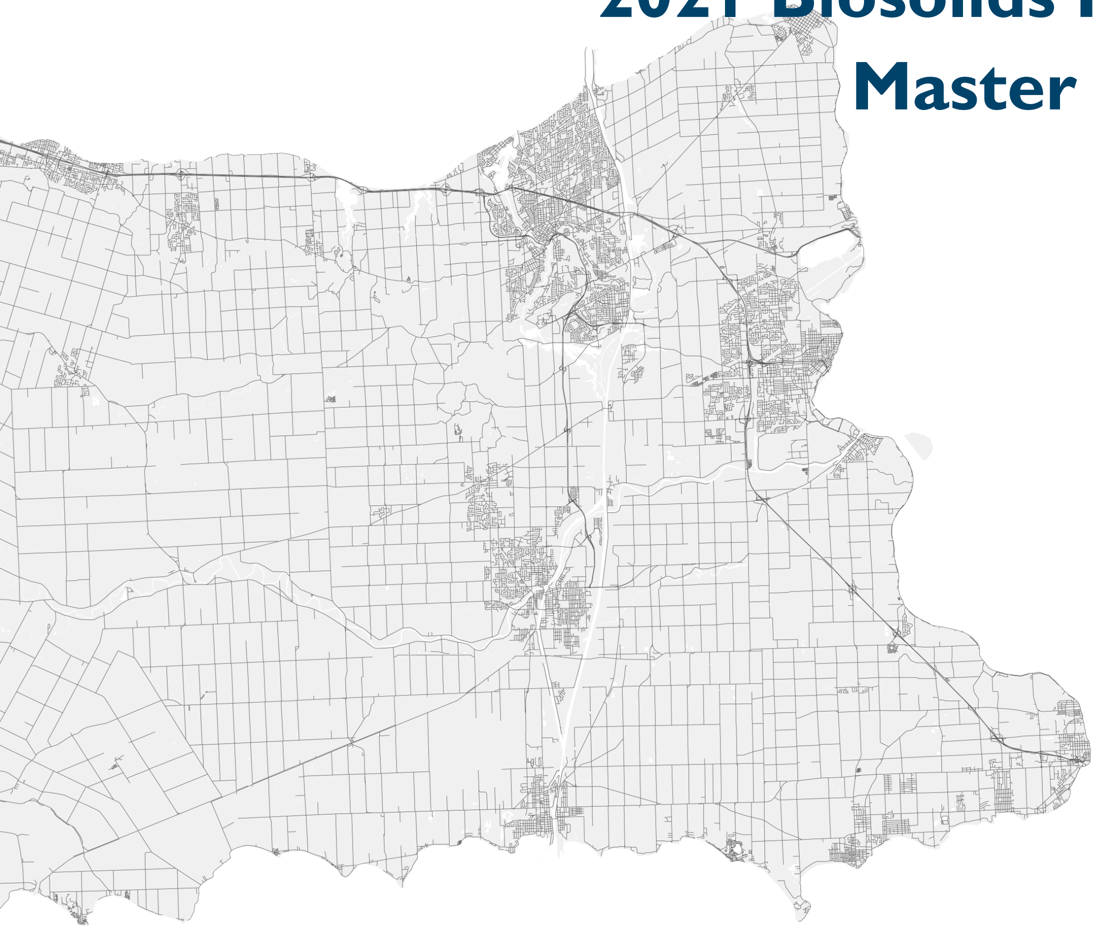
APPENDIX A4:
TM 4 – Treatment Facility Operations, Functions and Future Needs

Technical Memorandum 4

Treatment Facility Operations, Functions and Future Needs

2021 Biosolids Management Master Plan Update

August 8, 2022



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QA/QC - SIGN OFF SHEET

This report has been reviewed and approved by the undersigned.

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1.0 Introduction

1.1 Background and Purpose

Niagara Region has an extensive water and wastewater treatment serving system, with ten (10) wastewater treatment plants (WWTP) and six (6) water treatment plants (WTP). The majority of the liquid biosolids from the WWTPs are trucked to the centralized Garner Road Biosolids and Dewatering Facility. The residuals from the water treatment processes at the DeCew, Grimsby and Niagara Falls 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 biosolids and residuals received at the Garner Road Facility are either stored and trucked to be utilized directly on agricultural lands or dewatered and transported to the Walker facility (formerly N-VIRO Systems Canada), a biosolids processing facility located in Thorold.

The Region has two third party service providers to help manage their biosolids. Each provider manages approximately 50% of the Region's biosolids:

- Thomas Nutrient Solutions: responsible for managing Niagara's land application program. They are responsible for identifying and partnering with farmers on biosolids application to their agricultural land. They are also responsible for haulage, and lagoon Operation and Maintenance at the Garner Road Facility.
- Walker Environmental: responsible for further treatment of biosolids through their alkaline stabilization N-Viro process, as well as marketing and selling the end product through licensed distributors who sell the material as fertilizer and provide direct application service to farmers in Ontario.

In 2010, the Region of Niagara completed a Biosolids Management Master Plan (BMMP) to review the Region's management practices and assess alternative management strategies and to develop a strategy for managing their biosolids (including residuals) to 2031 in a sustainable and diverse manner. Since completion of the 2010 BMMP, there have been regulatory and environmental changes, as well as updated population growth projections that will have implications for biosolids management in Niagara. Regulatory changes since the 2010 BMMP, as well as anticipated future updates to regulations and potential Region responses are discussed in Technical Memorandum (TM) 9 – Long Term Market Strategies.

The purpose of this study is to complete a BMMP Update to develop a strategy for continuing to manage biosolids from the wastewater treatment plants (WWTPs) and residuals from the water treatment plant (WTPs) in a transparent, sustainable, reliable, environmentally friendly, cost-efficient, and flexible manner. The BBMP will build upon the 2010 BMMP, while also considering regulatory and environmental changes and infrastructure works implemented since its completion.

In addition to the BMMP Update, Region is currently updating their Water and Wastewater Master Servicing Plan (WWMSP) with expected completion in late 2022. The current WWMSP update provides water and wastewater servicing strategies to accommodate population growth and associated increases in flows to the year 2051. The WWMSP flow projections will be used as a basis to determine future biosolids management needs at each of the WWTPs and WTPs within the Region under the BMMP Update.

The purpose of TM 4 is to assess the ability of the existing facilities to meet biosolids and residual needs to 2051.

1.2 Technical Memorandum Outline

This TM is organized into the following sections:

1. **Introduction:** This section describes the BMMP purpose, how it integrates with the WWMSP and the TM outline.
2. **Future Treatment Needs**: This section describes the projected population growth within the Region to 2051, and the associated future water and wastewater flows compared to the existing plant rated capacities.
3. **Wastewater Treatment System:** Section 3 describes the ability of each WWTP to meet future flow and performance demands and identifies constraints and opportunities.
4. **Water Treatment System:** Section 4 describes the ability of each WTP to meet future flow and performance demands and identifies constraints and opportunities.
5. **Summary and Next Steps:** The final section summaries the major findings of the TM and presents an overview of the next steps in the assessment process.

2.0 Future Treatment Needs

The population growth forecasts to 2051 and associated increases in water and wastewater servicing requirements have been determined under the on-going WWMSP update. Growth forecasts for both residential and employment populations are summarized in Table 1 below. Overall, the population in the Region is expected to grow by approximately 42 - 45% over the next 30 years.

Table 1: Population Growth Forecasts within Region of Niagara to 2051

	POPULATION				
	Wastewater			Water	
	Serviced	Serviced	Total (Service + Unserviced)	Serviced	Serviced
	2021	2051		2021	2051
Residential Population	447,741	648,880	694,000	466,268	671,878
Employment Population	169,807	250,850	272,000	180,673	265,705
Total Population	617,548	899,730	966,000	646,937	937,582

As a result of population growth, water and wastewater flows are also expected to increase. A summary of current and future flows for each WTP and WWTP, along with current plant rated capacities are provided in Table 2 and Table 3 below.

Table 2: Forecasted Wastewater Flows to 2051

FACILITY	HISTORICAL AVERAGE DAY FLOW[1], MLD	ECA RATED CAPACITY, MLD	PROJECTED AVG DAY FLOW IN 2051, MLD	PERCENT INCREASE IN FLOW[2], %
Baker Road WWTP	19.4	31.3	35.82	111%
Port Dalhousie WWTP	34.5	61.4	45.49	43%
Port Weller WWTP	35.6	56.2	39.09	9%
Niagara-on-the-Lake WWTP	4.6	8	5.37	19%
Queenston WWTP	0.17	0.5	0.23	35%
Niagara Falls WWTP	39.6	68.3	37.75	8%
South Niagara Falls WWTP (Future)	n/a	60[3]	31.34	—
Anger Ave WWTP	14.2	24.5	18.07	40%
Crystal Beach WWTP	5.7	9.1	6.56	34%
Stevensville-Douglastown Lagoons	1.6	2.7	2.45	63%
Welland WWTP	35.1	54.6	48.87	42%
Seaway WWTP	12.0	19.6	13.44	30%

1. Average Daily Flow based on historical data from 2017-2021
2. Increase in flow is calculated by comparing flows from 2021 and 2051.
3. WWSMP suggests a rated capacity of 30 MLD from time of commissioning until 2051, at which time capacity would be increased to 60 MLD

The Baker Road WWTP has the largest expected increase in flow and is the only treatment plant that will exceed its current rated capacity by 2051, and capacity upgrades are planned.

Table 3: Forecasted Water Flows to 2051

FACILITY	AVG/MAX DAILY DEMAND[1], MLD	RATED CAPACITY, MLD	PROJECTED MAX DAILY DEMAND IN 2051, MLD	PERCENT INCREASE IN FLOW[2], %
DeCew WTP	52.9 / 94.9	227.3	122.0	29%
Rosehill WTP	12.1 / 20.8	50.0	26.6	28%
Grimsby WTP	15.0 / 27.8	44.0	46.3	67%
Niagara Falls WTP	44.2 / 77.5	145.5	97.0	25%
Welland WTP	22.6 / 36.4	102.3	55.2	52%
Port Colborne WTP	7.9 / 14.2	36.0	14.8	4%

1. Flow values are based on operational data from 2016 to 2020
2. Increase in flow is calculated by comparing average daily flow (2016-2020) and 2051.

