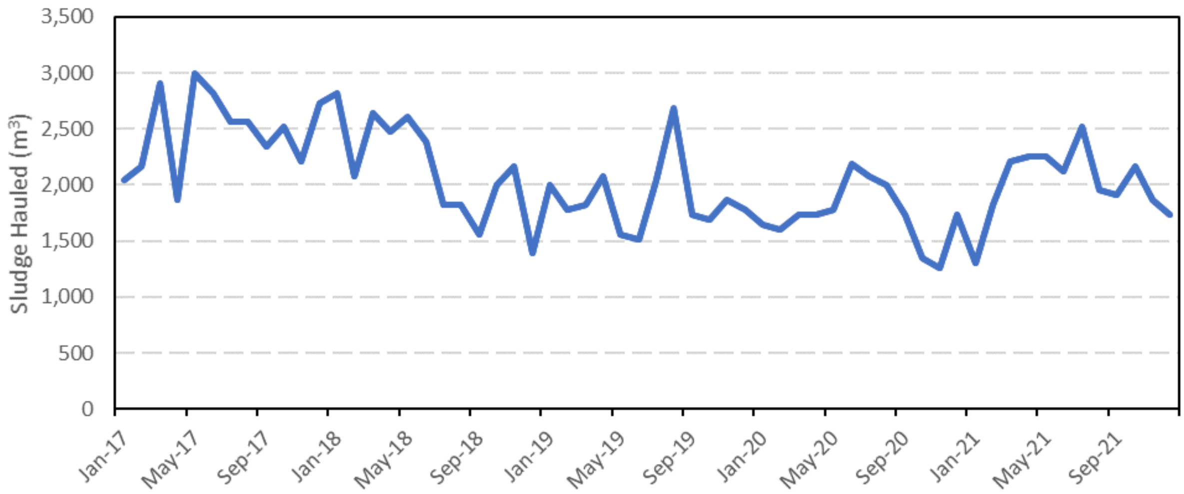


Figure 19 – Seaway WWTP Biosolids volumes hauled

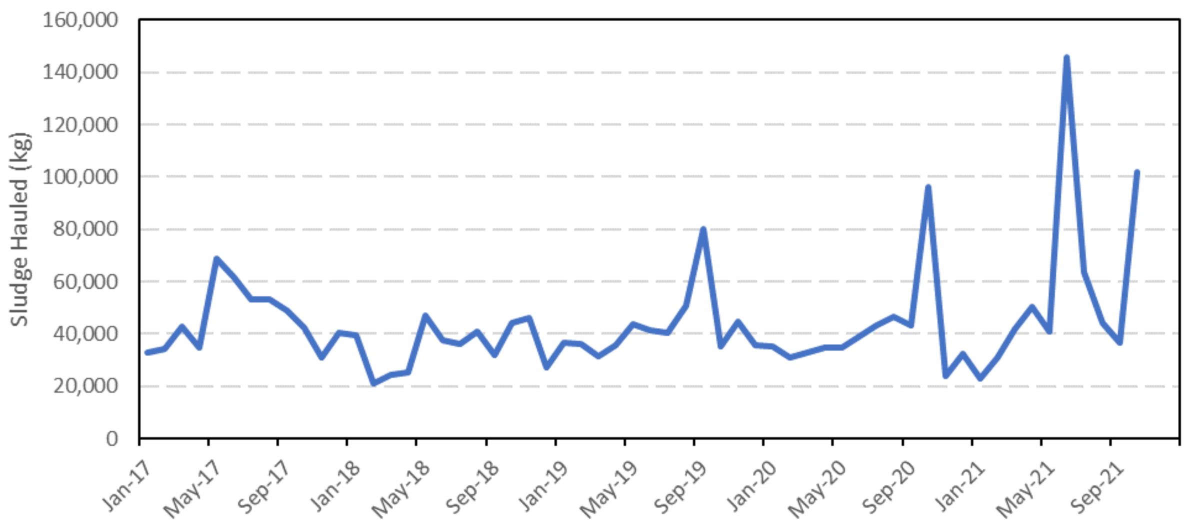


Figure 20 – Seaway WWTP Biosolids mass hauled

According to samples taken throughout the study period, the biosolids were also able to meet CM2 standards for land application, with results listed in Table 18.

Table 18: Comparison of Metal Content in Seaway WWTP Biosolids to Regulatory Limits for Land Application (2017-2021)

PARAMETER	2017-2021 AVERAGE (MG/KG)	CM2 (MG/KG)
Arsenic	8.37	170
Cadmium	0.81	34
Chromium	50.02	2,800
Cobalt	5.13	340
Copper	526.72	1,700
Lead	26.39	1,100
Mercury	0.25	11
Molybdenum	9.67	94
Nickel	63.45	420
Selenium	4.18	34
Zinc	621.21	4,200

5.9.3 Status of Planned Projects

Digester upgrades are currently in design, with planned construction in 2023.

5.10 Stevensville-Douglastown Lagoon

The Stevensville-Douglastown lagoon system consists of two stabilization ponds and was originally constructed as a facultative lagoon. In 2001, aeration and a ferric chloride addition system were installed in Pond 1 to improve treatment efficiency and sludge settling. Further upgrades were completed in 2012 to add chemical mixing and stand-by power. The current Stevensville-Douglastown lagoon system has a rated ADF capacity of 2,289 m^3/d. The plant receives wastewater generated in the rural communities of Stevensville and Douglastown within the Town of Fort Erie and is operated under ECA #2588-7JTL5C issued on October 2, 2008.

Currently, the lagoon facility consists of an aerated lagoon in series with a non-aerated lagoon, with ferric chloride for coagulation. The system has the flexibility to send sewage directly to cell 2 in case of cell 1 shutdown.

Accumulated settled sludge has not been removed since the lagoon was constructed, and lagoon cleanout is planned in the short term.

5.10.1 Biosolids Quantity

The 2051 design flow is projected to be 2,450 m^3/d. At this flowrate the second treatment cell provides 31 days of liquid storage. The biosolids accumulated from present to 2051 are projected to be a small fraction of the lagoon volume, ranging from 300 to 2,000 m^3 depending on the level of compaction in the lagoons (0 to 85%). This volume represents a maximum sludge depth of 0.04 m if evenly distributed across the lagoon. Operationally, the sludge will not be uniform and higher sludge depths will be observed particularly in the front portion of the second cell.

The biosolids can be periodically dredged during pre-planned periods. It should be anticipated to have one (1) dredging during the 2051 horizon. Prior to the dredging, a sludge survey, quantity and quality estimates should be provided to establish the framework for disposal. Typically, municipal lagoons are dredged during the summer months and hauled directly to land application. Hence, the lagoons are not incorporated into the operational plan.

5.10.2 Status of Planned Projects

Lagoon cleanout including draining, sludge removal and land application of sludge is planned for 2022. The intention is to regain capacity in the lagoons.

5.11 Welland WWTP

The Welland WWTP is a conventional activated sludge plant that provides treatment for wastewater generated from the City of Welland and the Town of Pelham. The plant is operated under MECP ECA No. 5599-9VTGG2 issued on July 30, 2015. The plant has a rated ADF capacity of 54,550 m^3/d and peak flow capacity of 118,000 m^3/d.

The existing unit treatment processes include screening, grit removal, primary clarification, aeration, secondary clarification, tertiary filtration, and chlorine disinfection and dechlorination. Alum is added at the inlet of the secondary clarifier for phosphorus removal.

The current biosolids management system consists of co-thickening, and anaerobic primary and secondary digestion. Co-thickened sludge is pumped from the primary clarifiers to one of two primary digesters. Primary digester 1 has a working volume of 2,318 m^3, equipped with a fixed steel cover with hydraulic mixing system. Primary digester 2 has a working volume of 2,600 m^3, equipped with a floating gas holding cover with hydraulic mixing system. Each primary digester has a designated heat exchanger and associated recirculation pump. Primary digested sludge is transferred to a secondary digester with a working volume of 2,130 m^3 prior to being hauled offsite.

All biogas at the plant is currently used as boiler fuel with excess quantities flared.

5.11.1 Wastewater Flow

Table 19 summarizes historic flows to the Welland WWTP over the period from 2017 to 2021. The Welland WWTP average raw wastewater flow during the review period was 35,017 m^3/d, approximately 64% of the rated capacity of 54,550 m^3/d. It is noted that the Welland WWTP can receive up to 23 m^3/d of wine waste with a pH of approximately 4.

