2021 Biosolids Management Master Plan Update Report FINAL

Oct 2024

Prepared for:

Regional Municipality of Niagara

Prepared by:

GEI Consultants (formerly GM BluePlan Engineering)

In Association with:

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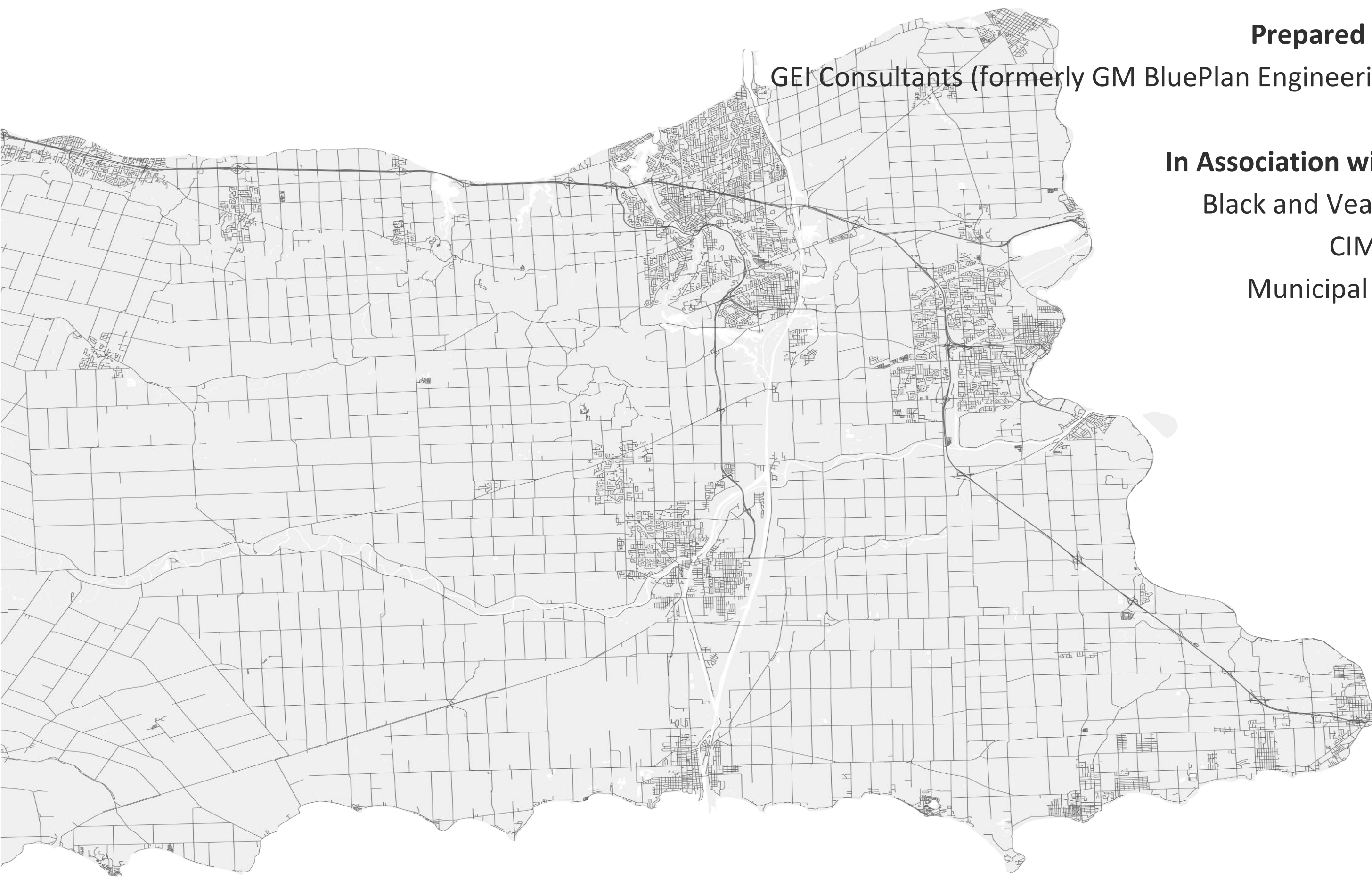
CIMA+

Municipal VU



Executive Summary

INTRODUCTION

In alignment with Niagara Region's (The Region) 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 should occur in a sustainable manner addressing economic, social, and environmental considerations.

The Region initiated the 2021 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 within the 2051 growth horizon that is endorsed by stakeholders and council.

The Region retained a consultant team from GEI Consultants (formerly GM BluePlan Engineering), Black and Veatch, CIMA+, and Municipal VU to complete this Biosolids Management Master Plan Update.

Overall, the BMMP is intended to identify and develop a strategy for meeting Niagara's biosolids management needs to the year 2051, in a manner that is transparent, sustainable, reliable, environmentally friendly, cost effective and flexible.

The BMMP has been 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.

CLASS ENVIRONMENT AND MASTER PLANNING PROCESS

This study follows the master planning process as established by the Municipal Engineer's Association Class Environmental Assessment process for Master Plans, which is an approved Ontario Environmental Assessment process (October 2000, as amended in 2007, 2011, 2015, and 2023).

The Biosolids Management Master Plan Update will satisfy Phases 1 and 2 of the Class Environmental Assessment process. Public and stakeholder input was sought and obtained throughout the process, and this Biosolids Management Master Plan Update Report is filed for public review.

CURRENT AND FUTURE BIOSOLIDS IN NIAGARA REGION

The study area for this Master Plan Update encompasses the entire Region of Niagara, as biosolids products are applied on agricultural lands throughout Niagara.

The Region is serviced by ten (10) conventional wastewater treatment plants (WWTPs), one (1) future plant to serve South Niagara Falls, the lagoon plant serving Stevensville / Douglastown and six (6) water treatment plants (WTPs). The Region currently beneficially uses all the solids generated by these facilities and has not had to dispose of any biosolids by landfill.

The Region operates the Garner Road Biosolids Facility which accepts both wastewater biosolids and water treatment plant residuals. From the Garner Road Facility, biosolids are either applied as a liquid on agricultural land or dewatered and transported by a third-party biosolids management firm, Walker Environmental, where the biosolids are further stabilized using an advanced alkaline stabilization process, N-Viro, at the Walker Environmental facility in Thorold. The N-Viro product is sold commercially as a fertilizer. Biosolids from Niagara Falls WWTP are dewatered at the plant and sent to Walker Environmental for further processing.

Three (3) of the WTPs, DeCew, Grimsby and Niagara Falls, transport their water treatment residuals to the Garner Road Facility for management. The other three (3) facilities, Port Colborne, Rosehill and Welland, discharge their waste residuals into the wastewater collection system for processing through the Seaway, Anger Avenue and Welland WWTPs, respectively.

Table ES1. Current and Projected Annual Solids Produced in Niagara Region to 2051

Parameter	Value
BIOSOLIDS	
Current Total Annual Biosolids	454 ML / 10,522 DT
2051 Total Annual Biosolids[1, 2]	706 ML / 16,962 DT
RESIDUALS	
Current Total Annual Residuals	82.8 ML / 1,242 DT
2051 Total Annual Residuals[2]	116.8 ML / 1,752 DT

1. Includes biosolids from future South Niagara Falls WWTP and all Existing WWTPs
2. Future solids are calculated based on population projections documented in the 2021 Water and Wastewater Servicing Master Plan.

EVALUATION PROCESS

The diagram on the following page describes the evaluation process used to develop the BMMP recommendations.

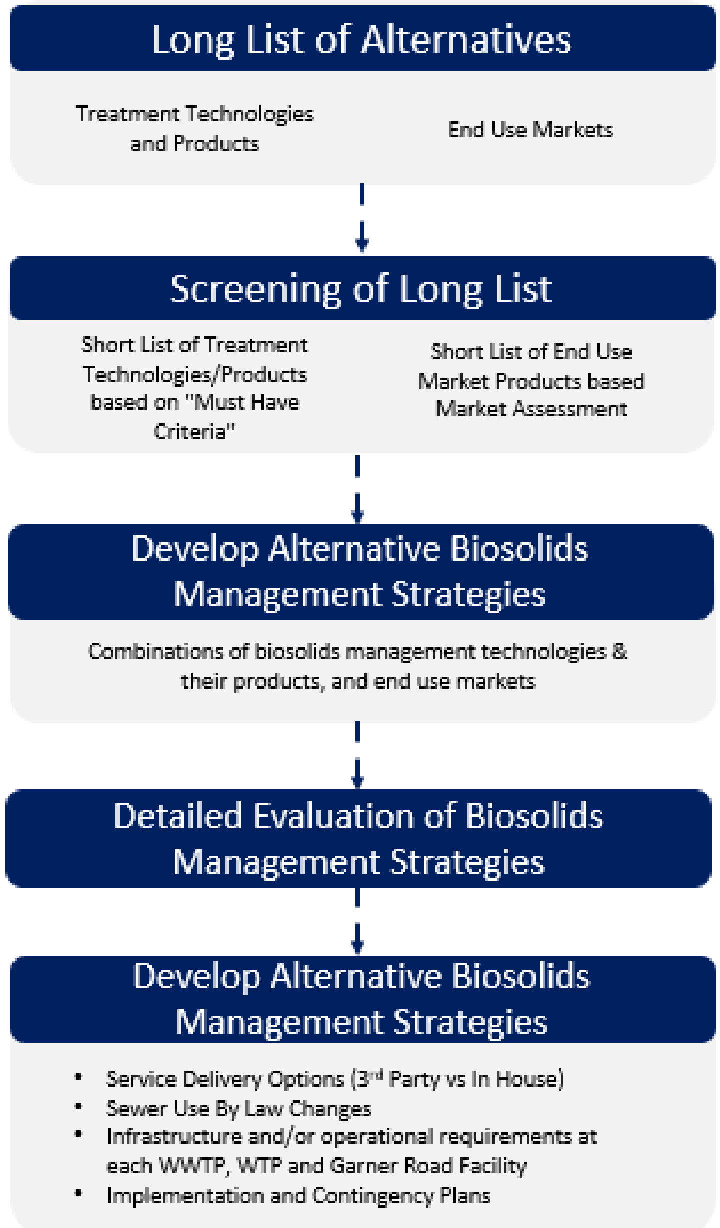


Figure ES1: Phase 2 Evaluation Process

LONG LIST OF BIOSOLIDS TECHNOLOGIES AND END USE MARKETS AND SCREENING

End Use Markets

The following long of list of end use markets were assessed for the Niagara Region and Golden Horseshoe area:

- Agriculture, Silviculture and Horticulture
- Parks and Recreation Departments
- Ontario Ministry of Transportation
- Landscape Contractors
- Golf Courses
- Land Rehabilitation
- Landfill Management
- Co-management with Source Separated Organics

The greatest potential market for biosolids products in and around the Region is the agricultural market. Biosolids products can serve to fertilize soils, increase soil organic matter, and amend soil pH, in the case of biosolids products such as alkaline stabilized and thermal-alkaline hydrolyzed products. Outlets for biosolids products in the agricultural market include land application of biosolids as a Category 3 NASM or as a biosolids product meeting CFIA fertilizer requirements.

The three (3) potential target markets/outlets for biosolids products recommended for consideration under the 2021 Niagara BMMP Update are:

1. Application of anaerobically digested biosolids to agricultural lands.
2. Soil amendment with fertilizers (biosolids products) meeting CFIA requirements for use by landscape contractors, golf courses, parks and recreation or horticulture.
3. Composted products to be used by landscape contractors

Biosolids Technologies

The long list of technologies considered for use at the Garner Road Facility are provided below:

1. Biological Digestion Technologies (Thermal Hydrolysis Process (THP) Anaerobic Digestion)

2. Thermal Drying Technologies
   - Direct Contact (Convection) (rotary drum, belt dryer, fluidized bed)
   - Indirect Contact (Conduction) (paddle/disc, solar dryer)

3. Chemical Stabilization Technologies
   - Alkaline Stabilization (conventional, with supplemental heat or acid, or with heat and high-speed mixing)

4. Composting

5. Thermal Conversion Technologies
    - Incineration
    - Gasification
    - Pyrolysis
    - wet oxidation
    - hydrothermal liquification

Four (4) screening criteria are established to screen the long list of technologies as summarized below.

Table ES1: Screening Criteria for the Long List of Biosolids Technologies

Screening Criteria	Description
Maturity of Technology	The technology must have been in use for long enough that most of its initial operational issues and inherent problems have been removed or reduced by further development. It must be robust, reliable and have a successful track record.
Compatibility with existing and future site development and biosolids end use markets.	The technology must be compatible with existing infrastructure investments and be constructible given existing site conditions at the Garner Road Facility. It must also compliment the end use alternatives and markets that have been identified for the Region of Niagara.
Proven application at similar scale facilities	The technology must be able to manage biosolids at the quantities that are and will be trucked to the Garner Road Facility; furthermore, the technology must have a successful operating history at facilities of similar capacity.
Implementable	The technology must be able to address implementation challenges at the Garner Road Facility or other centralized facilities. The challenges include space constraints, impacts of side stream waste generated, regulatory changes, public concerns including traffic, air quality and odour impacts.

Five (5) technologies for biosolids treatment met all four (4) of the screening criteria and were recommended to be developed into alternatives and evaluated, as listed below:

1. Thermal Hydrolysis Process (THP) Post-Treatment at Garner Road facility
2. Thermal drying at Garner Road facility
3. Advanced Alkaline Stabilization (by third party contractor)
4. Composting at Garner Road facility
5. Incineration at Garner Road facility

SHORT LIST OF BIOSOLIDS MANAGEMENT STRATEGIES, DETAILED EVALUATION AND RESULTS

Seven (7) biosolids management alternative strategies were developed for evaluation, based on the screened technologies and end use markets and products, as listed below:

1. Conventional mesophilic anaerobic digestion and land application of liquid biosolids
2. Conventional mesophilic anaerobic digestion, dewatering and land application of biosolids cake
3. Anaerobic digestion with Advanced THP post-treatment, dewatering and land application of fertilizer grade biosolids cake
4. Conventional mesophilic anaerobic digestion, dewatering, advanced alkaline stabilization and product distribution
5. Conventional mesophilic anerobic digestion, dewatering, aerated static pile composting and product distribution
6. Conventional mesophilic anaerobic digestion, dewatering, rotary drum direct thermal drying and product distribution
7. Conventional mesophilic anaerobic digestion, dewatering, fluidized Bed Incineration with Ash Management.

These strategies are presented in Table ES.2 below, which also indicates the technology, product and end user for each.

Table ES.2: Short List of Biosolids Management Alternative Strategies for Detailed Evaluation

Management Alternative	Process (Technology)	Product	Final User
Beneficial Use on Land	Anaerobic Digestion	Stabilized Liquid Biosolids	Land application with liquid biosolids
	Anaerobic Digestion and Dewatering	Stabilized Biosolids Cake	Land application with biosolids cake
	Advanced Digestion and Dewatering	Fertilizer Quality Cake	Land application of cake / un-restricted use
	Anaerobic Digestion, Dewatering, Advanced Alkaline Stabilization	Fertilizer / Soil Amendment	Un-restricted use on land
	Anaerobic Digestion, Dewatering, Composting	Compost	Un-restricted use on land
	Anaerobic Digestion, Dewatering, Drying	Dried Product	Un-restricted use on land or fuel source
Thermal Process	Anaerobic Digestion, Dewatering, Incineration	Ash	Manufacturing of landfill

Each of the seven short-listed biosolids strategies were carried forward for detailed evaluation using four key factors: natural environment impacts, socio/cultural impacts, technical feasibility, and financial viability (costs). Each factor is comprised of specific criteria (see TM 6 in Appendix A for details). The rating scale of 1 to 10, as shown below, was used to evaluate the impact of each strategy based on those criteria and develop a score and ranking.

ES.3: Evaluation Rating Scale

Impact Description	Impact Rating
Positive or no impact	9-10
Minor impact	7-8
Moderate impact	5-6
High impact	3-4
Severe impact	1-2

Using equal weighting of criteria, the initial evaluation resulted in five (5) of the seven (7) strategies with a similar score. To aid in evaluation, ten (10) criteria were selected as most critical, and the evaluation was carried out again with these criteria alone, namely:

1. Greenhouse Gas Emissions
2. Nutrient Recovery and Potential for Beneficial Reuse by Agricultural users
3. Proven Performance
4. Odour at Garner Road Facility
5. Truck Traffic
6. Long Term Sustainability
7. Ease of Operation
8. Resiliency
9. Ease of Implementation
10. Life Cycle Cost

The results of the detailed evaluation using the criteria above are summarized in the following table.

ES.4: Summary of Detailed Evaluation Results Using Only Differentiating Criteria

	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5	Strategy 6	Strategy 7
	AD + Liquid Biosolids Land Application	AD + Dewatering + Cake Land Application	AD + Advanced Stabilization (THP) + Fertilizer Quality Product	AD + Dewatering + Advanced Alkaline Treatment + Fertilizer Quality Product	AD + Dewatering + Composting + Product Distribution	AD + Dewatering + Thermal Drying + Product Distribution	AD + Dewatering + Thermal Processing
Total Score	69%	72%	63%	75%	61%	66%	54%
Ranking	3	2	5	1	6	4	7

Overall, it is recommended that Strategies 2 and 4 be developed further, with consideration for continuing with liquid land application (Strategy 1). Liquid storage and provisions for liquid land application could be maintained to ensure program diversification, considering liquid storage is already in place and the land being used for storage is not required to implement Strategies 2 or 4.

Key benefits of the recommended Strategies:

1. Reduction in truck traffic and transportation costs by dewatering a greater quantity of biosolids
2. Diversifying end use markets by introducing direct land application of cake while maintaining existing end use markets
3. Reducing 30-year life cycle cost compared to maintaining existing strategies and upgrading to accommodate growth only.

RECOMMENDATIONS AND PROPOSED IMPLEMENTATION PLAN

Overall, it is recommended that dewatering upgrades be implemented at the Garner Road Biosolids Facility in the short-term to provide a centralized dewatering centre for all the Region's biosolids. The Region has piloted direct cake application in collaboration with a third party biosolids transportation and land application firm to determine the feasibility of this approach in practice. The results of this pilot program support implementation of a direct cake land application program.

Upgrades at the Garner Road Facility should include:

- A new building with dewatering equipment with capacity to manage all the Region's biosolids expected to 2041 with room to expand to meet needs to 2051 and potentially beyond
- An enclosed cake storage facility to allow temporary storage of cake prior to land application or advanced treatment offsite using the N-Viro process. This storage facility could be incorporated into the same building as the dewatering equipment
- Odour control system to treat air from the cake storage and dewatering areas

- Addition of security cameras and a weigh scale to improve security and accuracy of measurements to ensure accurate service costs for Third Party firms.
- Expanded parking and truck loading area

Under the proposed upgrades above, the existing dewatering building would be decommissioned. The Region may also consider repurposing and modifying this building to house the new dewatering equipment and biosolids storage, although more limited space is available for future expansion in this area.

Existing liquid storage tanks and lagoons should be maintained to allow for temporary storage of liquid biosolids prior to dewatering, and to allow for the opportunity to directly land apply liquid biosolids to increase program flexibility. To maintain sufficient liquid storage capacity in the short-term, additional liquid storage tanks should be considered, particularly if a new dewatering and cake storage facility cannot be completed until beyond 2031.

It is recommended that dewatering at Niagara Falls WWTP continue in the interim, with cake transported to the N-Viro facility for processing and distribution, until the dewatering equipment at Niagara Falls WWTP reaches the end of its useful life or additional dewatering capacity is available at the Garner Road facility, whichever comes first. The Region may also choose to send liquid biosolids from Niagara Falls WWTP to Garner Road for dewatering immediately if liquid storage capacity is available, which will vary based on the time of year.