The Grimsby WTP is estimated to receive the greatest flow demand increase, followed by the Welland WTP.

3.0 Wastewater Treatment System

3.1 Methodology

The assessment of Niagara Region's biosolids handling capacity was conducted by preparing mass balances for the projected 2051 horizon on each of the existing WWTPs.

Five-year averages of flows and loads from 2017 to 2021 were used in conjunction with projected flows and loads to estimate future projected operations and future sludge and biosolids production values for average daily and maximum month loadings.

Historic flows and loads were used to establish the existing plant operation. This approach allows for the analysis to be representative of existing plant operations by incorporating all incoming sewage from the collection system and the taking of hauled wastes from septic systems, winery waste, etc. For projected flows and loads, per-capita generation rates of 75 g BOD_5/c/d and 90 g TSS/c/d were used for waste generation from future population growth. These values are based on the Province of Ontario Guidelines for Sewage Works and provide a level of conservatism in future solids generation estimates at the current plants. It is assumed the unserved population is incorporated in the historic flows and loads.

Typical yields of 0.6 g VSS/g BOD_5 and 1.0 g TSS/g BOD_5 were used in the mass balance calculations to account for biomass generated through treatment processes. These are representative of secondary treatment processes with phosphorus removal.

This capacity assessment assumes that all equipment operates adequately, and the full tankage volume as stated in each plant ECA is functional and in use. The following thresholds were identified for sludge storage:

- insufficient less than 3 days,
- limited but sufficient 3 to 5 days and
- sufficient is greater than 5 days.

In terms of dewatering capacity for the gravity belt thickeners (GBTs) and centrifuges, a minimum runtime threshold of 8hrs a day for 365 days a year was assumed as the minimum criteria for adequate capacity.

3.2 Anger Avenue WWTP

The Anger Avenue WWTP was originally built in 1963 as a primary treatment facility and has undergone several upgrades over its lifetime. The current Anger Avenue WWTP is an extended aeration secondary treatment facility with a rated average day flow (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 dechlorination prior to continuously discharging to the Niagara River. Ferric chloride is added to aeration tank effluent for phosphorus removal.

The solids treatment train for this plant receives only waste activated sludge (WAS) from the secondary clarifiers. The Anger Avenue WWTP digested sludge is blended with sludge from other Regional treatment plants.

The existing biosolids management system consists of WAS equalisation, WAS thickening via gravity belt thickener (GBT), staged anaerobic digestion (primary and secondary) with digested sludge storage. Digester gas produced during the anaerobic digestion process is directed to a waste gas burner and flared.

Staged anaerobic digestion is currently achieved through two (2) primary digesters, followed by one (1) secondary digester and two (2) digested sludge storage tanks which provide the sludge storage and equalisation capacity prior to export of biosolids to the Garner Road facility. Anaerobic digesters and storage tanks at this plant are not able to remove supernatant.

3.2.1 2051 Horizon Flow and Loadings

The projected inflow characteristics such as population, flow and loadings to the Anger Avenue WWTP for the 2051 horizon have been summarized below in Table 2. These values were used in the mass balance for this plant.

Table 4: Anger Avenue WWTP Year 2051 Plant Inputs

PARAMETER	UNIT	VALUES	COMMENT
Population 2051	pop.	38,121	--
Average Day Flow (ADF)	m^3/d	18,066	--
Max. Month Flow (MMF)	m^3/d	26,370	1.46 Max. Month Factor – Historical 2017-2021
BOD_5	mg/L	143	107 – Historical 2017-2021
TSS	mg/L	211	179 – Historical 2017-2021
Average BOD_5 Load	kg/d	2,584	--
Average TSS Load	kg/d	3,819	--
Max. Month BOD_5 Load	kg/d	3,844	1.49 Max. Month Factor – Historical 2017-2021
Max. Month TSS Load	kg/d	5,387	1.42 Max. Month Factor – Historical 2017-2021
Max. Month VSS Load	kg/d	4,579	85% of TSS Load - Assumed

3.2.2 Capacity Assessment

The plant mass balance was conducted at average and maximum month loadings. This was used to estimate WAS sludge flow to the solids handling processes and projected performance of the digesters. Estimated sludge production volumes are provided in Table 2.

Table 5: Anger Avenue WWTP Sludge Production Volumes

PARAMETER	UNIT	VALUES	COMMENT
WAS Production – MMF	m^3/d	483	
Biosolids Production – MMF	m^3/d	86.58	To Garner Road
Biosolids Production – ADF	m^3/d	58.13	To Garner Road
Annual Hauled Biosolids	ML	21.21	

Based on the projected flows and loads and as illustrated in Table 2, **the single gravity belt thickener does not have sufficient capacity** for biosolids processing at the 2051 horizon maximum monthly loading. **WAS equalization capacity ahead of this unit process is also insufficient**.

Table 6: Anger Avenue WWTP Sludge Thickening Capacity

PARAMETER	UNIT	VALUES	COMMENT
WAS Holding Capacity			
Tank Volume	m^3	56	--
HRT/ Equalization at WAS MMF	hrs	2.78	--
GBT Thickening Capacity			
Capacity	m^3/h	31.8	System Rated for 31.8 m3/h; From ECA
	m^3/d	763	--
Min. runtime per day	hrs	15.2	365 days/year
Min. Runtime for EQ volume + 1 day	hrs	16.95	365 days/year

Based on the projected flows and loads, the primary digesters are undersized hydraulically and for volatile solids (VS) loading, as shown in Table 2. Based on this assessment, **the anaerobic (primary) digesters will not have sufficient capacity** for biosolids processing at the 2051 horizon maximum monthly loading.

Table 7: Anger Avenue WWTP Anaerobic Digestion Capacity

PARAMETER	UNIT	VALUES	COMMENT
Primary Digestion			
Primary Digester Volume (2)	m^3	884	--
Primary HRT (2)	d	10.21	15-day min per Ontario Guideline for Sewage Works
VSS volumetric loading (2)	$kg/m^3/d$	2.33	<1.6 per Ontario Guideline for Sewage Works

The secondary digester and digested sludge storage would provide over 100 days of storage together in their current configuration, as presented in Table 8. There is sufficient digested sludge storage capacity to suit the plant's needs at the 2051 horizon.

Table 8: Anger Avenue WWTP Sludge Storage Capacity

SLUDGE STORAGE CAPACITY			
Parameter	**Unit**	**Values**	**Comment**
Secondary Digestion			
Secondary Digester Volume	m^3	1,176	--
HRT	d	13.58	--
Digested Sludge Storage			
Digested Sludge Storage Volume (2)	m^3	9,000	Per ECA; Oct. 24 2011
Sludge Storage (HRT)	d	103.95	--
Total Sludge Storage	d	117.53	--

3.2.3 Existing Opportunities/Constraints

Capacity and redundancy upgrades will be required for the WAS thickening process with respect to thickening equipment and WAS equalisation volume.

The digestion process train is principally limited by hydraulic capacity and loading to the primary anaerobic digesters for the 2051 horizon. Based on the projections herein, primary digester capacity upgrades will be required.

The recommendations for this WWTP are expected to be fulfilled by the currently planned biosolids process improvements.

3.2.4 Status of Planned Projects

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

3.3 Baker Road WWTP

The Baker Road WWTP is a conventional activated sludge plant that provides treatment for wastewater generated from the Towns of Grimsby, Lincoln and West Lincoln. 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 capacity 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 for phosphorus removal.

The solids treatment train for this plant receives both primary sludge and waste activated sludge (WAS) that are co-thickened through the primary clarifiers. The existing biosolids management system consists of staged anaerobic digestion (primary and secondary) with biosolids storage. Generated digester gas is used as boiler fuel, with excess directed to burners and flared.

Staged anaerobic digestion is currently achieved through one (1) primary digester, followed by one (1) secondary digester and one (1) biosolids storage tank which provide the biosolids storage and equalisation capacity prior to export of biosolids to the Garner Road facility. Secondary anaerobic digesters and storage tanks at this plant are not able to remove supernatant.

3.3.1 2051 Horizon: Flow and Loadings

The projected inflow characteristics such as population, flow and loadings to the Baker Road WWTP for the 2051 horizon are summarized Table 2. These values were used in the mass balance for this plant.

Table 9: Baker Road WWTP Year 2051 Plant Inputs

PARAMETER	UNIT	VALUES	COMMENT
Population 2051	pop.	143,723	--
Average Day Flow (ADF)	m^3/d	35,818	--
Max. Month Flow (MMF)	m^3/d	56,592	1.58 Max. Month Factor – Historical 2017-2021
BOD_5	mg/L	244	215 – Historical 2017-2021
TSS	mg/L	293	256 – Historical 2017-2021
Average BOD_5 Load	kg/d	8,756	--
Average TSS Load	kg/d	10,481	--
Max. Month BOD_5 Load	kg/d	12,609	1.44 Max. Month Factor – Historical 2017-2021
Max. Month TSS Load	kg/d	15,406	1.47 Max. Month Factor – Historical 2017-2021
Max. Month VSS Load	kg/d	13,095	85% of TSS Load - Assumed

3.3.2 Capacity Assessment

The plant mass balance was conducted at average and maximum month loadings. This was used to estimate co-thickened primary sludge flow to the solids handling process and projected performance of the digesters. Estimated sludge production volumes are provided in Table 10.