Table 19: Historic Flow to the Welland WWTP (2017 – 2021)

PARAMETERS	INFLUENT FLOW (% OF RATED CAPACITY)	PEAK FACTOR
Rated ADF Capacity (m^3/d)	54,550	-
Rated Peak Flow Rate (m^3/d)	118,000	-
Historic ADF (m^3/d)	35,017	-
Historic PDF (m^3/d)	100,757	2.87
Historic Max Month (m^3/d)	49,444	1.41

5.11.2 Historical Biosolids Quantity and Quality (5-year average)

The biosolids removed from the Welland WWTP have a total solids content of 2.73%. The digesters were able to achieve a VS destruction of 53%. The quantity of biosolids hauled, in terms of volume and mass, respectively, are provided in Figures 21 and 22.

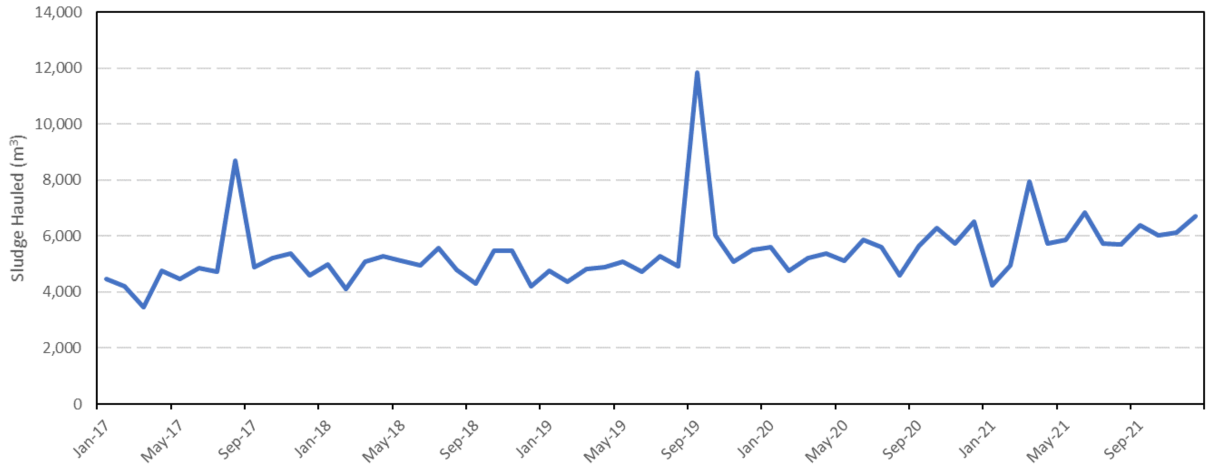


Figure 21 – Welland WWTP Biosolids volume hauled

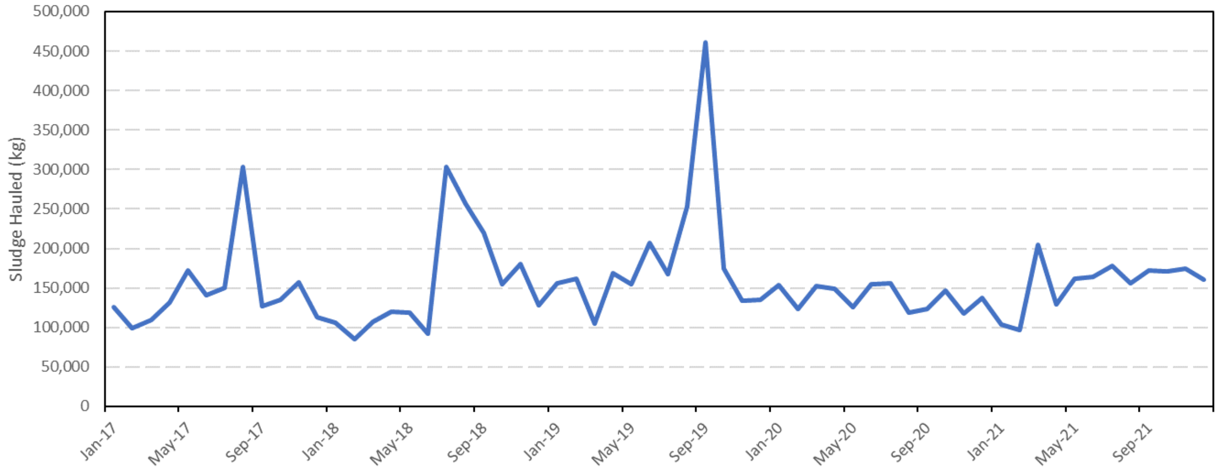


Figure 22 – Welland WWTP Biosolids mass hauled

According to samples taken throughout the study period, the biosolids were also able to meet CM2 standards for land application, with results listed in Table 20.

Table 20: Comparison of Metal Content in Welland WWTP Biosolids to Regulatory Limits for Land Application (2017-2021)

PARAMETER	2017-2021 AVERAGE (MG/KG)	CM2 (MG/KG)
Arsenic	8.24	170
Cadmium	0.65	34
Chromium	59.82	2,800
Cobalt	5.49	340
Copper	401.84	1,700
Lead	25.34	1,100
Mercury	0.21	11
Molybdenum	10.60	94
Nickel	23.42	420
Selenium	3.05	34
Zinc	546.02	4,200

5.11.3 Status of Planned Projects

There are currently no known planned projects for the solids handling.

5.12 WWTP Summary

The following table presents a summary of the WWTP historical biosolid data. The Stevensville-Douglastown Lagoon system is not included in this list, as biosolids produced remain onsite as settled solids in the lagoons.

Table 21: Summary of Existing Biosolids Management at Niagara Region WWTPs

PLANT	FACILITY TYPE	THICKENING	AVERAGE SOLIDS HAULED (M^3/YR)	AVERAGE SOLIDS HAULED (KG/YR)	**AVERAGE TOTAL SOLIDS**	ACHIEVES LAND APP STANDARDS
Anger Avenue WWTP	Extended Aeration	GBT WAS Thickening	16,719	478,163	2.86%	Yes (CP2/CM2)
Baker Road WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	53,586	1,259,271	2.35%	Yes (CP2/CM2)
Crystal Beach WWTP	Extended Aeration	GBT WAS Thickening	8,045	220,433	2.74%	Yes (CP2/CM2)
Niagara Falls WWTP[1]	Rotating Biological Contactor	PS + WAS Co-thickening (CEPT)	-	-		Yes (CP2/CM2)
Niagara-on-the-Lake WWTP	Extended Aeration	GBT WAS Thickening	12,255	273,287	2.23%	Yes (CP2/CM2)
Port Dalhousie WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	83,275	1,473,968	1.77%	Yes (CP2/CM2)
Port Weller WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	70,305	1,694,351	2.41%	Yes (CP2/CM2)
Queenston WWTP	Modified Extended Aeration	Gravity settling tank using ferric chloride	3,028	19,125	N/A[2]	N/A[2]
Seaway WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	24,590	427,866	1.74%	Yes (CP2/CM2)
Welland WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	64,976	1,773,845	2.73%	Yes (CP2/CM2)

1 – Digester failure occurred during the period of evaluation

2 – Queenston WWTP produces undigested that is send to other WWTPs, compliance for land application is n/a

6 Water Treatment System and Residual Management – Existing System, Performance and Planned Upgrades

6.1 Existing WTPs and Residual Management

The Region has six (6) WTPs. Their treatment capacities and process descriptions are summarized in Table 22. Water treatment residuals are mostly inorganic material that remain after water is treated at a WTP. Presently, the WTP residuals from the Decew, Grimsby and Niagara Falls WTPs are hauled to the Garner Road Biosolids Storage and Dewatering Facility, and co-managed with the WWTP solids. The other three WTPs in the Region discharge their residuals to the sanitary sewer system, and are subsequently treated at the receiving WWTPs, where the WTP residuals become part of the reported WWTP solids.

Table 22. Region of Niagara Water Treatment Plants (WTPs)

WTP	RATED CAPACITY (ML/D)	RESIDUAL DESTINATION	RESIDUAL MANAGEMENT
Decew	227.3	Garner Road	Process involves thickening of residuals then trucking to the Garner Road Facility for management, with larger quantities removed bi-annually during routine tank clean-out.
Grimsby	44	Garner Road	Process involves thickening of waste then trucking to Garner Road, with larger quantities removed bi-annually during routine tank clean-out.
Niagara Falls	145.4	Garner Road	Process involves thickening of waste then trucking to Garner Road, with larger quantities removed bi-annually during routine tank clean-out.
Port Colborne	36	Seaway WWTP	Residual discharged to sanitary sewer, then received and monitored as an integral part of the WWTP influent.
Rosehill	50	Anger Avenue WWTP	Residual discharged to sanitary sewer, then received and monitored as an integral part of the WWTP influent, with larger quantity discharged quarterly during routine tank clean-out.
Welland	65	Welland WWTP	Residual discharged to sewer, then received and monitored as an integral part of the WWTP influent.