To reduce hauling in the Region, WAS thickening should be considered at Port Dalhousie, Port Weller and Welland WWTPs to reduce liquid volume hauled to Garner Road. Timing of WAS thickening upgrades could be matched with other required upgrades at these WWTPs. The potential to land-apply stabilized biosolids directly from the Anger Ave WWTP should be investigated further.

Details of the recommended studies, operational modifications and upgrades, including phasing, are detailed below.

Very Short Term (within 3 years):

- Extend operating hours per day for centrifuges at Garner Road to increase capacity as needed;
- Confirm requirements for cake land application with MECP including odour classification of product after 7 to 30 days storage;
- Work with Third Party Biosolids Management Contractor to reduce liquid storage and transportation requirements, by optimizing decanting of Garner Road storage lagoons which will increase the total solids concentrations of liquid biosolids hauled offsite for land application.
- Maintain contract with a biosolids management firm that uses advanced alkaline stabilization process to manage a portion of biosolids generated at the Region's WWTPs.
- Continue to enforce sewer use by-law and work with industrial dischargers to address more frequent quality exceedances.
- Complete a feasibility study to assess the potential to construct a centralized anaerobic digester system at the Garner Road Facility to process all the Region biosolids as well as source separated organics that are currently composted at the Walker Facility in Thorold. The study should include the following elements:

- Complete cost-benefit and life cycle cost analyses comparing the options to 1) upgrade existing digesters at WWTPs and 2) construct a centralized digestion facility to replace WWTP digesters.
- Review potential for decommissioning or retrofitting the existing anaerobic digesters at each WWTP and incorporating solids thickening.
- Review potential for biogas utilization, and implications for greenhouse gas emissions and carbon footprint for each alternative.
- Review feasibility of different biogas utilization methods at a centralized facility, including but not limited to combined heat and power, and renewable natural gas
- Consider alignment with the Region's latest Official Plan objectives related to Climate Change Mitigation including transitioning to net zero emissions by 2051.
- Review the option of maintaining aerobic digestion at Baker Road WWTP and adding dewatering at this location to reduce transportation costs and environmental impacts.

Short-Term (by 2031):

- Design and construct a new dewatering facility at Garner Road that can serve as a centralized dewatering facility for the entire Region; size the dewatering facility structure to house the centrifuges needed to dewater ***all*** biosolids produced in Region to 2051 (or all biosolids excluding those from Baker Road WWTP, pending results of study). Initial dewatering equipment capacity could be set to match forecasted biosolids volumes to 2041, with additional process units phased in to increase capacity as flows increase over time.
- Design and construct new cake storage at Garner Road
- Maintain existing liquid storage facilities (lagoons and tanks)
- Security upgrades at Garner Road, and addition of weigh scale
- Decommission centrifuge at Niagara Falls WWTP at the end of its useful life, and haul to centralized dewatering facility at Garner Road.

Long Term (by 2051):

If the results of the centralized digestion facility feasibility study described above are favourable, the Region should work to develop this concept through design and construction, which should consider Public-Private Partnership opportunities with private contractors that could be involved in design, construction and/or operation of the facility. A centralized digestion facility at the Garner Road site is compatible with proposed interim dewatering upgrades at Garner Road.

Furthermore, by increasing dewatering capacity in the Region, which is a required pre-treatment for several other biosolids processing technologies including advanced alkaline stabilization, composting, drying, and incineration, the Region will be in a better position to implement further biosolids stabilization processes in the future, if deemed favourable under future conditions.

Regarding service delivery opportunities, the Region should continue using a third-party contractor to haul liquid biosolids from the WWTPs to the Garner Road Facility, as well as haul biosolids offsite for agricultural land application. The Region should also maintain a contract with Walker Environmental for processing a portion of the Region's biosolids at Walker's N-Viro Alkaline Stabilization Facility to further advance program diversification.

An overview of the proposed work is illustrated in Figure ES2 below.

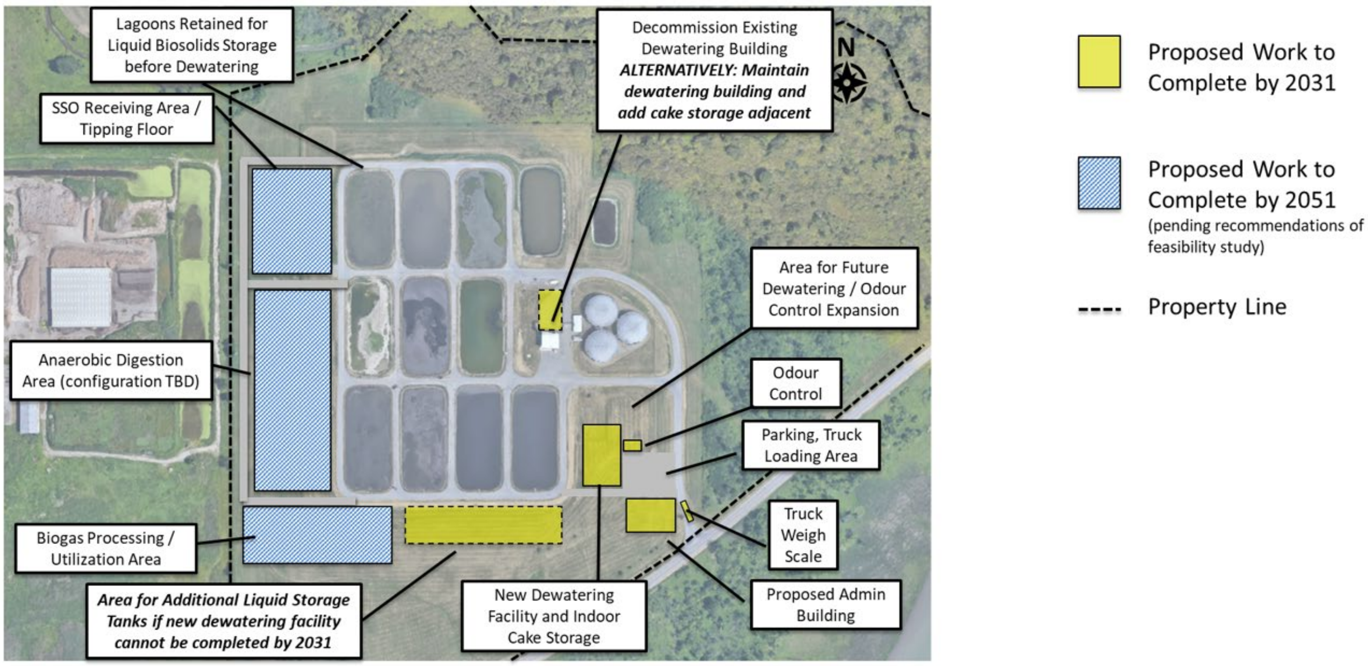


Figure ES2: Proposed Build-out of Garner Road Biosolids Facility

STAKEHOLDER CONSULTATION AND INDIGENOUS ENGAGEMENT

In accordance with the Municipal Class EA requirements, key stakeholders were identified, notified and consulted at specific points in the process.

Stakeholder consultation is summarized below:

- **May 24, 2022 - Notice of Commencement and Public Information Centre (PIC) 1**– Issued to stakeholders by mail or email and to public via local newspapers and on Region website on May 24, 2022;
- **June 8 to 22, 2022 - PIC 1** – Virtual Presentation posted on Region website and open to comments within stated date range;
- **April 21, 2023 – Agency Stakeholder meeting** – met virtually with key stakeholders at lower tier municipalities within Niagara Region, as well as Ministry of Environment, Conservation and Parks (MECP), Infrastructure Ontario, Ministry of Agriculture, Food and Rural Affairs (OMFRA), Niagara Parks Commission, Niagara Escarpment Commission, and Niagara Peninsula Conservation Authority to provide preliminary recommendations and feedback;
- **May 4, 2023 Notice of Public Information Centre 2 -** Issued to stakeholders by mail or email and to public via local newspapers and on Region website;

- **May 17 to 31, 2023 - PIC 2** - Virtual Presentation posted on Region website and open to comments within stated date range;
- **July 11, 2023 – Public Works Committee Presentation** – presented preliminary recommendations to Region's Public Works Committee for input prior to finalizing recommendations; and
- **October 8, 2024 – Public Works Committee Presentation** – present updated recommendations based on latest Region priorities, and addressed questions.
- **November 2024** –Notice of Completion issued and Final Master Plan Report made available for public review

The Crown has a legal obligation to consult with Indigenous rights-holders, where decisions or actions contemplated may adversely impact asserted or established treaty rights.

In their response letter to the Notice of Commencement (June 3, 2022), the MECP provided direction as to the appropriate Indigenous communities to engage and the protocols for engaging these communities. The MECP identified the following communities:

- Mississaugas of the Credit First Nation
- Six Nations of the Grand River (Elected Council and Haudenosaunee Confederacy Chiefs Council with a copy to Haudenosaunee Development Institute)

GM BluePlan contacted each community at the beginning of the study in June 2023 via email and mail to notify them of the study and give them an opportunity to provide feedback. The Region engaged with each community again in May 2023 by sending a letter (via email and mail) to let the communities know about the ongoing study and provide an update on the selected preliminary preferred strategies. No responses were received directly from the letters, so the project team followed up with each community to elicit additional feedback on the study. If there are any comments, questions or concerns, the project team will engage further with each individual community.

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Glossary and Abbreviations

Term or Acronym	Definition
ADF	Average daily flow
ASP	Aerated Static Pile
BEAM	Biosolids Emissions Assessment Model
BMMP	Biosolids Management Master Plan
BOD_5	Biochemical Oxygen Demand
BTG	Biosolids Task Group
CCME	Canadian Council of Ministers of the Environment
CEPA	Canadian Environmental Protection Act
CFIA	Canadian Food Inspection Agency
Class EA	Class Environmental Assessments
CO_2	carbon dioxide
COSSARO	Committee on the Status of Species at Risk in Ontario
DT	Dry Tonne
DT/ha-yr	Dry Tonnes per hectare per year
DT/Year	Dry Tonne per Year
EA	Environmental Assessment
EAA	Environmental Assessment Act
EASR	Environmental Activity and Sector Registry
ECA	Environmental Compliance Approvals
EPA	Environmental Protection Agency
ESA	Endangered Species Act
GBT	gravity belt thickener
GHG	Green House Gases
kg/Dt	Kilogram per Dry Tonne
km	Kilometer
m	Meter
m^3	Cubic meter
m^3/d	cubic meters per day
MCM	Ministry of Citizenship and Multiculturalism
MECP	Ministry of the Environment, Conservation and Parks
MLD	mega liters per day
mm	Millimeter

Term or Acronym	Definition
MNRF	Ministry of Natural Resources and Forestry
MTO	Ministry of Transportation Ontario
NASM	non-agricultural source material
NEC	Niagara Escarpment Commission
NMA	Nutrient Management Act
NPCA	Niagara Peninsula Conservation Authority
NPRI	National Pollutant Release Inventory
OHA	Ontario Heritage Act
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
OMAFRA	Ministry of Agriculture, Food and Rural Affairs
OPS	Ontario Provincial Standards for Roads and Public Works
PDF	Peak Daily Flow
PFAS	PFAS
pH	potential of hydrogen
PIC	Public Information Centre
SARA	Species at Risk Act
SSO	source separated organics
THP	Thermal Hydrolysis Process
TKN	Total Kjeldahl Nitrogen
TM	Technical Memorandum
TP	Total Phosphorus
TSS	Total Suspended Solids
VS	volatile solids
WAS	Waste Activated Sludge
WTP	Water Treatment Plants
WWTP	Wastewater Treatment Plant
yd^3	Cubic yard

Region of Niagara

2021 Biosolids Management Master Plan Update Report - FINAL

QA/QC - SIGN OFF SHEET

This report has been reviewed and approved by the undersigned.

Laura Verhaeghe, P.Eng.
Senior Project Manager

1 Introduction

1.1 Background

Niagara Region (The Region) has an extensive water and wastewater treatment system, with ten (10) wastewater treatment plants (WWTP), a wastewater lagoon and six (6) water treatment plants (WTP). The Region has also completed a Schedule C Class Environmental Assessment (EA) for a new WWTP in South Niagara Falls to meet future needs.

Wastewater treatment involves removal of solid material from sewage, which must be managed. Biosolids are the solid organic materials resulting from the physical, chemical and biological treatment of sewage sludge generated at wastewater treatment plants.

The solids materials removed during drinking water treatment are called residuals and are blended with wastewater biosolids in the Region. For simplicity, when the term 'biosolids' is used in this report, it includes both wastewater biosolids and water treatment residuals unless otherwise stated.

Biosolids have many potential beneficial uses including land application on agricultural lands and use in landscaping projects in parks, on golf courses and at private residences. The Region's biosolids are currently land applied. Approximately 50% of the Region's biosolids are applied to agricultural land as a liquid. The other 50% of the Region's biosolids have a portion of the water removed through a process called dewatering and are further stabilized using the N-Viro Alkaline Stabilization process to produce a fertilizer product that can be land applied.

1.2 Objectives of the Biosolids Management Master Plan

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.

1.3 Class Environmental Assessment and Planning Process

1.3.1 Ontario's Environmental Assessment Act

Ontario's Environmental Assessment Act (EAA) was passed in 1975 and was proclaimed in 1976. The EAA requires proponents to examine and document the environmental effects that could result from major projects or activities and their alternatives. Municipal undertakings became subject to the EAA in 1981.

The EAA's comprehensive definition of the environment is:

- Air, land or water,
- Plant and animal life, including human life,
- The social, economic, and cultural conditions that influence the life of humans or a community,
- Any building, structure, machine or other device or thing made by humans,
- Any solid, liquid, gas, odour, heat, sound, vibration, or radiation resulting directly or indirectly from human activities; and,
- Any part or combination of the foregoing and the interrelationships between any two or more of them, in or of Ontario.

The purpose of the EAA is the betterment of the people on the whole or any part of Ontario by providing for the protection, conservation, and wise management of the environment in Ontario (RSO1990, c.18, s.2).

The Environmental Assessment Act was further revised in 2021 and 2023, with the latest amendment in 2024 to include Schedule 1, Acquisition of Property.

- (7) for greater certainty, under this Act, a reference to acquiring property or rights in property is a reference to acquiring the property or rights in property by purchase, lease, expropriation or otherwise.

1.3.2 Principles of Environmental Planning

The EAA sets a framework for a rational, objective, transparent, replicable, and impartial planning process based on the following five key principles:

a. **Consultation with affected parties.** Consultation with the public, government review agencies and Indigenous Communities is an integral part of the planning process. Consultation allows the proponent to identify and address any concerns cooperatively before final decisions are made. Consultation should begin as early as possible in the planning process.
b. **Consideration of a reasonable range of alternatives.** Alternatives include alternative treatment technologies, alternative end uses for the biosolids products, and alternative overall management strategies (i.e., combinations of technologies and end uses).
c. **Identification and consideration of the effects of each alternative on all aspects of the environment**. These aspects include the natural, social, cultural, technical, and economic environments.
d. **Systematic evaluation of alternatives in terms of their advantages and disadvantages to determine their net environmental effects.** The evaluation shall increase in the level of detail as the study moves from the evaluation of treatment technologies and end uses to the biosolids

management strategies. Net effects refer to the potential impacts after mitigation techniques are considered.

e. **Provision of clean and complete documentation of the planning process followed to allow “traceability” of decision-making with respect to the project.** The planning process must be documented in such a way that it may be repeated with similar results.

1.3.3 Class Environmental Assessments

“Class” Environmental Assessments (Class EAs) were approved by the Minister of the Environment in 1987 for municipal projects having predictable and mitigable impacts to meet Ontario’s EAA requirements in a streamlined manner.

The Municipal Class Environmental Assessment, prepared by the Municipal Engineers Association (October 2000, as amended in 2007, 201, 2015 and 2023) outlines the procedures to be followed to satisfy Class EA requirements for water, wastewater, stormwater management and road projects.

The process includes up to five (5) phases:

- **Phase 1:** Problem or Opportunity Definition,
- **Phase 2:** Identification and Evaluation of Alternative Solutions to determine a preferred solution while taking input from the public and other stakeholders into consideration,
- **Phase 3:** Examination of Alternative Methods of implementation of the preferred solution while taking input from the public and other stakeholders into consideration,
- **Phase 4:** Documentation of the Class EA process in the form of an Environmental Study Report (ESR) for public review; and
- **Phase 5:** Implementation and Monitoring.

Public and agency consultation are integral to the Class EA planning process. Projects subject to the Class EA process are classified into the following four (4) “schedules” depending on the extend of the expected impacts.

Exempt Projects (Formerly known as Schedule A and A+ Projects) These projects are minor or emergency operational and maintenance activities. These projects are typically smaller in scale and do not have a significant environmental effect. These projects are exempt from Ontario’s EA Act and are pre-approved; however, the public is to be advised prior to the project implementation for those projects formerly categorized as Schedule A+.

Projects Eligible to be Screened to Exemption: These projects are eligible for exemption based on the results of a screening process. There are two (2) screening processes identified in the Municipal Class EA process:

- Collector Road Screening Process (CR)
- Archaeological Screening Process (ASP)

If the screening process determines that the project is not exempt, the applicable Schedule B or C assessment process must be completed. Proponents can also choose at the outset of the project to not follow a screening process and just complete the applicable Schedule B or C process.

Schedule B projects require a screening of alternatives for their environmental impacts and Phases 1 and 2 of the planning process must be completed. The proponent is required to consult with the affected public, relevant review agencies, Indigenous Communities and other stakeholders. If there are still outstanding issues after the public review period, requests may be made to the Minister of the Environment for a Section 16 Order (formerly known as a Part II Order). A Section 16 Order is also known as bumping-up the project to a Schedule C Class EA or an Individual EA. Provided that no significant impacts are identified and no requests for a Section 16 Order are received, once a Schedule B project is approved, work may proceed directly to implementation.

Schedule C projects must satisfy all five (5) phases of the Class EA process. These projects have the potential for greater environmental impacts. Phase 3 involves the assessment of alternative methods of carrying out the project, as well as public consultation on the preferred conceptual design. Phase 4 normally includes the preparation of an ESR that is filed for public review. Provided no significant impacts are identified, and no requests for Section 16 Orders are received, once a Schedule C project is approved, work can proceed directly to implementation.

Figure 1-1 illustrates the Municipal Class EA planning and design process approach as of March 1, 2023.