Table 10: Baker Road WWTP Sludge Production Volumes

PARAMETER	UNIT	VALUES	COMMENT
Biosolids Production – MMF	m^3/d	435	To Garner Road
Biosolids Production – ADF	m^3/d	300	To Garner Road
Annual Hauled Biosolids	ML	109.6	

Based on the projected flows and loads, the primary digesters are undersized hydraulically and for VS loading, as shown in Table 11. The **anaerobic (primary) digesters will not have sufficient capacity** for biosolids processing at the 2051 horizon maximum monthly loading.

Table 11: Baker Road WWTP Anaerobic Digestion Capacity

PARAMETER	UNIT	VALUES	COMMENT
Primary Digestion			
Primary Digester Volume	m^3	3,603	--
HRT	d	8.27	15-day min. per Ontario Guidelines for Sewage Works
VSS volumetric loading	$kg/m^3/d$	2.98	<1.6 per Ontario Guidelines for Sewage Works

The secondary digester and digested sludge storage provide 14.5 days of storage together in their current configuration, as presented in Table 12. There is sufficient digested sludge storage capacity to suit the plant's needs at the 2051 horizon.

Table 12: Baker Road WWTP Sludge Storage Capacity

SLUDGE STORAGE CAPACITY			
Parameter	**Unit**	**Values**	**Comment**
Secondary Digestion			
Secondary Digester Volume	m^3	3,603	--
HRT	d	8.28	--
Digested Sludge Storage			
Digested Sludge Storage Volume	m^3	2,500	--
HRT	d	5.74	--
Total sludge Storage	d	14.02	--

3.3.3 Existing Opportunities/Constraints

The anaerobic digestion process train is limited from a hydraulic and loading perspective for the 2051 horizon. Based on the projections herein, primary digester capacity upgrades will likely be required.

3.3.4 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.

3.4 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 the Lake Erie. Ferric chloride is added upstream of the secondary clarifiers.

The solids treatment train for this plant receives only waste activated sludge (WAS) from the secondary clarifiers. The existing biosolids management system consists of WAS equalisation, WAS thickening via gravity belt thickener (GBT), and anaerobic digestion (primary only). Digester gas produced during the anaerobic digestion process is directed to a waste gas burner and flared.

Anaerobic digestion is achieved with a single digester which is periodically drawn down for export to the Garner Road Facility. The anaerobic digester and storage tanks at this plant are not able to supernate.

3.4.1 2051 Horizon Flow and Loadings

The projected inflow characteristics such as population, flow and loadings to the Crystal Beach WWTP for the 2051 horizon are summarized in Table 13 below. These values were used in the mass balance for this plant.

Table 13: Crystal Beach WWTP Year 2051 Plant Inputs

PARAMETER	UNIT	VALUES	COMMENT
Population 2051	pop.	14,520	
Average Day Flow (AD)	m^3/d	6,557	
Max. Month Flow (MM)	m^3/d	9,138	1.4 Max. Month Factor – Historical 2017-2021
BOD_5	mg/L	147	125 – Historical 2017-2021
TSS	mg/L	211	187 – Historical 2017-2021
Average BOD_5 Load	kg/d	966	
Average TSS Load	kg/d	1,380	

Max. Month BOD_5 Load	kg/d	1,444	1.5 Max. Month Factor – Historical 2017-2021
Max. Month TSS Load	kg/d	2,542	1.85 Max. Month Factor – Historical 2017-2021
Max. Month VSS Load	kg/d	2,161	85% of TSS Load - Assumed

3.4.2 Capacity Assessment

The plant mass balance was conducted at average and maximum month loadings. This was used to estimate WAS sludge flow to the solids handling processes and projected performance of the digesters. Estimated sludge production volumes are provided in the Table 14.

Table 14: Crystal Beach WWTP Sludge Production Volumes

PARAMETER	UNIT	VALUES	COMMENT
Biosolids Production – MMF	m^3/d	32.7	To Garner Road
Biosolids Production – ADF	m^3/d	21.75	To Garner Road
Annual Hauled Biosolids	ML	7.90	--

Based on the projected flows and loads, the gravity belt thickener has sufficient capacity for a minimum runtime at or below 8 hours per day, as presented in Table 15. However, there is no redundancy on this process and prolonged down time may require diversion of the unthickened sludge to digesters for extended periods, which would negatively impact anaerobic digestion process performance.

Table 15: Crystal Beach WWTP Sludge Thickening Capacity

PARAMETER	UNIT	VALUES	COMMENT
WAS Holding Capacity			
Tank Volume (2)	m^3	246	
HRT/ Equalization at WAS MMF (2)	hrs	48.6	
GBT Thickening Capacity			
Pump Capacity	L/s	14.1	Based on the pumps available – assuming 1 duty and 1 standby
	m^3/d	1218	
Min. Runtime per day	hrs	3.6	365 days/year
Min. Runtime for EQ volume + 1 day	hrs	8.5	365 days/year

Based on the projected flows and loads, the primary digesters have sufficient hydraulic capacity and are within capacity for VSS loading, as shown in Table 16. Based on this assessment, the anaerobic (primary) digesters will have sufficient capacity for biosolids processing at the 2051 horizon maximum monthly loading.

Table 16: Crystal Beach WWTP Anaerobic Digestion Capacity

PARAMETER	UNIT	VALUES	COMMENT
Primary Digestion			
Primary Digester Volume	m^3	599	
HRT	d	18.30	15-day min. per Ontario Guideline for Sewage Works
VSS volumetric loading	$kg/ m^3/d$	1.30	<1.6 per Ontario Guidelines for Sewage Works

The existing facilities do not have dedicated tankage for storage of digested sludge. However, if operating the anaerobic digester at the minimum HRT of 15 days, the primary digester could provide up to 3.65 days of equalisation capacity, which would provide limited but sufficient digested sludge storage capacity to meet the plant's needs at the 2051 horizon.

3.4.3 Existing Opportunities/Constraints

The existing WAS thickening equipment will require extended thickening time at the 2051 horizon. Opportunities exist to provide process redundancy and additional capacity. Based on these projections, WAS thickening upgrades will likely be required.

Upgrades could also include provisions for on-site designated digested sludge storage, to improve operational flexibility.

3.4.4 Status of Planned Projects

The plant is currently undergoing a digester rehabilitation project, 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.

3.5 Niagara Falls WWTP

The Niagara Falls WWTP is a rotating biological contactor plant with activated sludge recirculation loop plant that provides treatment for wastewater generated from the City of Niagara Falls along with a portion of the wastewater from the Town of Niagara-on-the-Lake. 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, peak primary treatment flow capacity of 205,000 m^3/d, and Peak secondary treatment capacity is 136,400 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 solids treatment train for this plant receives both primary sludge and waste activated sludge (WAS) that have been co-thickened through the primary clarifiers, although under current conditions only waste activated sludge is sent to the solids stream. Primary clarifiers at this plant use Chemically Enhanced Primary Treatment (CEPT), which impacts sludge co-thickening effectiveness.

The existing biosolids management system consists of staged anerobic digestion (primary and secondary), digested sludge storage and sludge dewatering/handling facility. Biogas is used as boiler fuel, with excess flared.

Staged anaerobic digestion is currently achieved through one (1) primary digester, followed by one (1) secondary digester and one (1) digested sludge storage tank which provide sludge storage capacity and equalisation capacity ahead of biosolids dewatering. A second primary digester is currently out of service. The secondary anaerobic digester and storage tanks at this plant are not able to remove supernatant.

The sludge dewatering and handling facility consists of mechanical sludge grinder and high-speed centrifuge. A shaftless conveyor system transfers dewatered sludge cake from the sludge dewatering centrifuge to a truck for export to the Garner Road facility.

Future conditions for the Niagara Falls WWTP are based on two scenarios. The first scenario is without the new South Niagara Falls (SNF) WWTP, and the second is with the SNF WWTP being online. Under the latter scenario, a portion of the flow from Niagara Falls WWTP is assumed to be diverted to the new SNF WWTP.

3.5.1 2051 Horizon Flow and Loadings

The projected inflow characteristics such as population, flow and loadings to the Niagara Falls WWTP for the 2051 horizon are summarized in Table 2. These values were used in the mass balance for this plant.

Table 17: Niagara Falls WWTP Year 2051 Plant Inputs

PARAMETER	UNIT	VALUES (WITH NO SNF)	VALUES (WITH SNF ONLINE)	COMMENT
Population 2051	pop.	112,560	79,893	
Average Day Flow (ADF)	m^3/d	47,864	37,755	
Max. Month Flow (MMF)	m^3/d	66,756	52,657	1.4 Max. Month Factor – Historical 2017-2021
BOD_5	mg/L	205	193*	193 – Historical 2017-2021
TSS	mg/L	237	222*	222 – Historical 2017-2021
Average BOD_5 Load	kg/d	9.798	7,286	
Average TSS Load	kg/d	11,348	8,352	
Max. Month BOD_5 Load	kg/d	15,082	11,216	1.54 Max. Month Factor – Historical 2017-2021
Max. Month TSS Load	kg/d	17,944	13,207	1.59 Max. Month Factor – Historical 2017-2021
Max. Month VSS Load	kg/d	15,253	11,226	85% of TSS Load – Assumed

* Historical Values used due to redirection of flow to South Niagara Falls WWTP

3.5.2 Capacity Assessment

The plant mass balance was conducted at average and maximum month loadings. This was used to estimate WAS sludge flow to the solids handling processes and projected performance of the digesters. Estimated sludge production volumes are provided in Table 18.

Table 18: Niagara Falls WWTP Sludge Production Volumes

PARAMETER	UNIT	VALUES (WITH NO SNF)	VALUES (WITH SNF ONLINE)	COMMENT
Sludge Production – MMF	m^3/d	1,213	893	To Digesters
Sludge Production – ADF	m^3/d	769	566	To Digesters
Biosolids Production – MMF	m^3/d	1,213	893	To Centrifuge
Biosolids Production – MMF	kg TSS/d	15,198	11,189	To Centrifuge
Dewatered Cake Production – MMF	m^3/d	41	31	To N-VIRO facility
Dewatered Cake Production – ADF	m^3/d	26	20	To N-VIRO facility
Annual Dry Solids Production	tons/yr	3,343	2,460	Post-dewatering

Based on the projected flows and loads, the existing primary digesters are hydraulically undersized and are undersized for VS loading, as presented in Table 19. The **anaerobic (primary) digesters will not have sufficient capacity** for biosolids processing at the 2051 horizon maximum monthly loading.