6.2 Residuals Quantity

Based on the Annual Summary Reports (2019-2021) for each WTP, the average residuals quantities are presented in Table 23. The Decew, Grimsby and Niagara Falls WTPs generate residuals at a similar rate to the average flow treated. The Grimsby WTP has a slightly higher residuals generation rate than the Decew and Niagara Falls WTP. However, the Rosehill and Welland WTP have much higher residual generation rates, as no residual thickening is carried out at these WTPs.

Table 23. Summary of Residuals Quantities from 2019-2021

WTP	AVERAGE FLOW TREATED, ML/YR	AVERAGE RESIDUALS, ML/YR	RESIDUALS/TREATED FLOW, %
Decew	19,182.4	35.4	0.2
Grimsby	5,432.1	17.5	0.3
Niagara Falls	15,017.4	29.9	0.2
Port Colborne	2,498.1	23.4	0.9
Rosehill	4,129.9	176.1	4.3
Welland	8,738.5	350.7	4.0
Note: Residuals from Decew, Grimsby and Niagara Falls are sent to Garner Road Facility for dewatering. Residuals from Port Colborne, Rosehill and Welland are sent to sewer system within Seaway WWTP, Anger Avenue WWTP and Welland WWTP, respectively.			

The residuals quantities vary month to month due to water demand and raw water characteristics. Table 24 below summarizes monthly average residuals, maximum month peaking factors and minimum month peaking factors for all six WTPs in Niagara Region.

The water treatment residuals (WTR) generated at the Port Colborne, Rosehill and Welland WTPs are placed into the collection system and conveyed to the WWTPs. Those solids are accounted for as part of the WWTP solids generation at the respective facility.

Table 24. Summary of Residual Peaking Factors from 2019-2021

WTP	AVERAGE RESIDUALS, ML/MONTH	MAXIMUM MONTH PEAKING FACTOR	MINIMUM MONTH PEAKING FACTOR
Decew	2.9	2.1	0.2
Grimsby	1.5	2.4	0.2
Niagara Falls	1.2	4.2	0.2
Port Colborne	2.0	1.3	0.7
Rosehill	17.5	1.5	0.6
Welland	30.1	2.2	0.6

The total amount of solids from WTP residuals are calculated based on historical residual flows and solids concentrations, as summarized in Table 25. Because the Region does not monitor the residual solids concentrations at the Port Colborne, Rosehill, and Welland WTP in recent years, residuals solids concentration data from 2010 Biosolids Management Masterplan (BMMP) were used in this document.

The total annual average residual solids from the six WTP is approximately 3,284,195 kg/year between 2019 – 2021. Note that the calculated residuals solids from the Rosehill and Welland WTPs are significantly higher than the other four WTPS. It is recommended that the Region investigate the residual flows and strength to verify the data. For the purpose of this TM, it is recommended that the average residual solids over treated flow ratio from the four WTPs (Decew, Grimsby, Niagara Falls, and Port Colborne) of 30 kg residual solids / ML treated flow be used to estimate the residual solids from the Rosehill and Welland WTPs.

The adjusted residuals solids mass from the Rosehill and Welland WTPs are estimated at 123,897 kg/year and 262,155 kg/yr, respectively. The total residuals solids mass from the six WTPs would be reduced to 1,721,020 kg/yr.

Table 25. WTP Residual Solids Mass (2019-2021)

WTP	AVERAGE RESIDUAL, ML/YR	AVERAGE RESIDUAL SOLIDS CONCENTRATION, %TS	CALCULATED RESIDUAL SOLIDS, DRY KG/YR	AVERAGE RESIDUALS SOLIDS / TREATED FLOW, KG/ML
Decew	35.4	1.9	685,790	36
Grimsby	17.5	1.1	185,500	34
Niagara Falls	29.9	1.4	409,858	27
Port Colborne	23.4	[1] 0.2	53,820	21
Rosehill	*176.1*	[1] *0.4*	*686,803*	[3]*166*
Welland	*350.7*	[1] *0.4*	[2] *1,262,424*	[3]*144*
Total	**632.9**	**-**	**3,284,195**	

[1] Data from 2010 BMMP.

[2] Residual solids dry weight produced is twice the amount at Welland WTP than at Decew Falls WTP. Average treated flow is half the amount at Welland WTP than at Decew Falls WTP.

[3]It is recommended that the Region investigate the residuals flow and solids strength from the Rosehill and Welland WTPs. In this study, the average residual solids generation per ML treated flow from the other four WTPs could be used for the Rosehill and Welland WTPs.

6.3 Residuals Characteristics

Residual characteristics were reviewed in relation to potential final use and disposal alternatives, which will be investigated as part of this BMMP Update. The Region regularly samples and analyses the WTP residuals from the Grimsby, Decew, and Niagara Falls WTPs for a variety of quality parameters, including those related to land application guidelines, to be discussed in Technical Memorandum 9: Biosolids Long Term Market Strategies. These data are not recorded for the three WTPs that discharge their residuals to sewer for treatment through WWTPs.

Table 26 demonstrates 5-year average data for metal concentrations within WTP residuals from 2017 to 2020 on an annual basis and NASM's requirements. Refer to **Appendix A** for detailed data.

Table 26. Residuals Quality (2017-2020)

PARAMETERS (WET WEIGHT, MG/KG)	WTP FACILITY			NASM	
	Decew	**Grimsby**	**Niagara Falls**	**CM1**	**CM2**
Arsenic	34.88	56.39	29.21	13	170
Cadmium	1.88	1.87	0.70	3	34
Chromium	12.95	7.10	19.55	210	2,800
Cobalt	5.12	4.14	5.94	34	340
Copper	61.05	46.13	52.62	100	1,700
Lead	11.35	10.91	31.20	150	1,100
Mercury	0.03	0.02	0.02	0.8	11
Molybdenum	8.02	7.91	-	5	94
Nickel	16.79	8.14	19.26	62	420
Phosphorus	1385.77	1130.18	1490.99	-	-
Selenium	2.05	1.56	0.60	2	34
Sodium	908.19	2185.86	890.63	-	-
TKN	107.55	46.57	65.73	-	-
Zinc	59.93	79.37	98.22	500	4,200

The Grimsby, Niagara Falls, and Decew WTPs 2017-2020 data suggest that the residuals are normally of acceptable quality for land application as CM1 in terms of regulated metals, except that Arsenic and Molybdenum concentrations are within the CM2 range (170 mg/kg and 94 mg/kg separately in NASM).

7 Existing Garner Road Biosolids Facility, Performance and Planned Upgrades

The Garner Road Biosolids and Dewatering Facility (Garner Road Facility) receives liquid biosolids and residuals from the Regions wastewater and water treatment plants. The facility consists of ten (10) clay lined lagoons each with 6,840 m^3 of storage capacity and three (3) above ground glass fused to steel storage tanks each with 7,736 m^3 of storage capacity. The total storage volume available is approximately 92,000 m^3. The facility is permitted to receive a daily maximum of 3,000 m^3 hauled liquid biosolids or residuals per day excluding Sundays and statutory holidays (no hauling) (ECA A120215, April 2018).

Currently, the Garner Road Facility directly receives biosolids and residuals from:

- Anger Avenue WWTP
- Baker Road WWTP
- Crystal Beach WWTP
- Niagara Falls WWTP (if dewatering centrifuge is offline)
- Niagara on the Lake WWTP
- Port Dalhousie WWTP
- Port Weller WWTP
- Seaway WWTP
- Welland WWTP
- Decew Falls WTP
- Grimsby WTP
- Niagara Falls WTP

The wastewater biosolids are transported to the Garner Road Facility at 2 to 3 percent solids, whereas residuals from the water treatment plants are generally 1 to 2 percent solids. The solids are deposited into the lagoons for storage prior to land application or centrifuge dewatering on site.

The biosolids added to the lagoon cells settle and compact. The lagoons are periodically supernated to reduce the liquid volume for subsequent hauling. With successful supernating, the hauled solids can be as high as 6 to 7 percent, however; it is generally preferred by liquid biosolid land appliers to have solids at 4 to 6% to facilitate pumping. The thickened solids are land applied between April 1 and November 30 (weather dependent) with the majority of solids land applied between July and September.

At the time of writing, Thomas Nutrient Solutions is responsible for hauling the biosolids and WTP residuals to the facility, supernating the lagoons and hauling the biosolids for land application, as described previously in Section 3.2 of this technical memorandum.

The Garner Road facility is also equipped with two Andritz D7LL centrifuges each rated at 130 m^3/h. The facility is permitted to dewater up to 1,250 m^3/d (ECA A120215, April 2018). The Region is responsible for operating the dewatering facility. The dewatered cake is transported by Walker Environmental (formerly N-VIRO Systems Canada) for lime stabilization at separate privately-owned facility to be processed as fertilizer for land application.