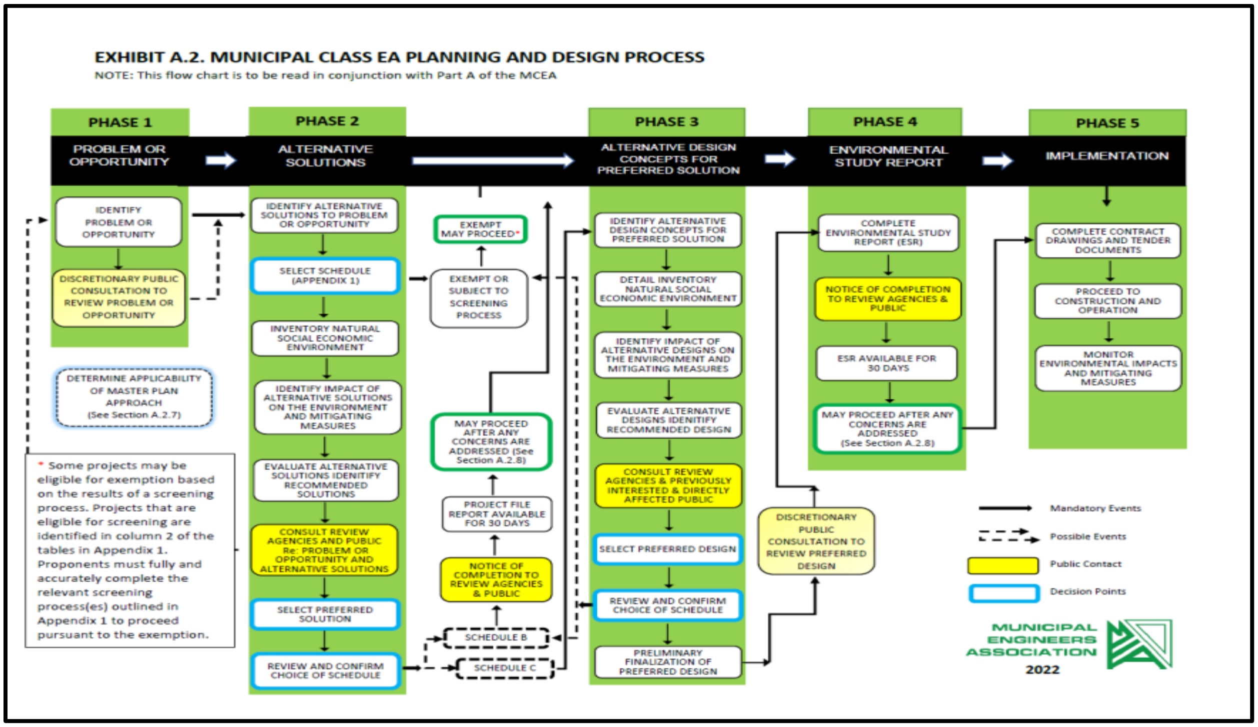


Figure 1-1: Municipal Class EA Process Schematic, Approved March 1, 2023

1.3.4 Master Plan Process

The Municipal Class EA for water and wastewater projects recognizes the importance of Master Plans as the basis for sound environmental planning.

In accordance with the Municipal Class EA, Master Plans are:

"Long range plans which integrate infrastructure requirements for existing and future land use with environmental assessment planning principles. These plans examine an infrastructure system(s) or group of related projects in order to outline a framework for planning for subsequent projects and/or developments."

Master plans have distinguishing features that set them apart from project specific studies. These features include the following:

a. Master plans are broad in scope and focus on the analysis of a system for the purpose of outlining a framework for the provision of future works and developments.
b. Specific projects recommended in a master plan are part of a larger management system and are distributed geographically throughout the study area.

The implementation of specific projects may occur over an extended time frame. According to the Class EA document, a master plan must at least satisfy the requirements of Phases 1 and 2 of the Class EA process and incorporate the five (5) key principles of environmental planning, as identified in Section 2.2. The master plan must also document public and agency consultation at each phase of the process and a reasonable range of alternative solutions must be identified and systematically evaluated.

The 2021 BMMP Update is designed to build on decision-making completed in the previous 2011 BMMP. It also considers changes to population forecasts, regulations, and policies, as well as infrastructure works completed since filing of the 2011 BMMP. The objective is to refine the overall biosolids strategy for all communities within Niagara Region.

This study follows Approach 1 of the approved master planning Class EA process. This approach involves preparing a Master Plan at the conclusion of Phase 2 of the Class EA process, which is made available for a minimum 30-day public review period. This approach allows for Exempt Projects (formerly Schedule A and A+ projects) and Exempt Projects with Screening identified in the Master Plan to move forward to implementation and become the basis for future investigations for specific Schedule B and C projects.

1.4 Project Organization and Approach

Key components of the decision-making process at each Phase of the Class EA are:

Phase 1- Background and Problem Definition/Opportunity Statement: This Phase of the Class EA process involves review of background information, including the current processes and operations at the WWTPs and WTPs and at Garner Road. The existing performance of the facilities is also evaluated, and their ability to meet future treatment needs to the year 2051 based on population growth projections is assessed. The information will be used to help define the BMMP goals and objectives, and ultimately the Phase 1 problem definition/opportunity statement.

Phase 2 – Assessment of Alternative Solutions: Given the complexity of the Niagara water and wastewater system, developing a preferred strategy for the long-term management of biosolids requires a detailed evaluation of various alternatives, including end-use options, technology options, management strategies and service delivery options.

Phase 2 takes the following systematic approach to developing and assessing alternatives, to establish the preferred overall strategy:

- A long-list of end use market options and a long-list of treatment technologies and their related end use products are identified. A market assessment is undertaken to identify a viable short list of end use options for biosolids produced in Niagara. The treatment technologies (and their associated products) are screened based on “must have criteria”, and those that passed the screening process carried forward for further consideration.
- Biosolids management strategies are developed by combining the short-listed treatment technology/ products, and available end-use options. The strategies are assessed in detail using evaluation criteria that consider all components of the environment – natural, social, cultural, technical, and economic. An overall preferred strategy is selected based on the assessment.
- The overall preferred strategy is developed in detail, including consideration of 3rd party management of biosolids vs. in-house management by the Region. An overall implementation plan is established, which will set the infrastructure works, contractual considerations and schedule for the Region to continue to efficiently manage their biosolids to the year 2051.

Documentation: The assessment process has been documented in a series of Technical Memoranda, which form the basis of this Biosolids Management Master Plan Update Report, which will be filed for a minimum 30-day public review period, following presentation to Council.

Public and Stakeholder Consultation: Public and stakeholder consultation is an important and necessary component of any successful Master Plan process. An extensive public and stakeholder consultation program has been undertaken as part of this 2021 BMMP Update to allow input and comments throughout the process. All comments received have been addressed and considered through the Master Plan process.

Figure 1-2 illustrates the Phase 2 evaluation process, followed by details of each step in the process.

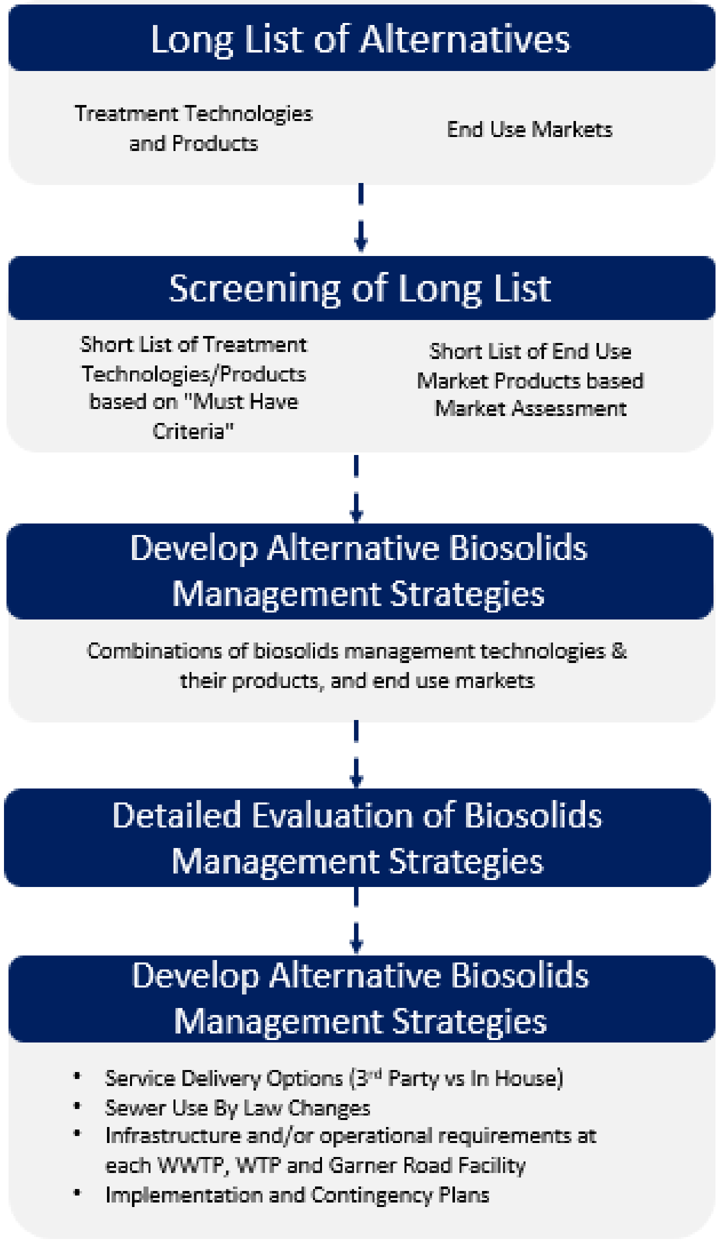


Figure 1-2: Phase 2 Evaluation Process

1.5 Regulatory Setting

This section provides an overview and summary of the Federal, Provincial and Local legislation and policies relating to the management of biosolids and the protection of the environment that are relevant to the Niagara Region BMMP Class EA.

1.5.1 Federal Legislation and Policy

The Canadian Environmental Protection Act

The Canadian Environmental Protection Act (CEPA) was enacted in September of 1999 and provides the Canadian government the power to protect the environment and human health while contributing to sustainable development. The CEPA does not directly apply to municipal biosolids products but helps advise and direct provincial policies. For example, it has supported stricter wastewater effluent ammonia limits for some municipal wastewater treatment facilities through its “Guideline for the Release of Ammonia Dissolved in Water Found in Wastewater Effluents”, released in 2004. It may also address new substances found in biosolids through the National Pollutant Release Inventory (NPRI). The NPRI is a program that requires the reporting of the release of 323 substances listed on the inventory based on an annual threshold. From a regulatory perspective, Environment Canada currently considers biosolids to be a waste product. As a result, biosolids may be impacted in the future if the substances on the inventory or the threshold quantities change.

Canadian Council of Ministers of the Environment Guidelines

The Canadian Council of Ministers of the Environment Guidelines (CCME) was established in 1964, and is composed of environmental ministers from the federal, provincial and territorial governments. The CCME supports evidenced-based environmental policy making by researching, reporting and developing guidelines and standards. Key guidelines relevant to biosolids are described below.

- Guidance Document for the Beneficial Use of Municipal Biosolids, Municipal Sludge and Treated Septage: The Guidance Document for the Beneficial Use of Municipal Biosolids, Municipal Sludge and Treated Septage was developed by the CCME Biosolids Task Group (BTG) and published in 2012. It was developed in support of a Canada-wide approach to the management of biosolids. The guidance supports the beneficial use of biosolids and the sound management of biosolids, wastewater treatment sludge and treated septage. The guidance “contains information to assist Canadian regulators and generators to manage these three (3) categories of wastewater residuals in an environmentally beneficial and sustainable manner” (Canadian Council of Ministers of the Environment, 2012).

- Canadian Council of Ministers of the Environment Guidelines for Compost Quality: In the early 1990s the CCME, to support the composting industry in Canada, established a committee to develop quality guidelines for compost products. The CCME, the Bureau de normalization du Quebec (BNQ) and the Canadian Food Inspection Agency (CFIA) agreed to coordinate and develop compost standards to provide consistency. This effort resulted in the first edition of the CCME Compost Quality Guidelines which were published in 1996. The growth in the composting industry since 1996 and the advances in science and technologies resulted in the need to update the guidelines. The revised guidelines published in 2005 are based on four criteria to ensure product safety and quality:
    - Foreign matter
    - Maturity
    - Pathogens and
    - Trace Elements

The Guidelines established two (2) grades of material:

- Category A – Unrestricted use and
- Category B – Restricted use

The Guidelines for Compost Quality are referenced in the CCME Guidance Document for the Beneficial Use of Municipal Biosolids, Municipal Sludge and Treated Septage.

The Canadian Food Inspection Agency Fertilizers Act and Fertilizers Regulations

The Canadian Food Inspection Agency (CFIA) administers several Acts and Regulations including the Fertilizers Act and Fertilizers Regulations. These have been designed to protect the food supply along with animals and plants. As a result, they enhance Canada's environment, economy and the well-being of its citizens. The Fertilizers Act and Regulations require that regulated fertilizers and soils supplements are safe for humans, animals, plants and the environment, including biosolids products.

While CFIA regulates the fertilizers and supplements that are sold and imported into Canada, the manufacturer of the product, their use and disposal are controlled by provincial and municipal regulations. The CFIA performs pre-market assessments and label verification on fertilizer products. For supplements such as biosolids products and compost they provide marketplace monitoring to verify their compliance with prescribed standards which include pathogens, metals, and pesticide residue along with dioxins and furans.

The Fertilizer Trade Memoranda provides product specific information and requirements for fertilizers and supplements regulated under the *Fertilizers Act* Section T-4-93. The safety standards for fertilizers and supplements, provide a series of metals concentrations that are acceptable in a fertilizer product. Section T-4-93 of the *Fertilizers Act* also addresses maximum acceptable cumulative additions to soils polychlorinated dibenzo-p-dioxins (dioxins; PCDD) and pathogen reduction in biosolids. Fertilizers, including biosolids products, must be of sufficient quality as to not exceed the maximum acceptable metal, dioxins, PCDD and pathogen concentrations.

Fisheries Act

The Fisheries Act provides provisions on the conservation and protection of freshwater and marine fish habitat in order to sustain fish species. In 2013, the Fisheries Policy statement was released to support the changes made to the Fisheries Act in 2012. The changes made to the Fisheries Act focuses on the protection of the productivity of commercial, recreational, and Aboriginal fisheries, improved implements for both compliance and protection, enhanced stakeholder partnerships (e.g., government agencies, local groups), and ensuring regulatory requirements are clear and consistent. In 2018, amendments for restoration of lost protections and incorporation of modern safeguards were proposed. The Fisheries Act received royal assent and became law as of June 21, 2019. While the Fisheries Act is not directly applicable at the BMMP stage, projects identified through the BMMP will be designed and constructed to mitigate potential impacts and meet the requirements of the Fisheries Act.

Species at Risk Act

The Species at Risk Act (SARA), administered by Environment Canada, focuses on restoring and maintaining populations of species that are at risk of extinction or extirpation due to human activity such as habitat destruction, hunting, introduction of competing species, or other anthropogenic causes.

Species are designated at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) by using biological information on a species deemed to be in danger. The COSEWIC reviews research information on population and habitat status, trends and threats and applies assessment criteria based on international standards. Once a species is added to Schedule 1 – List of Wildlife Species at Risk, it benefits from legal protection afforded and the mandatory recovery planning required under the *Act*. While the SARA is not directly applicable at the BMMP stage, projects identified through the BMMP will be designed and constructed to mitigate potential impacts and meet the requirements of the SARA.

1.5.2 Provincial Legislation and Policy

All municipalities in Ontario must operate within the administrative, legislative and financial framework established by senior levels of government. The following sections summarize key provincial initiatives relevant for the BMMP Class EA.

Provincial Policy Statement

The Provincial Policy Statement sets the policy foundation for land use planning and development in Ontario, providing guidance and support for appropriate land use planning and development while protecting resources of provincial interest, public health and safety, and the quality of the natural and built environment.

The Provincial Policy Statement contains policies relevant to infrastructure planning under policy section 1.6 including, but not limited to:

- Requirement that infrastructure shall be provided in an efficient manner that prepares for impacts of a changing climate while accommodating projected needs.
- Planning for infrastructure and public service facilities shall be financially viable over their lifecycle and available to meet current and projected needs.
- Optimization of the use of existing infrastructure and public service facilities before developing new infrastructure.

More specifically, under policy section 1.6.6, it states that water and wastewater services shall:

- Accommodate forecasted growth in a manner that promotes the efficient use and optimization of existing municipal water and wastewater services.
- Ensure that these systems are provided in a manner that:
    - can be sustained by the water resources upon which such services rely,
    - prepares for the impacts of a changing climate,
    - is feasible and financially viable over their lifecycle, and,
    - protects human health and safety, and the natural environment.
- Promote water conservation and water use efficiency.
- Integrate servicing and land use considerations at all stages of the planning process.

In 2020, the PPS received a revision to better integrate economic, social, and environmental considerations; respond to rural and northern challenges; clarify policies to better support implementation; and provide direction for emerging issues. The 2020 Provincial Policy Statement was used as input to the Niagara Region's Official Plan (2022). The Ministry of Municipal Affairs and Housing (MMAH) is consulting on a new integrated Provincial Policy Statement (2023) that that will replace the existing Provincial Policy Statement and A Place to Grow: Growth Plan for the Greater Golden Horseshoe. The new Provincial Policy Statement (2023) has been developed to support the achievement of the Provincial housing objectives under Bill 23, which states a goal of having 1.5 million homes built over the next 10 years.

The Planning Act

The Planning Act establishes the rules for land use planning in Ontario and describes how land uses may be controlled in communities. It also defines the respective roles and responsibilities of the province and municipalities, as listed below:

Provincial Responsibility

- Issuance of Provincial Policy Statement
- Promotion of provincial interests
- Preparation of provincial plans, such as the Greenbelt Plan and Growth Plan for the Greater Golden Horseshoe
- Provision of advice to municipalities and the public on land use planning issues
- Administration of local planning controls and approvals where required

Municipal Responsibility

- Decision-making for future community planning
- Preparation of planning documents such as Official Plan and Zoning By-Laws
- Ensuring that planning decisions and documents are consistent with Provincial plans
- For upper-tier municipalities (such as Peel Region), approval authority for lower-tier municipalities' Official Plans

The Province is currently seeking to amend the Planning Act, under the *Planning Statute Law Amendment Act, 2023* would, if passed, impact official plans and official plan amendments in 12 municipalities: the cities of Barrie, Belleville, Guelph, Hamilton, Ottawa, and Peterborough, Wellington County, and the regional municipalities of Halton, Niagara, Peel, Waterloo and York, by making changes to urban boundaries while maintaining protections for the Greenbelt.

Growth Plan for the Greater Golden Horseshoe and Related Land Use Plans

The Growth Plan for the Greater Golden Horseshoe, which falls under the Places to Grow Act (2005), was first introduced in July 2017, and later amended as of August 28, 2020. The Growth Plan sets out a vision and policies to manage rapid growth. It integrates land use planning, infrastructure planning and investment as well as demographic, economic growth, and health considerations to support the achievement of complete communities, a thriving economy, a clean and healthy environment, and social equity. Like other provincial plans, the Growth Plan builds upon the policy foundation provided by the

Provincial Policy Statement and provides additional and more specific land use planning policies to address issues facing the Greater Golden Horseshoe area of Ontario. The Growth Plan describes permissible population and employment growth areas for upper and single tier municipalities.

The following land use plans work together with the Growth Plan for the Greater Golden Horseshoe to protect the natural environment and determine where and how growth should be accommodated in the region:

- **Greenbelt Plan:** The Greenbelt Act, 2005 provides the authority for the creation of the Greenbelt Plan (2017). The Greenbelt Plan is aimed at protecting farmland, communities, forests, wetlands, watersheds, and cultural heritage resources, as well as supporting recreation and tourism in Ontario's Greater Golden Horseshoe. The Greenbelt Area also includes the Niagara Escarpment Plan and the Oak Ridges Moraine Conservation Plan areas.

- **Niagara Escarpment Plan (NEP):** The NEP (2017) was established under the Niagara Escarpment Plan Development Act (NEPDA; 1990) and serves as a framework of objectives and policies to balance development, protection, and the enjoyment of the Niagara Escarpment. The Plan is administered by the Niagara Escarpment Commission.

- **The Oak Ridges Moraine Plan (ORMP):** The ORMP was established in 2002 by the Ontario Government under the Oak Ridges Moraine Conservation Act, 2001, which aimed to protect the ecological and hydrological integrity of the Moraine. Niagara Region is not located in the Oak Ridges Moraine Plan.