Table 19: Niagara Falls WWTP Anaerobic Digestion Capacity

PARAMETER	UNIT	VALUES (WITH NO SNF)	VALUES (WITH SNF ONLINE)	COMMENT
Primary Digestion				
Primary Digester Volume (1)	m^3	1,700	1,700	
Primary HRT (1)	d	1.40	1.90	15-day min. per Ontario Guideline for Sewage Works
VSS volumetric loading (1)	$kg/m^3/d$	12.02	8.85	<1.6 per Ontario Guidelines for Sewage Works

The secondary digester and digested sludge storage would together provide around 5-6 days of storage in their current configuration, as presented in Table 20. There is sufficient digested sludge storage capacity to meet the plant's needs at the at the 2051 horizon.

Table 20: Niagara Falls WWTP Sludge Storage Capacity

PARAMETER	UNIT	VALUES (WITH NO SNF)	VALUES (WITH SNF ONLINE)	COMMENT
Secondary Digestion				
Secondary Digester Volume	m^3	3,825	3,825	
HRT	d	3.15	4.28	
Digested Sludge Storage				
Digested Sludge Storage Volume	m^3	1,700	1,700	
Sludge Storage (SRT)	d	1.40	1.90	< 2 to 3 days prior to dewatering
Total sludge Storage	d	4.55	6.19	

At the 2051 horizon, the sludge dewatering for this plant would operate at 35% of its hydraulic capacity and 20% of its solids loading capacity. However, this results in a minimum daily runtime of over 8 hours, as shown in Table 21.

Table 21: Niagara Falls WWTP Sludge Dewatering Capacity

PARAMETER	UNIT	VALUES (WITH NO SNF)	VALUES (WITH SNF ONLINE)	COMMENT
Sludge Grinder	L/s	22	22	Assuming 1 duty, 1 standby
	m^3/d	1,901	1,901	
Feed pumps	L/s	22	22	Assuming 1 duty, 1 standby
	m^3/d	1,901	1,901	
Centrifuge	L/s	22	22	
Hydraulic Capacity	m^3/d	1,901	1,901	
Influent Solids Capacity	kg/d	72,230	72,230	Hydraulic capacity at 3.8% Solids; per ECA
Min. Runtime per day	hrs	15.3	11.27	Based on hydraulic capacity; 365 days/year
Min. Runtime (Storage Volume + 1 day)	hrs	36.8	32.7	Based on hydraulic capacity; 365 days/year
Centrate Holding				
Volume	m^3	1,100	1,100	
HRT/ Flow Equalization at MMF	d	0.94	1.28	

3.5.3 Existing Opportunities/Constraints

The anaerobic digestion process train is limited hydraulically and for VS loading for the 2051 horizon both with and without the SNF WWTP online in the future. Based on the projections herein, primary digester capacity upgrades will likely be required.

Dewatering capacity is deemed sufficient; however, redundancy upgrades may be required to reduce dewatering time. There are opportunities to provide on-site storage of dewatered sludge cake, which would permit 24hr or flexible operation of the sludge dewatering process.

3.5.4 Status of Planned Projects

Plans for a new primary digester are currently in place for this plant. It is anticipated that the recommendations for that unit process will be fulfilled by this process improvement.

3.6 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. Of note, this WWTP also receives hauled winery waste in addition to conventional sanitary sewage.

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 solids treatment train for this plant receives only waste activated sludge (WAS) from the secondary clarifiers. The existing biosolids management system consists of WAS equalisation, WAS thickening via gravity belt thickener (GBT), and anaerobic digestion (primary only). Digester gas is directed to a waste gas burner and flared.

Anaerobic digestion is currently achieved through one (1) primary digester prior to export of digested biosolids to the Garner Road facility. The anaerobic digester is not able to remove supernatant at this plant.

3.6.1 2051 Horizon Flow and Loadings

The projected inflow characteristics such as population, flow and loadings to the NOTL WWTP for the 2051 horizon are summarized Table 2. These values were used in the mass balance for this plant.

Table 22: NOTL WWTP Year 2051 Plant Inputs

PARAMETER	UNIT	VALUES	COMMENT
Population 2051	pop.	17,318	
Average Day Flow (ADF)	m^3/d	5,374	
Max. Month Flow (MMF)	m^3/d	6,971	1.3 Max. Month Factor – Historical 2017-2021
BOD_5	mg/L	469	478 – Historical 2017-2021
TSS	mg/L	583	597 – Historical 2017-2021
Average BOD_5 Load	kg/d	2,521	
Average TSS Load	kg/d	3,134	
Max. Month BOD_5 Load	kg/d	3,275	1.3 Max. Month Factor – Historical 2017-2021
Max. Month TSS Load	kg/d	4,558	1.46 Max. Month Factor – Historical 2017-2021
Max. Month VSS Load	kg/d	3,874	85% of TSS Load - Assumed

3.6.2 Capacity Assessment

The plant mass balance was conducted at average and maximum month loadings. This was used to estimate WAS sludge flow to the solids handling processes and projected performance of the digesters. Estimated sludge production volumes are provided in Table 23 below.

Table 23: NOTL WWTP Sludge Production Volumes

PARAMETER	UNIT	VALUES	COMMENT
Sludge Production – MMF	m^3/d	73	To Digesters
Sludge Production – ADF	m^3/d	56	To Digesters
Biosolids Production – MMF	m^3/d	73	To Garner Road facility
Biosolids Production – ADF	m^3/d	56	To Garner Road facility
Annual Hauled Biosolids	ML	20.4	

Based on the projected flows and loads and as shown in Table 2, the single gravity belt thickener has sufficient capacity for biosolids processing at the 2051 horizon maximum monthly loading. **WAS equalisation capacity ahead of this unit process is insufficient**.

Table 24: NOTL WWTP WAS Holding and Thickening Capacity

PARAMETER	UNIT	VALUES	COMMENT
WAS Holding Capacity			
Tank Volume (2)	m^3	156	Effective volume per Design Brief
HRT/ Equalization at WAS MMF (2)	hrs	5.99	
GBT Thickening Capacity			
Capacity	m^3/h	54	
	m^3/d	763.2	
Min. Runtime per day	hrs	11.6	365 days/year
Min. Runtime for EQ volume + 1 day	hrs	14.5	365 days/year

Based on the projected flows and loads, the primary digesters have sufficient hydraulic capacity but are within capacity for VSS loading, as shown in Table 25. Based on this assessment, the anaerobic (primary) digesters will have sufficient capacity for biosolids processing at the 2051 horizon maximum monthly loading.

Table 25: NOTL WWTP Anaerobic Digestion Capacity

ANAEROBIC DIGESTION CAPACITY			
Parameter	**Unit**	**Values**	**Comment**
Primary Digestion			
Primary volume	m^3	1,500	
Primary HRT	d	20.67	15-day min. per Ontario Guideline for Sewage Works
VSS volumetric loading (1)	kg/m^3/d	1.24	<1.6 per Ontario Guidelines for Sewage Works

The existing facilities do not have dedicated tankage for storage of digested sludge. However, if operating the anaerobic digester at the minimum HRT of 15 days, the primary digester could provide up to 5.56 days of equalisation capacity, which would provide limited but sufficient digested sludge storage capacity to meet the plant's needs at the at the 2051 horizon.

3.6.3 Existing Opportunities/Constraints

Capacity and redundancy upgrades will be required for the WAS thickening process with respect to thickening equipment and WAS equalisation volume.

The anaerobic digestion process train has sufficient capacity to meet the plant's needs from projections for the 2051 horizon. It is likely that additional wine waste receiving capacity is available based on the digester sizing. There may be opportunities to provide a receiving station for wine waste that is directed to the primary digester that could reduce load on the liquid treatment train and optimize the use of the anaerobic digesters.

The principal limitations of the solids treatment train at this plant at the 2051 horizon are related to the limited operational flexibility as a result o the lack of dedicated digested sludge storage. An additional digester should be planned to add redundancy and to facilitate maintenance of the existing digester.

3.6.4 Status of Planned Projects

No solids upgrade projects are currently planned.

3.7 Port Dalhousie WWTP

The Port Dalhousie WWTP is a conventional activated sludge plant that provides treatment for wastewater generated from the Cities St. Catharines and Thorold. 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, aerated grit tanks, 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 solids treatment train for this plant receives both primary sludge and waste activated sludge (WAS) that have been co-thickened through the primary clarifiers. The existing biosolids management system consists of staged anaerobic digestion (primary and secondary) with digested sludge storage. Generated digester gas is directed to boilers for heating digesters with excess biogas flared.

Staged anaerobic digestion facilities consist of three (3) primary digesters, followed by one (1) secondary digester which provides the bulk of sludge storage and one (1) digested sludge storage tank which provides equalisation capacity prior to export of biosolids. The secondary anaerobic digester and storage tank at this plant are not able to remove supernatant.

3.7.1 2051 Horizon Flow and Loadings

The projected inflow characteristics such as population, flow and loadings to the Port Dalhousie WWTP for the 2051 horizon are summarized in Table 2. These values were used in the mass balance for this plant.

Table 26: Port Dalhousie WWTP Year 2051 Plant Inputs

PARAMETER	UNIT	VALUES	COMMENT
Population 2051	pop.	162,588	
Average Day Flow (ADF)	m^3/d	45,487	
Max. Month Flow (MMF)	m^3/d	65,192	1.44 Max. Month Factor – Historical 2017-2021
BOD_5	mg/L	200	175 – Historical 2017-2021
TSS	mg/L	270	248 – Historical 2017-2021
Average BOD_5 Load	kg/d	9,132	
Average TSS Load	kg/d	12,279	
Max. Month BOD_5 Load	kg/d	12,142	1.33 Max. Month Factor – Historical 2017-2021
Max. Month TSS Load	kg/d	16,941	1.38 Max. Month Factor – Historical 2017-2021
Max. Month VSS Load	kg/d	14,400	85% of TSS Load - Assumed

3.7.2 Capacity Assessment

The plant mass balance was conducted at average and maximum month loadings. This was used to estimate WAS sludge flow to the solids handling processes and projected performance of the digesters. Estimated sludge production volumes are provided in Table 27 below.