7.1 Historical Operating Data

The Garner Road facility is operated to land apply the maximum volume of sludge possible with the remainder dewatered and hauled for offsite disposal. Data is currently available for 2017 to 2019. In general, the land application program achieves the target of approximately 50% of the solids land applied. Applying biosolids to land requires appropriate environmental conditions for end use. Hence, the quantity of land applied biosolids can be volatile and wet seasons (such as 2021) can significantly reduce the capacity to land apply biosolids. This reduction needs to be compensated for by additional dewatering or storage. The incoming and outgoing liquid generally balanced well. Refer to the table below for details on solids mass balance.

Table 27. Mass Balance Data for Garner Road Biosolids and Dewatering Facility

	UNIT	2017	2018	2019
Land Application	m^3	75,234	120,564	104,764
Land Application Solids %	%	4.48%	4.03%	3.59%
Land Application	DT*	3370	4859	3761
Supernatant	m^3	242,578	212,317	218,809
Cake	DT	3825	3805	3208
Average Cake		32.7%	31.6%	32.0%
Cake Volume	m^3	10596	10966	9101
Centrate	m^3	119,939	129,231	105,407
Percent Land Applied		47%	56%	54%
Outbound	m^3	448,347	473,078	438,081

*DT = Dry tonne

7.2 Overview of Supernating Practices

The Lagoons at the Garner Road Facility are supernated and the sludge is pumped for hauling to land application. The current contract with Thomas Nutrient Solutions is structured such that they are responsible for supernating and hauling to land application. At the same time, the contractor is paid by liquid volume of sludge. This approach does not provide an incentive for supernating.

The total solids of land applied biosolids showed a decreasing trend over the three-year data period from 4.48% to 3.59%. In 2020 and 2021, the total solids of land applied biosolids was 4.78% and 3.90% respectively resulting in a five-year average of 4.2%. There are several possible reasons for this lower total solids percentage in the land applied sludge. There are environmental factors (i.e., hauling season, temperatures) as well as operational considerations with settling time and supernating.

It was reported by the plant operators and transportation firms in 2016 that the total solids percentage of biosolids for land application were too high and caused challenges for the spreading equipment. At that time, the average total solids concentration was 7.04% with some individual samples exceeding 20%. At the same time, the volatile solids content was reduced, indicating the solid material may have contained debris from maintenance activities. The following seasons produced a more stable biosolid, albeit at a lower total solid content. In general, the total solids in recent years have been on the low end or lower than the target range of 4 to 6%.

7.3 Overview of Centrifuge Practices

The centrifuges are operated as needed to generate dewatered cake for the N-VIRO process. The quality of the cake has been consistent with a total solids content of 32.1%. The centrifuged sludge is at the higher end of the typical range of 22 to 35% for anaerobically digested primary sludge and WAS. The average polymer consumption was 25 kg/DT, which is higher than the typical range of 7.5 to 15. Generally, sludge is more challenging to dewater after storage greater than 7 days, such as at the Garner Road Biosolids Facility. The elevated polymer consumption is likely assisting in producing the high solids content despite the sludge age. Overall, the centrifuge practices are producing high quality results with the potential for minor process optimization to reduce chemical consumption.

In recent years, the centrifuges were reported to be underperforming with additional time offline for maintenance activities. To service the centrifuge requires a multi-story external platform to be relocated and anchored to the ground. The increased frequency of maintenance and challenging servicing strategy with the existing infrastructure have created operational challenges.

7.4 Status of Planned Projects

Preliminary design is currently underway for construction of a new administration building at the Garner Road Biosolids Facility. The scope of this project had originally included upgrades to the existing dewatering building to allow for better accessibility for maintenance of centrifuges. However, due to limitations of the existing building, this has been removed from the project scope. Further upgrades to the facility may be pursued based on the recommendations of the current BMMP and associated implementation plan.

8 Biosolids and Residuals Management in Other Jurisdictions

As part of the background review for this study, current biosolids and residual management practices used at other Canadian jurisdictions were reviewed and compared to current practices in Niagara Region. The Canadian municipalities contacted included the Regions of Halton and Peel, the City of Toronto, Metro Vancouver, and the Cities of Kelowna, Calgary and Edmonton. New York States biosolids management program was also reviewed.

A summary of biosolids management practices in the Ontario municipalities contacted are summarized in Table 28. Biosolids management strategies in the municipalities in Western Canada are summarized in Table 29. The tables summarize information regarding each entity including the way they approach the management of their wastewater solids and their biosolids. All but one entity, the City of Calgary, contracts with one or more third party management firms to support their biosolids management program.

The tables summarize the services that the third party firms provide along with the responsibilities of municipality and those of the third party provider. Typically, the municipality is responsible for providing a minimum amount of solids having certain characteristics. The characteristics can include the solids concentration in the liquid solids or dewatered cake and the concentration of certain metals that could impact the third party firm’s ability to use the material in a beneficial use program.

The third party management firm is often responsible for the successful management of the material once they take position either at the WWTP or when the material is delivered to their facility. The third party management firm is also often responsible to provide documentation as to how the material was managed in accordance with applicable regulations.

The municipalities procure the services of the third party firms based on requests for proposals. The requests typically require a summary of the firm’s capabilities and experience along with a price quote based on the characteristic of the solids, liquid or dewatered cake. Due to the sensitive nature of the quotes, the time when the Requests for Proposals (RFPs) were published and the contract length, pricing information was not request from the municipalities.

Table 28. Biosolids Management in Other Municipalities

	REGION OF HALTON	REGION OF PEEL	CITY OF TORONTO
Population*	596,637	1,451,022	2,794,356
WWTPs and Biosolids	• Six (6) WWTPs • All solids are anaerobically digested and dewatered; • Two (2) WWTPs (Mid-Halton and Skyway WWTPs) produce dewatered cake, and four (4) WWTPs produce liquid biosolids.	• Two (2) WWTPs (G.E. Booth WWTP and Clarkson WWTP) • The Clarkson WWTP produce anaerobically digested and dewatered cake. • The G.E. Booth WWTP produce unstabilized sludge cake.	• Four (4) WWTPs (Ashbridges Bay (ABTP), Humber (HTP), North Toronto (NTTP) and Highland Creek (HCTP)) • ABTP produces anaerobically digested and dewatered biosolids cake and dried biosolids products. • HTP produces anaerobically digested sludge. The digested liquid sludge is then transferred to the ABTP via a pipe as part of the incoming sewage. • NTP discharges raw liquid sludge into a pipe that conveys the sludge into the ABTP as part of the incoming sewage. • HCTP is equipped with anerobic digestion and incineration. A portion of the sludge is anaerobically digested. The digested sludge is then mixed with un-digested sludge prior to dewatering and incineration.
Management Approach	• A diversified program is applied to manage the biosolids. • The Region has a Biosolids Management Centre (BMC) to store liquid biosolids. The liquid biosolids is either land applied or dewatered at the BMC. • The dewatered biosolids cake from the Mid-Halton and Skyway WWTPs and from the BMCis land applied in agriculture and / mine land reclamation (winter). • The Region also contracts with Lystek for biosolids management	• G.E. Booth WWTP incinerates unstabilized sludge cake onsite; the dewatered biosolids cake from the Clarkson WWTP is transported to the G.E. Booth WWTP for incineration at the G.E. Booth WWTP • One incineration facility at the G.E. Booth WWTP with two onsite ash storage lagoons • The incinerated ash is disposed at landfill sites.	• A diversified biosolids management program is applied a the ABTP, including: : 50% of biosolids cake are dried and distributed as fertilizer; 25% are land applied; 25% further processed by a third party to create another fertilizer product, which is marketed by the third-party firm. A small portion is reused at mine reclamation sites • Solids generated at the HTP and NTTP WWTPs are transported to ABTP; HCTP manages its sludge independently • HCTP: All sludge is incinerated, producing ash for landfill disposal.
Third Party Management Service Provider(s)	• The Region contracts with Green for Life (GFL) Environmental formerly Terrapure Environmental Ltd. for biosolids management	• The operation of the two WWTPs is contracted with the Ontario Clean Water Agency (OCWA). • When needed, Peel Region engages third party solids management firms to transport stabilized biosolids from the Clarkson WWTP for land application for further stabilization and product marketing.	• The existing drying facility at the ABTP is operated by Veolia who is also responsible for marketing and distributing the final drying product (pellets). • Multiple solids management firms are contracted to manage the biosolids beneficial use program at the ABTP.