Environmental Protection Act and Ontario Water Resources Act

The Environmental Protection Act (EPA) is the primary pollution control legislation in Ontario and is used with the *Water Resources Act* to protect air and water quality in Ontario. The EPA prohibits the discharge of contaminants into the environment that are likely to cause adverse effects, by establishing limits for air emissions and wastewater effluent that must not be exceeded. Environmental Compliance Approvals (ECAs) are issued under the Act. In addition, the *Act* controls the removal, transport, and disposal of excess soils, if they are deemed to be contaminated.

The Ontario Water Resources Act focuses on the protection of groundwater and surface water in Ontario. The *Act* regulates the approval, construction, and operation of wastewater treatment facilities, including ensuring that effluent discharges to receiving waters meet Provincial Water Quality Objectives (PWQOs). Permits-to-take-water from the ground or surface water sources of more than 50,000 liters of water per day are also regulated under the Water Resources Act.

Nutrient Management Act

As part of Ontario's Clean Water Strategy, the Nutrient Management Act (NMA), 2002 was developed to reduce the potential for water and environmental impacts from agricultural activities. The NMA was developed by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), and the Ministry of the Environment, Conservation and Parks (MECP), and sets the framework for best practices regarding application of nutrients to agricultural fields, including fertilizers, manure, and wastewater biosolids.

OMAFRA is responsible for the approvals, training, certification and education activities required for the safe application of non-agricultural source material (NASM). They will also notify the local municipality (lower or single tier) when any NASM Plan within its jurisdiction is approved. MECP is responsible for enforcing compliance with the O. Reg. 267/03 of the NMA. They will also carry out proactive inspections and respond to complaints of NASM land application activities to ensure compliance with the regulatory standards and protection of the environment.

The NMA regulates biosolids as NASM intended for application to agricultural land as nutrients. NASM categories include yard waste, fruit and vegetable peels, food processing waste, pulp and paper biosolids and municipal sewage biosolids. O. Reg. 267/03 under the NMA prohibits application of these materials to land that is unsuitably close to adjacent surface waters and sensitive areas; sets out criteria regarding heavy metal concentrations and suitable soil types and topography; and outlines the amount, method and timing of application. Before being approved for application on farmland, biosolids must be tested for pH, available nitrogen, potassium and phosphorus, pathogens, 11 regulated heavy metals, and meet sampling requirements set out in the regulation.

NASM is categorized into three categories (1, 2, and 3) under the NMA, based on material quality. These categories set requirements for material and soil testing and level of approval. Biosolids are a Category 3 NASM. In addition, materials are further sub-categorized into pathogen (CP1 and CP2), odour (OC1, OC2, and OC3), and metal (CM 1 and CM2) categories. Metal and pathogen categories determine setbacks from wells, surface water, groundwater and bedrock. Setback distances to residential, commercial, community or institutional properties are determined by odour category.

New approvals for land application (NASM Plans) are subject to loading restrictions and must meet beneficial use criteria (demonstrate beneficial use for either organic matter content, nutrients, increase soil pH or irrigation) as well as maximum application rates for nitrogen, phosphorus, regulated metals and dry matter.

Quality Standards and Guidelines for the Production of Compost (2012)

In 2012, Ontario updated its quality standards and guidelines for the production of compost, to encourage the composting of more materials, while protecting the environment and human health (Ontario Ministry of the Environment, Waste Management Policy Branch, 2012). The new standards include three categories of compost (AA, A, and B), which provide additional options for the management of biosolids. These standards set quality criteria for metals, pathogens, maturity and foreign matter for each category of finished compost.

Category AA is unrestricted use that allows compost to be given away and used by the public freely. Under the Ontario compost regulation, a compost that contains biosolids cannot be classified as AA Category. Categories A and B allow municipal wastewater biosolids to be used as feedstocks up to 25%, allowing for the beneficial use of these resources. Category A compost is exempt from the need for approvals provided that it meets the new standards, including labelling, while Category B, falls under the same requirements as a NASM, will continue to require government approval for use and transportation, including an ECA or Environmental Activity and Sector Registry (EASR) registration for transport and ECA for use off-farm or approved NASM Plan for on-farm use. The new standards also align Ontario more closely with those set out in 2005 by the CCME.

More Homes Built Faster Act (2022) (Bill 23)

On April 14, 2022, the More Homes Built Faster Act received Royal Assent. The aim of the Act is to advance the province's goal to increase housing supply in Ontario; The goal is to have 1.5 million new homes built over the next ten (10) years. It builds on the province's early More Homes, More Choice Plan and the More Homes for Everyone Plan, and sets framework for growth by:

- Reducing the bureaucratic costs and red tape that are delaying construction and pushing home prices even higher;
- Promoting building up near transit and reforming zoning to create more "gentle density"; and
- Protecting homebuyers and utilizing provincial lands to build more attainable homes.

The Act amends various statutes to achieve the goal of increasing housing supply in Ontario, including the Planning Act, the Growth Plan, and the Conservation Authorities Act.

The More Homes Built Faster Act was enacted during this BMMP process. This BMMP is based on approved population growth forecasts as presented in the Region's 2021 Water and Wastewater Servicing Master Plan (WWSMP) update, which did not account for the quicker population growth rate anticipated through Bill 23. However, it is noted this does not change the assessment process or recommendations presented herein; only the schedule of proposed works would change (i.e., infrastructure may be needed earlier than scheduled).

Ontario Heritage Act

The province and municipalities are enabled to conserve significant individual properties and areas through the Ontario Heritage Act (OHA). The OHA, administrated by the Ministry of Citizenship and Multiculturalism (MCM) requires that cultural heritage resources, including buildings, sites and archaeological (land and marine) resources be protected. Impacts to these features must be avoided or mitigated. While the OHA is not directly applicable at the BMMP stage, projects identified through the BMMP will be designed and constructed to mitigate potential impacts and meet the requirements of the OHA.

Endangered Species Act

The Endangered Species Act (ESA) was originally written in 1971 and amended in 2008. Similar to the Federal SARA, the ESA aims to provide protection to plant and animal species that are at risk of extinction or extirpation from Ontario. Species thought to be at risk in Ontario are initially determined by the

Committee on the Status of Species at Risk in Ontario (COSSARO), and if approved by the provincial Ministry of Natural Resources and Forestry (MNRF), species will be added to the provincial list of endangered and threatened species in compliance with the ESA. The ESA immediately provides habitat protection to all species listed as threatened, endangered or extirpated.

The ESA provides guidance on determining whether anthropogenic activities, such as construction, could impact regulated species and considers biology and behaviour of the species, details of the activity, and how the activity may affect the species' ability to carry out its life processes. While the ESA is not directly applicable at the BMMP stage, projects identified through the BMMP will be designed and constructed to mitigate potential impacts and meet the requirements of the ESA.

1.5.3 Municipal and Local Legislation Policy

Key municipal and local stakeholders that have a direct interest in the Class EA that are being consulted with as to concerns and requirements are described below.

Niagara Region Official Plan

Niagara Regional Council adopted the Niagara Official Plan in June 2022, and the Minister of Municipal Affairs and Housing approved the plan with modifications in November 2022. This new Official Plan reflects where the community is today and where it will be in 30 years. The plan includes land-use policies that reflect Niagara's natural environment, land needs, growth allocations, housing, transportation, urban design, employment lands and agriculture. These variables are interconnected and are considered holistically to plan for communities that are sustainable, resilient, vibrant and thriving. The BMMP is consistent with the requirements of Niagara's New Official Plan. It is noted that there are ongoing discussions related to the More Homes Built Faster Act (2022) (Bill 23) and required updates to the Niagara Region's Official Plan.

Niagara Escarpment Plan

The 2017 Niagara Escarpment Plan provides for the maintenance of the Niagara Escarpment and land in its vicinity substantially as a continuous natural environment, and to ensure only such development occurs as is compatible with that natural environment. The objectives of the Plan are as follows:

1. To protect unique ecologic and historic areas;
2. To maintain and enhance the quality and character of natural streams and water supplies;
3. To provide adequate opportunities for outdoor recreation;
4. To maintain and enhance the open landscape character of the Niagara Escarpment in so far as possible, by such means as compatible farming or forestry and by preserving the natural scenery;
5. To ensure that all new development is compatible with the purpose of this Act;
6. To provide for adequate public access to the Niagara Escarpment; and,
7. To support municipalities within the Niagara Escarpment Planning Area in their exercise of the planning functions conferred upon them by the Planning Act.

1.5.4 Area Municipalities

This study directly affects the surrounding municipalities including; Town of Grimsby, Township of West Lincoln, Town of Lincoln, Town of Pelham, Township of Wainfleet, City of St Catharines, City of Thorold, City of Welland, City of Port Colborne, Town of Niagara-on-the-Lake, City of Niagara Falls and Town of Fort Erie. Consequently, representatives from the area municipalities were represented at key project meetings.

1.6 Background Conditions of Study Area

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 shown in Figure 1-3, as biosolids products are applied on agricultural lands within Niagara, including Wainfleet, as illustrated in Figure 1-4.

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 1-5, 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 1-4. In addition to agriculture, key industries within the Region include manufacturing, automotive and tourism.

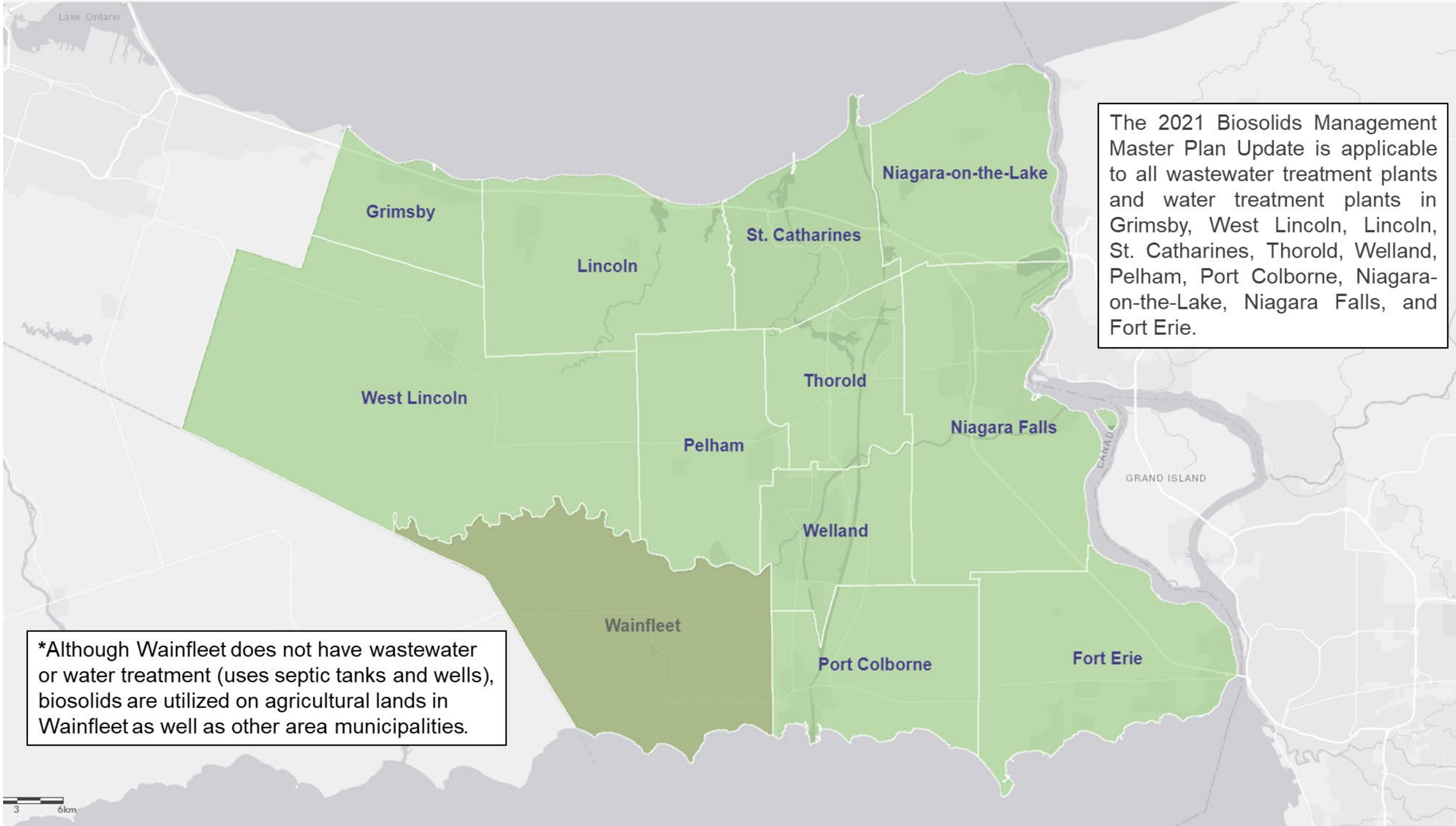


Figure 1-3: Biosolids Management Master Plan Study Area Map

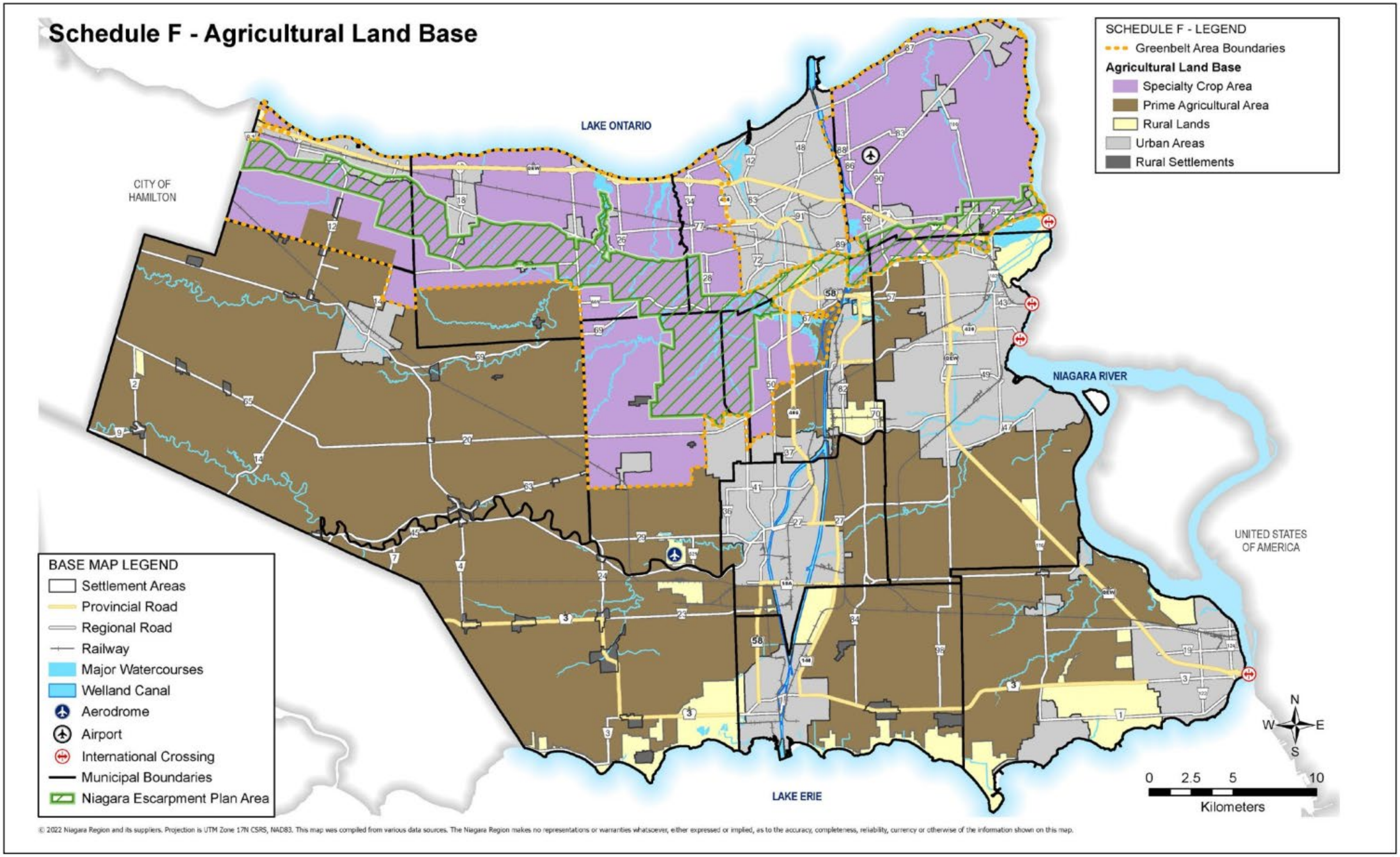


Figure 1-4: Agricultural Land Base within Niagara Region (excerpt from 2022 Regional Official Plan)

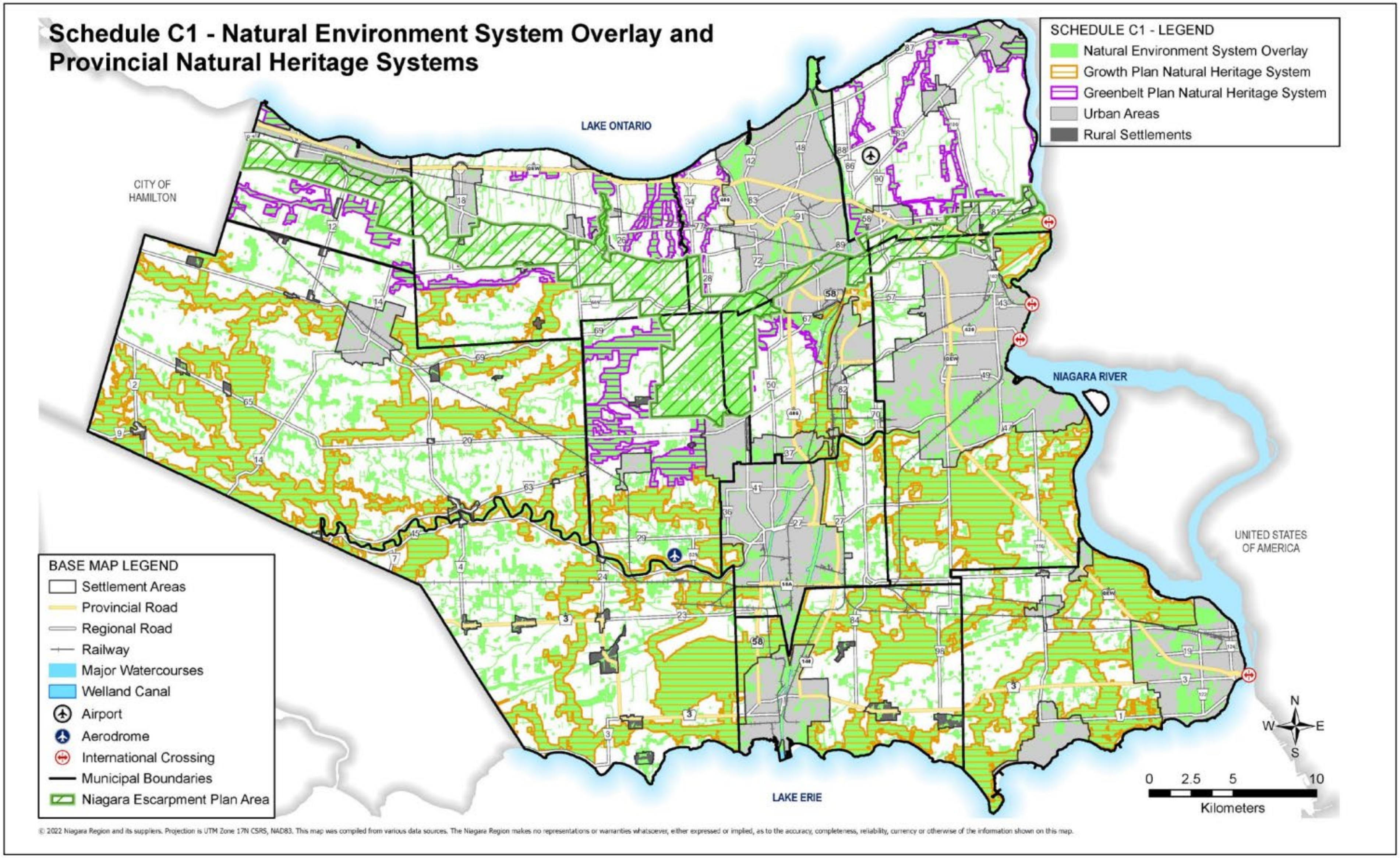


Figure 1-5: Natural Environment Systems within Niagara Region (excerpt from 2022 Regional Official Plan)

2 Existing Biosolids and Residuals Management Program and Projected Growth

2.1 Overview of Existing Facilities

The Region is serviced by ten (10) conventional WWTPs, one (1) future plant to serve South Niagara Falls, the lagoon plant serving Stevensville / Douglastown and six (6) WTPs. The Region currently beneficially uses all the solids generated by these facilities and has not had to dispose of any biosolids by landfill.