Table 27: Port Dalhousie WWTP Sludge Production Volumes

PARAMETER	UNIT	VALUES	COMMENT
Biosolids Production – MMF	m^3/d	446	To Garner Road
Biosolids Production – ADF	m^3/d	330	To Garner Road
Annual Hauled Biosolids	ML	120.5	

Based on the projected flows and loads, the primary digesters are undersized from hydraulic and volatile solids loading perspectives, as shown in Table 28. Based on this assessment, **the anaerobic (primary) digesters will not have sufficient capacity** for biosolids processing at the 2051 horizon maximum monthly loading.

Table 28: Port Dalhousie WWTP Anaerobic Digestion Capacity

PARAMETER	UNIT	VALUES	COMMENT
Primary Digestion			
Primary Digester Volume (3)	m^3	5,600	
Primary HRT (3)	d	12.55	15-day min. per Ontario Guideline for Sewage Works
VSS volumetric loading (3)	$kg/m^3/d$	2.00	<1.6 per Ontario Guidelines for Sewage Works

The secondary digester and digested sludge storage would provide at least 4 days of storage together in their current configuration, as described in Table 29. There is limited, but sufficient sludge storage capacity at the 2051 horizon maximum monthly loading.

Table 29: Port Dalhousie WWTP Sludge Storage Capacity

PARAMETER	UNIT	VALUES	COMMENT
Secondary Digestion			
Secondary Digester Volume	m^3	1,560	--
HRT	d	3.49	--
Digested Sludge Storage			
Digested Sludge Storage Volume	m^3	274	--
Sludge Storage (HRT)	d	0.61	--
Total Sludge Storage	d	4.11	--

3.7.3 Existing Opportunities/Constraints

The anaerobic digestion process train is hydraulically and volatile solids loading limited for the 2051 horizon. Based on the projections herein, primary digester capacity upgrades will likely be required.

The Region has had limited success with operation and maintenance of egg-shape digesters; a preference for circular digesters should be considered due to their compatibility with the Region's operational practices. However, there may be an opportunity to rehabilitate the existing egg shape digester which currently remains unused to meet part of the required digester volumes. This would require a full condition assessment and preparation of detailed rehabilitation drawings for the existing digester. A full evaluation of salvaging vs. rehabilitation should be considered at time of design.

There may also be opportunities to provide additional digested sludge storage to provide improved operational flexibility at the 2051 horizon.

3.7.4 Status of Planned Projects

A digester cleanout and flare upgrade are planned under the Phase 2 upgrades currently in design. This will not likely address the noted capacity limitations.

3.8 Port Weller WWTP

The Port Weller WWTP is a conventional activated sludge plant that provides treatment for wastewater generated from the Cities St. Catharines and Thorold. 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 and peak flow capacity of 112,360 m^3/d.

The existing unit treatment processes includes 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 solids treatment train for this plant receives both primary sludge and waste activated sludge (WAS) that are co-thickened through the primary clarifiers. The existing biosolids management system consists of staged anaerobic digestion (primary and secondary). Generated digester gas is directed to burners and flared or directed to plant boilers. For the projections in this report, it is assumed that biosolids are blended with all sludge from the Queenston WWTP.

Staged anaerobic digestion is currently achieved through one (1) primary digester, followed by one (1) secondary digester providing sludge storage and equalisation capacity prior to export of biosolids. The secondary anaerobic digester is able to remove supernatant at this plant.

3.8.1 2051 Horizon Flow and Loadings

The projected inflow characteristics such as population, flow and loadings to the Port Weller WWTP for the 2051 horizon are summarized in Table 2. These values were used in the mass balance for this plant.

Table 30: Port Weller WWTP Year 2051 Plant Inputs

PARAMETER	UNIT	VALUES (WITH NO SNF)	VALUES (WITH SNF ONLINE)	COMMENT
Population 2051	pop.	125,430	112,676	
Average Day Flow (ADF)	m^3/d	40,560	39,092	
Max. Month Flow (MMF)	m^3/d	57,818	55,724	1.43 Max. Month Factor – Historical 2017-2021
BOD_5	mg/L	177	159	154 – Historical 2017-2021
TSS	mg/L	248	228	225 – Historical 2017-2021
Average BOD_5 Load	kg/d	7,169	6,214	
Average TSS Load	kg/d	10,046	8,897	
Max. Month BOD_5 Load	kg/d	9,757	8,457	1.37 Max. Month Factor – Historical 2017-2021
Max. Month TSS Load	kg/d	15,156	13,422	1.51 Max. Month Factor –

				Historical 2017-2021
Max. Month VSS Load	kg/d	12,883	11,408	85% of TSS Load - Assumed

3.8.2 Capacity Assessment

The plant mass balance was conducted at average and maximum month loadings. This was used to estimate WAS sludge flow to the solids handling processes and projected performance of the digesters. Estimated sludge production volumes are provided in Table 31 below.

Table 31: Port Weller WWTP Sludge Production Volumes

PARAMETER	UNIT	VALUES (WITH NO SNF)	VALUES (WITH SNF ONLINE)	COMMENT
Sludge Production – MMF	m^3/d	464	407	To Digesters
Sludge Production – ADF	m^3/d	320	280	To Digesters
Sludge Production – MMF	m^3/d	347	303	To Garner Road facility
Sludge Production – ADF	m^3/d	242	211	To Garner Road facility
Annual Hauled Biosolids	ML	88.3	77.0	

Based on the projected flows and loads, the primary digesters are undersized hydraulically and for VS loading, as shown in Table 32. Based on this assessment, **the anaerobic (primary) digesters will not have sufficient capacity** for biosolids processing at the 2051 horizon maximum monthly loading.

Table 32: Port Weller WWTP Anaerobic Digestion Capacity

PARAMETER	UNIT	VALUES (WITH NO SNF)	VALUES (WITH SNF ONLINE)	COMMENT
Primary Digestion				
Primary volume (1)	m^3	5,046	5,046	
Primary HRT (1)	d	10.86	12.39	15-day min. per Ontario Guideline for Sewage Works
VSS volumetric loading (1)	$kg/m^3/d$	1.89	1.65	<1.6 per Ontario Guidelines for Sewage Works

The secondary digester would provide about 10 days of storage in its current configuration, as documented in Table 33. There is sufficient digested sludge storage capacity to meet the plant's needs at the 2051 horizon.

Table 33: Port Weller WWTP Sludge Storage Capacity

PARAMETER	UNIT	VALUES (WITH NO SNF)	VALUES (WITH SNF ONLINE)	COMMENT
Secondary Digestion				
Secondary Digester Volume	m^3	4,400	4,400	
SRT	d	9.47	10.80	

3.8.3 Existing Opportunities/Constraints

The anaerobic digestion process train is limited hydraulically in all scenarios and for VS Loading for the 2051 horizon with the SNF WWTP offline. Based on the projections herein, primary digester capacity upgrades will likely be required.

3.8.4 Status of Planned Projects

Upgrades are planned for new digester tankage. Furthermore, 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.

3.9 Queenston WWTP

The Queenston WWTP is an extended-aeration plant that provides treatment for wastewater generated by the community of Queenston. The plant is currently operated under MECP ECA No. 0371-93YM2L issued on February 22, 2013. The Queenston WWTP has a rated average day flow (ADF) capacity of 500 m^3/d and a peak flow capacity of 1,700 m^3/d. This plant could be decommissioned for the long-term planning horizon.

The existing treatment processes include screening, grit removal, aeration, secondary clarification, phosphorus removal and chlorine disinfection and dechlorination prior to discharge to the Niagara River. Ferric chloride is added downstream of the grit tanks.

The solids treatment train for this plant receives only waste activated sludge (WAS) from the secondary clarifiers. Sludge storage facilities at this plant have the ability to remove supernatant. The existing biosolids management system only consists of WAS equalisation / storage. All sludge produced at this plant are exported to another Regional WWTP for digestion since 2018.

3.9.1 2051 Horizon Flow and Loadings

The projected inflow characteristics such as population, flow and loadings to the Queenston WWTP for the 2051 horizon are summarized in Table 2. These values were used in the mass balance for this plant.

Table 34: Queenston WWTP Year 2051 Plant Inputs

PARAMETER	UNIT	VALUES	COMMENT
Population 2051	pop.	1,223	
Average Day Flow (ADF)	m^3/d	230	
Max. Month Flow (MMF)	m^3/d	485	2.11 Max. Month Factor – Historical 2017-2021
BOD_5	mg/L	186	164 – Historical 2017-2021

TSS	mg/L	268	246 – Historical 2017-2021
Average BOD_5 Load	kg/d	43	
Average TSS Load	kg/d	62	
Max. Month BOD_5 Load	kg/d	98	2.3 Max. Month Factor – Historical 2017-2021
Max. Month TSS Load	kg/d	132	2.13 Max. Month Factor – Historical 2017-2021
Max. Month VSS Load	kg/d	112	85% of TSS Load - Assumed

3.9.2 Capacity Assessment

The plant mass balance was conducted at average and maximum month loadings. This was used to estimate WAS sludge flow to the solids handling processes and projected performance of the digesters. Estimated sludge production volumes are provided in Table 35 below.