	REGION OF HALTON	REGION OF PEEL	CITY OF TORONTO
Municipality Responsibilities	• Minimum quantity of solids to GFL • Biosolids to meet local regulations	• When the Clarkson biosolids cake aretrucked offsite by third-party vendors to be applied on land, the biosolids need to meet the NASM requirements. • The incinerated ash meets local regulations for landfill disposal.	• Minimum quantity of solids for management • Biosolids to meet local regulations
Third Party Responsibilities	• Take ownership of biosolids from pick up • Provide documentation on biosolids disposal approaches to meet provincial regulations	• OCWA is responsible for operation and maintenance of the two WWTPs. • A third-party vendor is engaged to transport the dewatered biosolids cake from the Clarkson WWTP to the G.E. Booth WWTP.	• Take ownership of biosolids for management • Provide documentation on biosolids management approaches to meet provincial regulations
Third Party Management Service Provider Procurement	• Region issued RFP to i. look for demonstrated experience on biosolids land application; and ii. prefer biosolids land applied in Region's agricultural land.	• As a contingency measure, Peel Region requests third party vendors to provide as needed services to truck dewatered cake offsite.	• City issued RFP to i. look for demonstrated experiences in biosolids beneficial reuse and hauling; ii. good management capability of public relationships and local community communication; iii. proof of certificates from all end use facilities; and iv. proof of ISO system or equivalent to manage the biosolids management process.

Table 29. Biosolids Management in Key Municipalities in Western Canada

	CITY OF KELOWNA	METRO VANCOUVER	CITY OF EDMONTON (EPCOR UTILITIES INC.)	CITY OF CALGARY
Population*	144,576	2,642,825	1,010,899	1,306,784
WWTPs and Biosolids	• Two (2) WWTPs • Both produce anaerobically digested and dewatered biosolids cake	• Five (5) WWTPs • All produce anaerobically digested and dewatered biosolids cake.	• One (1) WWTP • Produces anaerobically digested biosolids.	• Three (3) WWTPs • All produce anaerobically digested biosolid
Management Approach	• Biosolids produced at the City of Kelowna and Vernon are transported to a City owned and operated Aerated Static Pile Composting facility. • The City has a total of nine staff associated with the composting operation • Composted biosolids are stored at a City owned landfill prior to distribution. • The City markets the composted biosolids product • The City works with a consultant to review their program and help set the product pricing. • 2022 pricing ranges from $33 to $16 per yd^3 based on volume purchased. They have a "sale" at the end of the fall to allow for more storage space over the winter months.	• Approximately 98% of biosolids are beneficially used in a soil blending program • The City is planning to install a drying system which to be operational in 2028. • The City uses the biogas from anaerobic digestion to generate electricity. • Dewatered cake which does not meet land application requirements are trucked to Alberta	A diversified biosolids management program is applied, including: • 20% of all biosolids products are dewatered and beneficially used in non-agricultural sectors • 80% of biosolids are beneficially used on agricultural lands, including 65% used in a liquid program and 15% in a dewatered cake program.	A Diversified biosolids management program is applied, including: • approximately 50% of total biosolids are land applied • 29% of biosolids are composted • Remaining 21% is sent to the Willow Land Reclamation Demonstration Program. • In shoulder seasons, biosolids are sent to land reclamation; in winter, biosolids are sent to the composting facility.
Third Party Management Service Provider(s)	• The City contracts the transportation of the dewatered cake to the composting site and the compost product to the storage site locates on the landfill property. • The City works with a consultant on their marketing program.	• A third party firm is hired to produce the blended soil material. • The firm manages the market program which focuses on sales to large earthwork projects.	• EPCOR Utilities Inc. owns water and wastewater treatment facilities in Edmonton. • One hauler contract. • The dewatering facility at the WWTP is operated and maintained by Veolia.	• No third-party companies. • City of Calgary owns trucks and tanks to transfer biosolids.
Municipality Responsibilities	• Provide educational program to public • Biosolids to meet local regulation	• Minimum quantity of solids to third-party firm • Biosolids to meet local regulation	• Biosolids to meet local regulation	• City is responsible for the entire operation.

	CITY OF KELOWNA	METRO VANCOUVER	CITY OF EDMONTON (EPCOR UTILITIES INC.)	CITY OF CALGARY
Third Party Responsibilities	• Take responsibilities of transportation of dewatered cake and compost product.	• Blender: takes ownership of material and provide transportation blending and marketing services.	• Hauler: take responsibilities of transportation process • Veolia: take responsibilities of dewatering facility operation	• No Third Party
Third Party Management Service Provider Procurement	• City issues RFPs for transportation of material • City currently has a three-year contract with the sludge transportation firm with options to extend.	• City issues RFP to third party firms • Long-term contract with a single firm is preferred	• EPCOR issued RFP to i. look for demonstrated experiences in biosolids beneficial reuse and hauling; ii. good management capability of public relationships and local community communication.	• No Third Party

*Population data from Statistics Canada 2021 Census of Population: https://www12.statcan.gc.ca/census-recensement/index-eng.cfm

In New York (NY) State, the beneficial use of biosolids continues to decline. Several successful programs have been closed in favour of landfill disposal. An N-Viro Alkaline stabilization system serving the Syracuse NY area was shut down due to internal County politics after 18 years of successful operation. Prior to the closure, the facility was the largest supplier of Agricultural Lime fertilizer in central NY.

Two horizontal agitated bin composting facilities were closed down due to financial reasons; one in the City of Lockport, NY and the other at the Budweiser Brewery in Baldwinsville, NY. The Budweiser facility was a pioneer in establishing a compost product market in NY.

Denali Water Solutions, with almost 2,000 employees operating 27 composting facilities, whose product is marketed in wholesale and retail markets. Denali has seen several agencies and corporate clients increasing the use of composting to process biosolids and/or separated organic waste. A number of corporate clients are using separated organic composting to meet Environmental, Social and Governance (ESG) goals. Denali also supports organic composting and use for Amazon and Waste Management Inc.

Table 30 summarizes WTP residuals management processes in other Ontario municipalities. As illustrated, Region of Niagara WTPs manage their WTP residuals in a similar manner as other municipalities in the area, by sending their residuals to the sanitary sewer system.

Table 30. WTP Residuals Management in Other Municipalities

MUNICIPALITY	RESIDUAL MANAGEMENT
Region of Halton	WTP residuals are directly discharge into sanitary sewers through sanitary connection. While sanitary connection is not available, the waste residuals are pump out by a septic hauler from backwash holding tanks.
City of Barrie	WTP residuals are discharged into the sewer directly
City of Toronto	WTP residuals are either hauled offsite for landfill or incineration.
York Region	Waste holding tanks are used to store residuals before pumping into sanitary sewers. The supernatant from the waste holding tanks is discharged into storm sewers or lake.
Region of Peel	Settling process and tube clarifiers are used to treat waste residuals. The residuals are discharged into sanitary sewers. The supernatant from the settling process is discharged directly into Lake Ontario.

Further details on quantities and quality of biosolids and residuals produced in other municipalities will be documented in Technical Memoranda 8 and 9.

9 Summary and Next Steps

This Technical Memorandum summarizes the existing biosolids and residuals management plan in Niagara Region, and current treatment and disposal capacity. It provides historical context and a baseline for development of alternative strategies for biosolids and residuals management moving forward. Technical Memorandum 4 outlines future needs and any limitations in the existing system to meet those needs.

Appendix A – Water Residuals Data

Table 1 presents the reported residuals production from each of the Region's WTPs between 2017 and 2021.

Table 1. Residuals Production Data (2017-2021)

WTPs	Year	Average Hauled Sludge (ML/month)	Average Residuals % Total Solids
DeCew	2017	2.90	1.53
	2018	2.84	2.20
	2019	2.88	2.06
	2020	2.52	1.87
	2021	3.44	1.89
Grimsby	2017	1.06	1.00
	2018	1.20	1.00
	2019	0.96	1.01
	2020	1.04	1.16
	2021	1.04	1.00
Niagara Falls	2017*	0.26	-
	2018*	2.12	1.27
	2019*	-	1.00
	2020	0.57	1.69
	2021	0.79	1.42

*Data missing or incomplete.

Table 2 presents the wet weight of metal solids within the residuals.