The WWTPs include:

- Crystal Beach WWTP (Town of Fort Erie)
- Seaway WWTP (Town of Port Colborne)
- Welland WWTP (City of Welland)
- Port Weller WWTP (City of St. Catharines)
- Port Dalhousie WWTP (City of St. Catharines)
- Baker Road WWTP (Town of Grimsby)
- Anger Avenue WWTP (Town of Fort Erie)
- Niagara Falls WWTP (City of Niagara Falls)
- Niagara-on-the-Lake WWTP (Town of Niagara-on-the-Lake)
- South Niagara Falls WWTP (*Future Facility)* (City of Niagara Falls)
- Queenston WWTP (Town of Niagara-on-the-Lake)
- Stevensville /Douglastown lagoons (Town of Fort Erie)

Furthermore, six (6) WTPs service the Region’s urban areas, as shown in Figure 2-2, and as listed below:

- DeCew WTP (City of St. Catherines)
- Grimsby WTP (Town of Grimsby)
- Niagara Falls WTP (City of Niagara Falls)
- Port Colborne (Town of Port Colborne)
- Rosehill WTP (Town of Fort Erie)
- Welland WTP (City of Welland)

The Region operates the Garner Road Biosolids Facility in Niagara Falls which serves several of the Regions WWTPs and WTPs and accepts both wastewater biosolids and water treatment plant residuals. From the Garner Road Facility, biosolids are either applied as a liquid on agricultural land or dewatered and transported by a third-party biosolids management firm, Walker Environmental, where the biosolids are further stabilized using an advanced alkaline stabilization process, N-Viro, at the Walker facility in Thorold. The N-Viro product is sold commercially as a fertilizer.

Currently all the WWTPs, except for Niagara Falls WWTP which has its own dewatering on-site, transport their solids to the Garner Road Facility as a liquid in tanker trucks. The wastewater solids are placed into the lagoons for storage and thickening. From there they are land applied as a liquid or dewatered and transported to Walker Environmental for further stabilization. Figure 2-1 illustrates the existing and planned wastewater treatment facilities within Niagara Region, as well the Garner Road Biosolids Storage and Dewatering Facility.

Three (3) of the WTPs, DeCew, Grimsby and Niagara Falls, transport their water treatment residuals to the Garner Road Facility for management. The other three facilities, Port Colborne, Rosehill and Welland discharge their waste residuals into the wastewater collection system for disposal at the Seaway, Anger Avenue and Welland WWTPs, respectively. Biosolids from Seaway, Anger Avenue and Welland WWTPs are therefore a combination of digested wastewater biosolids and WTP residuals.

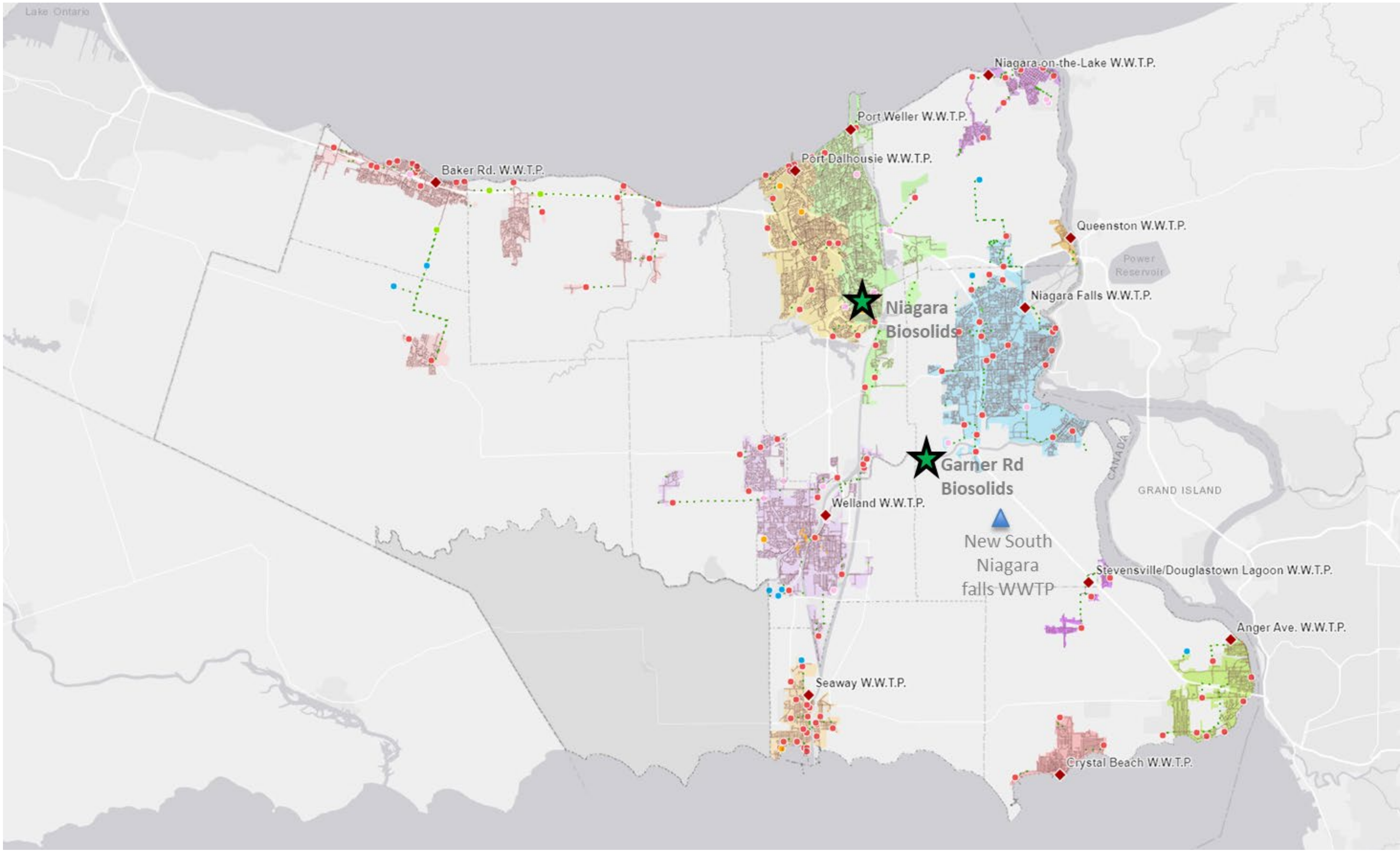


Figure 2-1: Existing and Planned Wastewater Treatment and Biosolids Facilities in Niagara Region

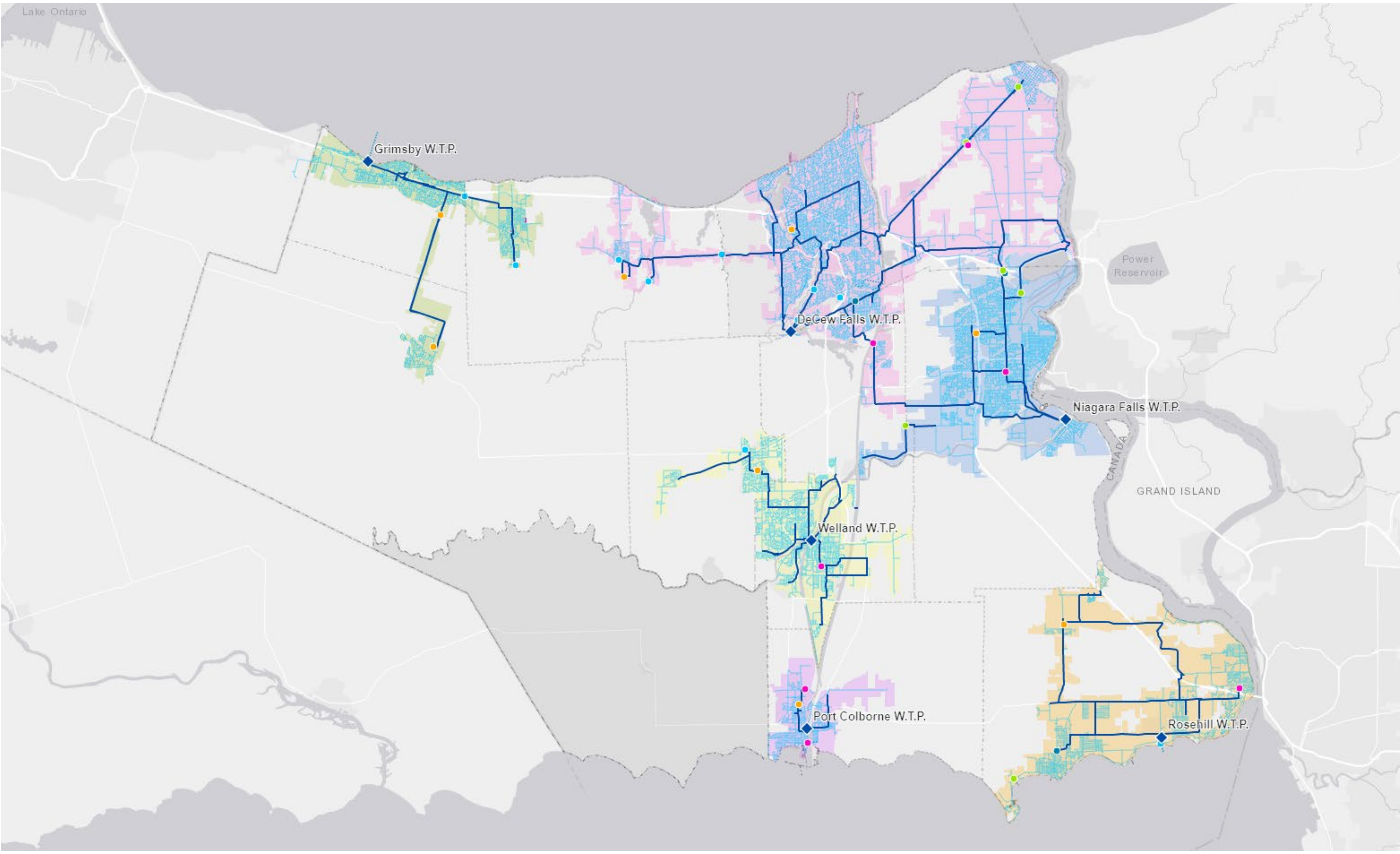


Figure 2-2: Existing Water Treatment Plants in Niagara Region

An overview of the current biosolids and residuals management practices is illustrated in Figure 2-3.

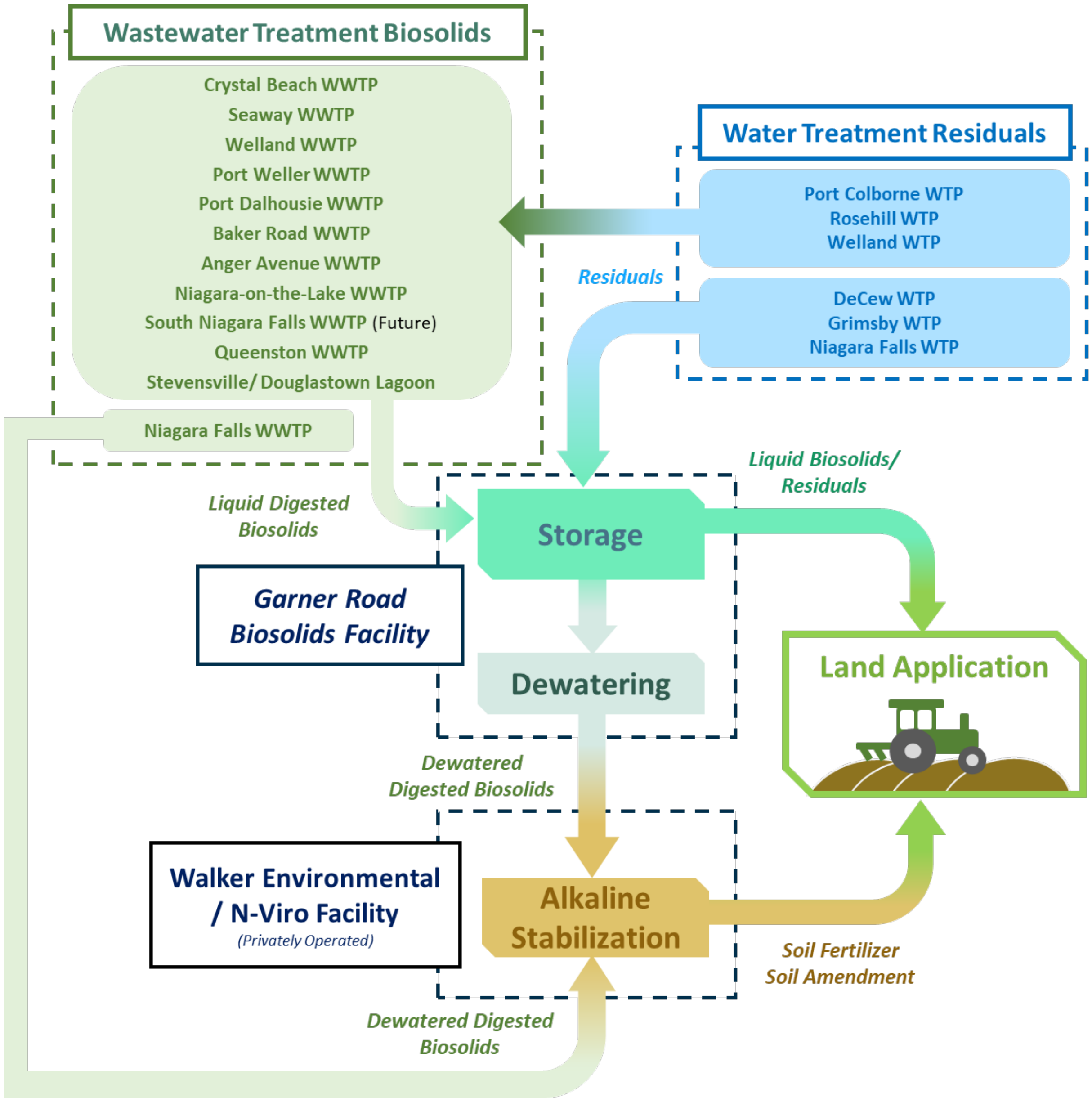


Figure 2-3: Overview of Current Biosolids and Residuals Management Practices in Niagara Region

2.2 Third Party Contractors for Biosolids Management

At the time when this Biosolids Management Master Plan was initiated, the Region had contracts with two (2) third party contractors as part of their Biosolids Management Program: Walker Environmental and Thomas Nutrient Solutions. The Region's contract with Walker is still active and valid until March 31, 2017. The contract with Thomas Nutrient Solutions will expire December 31, 2024, and a new contract is being tendered at the time this report was submitted in anticipation of the current contract expiry.

2.2.1 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.

2.2.2 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. As previously noted, the contract extension option has not be taken, and this contract has been re-tendered, with award pending at time of writing. Until the end of their current contract, Thomas Nutrient Solutions is responsible for the following hauling operations:

1. Hauling liquid biosolids from all Region WWTPs and residuals from Decew, Grimsby and Niagara Falls WTPs to Garner Road Biosolids Facility
2. Transferring biosolids and residuals between WWTPs and WTPs as required
3. Hauling approximately 50% of liquid biosolids from the Garner Road Facility to various agricultural sites for land application
4. 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.
5. 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.

2.3 Projected Growth

The population growth forecasts to 2051 and associated increases in water and wastewater servicing requirements have been determined under the 2021 Water and Wastewater Servicing Master Plan (WWSMP) update. Growth forecasts for both residential and employment populations are summarized in Table 2-1 below. Overall, the population in the Region is expected to grow by approximately 42 - 45% over the next 30 years.

Table 2-1. Population Growth Forecasts within Region of Niagara to 2051

	Wastewater			Water	
	Serviced	Serviced	Total (Service + Un-serviced)	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

3 Sewer Use By-Law Review

3.1 Overview and Objectives of Sewer Use By-Law

The quality of biosolids produced in the Region are impacted by what is discharged into the sewer system. Niagara Region has had a Sewer Use By-Law in place since 1976, which regulates discharges into the sewer. In 2002, as part of the Sewer Use Program, the By-law was revised to reflect the Model Sewer Use By-Law from the Ontario Ministry of the Environment, now the MECP.

The Sewer Use By-Law is aimed at reducing the loading of contaminants originating from industrial, commercial, and institutional facilities that enter the municipal sewer system to reduce harmful contaminants that are difficult to treat at receiving wastewater treatment plants. Therefore, the Sewer Use By-Law helps improve effluent quality from WWTPs, as well as biosolids quality. Improving biosolids quality will allow the Region to continue to meet biosolids regulations and guidelines with respect to treatment and end-uses, and to be prepared for potentially more stringent regulations in the future.

3.2 Sewer Discharge Streams

3.2.1 Residential, Commercial and Institutional Sewer Discharges

The Region does not monitor individual residential dischargers, and data was not available for commercial and institutional dischargers. It is expected that residential, commercial and institutional sewer dischargers in the Region generally adhere to the requirements of the sewer use by-law limits and would not require a Sewer Use By-Law Discharge Agreement that allows for by-law exceedances. It is noted that a portion of wastewater from residential septic tanks and holding tanks is hauled to select WWTPs in the Region, and this hauled waste is monitored by Region staff for compliance with the Sewer Use By-Law.

3.2.2 Industrial Sewer Discharges

Industrial sewer dischargers within the Region primarily include wineries and food processing plants, with a few other miscellaneous sectors. There are 17 companies with Surcharge Agreements which allow discharges to exceed the Sewer Use By-Law limits by an agreed upon threshold for Biochemical Oxygen Demand (BOD_5), Total Phosphorus (TP), or Total Suspended Solids (TSS). The companies pay a fee based on the extra loading which is intended to cover the additional costs associated with treating the overstrength contributions. Metals over the concentration limit are not permitted as any metals in the influent to the wastewater treatment plant will result in more toxic sludge, and if not adequately removed through the treatment process, may contribute to aquatic contamination which can enter the food chain. Metals are more efficiently removed through targeted processes at their source.

The average and maximum monthly BOD_5, TSS, and TP concentrations for the Surcharge Agreement holders from 2017 to 2021 are summarized in Table 3-1 in comparison to the allowable limits under the Region's Sewer Use By-law. Overall, the winery sector contributes more BOD_5 loading and food processing produces greater TSS and TP loading.