Table 35: Queenston WWTP Sludge Production Volumes

PARAMETER	UNIT	VALUES	COMMENT
Sludge Production – MMF	m^3/d	12	To Port Weller Ave WWTP - Undigested 0.8% Solids
Sludge Production – ADF	m^3/d	5	To Port Weller WWTP - Undigested 0.8% Solids
Annual Hauled Biosolids	ML	1.89	

The digested sludge storage would provide at least 2 days of storage together in its current configuration, as presented in Table 36. There is sufficient sludge storage capacity to meet the plant's needs at the 2051 horizon.

Table 36: Queenston WWTP Sludge Storage Capacity

PARAMETER	UNIT	VALUES	COMMENT
Sludge Storage			
Sludge Storage Volume	m^3	60	
Solids Storage (SRT)	d	4.46	< 7 days MECP

3.9.3 Existing Opportunities/Constraints

There are limited opportunities for optimization at this plant due to the limited population growth and current plant configuration.

3.9.4 Status of Planned Projects

No sludge upgrade projects are currently planned. 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.

3.10 Seaway WWTP

The Seaway WWTP is a conventional activated sludge plant that provides treatment for wastewater generation from 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, vortex grit removal, 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 solids treatment train for this plant receives both primary sludge and WAS that have been co-thickened through the primary clarifiers. The existing biosolids management system consists of anaerobic digestion with digested sludge storage. Generated digester gas is directed to burners and flared.

Anaerobic digestion is currently achieved through two (2) digesters (both operating as primary), followed by digested sludge storage which provides equalisation capacity prior to export of digested biosolids to the Garner Road facility. Anaerobic digesters and storage tanks at this plant are not able to remove supernatant.

3.10.1 2051 Horizon Flow and Loadings

The projected inflow characteristics such as population, flow and loadings to the Seaway WWTP for the 2051 horizon are summarized Table 2. These values were used in the mass balance for this plant.

Table 37: Seaway WWTP Year 2051 Plant Inputs

PARAMETER	UNIT	VALUES	COMMENT
Population 2051	pop.	26,686	
Average Day Flow (ADF)	m^3/d	13,441	
Max. Month Flow (MMF)	m^3/d	18,892	1.41 Max. Month Factor – Historical 2017-2021
BOD_5	mg/L	133	112 – Historical 2017-2021
TSS	mg/L	175	152 – Historical 2017-2021
Average BOD_5 Load	kg/d	1,785	
Average TSS Load	kg/d	2,348	
Max. Month BOD_5 Load	kg/d	2,258	1.27 Max. Month Factor – Historical 2017-2021
Max. Month TSS Load	kg/d	3,036	1.3 Max. Month Factor – Historical 2017-2021
Max. Month VSS Load	kg/d	2,581	85% of TSS Load - Assumed

3.10.2 Capacity Assessment

The plant mass balance was conducted at average and maximum month loadings. This was used to estimate WAS sludge flow to the solids handling processes and projected performance of the digesters. Estimated sludge production volumes are provided in Table 38.

Table 38: Seaway WWTP Sludge Production Volumes

PARAMETER	UNIT	VALUES	COMMENT
Biosolids Production – MMF	m^3/d	79.0	To Garner Road
Biosolids Production – ADF	m^3/d	62.2	To Garner Road
Annual Hauled Biosolids	ML	22.7	

Based on the projected flows and loads, the primary digesters have sufficient hydraulic capacity and are within capacity for VS loading, as shown in Table 39. Based on this assessment, the anaerobic (primary) digesters will have sufficient capacity for biosolids processing at the 2051 horizon maximum monthly loading.

Table 39: Seaway WWTP Anaerobic Digestion Capacity

PARAMETER	UNIT	VALUES	COMMENT
Primary Digestion			
Primary volume (2)	m^3	1,920	
Primary HRT (2)	d	24.17	15-day min. per Ontario Guideline for Sewage Works
VSS volumetric loading (2)	$kg/m^3/d$	1.04	<1.6 per Ontario Guidelines for Sewage Works

The digested sludge storage would provide at least 2 days of storage together in its current configuration, as shown in Table 40, which would be insufficient for operational flexibility. However, if operating the anaerobic digester at the minimum HRT of 15 days, the primary digester could provide up to 10 days of equalisation capacity, which would provide sufficient digested sludge storage capacity to meet the plant's needs at the 2051 horizon.

Table 40: Seaway WWTP Sludge Storage Capacity

PARAMETER	UNIT	VALUES	COMMENT
Digested Sludge Storage			
Digested Sludge Storage Volume	m^3	163	
Sludge Storage (HRT)	d	2.06	

3.10.3 Existing Opportunities/Constraints

The anaerobic digestion process train has sufficient capacity for the 2051 horizon but will likely remain oversized in terms of VS loading. There are opportunities to use the excess digester capacity for treatment of high strength wastes (i.e., winery wastes), although this may not be practical considering the majority of winery waste is generated in the northern part of the Region.

There may also be opportunities to provide additional designated digested sludge storage to provide increased operational flexibility at the 2051 horizon.

3.10.4 Status of Planned Projects

Installation of new roof for south digester planned for 2023 construction, with north digester clean-out/repairs to follow once south digester is back online.

3.11 Welland WWTP

The Welland WWTP is a conventional activated sludge plant that provides treatment for wastewater generated from the City of Welland, the Town of Pelham and portions of the City of Thorold. The plant is operated under MECP ECA No. 3922-C9PJKZ issued on April 3, 2022. The plant has a rated ADF capacity of 54,550 m^3/d, peak primary treatment flow capacity of 118,000 m^3/d, and peak secondary treatment capacity of 65,000 m^3/d.

The existing unit treatment processes includes screening, grit removal, primary clarification, aeration, secondary clarification, and chlorine disinfection and dechlorination. Tertiary treatment is installed at the WWTP but is not currently in use. Ferric chloride is added at the inlet of the secondary clarifier for phosphorus removal.

The solids treatment train for this plant receives both primary sludge and WAS that have been co-thickened through the primary clarifiers. The existing biosolids management system consists of staged anaerobic digestion (primary and secondary). Generated digester gas is directed to boilers to heat the digesters, with excess biogas sent to burners and flared.

Staged anaerobic digestion is currently achieved through two (2) primary digesters, followed by one (1) secondary digester providing some sludge storage and equalisation capacity prior to export of biosolids to the Garner Road facility. Secondary anaerobic digesters at this plant are able to supernate.

3.11.1 2051 Horizon Flow and Loadings

The projected inflow characteristics such as population, flow and loadings to the Welland WWTP for the 2051 horizon are summarized Table 2. These values were used in the mass balance for this plant.

Table 41: Welland WWTP Year 2051 Plant Inputs

PARAMETER	UNIT	VALUES	COMMENT
Population 2051	pop.	150,273	
Average Day Flow (ADF)	m^3/d	48,868	
Max. Month Flow (MMF)	m^3/d	69,004	1.42 Max. Month Factor – Historical 2017-2021
BOD_5	mg/L	166	115 – Historical 2017-2021
TSS	mg/L	217	163 – Historical 2017-2021
Average BOD_5 Load	kg/d	8,120	
Average TSS Load	kg/d	10,627	

Max. Month BOD_5 Load	kg/d	11,440	1.41 Max. Month Factor – Historical 2017-2021
Max. Month TSS Load	kg/d	18,187	1.72 Max. Month Factor – Historical 2017-2021
Max. Month VSS Load	kg/d	15,459	85% of TSS Load - Assumed

3.11.2 Capacity Assessment

The plant mass balance was conducted at average and maximum month loadings. This was used to estimate WAS sludge flow to the solids handling processes and projected performance of the digesters. Estimated sludge production volumes are provided in Table 42 below.

Table 42: Welland WWTP Sludge Production Volumes

PARAMETER	UNIT	VALUES	COMMENT
Sludge Production – MMF	m^3/d	499	To Digesters
Sludge Production – ADF	m^3/d	316	To Digesters
Biosolids Production – MMF	m^3/d	391	To Garner Road facility
Biosolids Production – ADF	m^3/d	251	To Garner Road facility
Annual Hauled Biosolids	ML	91.7	

Based on the projected flows and loads, the primary digesters are undersized hydraulically and for VS loading, as shown in Table 43. Based on this assessment, **the anaerobic (primary) digesters will not have sufficient capacity** for biosolids processing at the 2051 horizon maximum monthly loading.

Table 43: Welland WWTP Anaerobic Digestion Capacity

ANAEROBIC DIGESTION CAPACITY			
Parameter	**Unit**	**Values**	**Comment**
Primary Digestion			
Primary volume (2)	m^3	4,918	
Primary HRT (2)	d	9.85	15 day minimum. Per Ontario Guideline for Sewage Works
VSS volumetric loading (2)	$kg/m^3/d$	2.46	<1.6 per Ontario Guidelines for Sewage Works

The secondary digester would provide at least 4 days of storage in its current configuration, as presented in Table 44. There is limited, but sufficient sludge storage capacity at the 2051 horizon maximum monthly loading.

Table 44: Welland WWTP Sludge Storage Capacity

PARAMETER	UNIT	VALUES	COMMENT
Secondary Digestion			
Secondary Digester Volume	m^3	2,130	
HRT	d	4.27	

3.11.3 Existing Opportunities/Constraints

The anaerobic digestion process train is limited hydraulically and for VS loading for the 2051 horizon. Based on the projections herein, primary digester capacity upgrades will likely be required.

Upgrades could also include provisions for designated on-site digested sludge storage to improve operational flexibility.

3.11.4 Status of Planned Projects

No solids upgrade projects are currently planned.

3.12 South Niagara Falls WWTP

The South Niagara Falls WWTP is a planned conventional activated sludge plant currently in the planning and design stage. In addition to supporting growth, this plant will receive sewage that would have otherwise been directed to existing WWTPs within the 2051 horizon, notably from the Port Weller (1.5 MLD) and Niagara Falls (10.1 MLD) WWTPs. The information on the future plant is based on its Conceptual Design Report prepared by CIMA+ in 2022 (*South Niagara Falls WWTP Class Environment Assessment and Conceptual Design, 2022*).