Table 2. Metal Concentration (2017-2021)

Metal - Solid Wet Weight (mg/kg)						
	Metal	**2017**	**2018**	**2019**	**2020**	**2021**
DeCew	Arsenic	33.87	34.38	32.54	35.53	38.10
	Cadmium	1.48	1.56	1.88	2.56	1.92
	Chromium	14.77	11.09	11.73	16.27	10.88
	Cobalt	4.27	4.49	5.41	6.87	4.55
	Copper	71.00	49.75	63.34	65.49	55.67
	Lead	8.70	8.49	8.28	[2] 22.62	8.67
	Mercury	0.01	0.01	0.06	0.05	0.01
	Molybdenum	6.80	6.61	8.28	9.74	8.67
	Nickel	16.59	15.37	15.74	20.10	16.17
	Phosphorus	2521.63	974.18	891.38	1459.59	1082.06
	Selenium	1.83	1.54	1.51	4.02	1.36
	Sodium	1232.46	726.59	818.04	1090.61	673.23
	TKN	77.39	109.74	86.26	131.57	132.79
	Zinc	84.50	49.10	52.56	67.80	45.71

Grimsby	Arsenic	52.02	68.90	48.18	58.90	53.96
	Cadmium	1.59	1.30	1.96	2.47	2.02
	Chromium	9.19	2.64	7.33	8.27	8.08
	Cobalt	3.57	2.50	4.67	5.21	4.73
	Copper	54.85	30.40	43.96	53.27	48.16
	Lead	8.49	5.30	9.15	[2] 22.38	9.22
	Mercury	0.01	0.01	0.03	0.02	0.03
	Molybdenum	6.68	5.30	9.14	9.19	9.22
	Nickel	8.98	4.20	8.51	10.08	8.94
	Phosphorus	2131.19	589.20	913.12	1071.88	945.51
	Selenium	1.12	0.87	1.57	2.87	1.34
	Sodium	1981.28	1621.00	2423.52	2721.25	2182.24
	TKN	30.50	37.52	25.97	95.25	43.62
	Zinc	96.09	49.18	78.04	94.56	78.96
[1] Niagara Falls	Arsenic	-	23.25	37.00	25.57	31.00
	Cadmium	-	-	-	-	0.70
	Chromium	-	9.03	24.00	17.96	27.22
	Cobalt	-	3.45	9.00	5.60	5.69
	Copper	-	44.75	40.00	82.00	43.73
	Lead	-	-	8.00	[2] 54.40	-
	Mercury	-	0.01	0.01	0.03	0.02
	Molybdenum	-	-	-	-	-
	Nickel	-	11.58	26.00	16.50	22.97
	Phosphorus	-	732.00	1070.00	3246.13	915.82
	Selenium	-	0.80	-	0.50	0.50
	Sodium	-	759.50	1310.00	682.86	810.18
	TKN	-	40.25	17.00	132.50	73.16
	Zinc	-	98.60	90.00	131.95	72.32

[1] Data missing or incomplete.

[2] The wet weight of metal solids is unexpectedly higher than other years.

To identify the residuals quantity variations, the monthly data were plotted in Figure 1-9.

Figure 1. Decew Falls WTP Residuals Variation (Based on Waste Sludge)

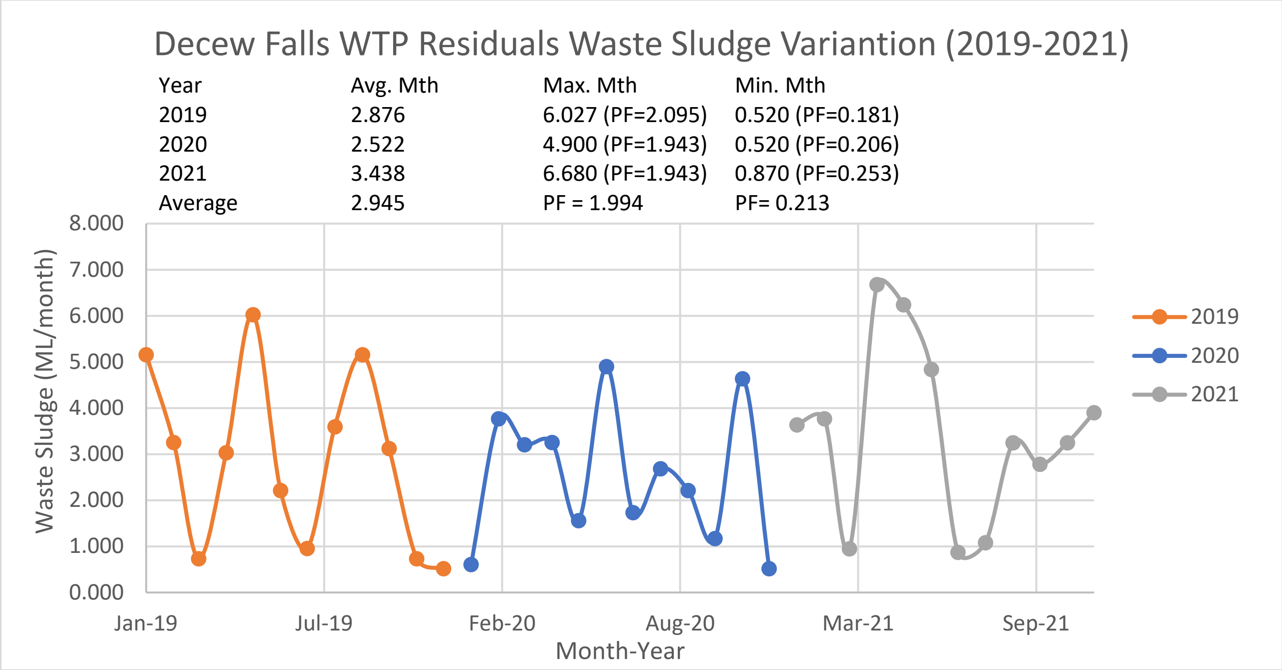


Figure 2. Decew Falls WTP Residuals Variation (Based on Residual Solids Dry Weight)

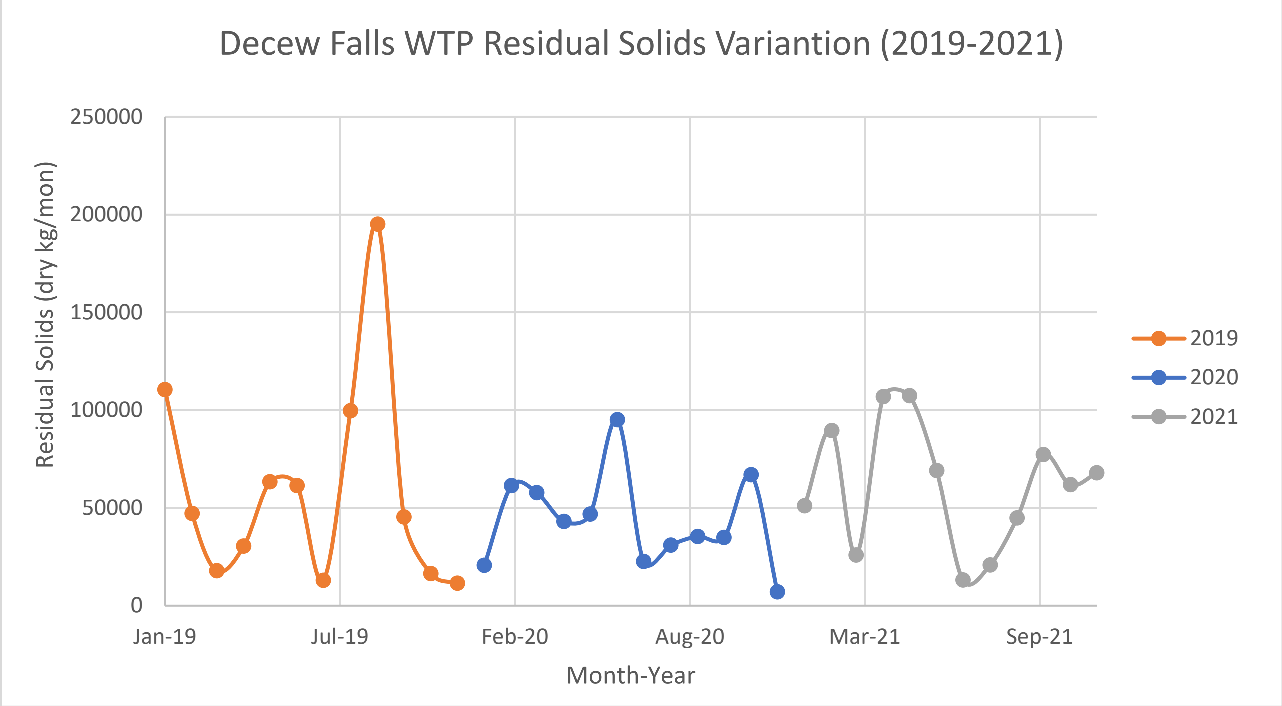


Figure 3. Grimsby WTP Residuals Variation (Based on Waste Sludge)