Table 3-1: Average and Maximum Monthly Concentrations from Surcharge Agreement Holders

	Average Monthly (mg/L)			Maximum Monthly (mg/L)		
	BOD_5	TSS	TP	BOD_5	TSS	TP
SUB Limit	300	350	10	300	350	10
2017	8,294	729	23	100,000	12,465	127
2018	8,158	701	21	100,000	5,286	124
2019	8,051	595	19	100,000	3,945	120
2020	8,338	718	23	100,000	5,328	150
2021	8,242	605	21	100,000	4,683	193

Increased BOD_5 loading to the downstream WWTPs from industrial dischargers will increase biosolids production at the plants. Future biosolids production estimated at the WWTPs as described in TM 4 in Appendix A, incorporates loading from existing industrials dischargers and assumes this will not change in the future. If any additional SUB agreements are to be issued that would increase BOD_5 loading to the downstream WWTP, impacts on plant performance and biosolids production should be reviewed.

Of the 17 companies with Surcharge Agreements, wastewater sample data was occasionally taken to test for various contaminants between 2017 – 2021. The eleven metals for which biosolids guidelines and/or regulations exist were sampled at seven of the companies, and no metal exceedances were measured during this period. Sampling was also conducted at 14 other companies that do not have Surcharge Agreements, with some metal exceedances measured from manufacturing, metallurgy and waste management industries. Over 357 tests, there were 55 exceedances as summarized in Table 3-2.

Sampling for contaminants from eight landfills (67 samples) found no metal exceedances. Based on this review of all sampling data, metal exceedances tend to be isolated to specific industrial dischargers and are not widespread.

For a more details on historical contaminant levels from industrial dischargers, refer to TM 2 in Appendix A.

Table 3-2: Exceedances for Restricted Contaminants from Monitored Industrial Dischargers (2017 to 2021)

Industry Sector	# of Samples	# of Exceedances	Contaminant
Surcharge Agreement			
Winery	11	0	--
Food Processing	3	0	--
Distillery	1	0	--
No Surcharge Agreement			
Brewery	2	0	--
Forge	13	0	--
Manufacturing	265	33	Copper (13 – all in Fort Erie), Cobalt (1 – Fort Erie) Chromium (1 - Lincoln), Lead (5 – all in Fort Erie), Selenium (13 – all in Fort Erie)
Metallurgy	10	7	Chromium (2), Molybdenum (1), Nickel (1), Zinc (3)
Waste Management	66	15	Zinc
Winery	1	0	--
Landfill	67	0	--
Total	**439**	**55**	**--**

3.2.1 Region-Generated Discharges

The Region also discharges waste streams into the sewer system, primarily:

1. **Garner Road Facility sidestreams** (centrate, supernatant from lagoons) which is pumped to the Niagara Falls WWTP sewershed or hauled to a discharge maintenance hole in the Port Weller WWTP sewershed. These side streams are blended and pumped out from the lagoons and include some dilution from stormwater

2. **WTP residuals** from Port Colborne, Rosehill and Welland WTPs discharged into local sewershed

Table 3-3 shows the quantity data measured for the blended discharge stream from Garner Road, including centrate, supernatant and stormwater. The data available for the blended wastewater stream that leaves Garner Road does not include metals or Total Kjeldahl Nitrogen (TKN), but does show average discharge concentrations for BOD_5, TSS and potential of hydrogen (pH) comply with the by-law.

Table 3-3: Garner Road Forcemain Discharge Quality, July 2018 – Nov 2022

Parameter	By-law 27-2014	Concentration (mg/L)		
		Average	95th percentile	Maximum
BOD_5	300 mg/L	49*	224*	2565*
TSS	350 mg/L	210	468	1800
pH	6 to 11	8.04	8.3	8.4

**Data value available was for COD, not BOD_5. A correlation factor of 3.8 (COD:BOD_5) was used to convert COD to BOD_5 based on typical correlation values seen at Niagara Falls WWTP in 2021.*

An assessment was also completed on residuals quality from WTPs with available data between 2017 and 2021 to determine impact of sending water residuals to the sewer, as shown in Table 3-4. It is noted that quality data was only available for WTPs that currently haul their waste to the Garner Road Biosolids Facility (i.e., DeCew Falls WTP, Grimsby WTP and Niagara Falls WTP), and not the WTPs that currently send their residuals to the sewer (i.e., Port Colborne WTP, Rosehill WTP and Welland WTP). The concentrations provided in the table below are based on a thickened residual, so those WTPs that discharge directly to the sewer would have a lower concentration than shown.

Table 3-4 Residuals Quality from Region Water Treatment Plants with hauled residuals, 5 Year Average (2017 – 2021)

	DeCew Falls WTP (mg/L)	Grimsby WTP (mg/L)	Niagara Falls WTP (mg/L)	Niagara Region By-law 27-2014 (mg/L)
Arsenic	34.816	53.644	29.583	1.0
Cadmium	1.879	1.966	1.992	0.7
Cobalt	5.079	4.464	6.413	3.0
Chromium	12.891	7.740	20.967	5.0
Copper	60.224	46.336	56.500	3.0
Lead	11.179	10.675	9.558	1.0
Mercury	0.030	0.019	0.022	0.01
Molybdenum	8.037	8.473	5.967	5.0
Nickel	16.699	8.718	19.604	2.0
Selenium	2.039	1.535	3.467	1.0
Zinc	58.940	82.214	97.313	3.0

Based on the data in Table 3-4, WTP residuals from the listed plants that haul residuals would not currently meet the Region's SUB if they were to discharge to the sewer. However, residuals from these WTPs are thickened prior to hauling, which increases metals concentrations, so this is not expected to be a concern.

Per the Garner Road ECA, water treatment residuals must be mixed at a ratio of 1:20 with sewage biosolids, which results in a dilution effect. It is also noted that land application rate can be varied to ensure NMA loading limits are achieved. As such, it is not necessarily effective to increase treatment of WTP residuals before release into the sewer from a biosolids quality perspective. Source reduction of metals is preferred over treatment of residuals at the WTPs.

Referring to Table 3-5, two (2) of the three (3) WTPs that directly discharge to the sewer have intermittent exceedances of TSS, which are expected during cleaning operations when high solids concentrations are flushed into the sewer. Average TP and TKN are within the by-law limit. Metal data is not available for the three (3) WTPs that directly discharge to the sewer.

Table 3-5 Residuals Quality from Region Water Treatment Plants Discharging to Sewer (2017-2022

	Welland WTP (mg/L)		Port Colborne WTP (mg/L)		Rosehill WTP (mg/L)		Niagara Region By-law 27-2014 (mg/L)
	Avg	95th Perc.	Avg	95th Perc.	Avg	95th Perc.	
TSS	1958*	11,880*	1566*	4992*	61.8	212	350 mg/L
TP	4.9	28*	1.4	4.2	0.13	0.29	10 mg/L
TKN	21.6	130*	7.0	22.5	0.83	3.3	100 mg/L

* Value exceeds current By-Law limit

Overall, the residuals that are discharged to the sewer are eventually blended with biosolids at the downstream WWTPs and hauled to Garner Road. As long as the receiving WWTP can handle the intermittent TSS loading, the practice of discharging directly to the sewer will not negatively impact biosolids quality. The Region may consider discontinuing direct discharge of residuals to the sewer during clean-out operations, and instead dewater and send directly to landfill to avoid downstream WWTP upsets. This and other opportunities for managing WTP residuals is discussed further in TM 8 in Appendix A.

3.3 Recommended Updates to Sewer Use By-Law

To reduce impacts of sewer discharge streams on biosolids quality now and in the future, the following updates to the Niagara Region's Sewer Use By-Law should be considered:

1. **Continue to Enforce By-Law**: Region should continue to track industrial users and enforce by-law limits to improve compliance with existing Sewer Use By-Law.
2. **Continue to work with industrial discharger** to address more frequent exceedances, including those related to BOD_5, FOG and TSS.
3. **Monitor status of PFAS regulations:** As WWTP effluent discharge limits are expected to be implemented for PFAS compounds, sometimes referred to as 'forever chemicals', the Region should continue to monitor status of regulatory changes and consider updating their Sewer Use By-Law to reduce PFAS inputs into the system once changes are confirmed.

No changes to Region's Sewer Use By-Law limits are proposed at this time, as the current limits are close to the CCME limits. Lowering them further will likely result in more exceedances, as additional treatment for metals by industries is difficult given limitations in available technologies and is not cost effective. No changes to the lower-tier municipalities' SUBs are required as they all reference the Regional By-law.

4 Wastewater Treatment Plant Operation, Biosolids Generation and Future Needs

The following section provides details of each WWTP's current operation, solids generation rate, and performance as well as future needs based on project population growth to 2051.

As a result of population growth, water and wastewater flows are also expected to increase. A summary of current and future flows for each WWTP, along with current plant rated capacities are provided in Table 4-1 below.

Table 4-1: 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.

4.1 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 average daily flow (ADF) capacity of 24,500 cubic meters per day (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 more than 49,000 m^3/d and up to 98,000 $m^{3/}d$. The system consists 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 (4) 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. Waste Activated Sludge (WAS) is thickened via a gravity belt thickener (GBT) in the GBT building, with thickened WAS (TWAS) being directed to two (2)-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.

4.1.1 Wastewater Flow

Table 4-2 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 4-2: 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 Peak Daily Flow (PDF) (m^3/d)	51,648	3.63
Historic Max Month (m^3/d)	20,731	1.46

4.1.2 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 volatile solids (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 4-1.

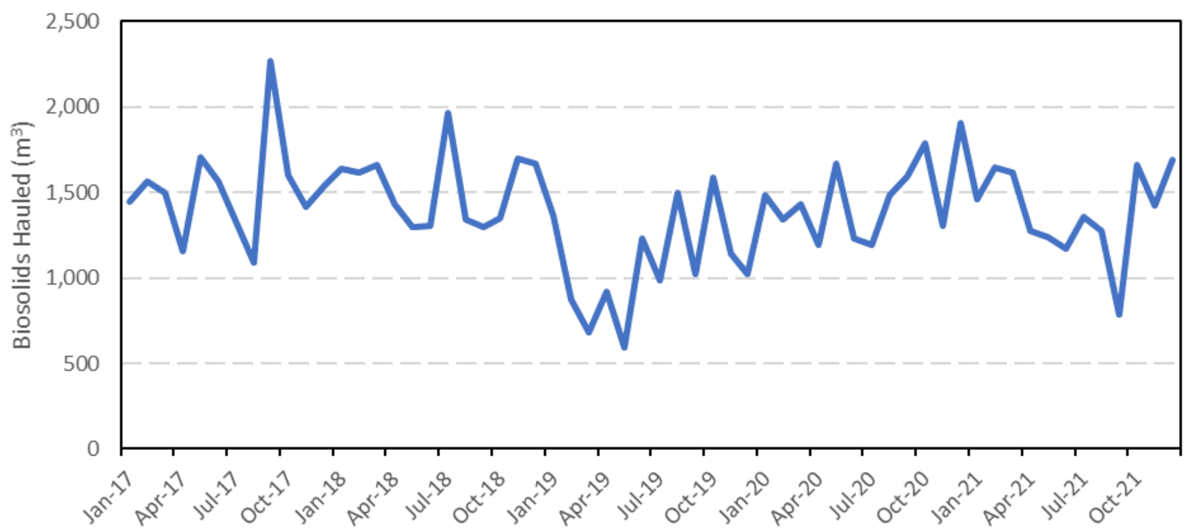


Figure 4-1: Anger Avenue WWTP Hauled Sludge Volume

4.1.1 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.

4.1.2 Status of Planned Projects

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

4.2 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 meter (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 cubic meter (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.

4.2.1 Wastewater Flow

Table 4-3 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 4-3: 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

4.2.2 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 volatile solids (VS) destruction of 42%. The quantity of biosolids hauled, in terms of volume and mass, respectively, are provided in Figure 4-2. With reference to Figure 4-2, 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.

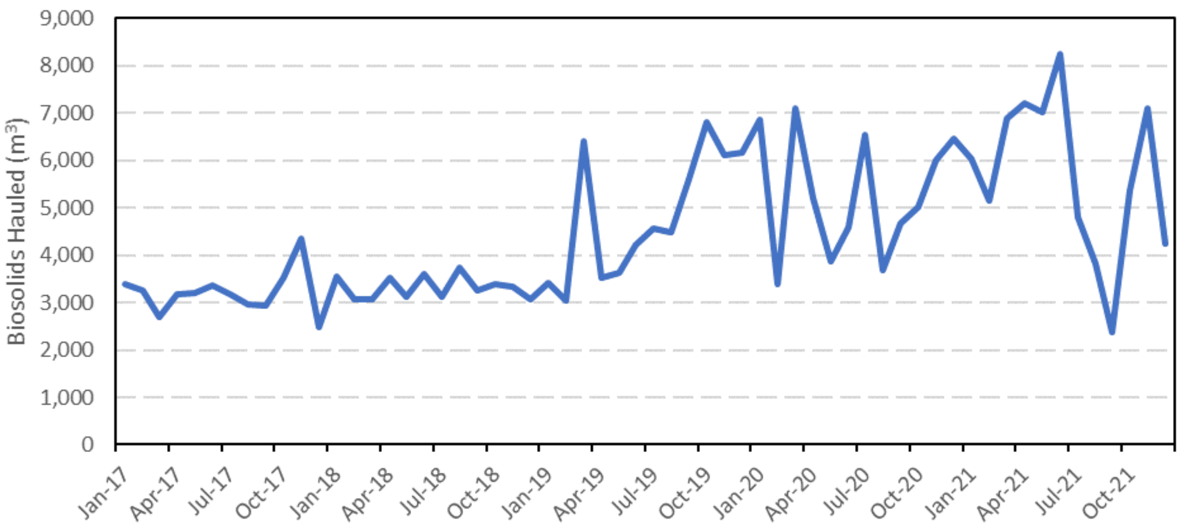


Figure 4-2: Baker Road WWTP Hauled Sludge Volume

4.2.1 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.

4.2.2 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 mega liters per day (MLD) to 48 MLD is underway.

4.3 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 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. 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.

4.3.1 Wastewater Flow

Table 4-4 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 4-4: 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

4.3.2 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 VS destruction of 41%. The quantity of biosolids hauled, in terms of volume and mass, respectively is provided in Figure 4-3.

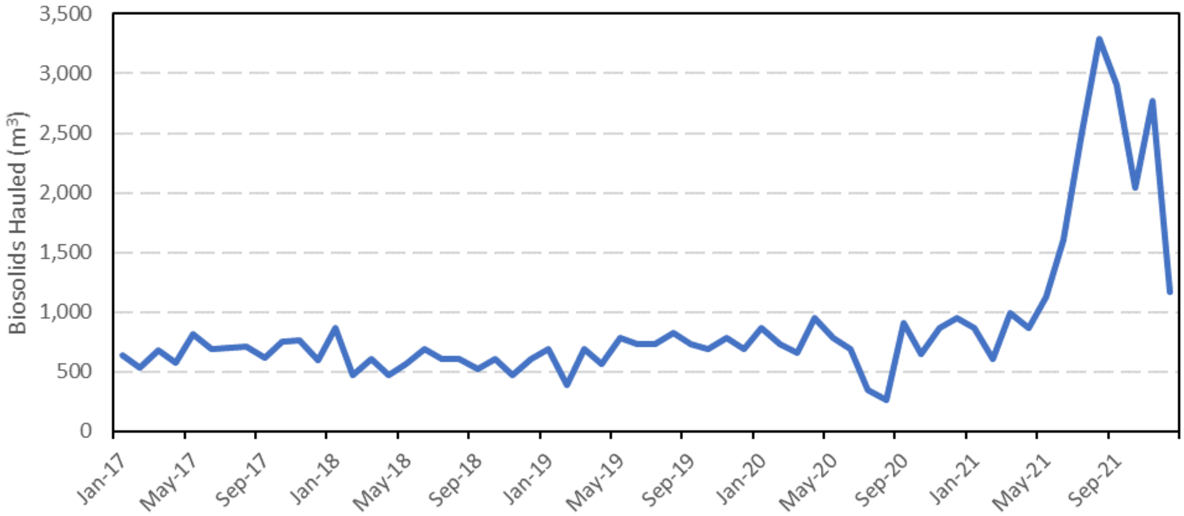


Figure 4-3: Crystal Beach WWTP Biosolids Volumes Hauled

*Note Digester refurbishment in 2021.

4.3.3 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.

4.3.4 Status of Planned Projects

The plant recently underwent 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 was also recently completed to increase the plant capacity.

4.4 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 (2)-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 (1) of two (2) 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.

4.4.1 Wastewater Flow

Table 4-5 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 4-5: 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

4.4.2 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.

4.4.3 Existing Opportunities/Constraints

The anaerobic digestion process train is limited hydraulically and for VS loading for the 2051 horizon both with and without the South Niagara Falls 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 24 hour or flexible operation of the sludge dewatering process.

4.4.4 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.

4.5 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.

4.5.1 Wastewater Flow

Table 4-6 summarizes historic flows to the 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 4-6: 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

4.5.2 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, is provided in Figure 4-4.

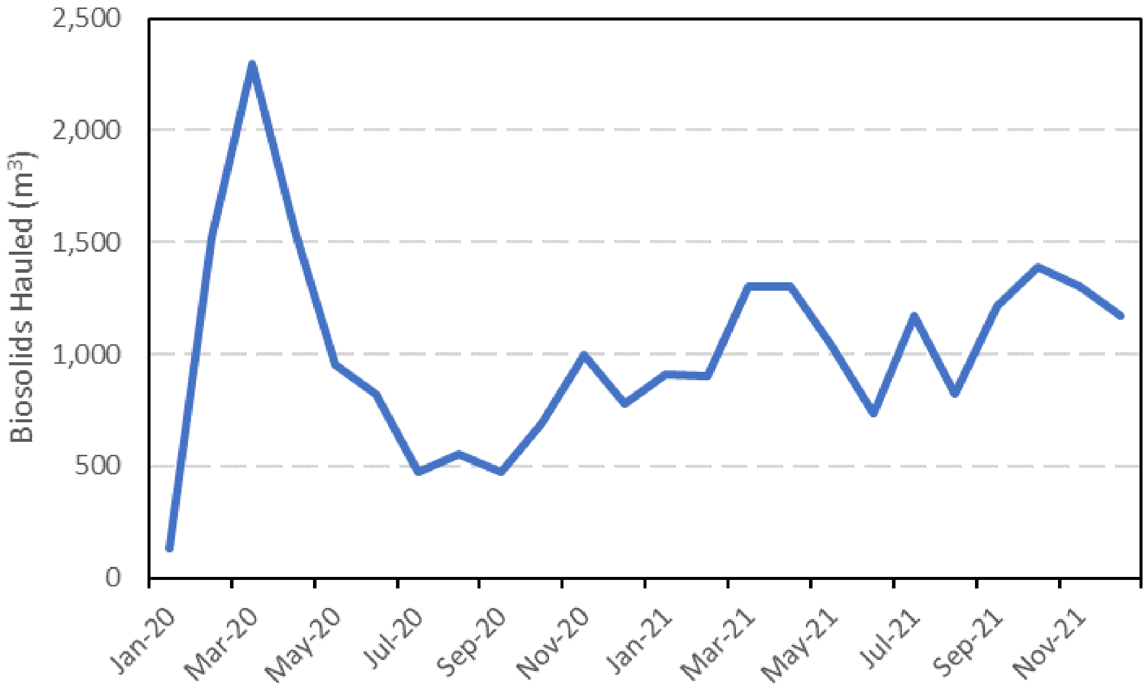


Figure 4-4: Niagara on the Lake WWTP Biosolids Volume Hauled.

*Note plant was commissioned in late 2019

4.5.3 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 in relation to limited operational flexibility due to a lack of dedicated digested sludge storage. An additional digester should be planned to add redundancy and to facilitate maintenance of the existing digester.