The major liquid treatment processes will include screening and aerated grit removal, primary treatment, aeration, secondary clarification, and effluent disinfection and dechlorination prior to discharge. Ferric chloride will be added to aeration tank effluent for phosphorus removal.

The solids treatment train for this plant will receive both primary sludge and waste activated sludge (WAS) that are co-thickened through the primary clarifiers. The biosolids management system will consist of staged anaerobic digestion, without biosolids storage.

Staged anaerobic digestion will be achieved through one (1) primary digester and one (1) secondary digester prior to export of biosolids to the Garner Road facility. It is assumed that anaerobic digesters at this plant will not be able to supernate. Dewatering at South Niagara Falls WWTP is not planned at the current time but may be considered in future.

3.12.1 2051 Horizon Flow and Loadings

The projected inflow characteristics such as population, flow, and loadings to the South Niagara Falls WWTP for the 2051 horizon are summarized in Table 2. The South Niagara Falls WWTP is intended to accept the centrate from Garner Road as well as hauled sewage, which increases the wastewater strength relative to the existing wastewater treatment facilities. The values in the table below were used in the mass balance for this plant.

Table 45: South Niagara Falls WWTP Year 2051 Plant Inputs

PARAMETER	UNIT	VALUES	COMMENT
Population 2051	pop.	99,642	
Average Day Flow (ADF)	m^3/d	23,370	
Max. Month Flow (MMF)	m^3/d	30,381	1.3 Max. Month Factor – From Conceptual Design
BOD_5	mg/L	348	

TSS	mg/L	486	
Average BOD_5 Load	kg/d	8,140	
Average TSS Load	kg/d	11,350	
Max. Month BOD_5 Load	kg/d	10,583	1.3 Max. Month Factor – From Conceptual Design
Max. Month TSS Load	kg/d	14,755	1.3 Max. Month Factor – From Conceptual Design
Max. Month VSS Load	kg/d	15,056	85% of TSS Load - Assumed

3.12.2 Capacity Assessment

The plant mass balance was conducted at average and maximum month loadings. This was used to estimate co-thickened primary sludge flow to the solids handling process and projected performance of the digesters. Estimated sludge production volumes are provided in Table 46.

Table 46: South Niagara Falls WWTP Sludge Production Volumes

PARAMETER	UNIT	VALUES	COMMENT
Biosolids Production – MMF	m^3/d	462	To Garner Road facility
Biosolids Production – ADF	m^3/d	356	To Garner Road facility
Annual Hauled Biosolids	ML	130	

Based on the projected flows and loads, the primary digesters have sufficient hydraulic capacity and are within capacity for VSS loading, as shown in Table 47. Based on this assessment, the anaerobic (primary) digesters will have sufficient capacity for biosolids processing at the 2051 horizon maximum monthly loading.

Table 47: South Niagara Falls WWTP Anaerobic Digestion Capacity

ANAEROBIC DIGESTION CAPACITY			
Parameter	**Unit**	**Values**	**Comment**
Primary Digestion			
Primary Digester Volume	m^3	11,000	
HRT	d	23.80	15 day minimum. Per Ontario Guideline for Sewage Works
VSS volumetric loading (2)	$kg/m^3/d$	0.90	<1.6 per Ontario Guidelines for Sewage Works

The secondary digester would provide at least 23 days of digested sludge storage, as presented in Table 48. There is sufficient digested sludge storage capacity to suit the plant's needs at the 2051 horizon.

Table 48: South Niagara Falls WWTP Sludge Storage Capacity

PARAMETER	UNIT	VALUES	COMMENT
Secondary Digestion			
Secondary Digester Volume	m^3	11,000	
Total Sludge Storage	d	23.80	

3.12.3 Existing Opportunities/Constraints

As this is a new, planned facility, there are no existing constraints.

3.12.4 Status of Planned Projects

This plant will be undergoing design and construction and is targeted to be in service in 2027.

3.13 Stevensville-Douglastown Lagoons

The Stevensville-Douglastown Lagoons are a two-cell lagoon system. The first cell is 66,000 m^3 of volume that is partitioned with a baffle curtain into an aerated and facultative zone. The second cell is 76,500 m^3 of volume and is operated as a facultative cell. The lagoons provide secondary level of wastewater treatment as well as serve as a digester and biosolids storage.

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.

3.14 Summary of Wastewater Treatment Future Needs

A summary of the wastewater treatment plant capacities and future needs is provided in Table 49: Summary of Wastewater Treatment Future Needs. The values provided are the minimum required to achieve the 2051 horizon without considering redundancy. It is important to note, the facilities generally lack redundancy for thickening and digestion. Redundancy can be achieved with additional process units or a contingency plan can be developed to mitigate impacts of units offline for planned or unplanned maintenance.

Table 49: Summary of Wastewater Treatment Future Needs

PLANT	FACILITY TYPE	THICKENING	PROJECTED HRT (D)	PROJECTED VS LOADING (KG VSS/M³/D)	ANAEROBIC DIGESTION UPGRADES[1]		UPGRADES CURRENTLY PLANNED? (YES/NO)	ON-SITE DEWATERING (YES/NO)	ANNUAL HAULED BIOSOLIDS (ML)
					Additional Volume Required (m³) – based on Hydraulics	**Additional Volume Required (m³) – based on VSS load**			
Anger Avenue WWTP	Extended aeration	GBT WAS Thickening	10.51	2.26	**391**	405	yes	no	20.6
Baker Road WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	8.57	2.88	2,798	**3,116**	no	no	106
Crystal Beach WWTP	Extended aeration	GBT WAS Thickening	18.65	1.28	0	0	no	no	7.80
Niagara Falls WWTP (with SNF offline)	Rotating Biological Contactor / MBBR	PS + WAS Co-thickening (CEPT)	1.42	11.86	**16,473**	11,072	yes	yes	3,297 t/y (dewatered biosolids)
Niagara Falls WWTP (with SNF online)	Rotating Biological Contactor / MBBR	PS + WAS Co-thickening (CEPT)	1.9	8.85	**11,699**	7,703	yes	yes	2,460 t/yr (dewatered biosolids)
Niagara-on-the-Lake WWTP	Extended aeration	GBT WAS Thickening	20.81	1.23	0	0	no	no	20.3
Port Dalhousie WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	12.82	1.96	973	**1,387**	no	no	118
Port Weller WWTP (with SNF offline)	Conventional Activated Sludge	PS + WAS Co-thickening	11	1.86	**1,856**	906	yes	no	87.0
Port Weller WWTP (with SNF online)	Conventional Activated Sludge	PS + WAS Co-thickening	12.5	1.64	**1,018**	171	yes	no	76.4
Queenston WWTP	Extended aeration	n/a	n/a	n/a	n/a	n/a	no	no	1.87 (undigested sludge)
Seaway WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	24.56	1.02	0	0	no	no	22.4
Welland WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	10.16	2.39	2,416	**2,647**	no	no	88.8
South Niagara Falls WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	23.80	0.90	0	0	no	no	130
Stevensville-Douglastown Lagoon	Aerated-Facultative Lagoons	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Note: 1. Bold values noted in anaerobic digestion upgrades represent the limiting condition, i.e. if the greater additional capacity is dictated by hydraulic limitation or volatile solids limitation.

4.0 Water Treatment System

4.1 Future Water Treatment and Residual Estimate

To estimate future residuals, it is assumed that each WTP will continue with its existing treatment processes and residuals management approach. Based on the residuals generation rates identified in TM 1, Table 50 summarizes the projection of future residuals at each WTP.

Table 50: Future Residuals Estimate in 2051

WTP	CURRENT RATED CAPACITY (MLD)	2051 PROJECTED AVERAGE DEMAND (MLD)	RESIDUALS SOLIDS / ML OF TREATED WATER (DRY KG/ML)	2051 ESTIMATED RESIDUALS GENERATION (DRY KG/YEAR)
Decew WTP	227.3	68.2	36	896,148
Niagara Falls WTP	145.4	55.3	27	544,982
Grimsby WTP	44	25.1	34	311,491
Port Colborne WTP	36	8.2	21	62,853
Rosehill WTP	50	15.5	*30	169,725
Welland WTP	65	34.4	*30	375,585
Total	**567.7**	**206.7**	**145**	**2,360,784**
Note: *Due to limited data availability for The Rosehill and Welland WTPs, the average residuals solids generation rate from the Decew, Niagara Falls, Grimsby, and Port Colborne WTPs was used to estimate the future residuals generation for the Rosehill and Welland WTPs.				

The total 2051 estimated residuals generation is 2,360,784 kg/year, which is less than the total annual average residuals between 2019 – 2021 (3,284,195 kg/year). The historical dry weight of residuals for the Rosehill and Welland WTPs are not recorded by the Region. As discussed in TM 1, the calculated residuals solids from the Rosehill and Welland WTPs are significantly higher than expected. Based on the average residual solids over treated flow ratio from the four WTPs (Decew, Grimsby, Niagara Falls, and Port Colborne), 30 kg residual solids / ML treated flow is used to estimate the residual solids from the Rosehill and Welland WTPs. Using this assumption, the revised annual residual quantity is 1,721,020 kg/yr. With anticipated 1.5% total solids, the total annual residual volume is 114.7 ML/year.

4.2 Residual Management Capacity Needs Assessment

4.2.1 Decew Falls WTP

The existing residuals management system at Decew Falls WTP includes two backwash holding tanks, two gravity sludge thickeners, and one thickened solids holding tank. Their capacities are summarized in Table 51.