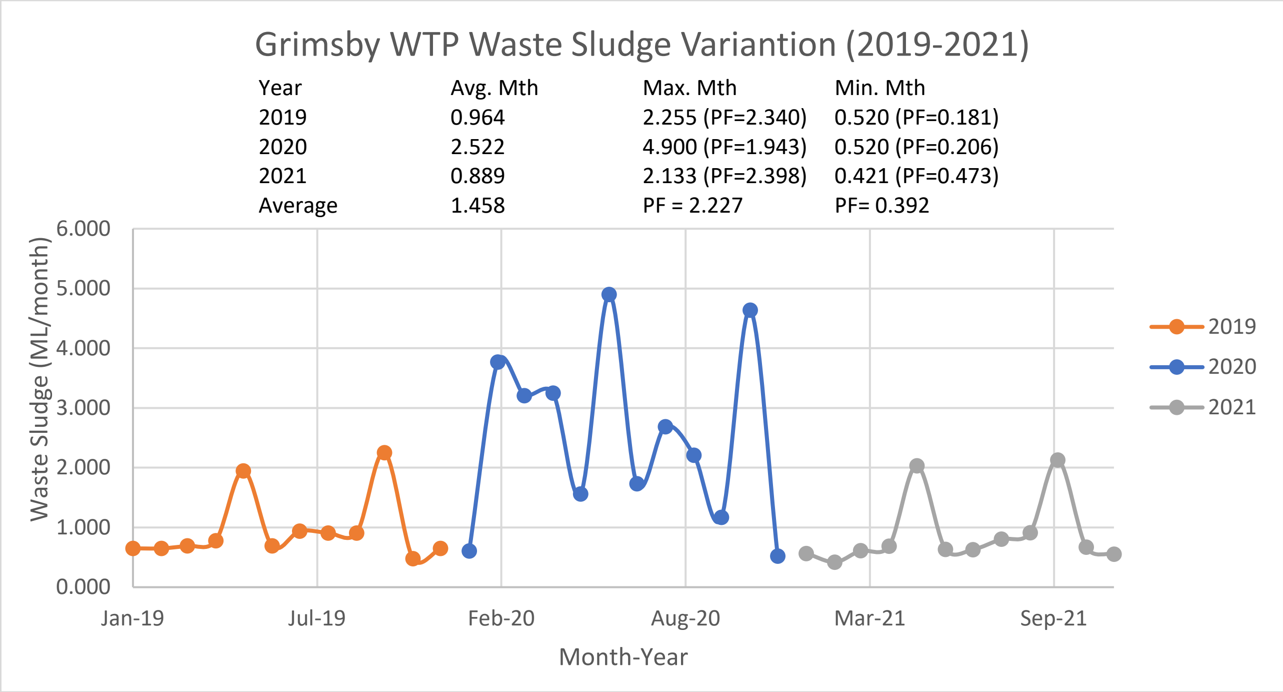
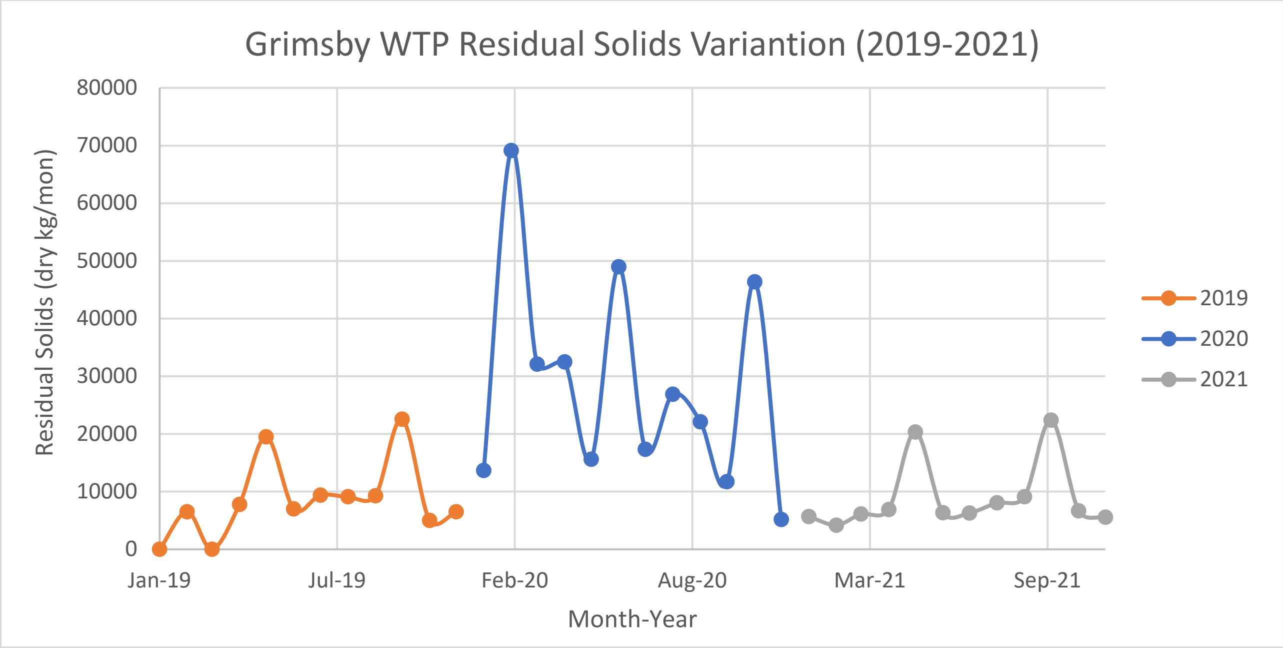
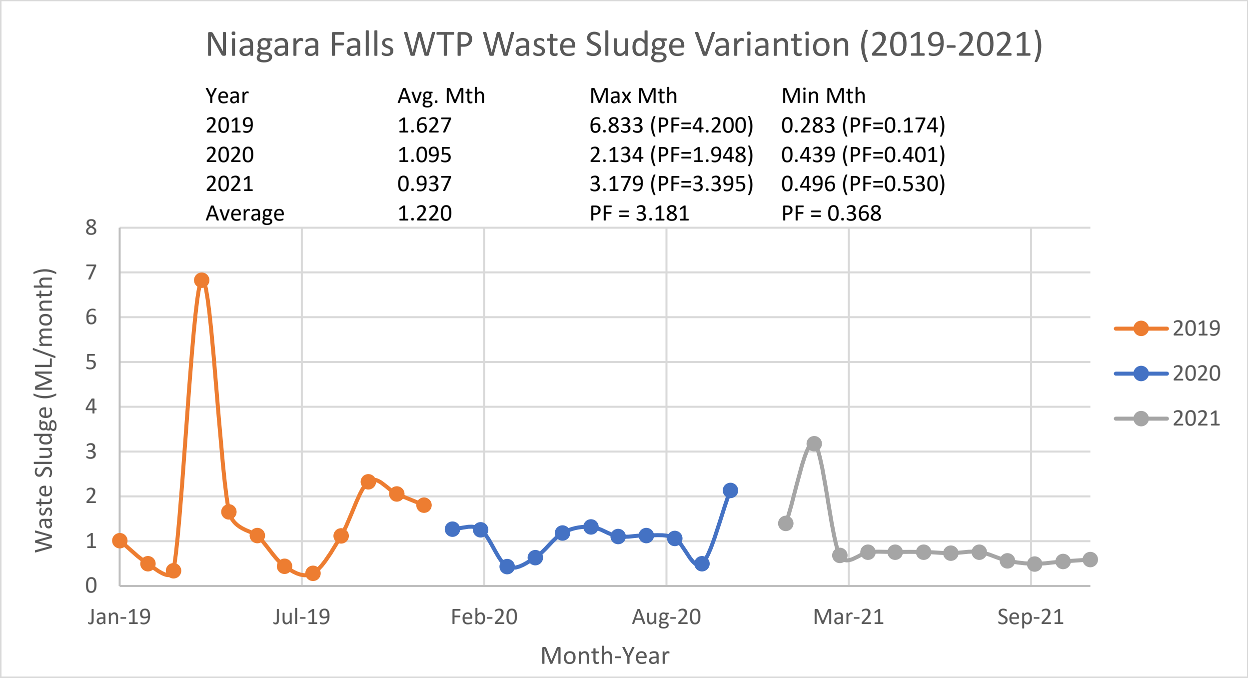


Figure 4. Grimsby WTP Residuals Variation (Based on Residual Solids Dry Weight)