4.5.4 Status of Planned Projects

No solids upgrade projects are currently planned.

4.6 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 (2) 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.

4.6.1 Wastewater Flow

Table 4-7 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 4-7: 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

4.6.2 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, is provided in Figure 4-5.

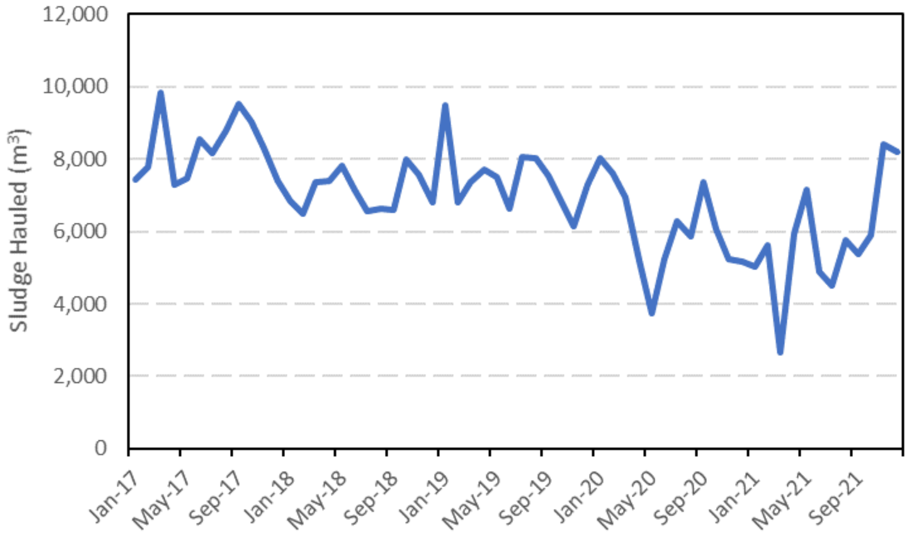


Figure 4-5: Port Dalhousie WWTP Biosolids volume hauled

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

4.6.4 Status of Planned Projects

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

4.7 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.

4.7.1 Wastewater Flow

Table 4-8 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 NOTL WWTP during the 2021 season.

Table 4-8: 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

4.7.2 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, is provided in Figure 4-6 .

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.

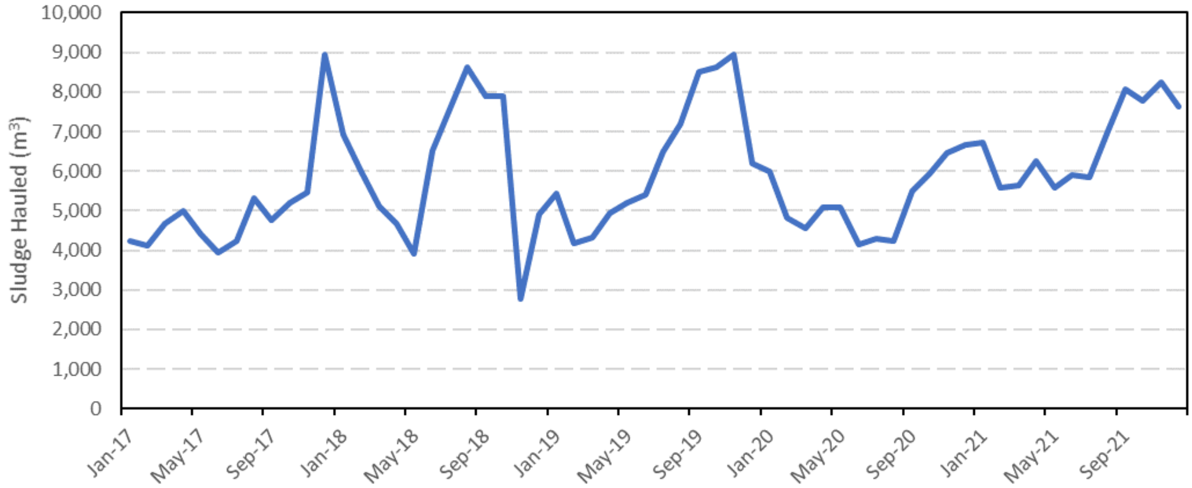


Figure 4-6: Port Weller WWTP Biosolids Volume Hauled

4.7.3 Existing Opportunities/Constraints

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

4.7.4 Status of Planned Projects

Upgrades are planned for new digester tankage. The Region is also considering WAS thickening at this WWTP to improve digester operation.

4.8 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 Region has recently finalized the Queenston - St. Davids Wastewater Servicing Strategy Class EA (June 2023) which entailed developing a preferred solution to meet current and future servicing requirements (to 2051) in the Queenston WWTP service area. The study concluded that upgrading the existing Queenston WWTP was identified as the preferred solution. This preferred solution will include:

- Rehabilitation of the existing facility to maintain the plant's average rated flow capacity (500 m^3/day) while continuing to meet effluent quality requirements
- Upgrades to meet Niagara's State-of-Good Repair requirements including upgrades to the treatment, electrical, control and site security systems, and repair of the existing access road

4.8.1 Wastewater Flows

Table 4-9 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 4-9: 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

4.8.2 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 VS destruction of 31%. The quantity of biosolids hauled, in terms of volume and mass, respectively, is provided in Figure 4-7. Biosolids from Queenston WWTP are typically hauled to MH13 in the Port Weller WWTP catchment.

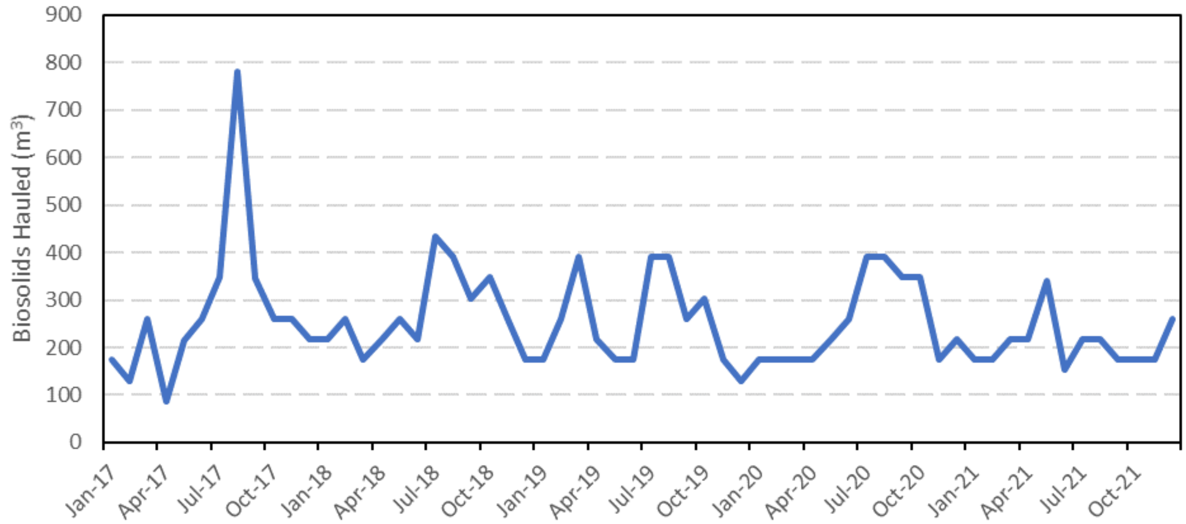


Figure 4-7: Queenston WWTP Biosolids Volume Hauled 5

4.8.3 Existing Opportunities/Constraints

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

4.8.4 Status of Planned Projects

No sludge upgrade projects are currently planned. The Region is proceeding with the conceptual design for the Queenston WWTP as identified in the Schedule B Class EA (June 2023).

4.9 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 (1) 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.

4.9.1 Wastewater Flow

Table 4-10 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 4-10: 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

4.9.2 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, is provided in Figure 4-8.

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.

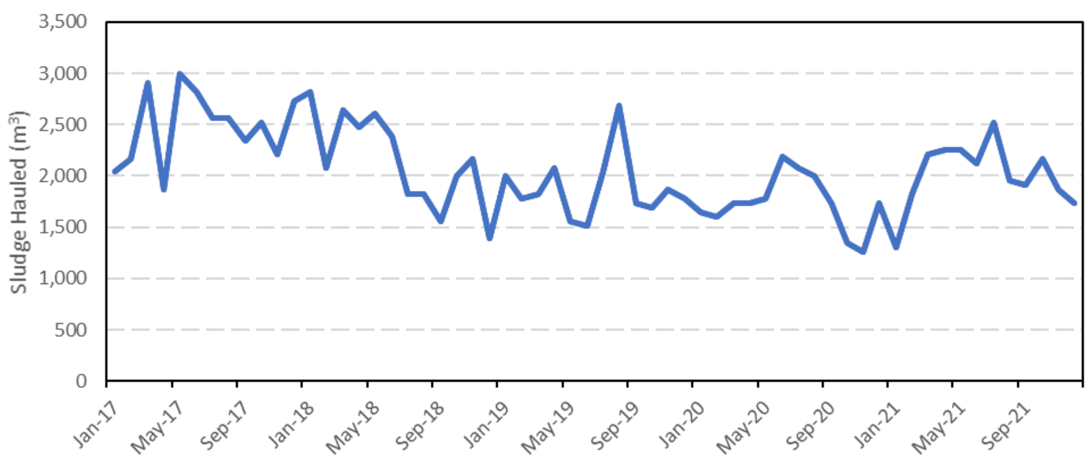


Figure 4-8: Seaway WWTP Biosolids Volumes Hauled

4.9.3 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.

4.9.4 Status of Planned Projects

Installation of a new roof for the south digester was completed in 2023, with north digester clean-out/repairs to follow once south digester is back online.

4.10 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.

4.10.1 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.

4.10.2 Status of Planned Projects

Region is considering pumping settled sludge via a forcemain to the propose South Niagara Falls WWTP once the new plant is commissioned.

4.11 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.

4.11.1 Wastewater Flow

Table 4-11 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 m3/d, approximately 64% of the rated capacity of 54,550 m3/d. It is noted that the Welland WWTP can receive up to 23 m3/d of wine waste with a pH of approximately 4.

Table 4-11: 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

4.11.2 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, is provided in Figure 4-9 .

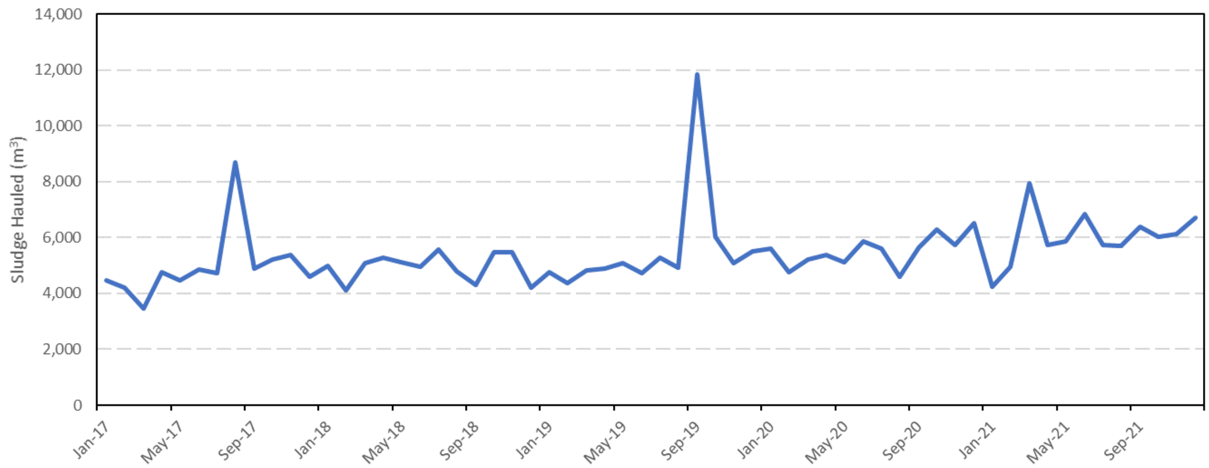


Figure 4-9: Welland WWTP Biosolids Volume Hauled

4.11.3 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.

4.11.4 Status of Planned Projects

No solids upgrade projects are currently planned.

4.1 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.

As this is a new, planned facility, there are no existing constraints. The Region is currently in the process of selecting a consultant to design the new WWTP, with design expected to begin in early 2024. This plant is targeted to be in service in 2027.

4.2 WWTP Summary of Existing Conditions and Future Needs

The following table presents a summary of the WWTP historical biosolid data and future biosolids production to 2051 based on project population growth. The Stevensville-Douglastown Lagoon system is not included in this list, as biosolids produced remain onsite as settled solids in the lagoons.

Table 4-12: Existing Biosolids Management at Niagara Region WWTPs and Future Needs

Plant	Facility Type	Thickening	Historical Average Solids Hauled (ML/year)	Average Total Solids %	Projected Average Solids Hauled to 2051 (ML/Year)
Anger Avenue WWTP	Extended Aeration	GBT WAS Thickening	16,719	2.86%	20.6
Baker Road WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	53,586	2.35%	106
Crystal Beach WWTP	Extended Aeration	GBT WAS Thickening	8,045	2.74%	7.80
Niagara Falls WWTP[1]	Rotating Biological Contactor	PS + WAS Co-thickening (CEPT)	-	-	3,297 t/yr (S. Niagara Falls offline) 2,460 t/yr (S. Niagara Falls online)
Niagara-on-the-Lake WWTP	Extended Aeration	GBT WAS Thickening	12,255	2.23%	2,460 t/yr (dewatered biosolids)
Port Dalhousie WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	83,275	1.77%	20.3
Port Weller WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	70,305	2.41%	118
Queenston WWTP	Modified Extended Aeration	Gravity settling tank using ferric chloride	3,028	N/A[2]	87.0
Seaway WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	24,590	1.74%	76.4
Welland WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	64,976	2.73%	1.87 (undigested sludge)
South Niagara Falls WWTP	Conventional Activated Sludge	PS + WAS Co-thickening	--	--	130

1 – Biosolids from Niagara Falls WWTP are dewatered and sent directly to Walker Environmental N-Viro Facility

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

5 Water Treatment Plant Operation, Residuals Generation and Future Needs

The following section provides details of each WTP's current operation and residuals generation rate and future needs based on projected population growth to 2051.

The Region has six (6) WTPs. Their treatment capacities and process descriptions are summarized in Table 5-1.

Table 5-1: 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.

The water treatment residuals 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.

5.1 Residuals Quantity

Based on the Annual Summary Reports (2019-2021) for each WTP, the average residuals quantities are presented in Table 5-2 along with projected quantities to 2051. 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 5-2. Summary of Historical (2019-2021) and Projected Residuals Quantities

WTP	Average Residual, ML/Yr (2019-2021)	Average Residual Solids Conc., %TS (2019-2021)	Calculated Residual Solids, dry kg/Yr (2019-2021)	2051 Estimated Residuals Generation (Dry kg/Year)
Decew	35.4	1.9	685,790	896,148
Grimsby	17.5	1.1	185,500	311,491
Niagara Falls	29.9	1.4	409,858	544,982
Port Colborne	23.4	[1] 0.2	53,820	62,853
Rosehill	*176.1*	*[1] 0.4*	*686,803 (adjust to 123,897)*[2]	169,725
Welland	*350.7*	*[1] 0.4*	*1,262,424 (adjust to 262,155)*[2]	375,585
Total	**632.9**	**-**	**3,284,195 (adjust to 1,721,020)**[2]	**2,360,784**

[1] *Data from 2010 BMMP.*

[2] *Justification for adjustment is described in paragraph below*

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 (4) 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.

5.2 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, which are further discussed in TM 8 in Appendix A. These data are not recorded for the three (3) WTPs that discharge their residuals to sewer for treatment through WWTPs.

Table 5-3 demonstrates 5-year average data for metal concentrations within WTP residuals from 2017 to 2020 on an annual basis and NASM's requirements.

Table 5-3: 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).

5.3 Summary of Residual Treatment Needs

Recommendations for capacity upgrades related to residuals for the six (6) WTPs are summarized in following Table 5-4**.** Further details on capacity assessment at each WTP is provided in TM 4 in Appendix A.

Table 5-4: Summary of Residual Recommendations for Individual Plants

WTP	Process	Recommendations
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

6 Garner Road Biosolids Facility, Existing Conditions, Future Needs and Constraints

6.1 Existing Conditions

Niagara Region manages ten (10) WWTPs, eight (8) of which send their biosolids to the Garner Road Biosolids facility; one (1) plant (Niagara Falls WWTP) has on-site dewatering and one (1) plant (Queenston WWTP) hauls their WAS to the Port Weller WWTP for anaerobic digestion. The Garner Road Biosolids Facility receives the liquid biosolids from the other eight (8) WWTPs along with the residuals from Decew, Niagara Falls and Grimsby WTPs.

The biosolids and residuals received at the Garner Road Biosolids Facility are either stored and trucked to be utilized directly on agricultural lands or dewatered and transported to the N-Viro facility (owned by Walker Environmental), a biosolids processing facility located in Thorold. Liquid biosolids received at the Garner Road Biosolids Facility are unloaded from tanker trucks into lagoons where gravity settling occurs. A portion of the liquid biosolids from the lagoons is transferred to steel storage tanks prior to centrifuge-based dewatering, and the remaining settled biosolids are hauled away for direct land application. Supernatant from the lagoons and centrate from the centrifuge dewatering system are pumped to the sanitary sewer for treatment at the Niagara Falls WWTP.

Each of the lagoons at Garner Road have a storage capacity of 6,830 m^3, and the three (3) glass-steel fused storage tanks each have capacity of 7,736 m^3. However, not all the lagoons are dedicated to biosolids storage, as one (1) of the lagoons is used for storage of centrate. In total, the facility has approximately 85,200 m^3 of liquid biosolids storage capacity.

Currently the facility is land applying approximately 50% of the biosolids that enter the facility as a liquid, while the remainder is stored at the facility or sent to the centrifuges for dewatering and further processing at the N-Viro facility. Over the past two (2) years, the facility has been exceeding capacity for storage at the lagoon due to pumping limitations.

The Garner Road facility has two (2) centrifuges for dewatering biosolids. A portion of the lagoon biosolids are sent to the centrifuges for dewatering. The centrifuges produce a cake that has historically been approximately 32.1% solids, along with centrate. The centrate is either stored on site at Garner Road, or sent to the sanitary sewer system, via forcemain, and then processed at the downstream Niagara Falls WWTP. The cake from the centrifuges is sent to Walker Environmental for further processing.

6.2 Future Needs

Table 6-1 provides both the current quantity of biosolids and residuals produced in the Region as well as future expected values within the 2051 planning horizon. From these values, the future storage requirements can then be determined, and the possible storage limitations at Garner Road can be assessed.

Table 6-1. Annual Solids to be Managed at Garner Road Facility, Current and by 2051

Parameter	Value
Biosolids	
Current Total Annual Biosolids [1]	334 ML / 7,601 DT (excluding biosolids from Niagara Falls WWTP)[2] 454 ML / 522 DT (including biosolids from Niagara Falls WWTP)[3]
2051 Total Annual Biosolids: Including biosolids from future South Niagara Falls WWTP and all WWTPs	586 ML / 14,041 DT (excluding biosolids from Niagara Falls WWTP)[4] 706 ML / 16,962 DT (including biosolids from Niagara Falls WWTP)
Residuals	
Current Total Annual Residuals [4]	82.8 ML / 1,242 DT
2051 Total Annual Residuals [4]	116.8 ML / 1,752 DT

Notes:

1. Garner Road does not normally receive biosolids from Niagara Falls WWTP, except on occasions when dewatering equipment at Niagara Falls WWTP is unavailable.
2. Dry tonnes are calculated based on 2.28% total solids concentration (average for all WWTPs sending biosolids to Garner Road).
3. Digester failure occurred during the period of evaluation. Flows and loads are not expected to significantly increase with the New South Niagara Falls WWTP online, thus mass balances were used to estimate current production. The estimates are comparable with available data prior to digester failures.
4. Dry tonnes are calculated based on anticipated 2.4% total solids concentration.
5. Considers residuals generated at Decew Falls, Grimsby and Niagara Falls WTPs. Calculated based on anticipated 1.5% total solids concentration.