Table 51: Existing Residual Management System at Decew Falls WTP

PROCESS	UNIT	EXISTING	OPERATING AT PROJECTED 2051 ADF, 68.2 MLD, RESIDUAL GENERATION IS 896,148 KG/YR (2455 KG/D)
Backwash Holding Tanks			Backwash waste = 1,300 m^3/d (0.2% TS) Retention Time = 2.7 days Recommendation: no expansion needed
Number of Unit	#	2	
Volume	m^3	2,100 (Plants 1&2) 1,377 (Plant 3)	
Gravity Sludge Thickeners			Surface overflow rate: 7.14 $m^3/m^2/d$ (one in operation) 3.57 $m^3/m^2/d$ (two in operation) Surface area and loading rate: 181 m^2, 4,500 to 9,000 kg/d (one in operation) 362 m^2, 9,000 to 18,000 kg/d (two in operation) Recommendation: no expansion needed
Number of Unit	#	2	
Diameter	m	15.24	
Polymer Feed Pump	L/hr	9.5	
Sludge Holding Tank			Thickened residuals = 136 m^3/d (1.9%TS) Holding Tank Retention Time = 2.5 days Recommendation: additional capacity to provide a minimum of 3-day storage time
Number of Unit	#	1	
Dimension	m	8.33 (L) x 9.33 (W) x 4.37 (H)	
Volume	m3	340	

4.2.2 Niagara Falls WTP

The existing residuals management system at the Niagara Falls WTP includes one wastewater holding tank, three wastewater transfer pumps, two sludge thickeners and one solids holding tank. Their capacities are summarized in Table 52.

Table 52: Existing Residual Management System at the Niagara Falls WTP

PROCESS	UNIT	EXISTING	OPERATING AT PROJECTED 2051 ADF, 55.3 MLD, RESIDUAL GENERATION IS 544,982 KG/YR (1493 KG/D)
Wastewater Holding Tank			Backwash waste = 774 m^3/d (0.2% TS) Retention Time = 0.9 days Recommendation: no expansion needed
Number of Unit	#	1	
Volume	m^3	690	
Wastewater Transfer Pumps			Total pumping capacity = 7,300 m3/d Recommendation: no expansion needed
Number of Unit	#	3	
Capacity	ML/d	5.31 (2 pumps) 1.99 (1 pump)	
Sludge Thickeners			Surface overflow rate: 20.1 m^3/m^2/d (one in operation) 10.5 m^3/m^2/d (two in operation) Surface area and loading rate: 37 m^2, 925 to 1,850 kg/d (one in operation) 74 m^2, 1,850 to 3,700 kg/d (two in operation) Recommendation: no expansion needed
Number of Unit	#	2	
Dimension	m	7.1 (L) x 5.2 (W) x 6.0 (H)	
Sludge Holding Tank			Thickened residuals = 110 m^3/d (1.4%TS) Holding Tank Retention Time = 13.6 days Recommendation: no expansion needed
Number of Unit	#	1	
Dimension	m	13.8 (L) x 14.5 (W) x 7.5 (H)	
Volume	ML	0.4	

4.2.3 Grimsby WTP

The existing waste management system at the Grimsby WTP includes two wash water holding tanks, two wash water settling tanks, two sludge holding/thickener tanks and three domestic wastewater sump pumps. Their capacities are summarized in Table 53.

Table 53: Existing Residual Management System at the Grimsby WTP

PROCESS	UNIT	EXISTING	OPERATING AT PROJECTED 2051 ADF, 25.1 MLD, RESIDUAL GENERATION IS 311,491 KG/YR (853 KG/D)
Wash Water Holding Tanks			Backwash waste = 414 m^3/d (0.2% TS) Retention Time = 0.9 days Transfer pump = 3,240 m^3/d Recommendation: no expansion needed
Number of Unit	#	2	
Dimension	m	10.7 (L) x 4.5 (W) x 4.0 (H)	
Wash Water Transfer Pumps	#	4 (2 per tank)	
	ML/d	3.24	
Wash Water Settling Tanks			Surface overflow rate = 17.3 $m^3/m^2/d$ (one in operation) or 8.6 (two in operation) Recommendation: no expansion needed
Number of Unit	#	2	
Dimension	m	6.0 (L) x 4.5 (W) x 4.0 (H)	
Sludge Holding/Thickener Tanks			Thickened residuals = 75 m^3/d (1.1%TS) Holding Tank Retention Time = 2.8 days Recommendation: additional capacity needed to provide a minimum of 3-day storage time
Number of Unit	#	2	
Dimension	m	4.25 (L) x 4.0 (W) x 6.2 (H)	
Horizontal Centrifugal Thickened Sludge Transfer Pumps	#	2 (1 per tank)	
	ML/d	1.3	

4.2.4 Port Colborne WTP

The existing waste management system at the Port Colborne WTP includes one waste holding tank, two waste transfer pumps and one conditioning tank. Their capacities are summarized in Table 54**.**

Table 54: Existing Residual Management System at the Port Colborne WTP

PROCESS	UNIT	EXISTING	OPERATING AT PROJECTED 2051 ADF OF 8.2 MLD, RESIDUAL GENERATION IS 62,853 KG/YR (172 KG/D)
Waste Holding Tank			Backwash waste = 74 m^3/d (0.2% TS) Retention Time = 7.3 days Recommendation: no expansion needed
Number of Unit	#	1	
Dimension	m	13.15 (L) x 15.0 (W) x 2.74 (H)	
Volume	m^3	541	
Waste Transfer Pumps			Total capacity = 1,800 m3/d Recommendation: no expansion needed
Number of Unit	#	2	
Capacity	ML/d	1.8	
Conditioning Tank			Retention time = 6.5 days Recommendation: no expansion needed
Number of Unit	#	1	
Dimension	m	20.7 (L) x 7.02 (W) x 3.3 (H)	
Volume	m^3	480	

4.2.5 Rosehill WTP

The existing waste management system at the Rosehill WTP includes one waste residual holding tank, two sludge transfer pumps with different discharging destination and two sludge holding tanks. Their capacities are summarized in Table 55.

Table 55. Existing Residual Management System at the Rosehill WTP

PROCESS	UNIT	EXISTING	OPERATING AT PROJECTED 2051 ADF OF 15.5 MLD, RESIDUAL GENERATION IS 169,725 KG/YR (465 KG/D)
Waste Residual Holding Tank			Waste residuals = 42 m^3/d (0.4% TS) Retention Time = 23.5 days Recommendation: no expansion needed Pump speed = 25 L/s or 2,160 m3/d Recommendation: no expansion needed
Number of Unit	#	1	
Dimension	m	11.15 (L) x 24.28 (W) x 3.65 (H)	
Pump Speed	L/s	25	
Sludge Transfer Pumps			Sludge transfer pump capacity = 950 m3/d Recommendation: no expansion needed
Number of Unit	#	2	
Capacity	ML/d	0.95	
Sludge Holding Tanks			Retention time = 10.3 hours Recommendation: no expansion needed
Number of Unit	#	2	
Volume	m^3	18	

4.2.6 Welland WTP

The existing waste management system at the Welland WTP includes one waste residual holding tank and four wastewater transfer pumps. Their capacities are summarized in Table 56.

Table 56: Existing Residual Management System at the Welland WTP

PROCESS	UNIT	EXISTING	OPERATING AT PROJECTED 2051 ADF OF 34.4 MLD RESIDUAL GENERATION IS 375,585 KG/YR (1029 KG/D)
Waste Residual Holding Tank			Waste residuals = 94 m^3/d (0.4% TS) Retention Time = 12.7 days Recommendation: no expansion needed
Number of Unit	#	1	
Dimension	m	15.0 (L) x 15.0 (W) x 5.3 (H)	
Volume	m^3	1,192.5	
Wastewater Transfer Pumps			Pump capacity = 4,320 m^3/d Recommendation: no expansion needed
Number of Unit	#	4	
Capacity	ML/d	4.32	

4.1 Summary of Residual Recommendations

All recommendations for 6 WTPs including 18 individual processes are summarized in following Table 57.

Table 57: Summary of Residual Recommendations for Individual Plants

WTP	PROCESS	RECOMMENDATION
Decew WTP	Backwash Holding Tanks	No expansion needed
	Gravity Sludge Thickener	No expansion needed
	Sludge Holding Tank	Additional capacity to provide a minimum of 3-day storage time
Niagara Falls WTP	Wastewater Holding Tank	No expansion needed
	Wastewater Transfer Pumps	No expansion needed
	Sludge Thickeners	No expansion needed
	Sludge Holding Tank	No expansion needed
Grimsby WTP	Wash Water Holding Tanks	No expansion needed
	Wash Water Settling Tanks	No expansion needed
	Sludge Holding/Thickener Tanks	Additional capacity to provide a minimum of 3-day storage time
Port Colborne WTP	Waste Holding Tank	No expansion needed
	Waste Transfer Pumps	No expansion needed
	Conditioning Tank	No expansion needed
Rosehill WTP	Waste Residual Holding Tank	No expansion needed
	Sludge Transfer Pumps	No expansion needed
	Sludge Holding Tanks	No expansion needed
Welland WTP	Waste Residual Holding Tank	No expansion needed
	Wastewater Transfer Pumps	No expansion needed

5.0 Summary and Next Steps

As presented in TM 1, the Garner Road Facility receives solids from all WWTPs and residuals from three WTPs. Table 58 presents a summary of the total solids to be managed at Garner Road at the 2051 planning horizon.

Table 58: Annual Biosolids and Residuals Generated in Region within 2051 Horizon

PARAMETER	UNIT	2021 VALUE	2051 VALUE
Total Annual Dewatered Biosolids Generated from Niagara Falls WWTP	Dry tonnes	1,700	2,500
Total Annual Biosolids Received at Garner Road [1]	ML	367	601
Total Annual Residuals Received at Garner Road [2]	Dry tonnes	876[3]	1,800
Total Annual Residuals Received at Garner Road [2]	ML	58	117[3]

Notes:

1. 2051 volume considers biosolids generated with SNF online. Does not include dewatered biosolids generated at Niagara Falls WWTP, which are not managed at Garner Road.
2. Considers residuals generated at Decew Falls, Grimsby and Niagara Falls WTPs.
3. Estimated based on anticipated 1.5% total solids concentration and future quantities presented on Table 50.

TM 5 will provide additional details regarding the capacity of the Garner Road facility, limitations and opportunities for solids management at the facility.