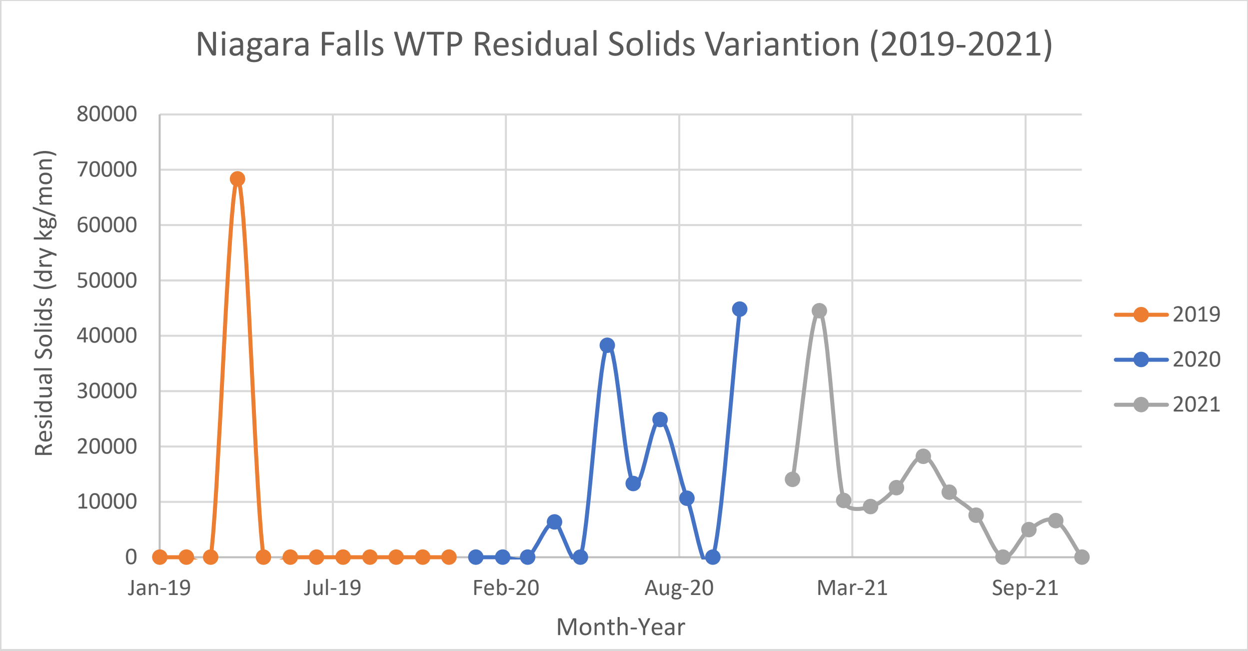
*Points on x-axis (0 kg/month) has missing "Average Residuals % Total Solids" data.

Figure 5. Niagara Falls WTP Residuals Variation (Based on Waste Sludge)



*Waste Sludge (ML) for April 2020 was excluded as it was unexpectedly higher than other months.

Figure 6. Niagara Falls WTP Residuals Variation (Based on Residual Solids Dry Weight)



*Points on x-axis (0 kg/month) has missing "Average Residuals % Total Solids" data.

Figure 7. Port Colborne WTP Residuals Variation (Based on Waste Sludge)

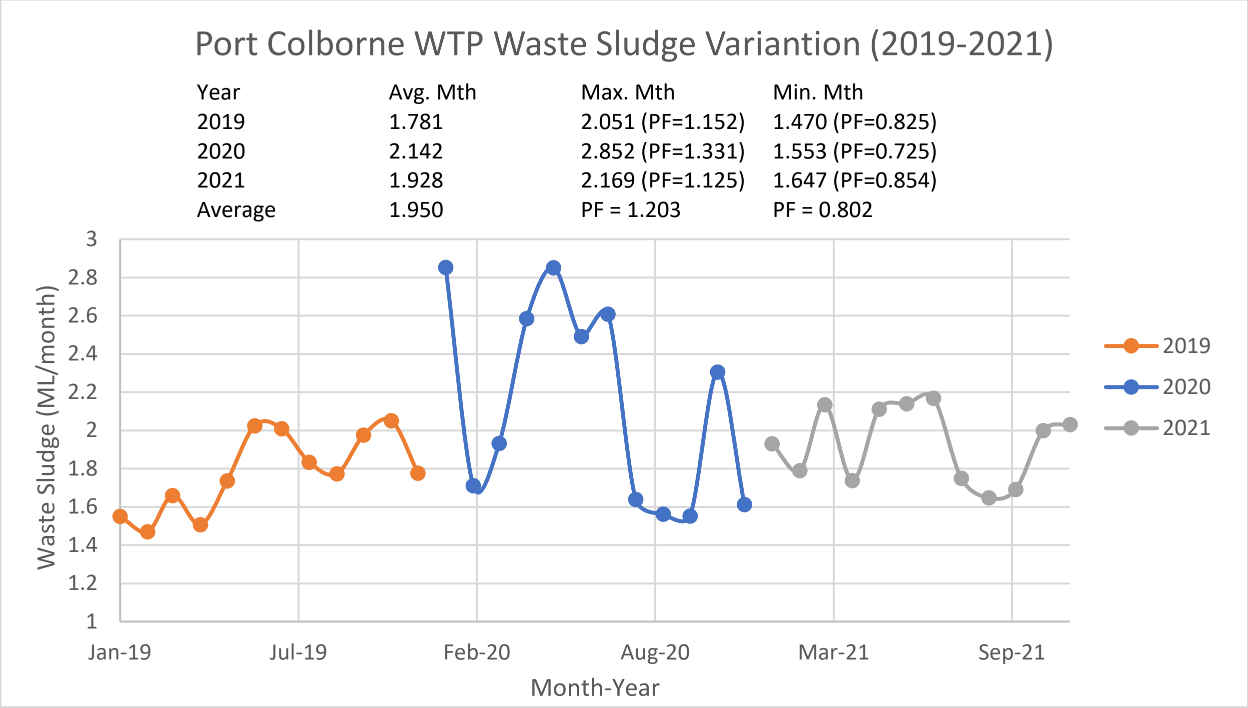


Figure 8. Rosehill WTP Residuals Variation (Based on Waste Sludge)

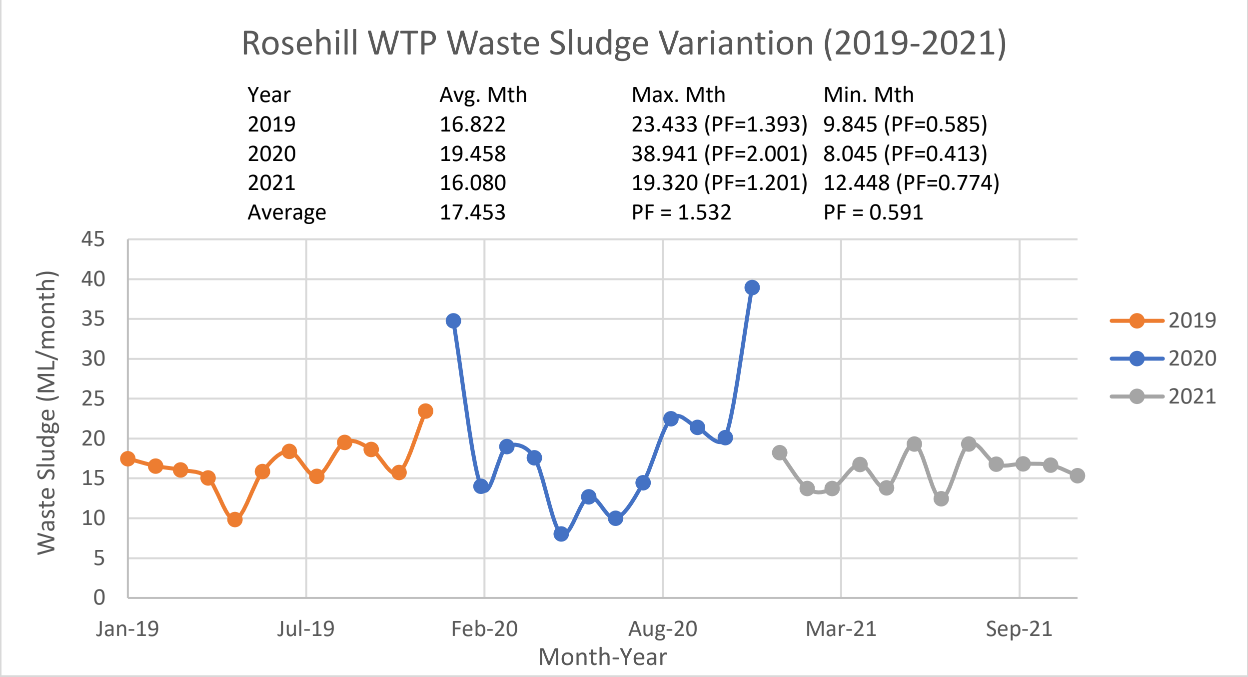


Figure 9. Welland WTP Residuals Variation (Based on Waste Sludge)