A solids mass balance for flows into and out of the Garner Road Biosolids Facility under both current and future conditions was completed which further details can be found in TM 4 in Appendix A.

6.3 Constraints

6.3.1 Storage Capacity

With a population that is anticipated to increase by 55% from 2021 to 2051, the Garner Road facility will face a storage challenge in the coming years. There are development pressures in the surrounding area which are anticipated to increase due to the opening of the new South Niagara Hospital and other planned residential and commercial developments nearby. Storage at the facility is greatly affected by its current use of liquid land application as the solids must be stored and the outlet inherently carries seasonal risk due to environmental conditions.

Land application historically has taken place from May to November, with some variability of volume that can be land applied month to month. The volumes that can be land applied are affected by either dry or wet weather in the Region, effecting storage requirements. The Garner Road facility must have the capacity to store biosolids throughout the winter and must also have adequate capacity for wet weather years.

The ability to adequately dewater biosolids is a factor when calculating future storage requirements. Historically, the facility's centrifuges have been used to process approximately 50% of the biosolids entering Garner Road, despite one of the facility's centrifuges consistently being out of service. When calculating available storage, it is assumed that the solids content entering the centrifuges is 3.1% (2017-2022 average) during winter months, and 4% (adequate land applying solids content) during land application months. This assumption is based on historical solids concentrations; decanting has been historically increased during land application months.

The Garner Road facility utilizes predominantly lagoon storage for biosolids, and according to the Ontario Design Guidelines for lagoons, a lagoon cannot be pumped dry, and must maintain a minimum freeboard of 0.9 m above liquid level. The Operations and Management Plan for Garner Road states the minimum depth of each lagoon is 1.5 m, equating to approximately 60% of lagoon volume. The residual that must be kept in each lagoon, and the minimum required freeboard, limits storage availability for liquid storage at the facility. The Region is currently reviewing actual lagoon capacity, as they suspect there may be unaccounted volume available after lagoon upgrades completed in recent years. For the purposes of the Master Plan study, the lagoon volumes stated in the ECA are assumed to be correct, as this is a more conservative approach. Regardless, the available storage at Garner Road is insufficient for future needs to 2051. The storage tanks on-site do not have this requirement and can be pumped to a lower ratio.

6.3.2 Dewatering Capacity

Currently the biosolids flow into the centrifuges is approximately 550 m^3/d, which can fill approximately two (2) trucks per day. The centrifuges are capable of processing larger daily quantities if allowed to run longer hours but are restricted due to contractors' limitations on truck availability.

The centrifuges are currently producing a cake with a solids content of 32.1%, while typical solids content range for cake is 22 to 35%. The facility provides the centrifuges an above average amount of polymer about 25 Kilogram per Dry Tonne (kg/Dt) (average is between 7.5 kg/Dt to 15 kg/Dt), which is likely contributing to the high solids content of the cake.

Two (2) issues that have hindered the Garner Road facility are the reliability of the centrifuges and staffing limitations as the facility is only able to operate eight (8) hours per day. Garner Road has two (2) centrifuges and often one (1) is shutdown for maintenance or repair. Furthermore, it is challenging to remove the centrifuges for maintenance based on the current building design, and requires a temporary platform be installed. This increases shut-down time if repairs are required on the centrifuges.

7 Problem and Opportunity Statement

The purpose of this project is to develop a BMMP Update to provide direction for biosolids management activities in the Niagara Region to the year 2051. This BMMP will consider the decisions made during the 2011 BMMP and any changes in Niagara's treatment system and biosolids management approach since its completion. It will also consider regulatory, population growth and environmental changes since completion of the 2011 BMMP.

The draft problem/opportunity statement for the 2021 BMMP Update is to:

Identify and develop a strategy for meeting Niagara's biosolids treatment needs to the year 2051, in a manner that is transparent, sustainable, reliable, environmentally friendly, cost effective and flexible.

The BMMP will be developed to:

1. Meet the unique needs of Niagara Region and its customers, including treatment requirements, land uses and users, and environmental features.
2. Meet future needs associated with population growth, new regulations, climate resiliency, and energy efficiency.
3. Provide greater flexibility and reliability for biosolids management, both in the short term (i.e., 5 years) and long term (to the year 2051).
4. Improve biosolids marketability.
5. Address community expectations regarding level of service, odour, air/noise, water quality, protection of the environment and aesthetics.

The problem/opportunity statement has been developed through preliminary background review and discussions with the Region and through public input as part of Public Information Centre (PIC) 1.

8 Development of Long List of Technologies and End Use Markets and Screening

Biosolids are an end-product of the wastewater treatment process. In the case of Niagara, residuals, a by-product of the water treatment process, are mixed with the biosolids.

Biosolids management strategies can be categorized as beneficial land use, thermal conversion, landfilling, co-management with source separated organics (SSO) and energy recovery. The selection of management option depends on:

- The type of treatment process applied and the products that result from the treatment process, and
- The different markets where a product can be used.

Niagara's current management strategy is beneficial land use (primarily on agricultural lands within the Region), utilizing two (2) technologies and related products, as shown in the figure below.

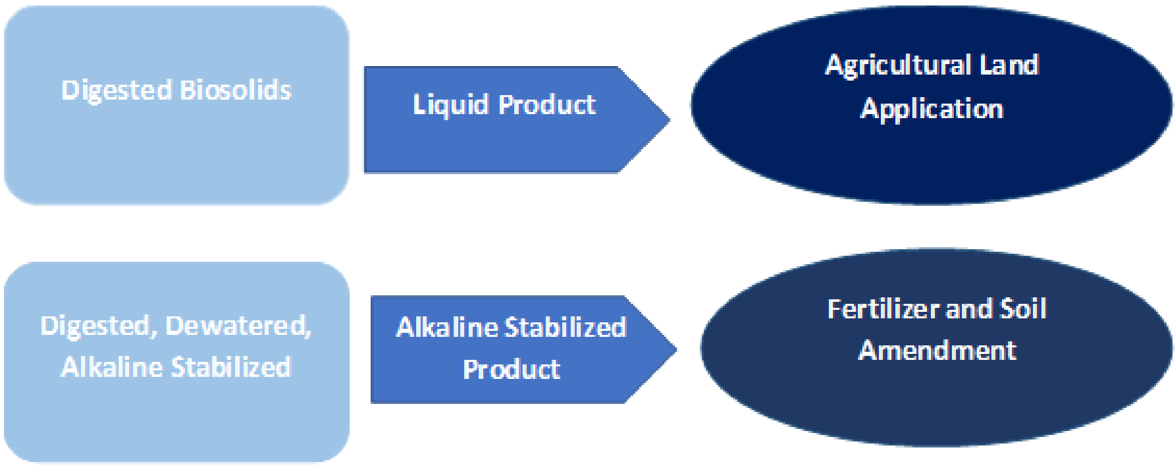


Figure 8-1: Beneficial Land Use Technologies and Related Products

As discussed previously, the Region has two (2) third-party service providers to help manage their biosolids:

- **Thomas Nutrient Solutions:** responsible for managing Niagara's land application program of digested liquid biosolids until December 31, 2024.
- **Walker Environmental:** responsible for further treatment of biosolids through their alkaline stabilization process, and marketing and selling the end product through licensed distributors who sell the material as fertilizer.

Other management strategies may be applicable to Niagara. To develop these alternative strategies the potential markets for biosolids and the technologies /products that are applicable in Niagara must be first identified.

Market Assessment: End use markets for biosolids products produced in Niagara Region are identified through a market assessment. The market assessment considers the different biosolids products and their characteristics, identifies target markets/outlets available and provides an overview of estimated demand and market potential. The Market Assessment identified end use options available to Niagara Region for their biosolids products. The results of the end use market assessment are detailed in TM 9 in Appendix A.

Technologies and Products: A screening of applicable biosolids treatment technologies (and their associated products) was undertaken. The screening criteria are illustrated in Table 8-1 below.

Table 8-1: Screening Criteria for Treatment Technologies and their Associated Products

Screening Criteria	Description
Maturity of Technology	The technology must have been in use for long enough that most of its initial operational issues and inherent problems have been removed or reduced by further development. It must be robust, reliable and have a successful track record.
Compatibility with existing and future site development and biosolids end use markets.	The technology must be compatible with existing infrastructure investments and be constructible given existing site conditions at the Garner Road Facility. It must also compliment the end use alternatives and markets that have been identified for the Region of Niagara.
Proven application at similar scale facilities	The technology must be able to manage biosolids at the quantities that are and will be trucked to the Garner Road Facility; furthermore, the technology must have a successful operating history at facilities of similar capacity.
Implementable	The technology must be able to address implementation challenges at the Garner Road Facility or other centralized facilities. The challenges include space constraints, impacts of side stream waste generated, regulatory changes, public concerns including traffic, air quality and odour impacts.

Based on the results of the screening exercise, alternative biosolids management strategies are developed by combining treatment technology, products, and end uses.

8.1 Long List of End Use Markets

This section details the long list of potential end use markets and assesses their viability for receiving Region biosolids.

8.1.1 Agriculture, Silviculture and Horticulture

Market Availability

Agriculture, silviculture and horticulture refers to the reuse of biosolids that get applied and utilized within the agriculture, silviculture and horticulture lands.

Summarized within the Region's 2016 Census of Agriculture, fruit orchards are the Region's largest agricultural sector, accounting for two-thirds of Ontario's tender fruit orchards (Region of Niagara, 2017). Fruit and tree nut farms represent 30 % of the Region's farms. Oilseed and grain farms represent 18 % of the Region's farms. Greenhouse, nursery and floriculture producing flowers, maple syrup, honey and vegetables represent another 14 % of the Region's farms. The amount of land in agriculture decreased by 9 % between the 2011 and 2016 census. 39 % of agricultural land was leased, rented or crop-shared in the Region in 2016. Of that agricultural land, 152,564 acres (61,740 hectares) is dedicated to cropland and 6,245 acres (2,527 hectares) to pasture for both natural land and managed grassland.

Demand Assessment

The demand for biosolids products will depend on the land use being supported and the biosolids product(s) being applied. In agriculture, application rate-based nutrient requirements typically could range between 2 and 4 DT/ha-yr. Anticipating an application rate of 2 DT/ha-yr, the 61,740 hectares of cropland in the Niagara Region could require over 120,000 Dry Tonne (DT) of biosolids annually. Cropland in the Golden Horseshoe, 296,000 hectares, anticipating the same application rate, could require approximately 600,000 DT of biosolids to meet the nutrient demand. A summary of the 2019 Garner Road operating data indicates the Region land applies approximately 7,000 DT of biosolids, 3,800 DT of liquid biosolids and 3,200 DT of dewatered cake. It was noted that this represents 54 % of the total biosolids generated, just under 13,000 Dry Tonne per Year (DT/ year). This current generation rate, 13,000 DT/year represents 9 % of the nutrients required in the Region of Niagara and 2 % of the cropland nutrient requirements in the Golden Horseshoe.

Anaerobically digested biosolids, conventional or advanced, as a liquid, a cake or thermally dried, will provide the highest concentration of nitrogen per dry ton. Alkaline stabilized biosolids products will provide a lower concentration per dry ton of product due to the amount of alkaline material added to the biosolids in the process. This will result in a slightly higher required application rate. The alkaline material in the product will provide a lime substitute which is attractive in several agriculture practices. An alkaline stabilized product using the N-Viro process was one on of the highest sources of agricultural lime in Central New York State. The lime used in the process was an added benefit to farmers who wanted to raise the pH of their soil. It is difficult to estimate the lime demand in the Region, however there are several firms producing agricultural lime that is applied on agricultural lands in Niagara Region.

Compost product and thermally dried biosolids can be marketed as a CFIA fertilizer product. This broadens the available markets beyond the agricultural market. As mentioned above, thermally dried biosolids product can be used efficiently in agriculture applications. However, while compost products can also be used in agriculture, the volume required is greater due the amendment used in the process. Therefore, compost products are not often used in the production of row crops. Thermally dried biosolids have a much higher total solids concentration, greater than 90 %compared to 20 to 30 %for a dewatered cake. As a result, less volume of dried product is required. This is a benefit to the agriculture community by reducing the truck traffic needed to transport biosolids to and onto the farm fields there by reducing impacts such as noise, air emission and soil compaction.

The City of Kelowna, British Columbia uses an Aerated Static Pile process (ASP) to create a compost product using dewatered biosolids from two WWTPs along with processed yard waste and ground waste dimensional lumber. They are a member of the Canadian Composting Council. The city mentioned that the process optimization recommendations provided by the Council has benefited their overall program

One of the outlets for their compost product are the vineyards in their area. They have seen competition in the vineyard market from other compost products that do not contain biosolids. Some vineyards have chosen to use other compost products that have been certified organic.

Estimates indicate that the potential agricultural demand for biosolid products in the Niagara Region is higher than the amount that could be produced in the 2051 plan year. To support this demand the Region will require proper stabilization, transportation, storage and marketing as well as third-party firms to support.

8.1.2 Parks and Recreation Departments

Market Availability

Similar to agriculture end use, there is also a need for biosolids products to provide fertilization and soil amendments to outdoor recreational fields and parks in the Region. Since these areas serve the public the biosolids products used will require additional stabilization to meet the fertilizer standards discussed previously.

Parks within the Region cover approximately 2,100 hectares of land (City of Niagara Falls, 2021; City of Port Colborne, 2019; City of St. Catharines, 2015; City of Thorold, 2020; City of Welland, 2019; Town of Fort Erie, 2018; Town of Lincoln, 2019; Township of West Lincoln, 2010).

Demand Assessment

The 2,100 hectares of parks and recreational fields in the Region represent a significant demand. The grounds could be top dressed using compost product or thermally dried product.

The City of Kelowna, British Colombia sells their compost product to soil blenders who could provide the product to these municipal departments directly or to the landscaping firms who are contracted to maintain the grounds.

In 2022 The City of Kelowna is selling their compost product wholesale in a minimum volume of 3.8 m^3 (5 cubic yard (yd^3)) for approximately \$25/ m^3 (\$33/ yd^3). They sell their compost in 20 Liter bags for \$4/bag.

8.1.3 Ministry of Transportation

Market Availability

The Ontario Provincial Standards for Roads and Public Works (OPS) organization produces a comprehensive set of standards for use by road and public works departments, contractors, and consultants in Ontario. The Ministry of Transportation Ontario (MTO) manages the publishing and electronic distribution of the OPS standards. The use of OPS standards by MTO and other infrastructure owners is not mandatory, however they do serve as a guideline and are often considered by municipalities when developing their design standards and specifications. The use of compost or biosolids in blended soils is not restricted by these standards. OPS construction specification for topsoil (OPSS.MUNI 802) requires only that topsoil shall not contain material greater than 25 millimeter (mm) in size, such as stones and clods, shall not have contaminants that adversely affect plant growth and will have organic content between 7-11 % by weight and a pH between 6 to 8 (Ministry of Transportation Ontario, 2019).

Demand Assessment

The Region had 6.9 million vehicle-km daily in 2011. Over the 30-year period captured in the Region's population and employment growth, travel by motorized vehicles is expected to grow by 55 %, reaching 10.7 million vehicles-kilometer (km) daily in 2041 (Region of Niagara, 2017). Manufactured topsoil products using compost product or thermally dried biosolids product could be used in the revegetation of right of way areas following road construction or maintenance projects. Given the variability of network growth and maintenance and the currently relatively low demand of biosolids as feedstock for compost or blended soils, this is considered a limited market.

8.1.4 Landscape Contractors

Market Availability

Soil amendments and composts are often sold, used, or distributed by landscapers. As mentioned previously, Class A or AA compost and thermally dried biosolids product that meet fertilizer requirements of the CFIA can be used in the production of a manufactured topsoil. This topsoil product can be used in a variety of landscaping projects including new construction, landscape maintenance and sod production.

Demand Assessment

Landscape contractors represent a good market to showcase the benefits of Class A and AA compost and thermally dried biosolids. While the volume of material they will consume may be less than other markets, they can help to educate the public on the benefits of biosolids use, which will benefit all markets.

8.1.5 Golf Courses

Markey Availability

Both thermally dried biosolids and compost are used at golf courses, with dried product used as an organic fertilizer and Class AA and A compost is used as a top dressing that supplies nutrients to the turfgrass.

The 37 golf courses in Niagara Region, are presented in Table 8-2 below. The courses are public, semi-private or private. They are comprised of nine (9) holes, 11 holes, 18 holes, 27 holes or 45 holes. On average, 27-hole courses have 135 acres of greenway, 18-hole courses have 90 acres of greenway, and 9-hole courses typically have 45 acres of greenway. Altogether, the courses identified within Niagara Region, representing 1,400 hectares of greenway (3,430 acres).

Demand Assessment

Using an application rate of 2 DT/ha-yr, the 1,400 hectares of golf courses in the Region could represent a maximum annual demand of 2,800 DT of biosolids product. This represents almost all the biosolids produced at Garner Road Facility. Thermally dried biosolids products are very popular at golf courses. Golf courses in the Niagara Region have not been contacted at this time to discuss the potential use of dried biosolids. There are courses in Western New York State that use a thermally dried biosolid products. They use the material on their greens and tees. The product is produced in Wisconsin and available only in bags in New York.

Table 8-2: Golf Courses in Niagara Region

Golf Course	Size	Area (acres)
Beechwood Golf & Social House	18-Hole	90
Bridgewater Country Club	18-Hole	90
Brock Gold Course	18-Hole	90
Cardinal Lakes Golf Club	36-Hole	180
Caistorville Gold Club	18-Hole	90
Cherry Hill Club	18-Hole	90
Eagle Valley GC & Golf Academy	18-Hole	90
Fort Erie Golf Club	18-Hole	90
Fox Run Golf Course	9-Hole	45
Freedom Oaks Golf Club	18-Hole	90
Garden City Golf Course	18-Hole	90
Grand Niagara Golf Club	18-Hole	90
Grassy Brook Golf Course	9-Hole	45
Heritage Woods Golf Course	11-Hole	55
Legends on the Niagara	45-Hole	225
Long Beach Country Club	9-Hole	45
Lookout Point Country Club	18-Hole	90
Niagara Falls Golf Club	18-Hole	90
Niagara National Golf Club	27-Hole	135

Golf Course	Size	Area (acres)
Niagara-on-the-Lake Golf Club	9-Hole	45
Oak Hall Par 3 Golf Course	9-Hole	45
Pelham Hills Golf Club	18-Hole	90
Peninsula Lakes Golf Club	27-Hole	135
Port Colborne Country Club	18-Hole	90
Queenston GC / St. Davids GC	9-Hole	45
Riverview Golf and Country Club	18-Hole	90
Rockway Vineyards Golf Course	18-Hole	90
Rolling Meadows G&CC	18-Hole	90
Royal Niagara Golf Club	27-Hole	135
Sawmill Golf Course	18-Hole	90
St. Catharines Golf & Country Club	18-Hole	90
Thundering Waters Golf Club	18-Hole	90
Twenty Valley Golf & Country Club	18-Hole	90
Water Park Golf & Country Club	18-Hole	90
Whirlpool Golf Course	18-Hole	90
Whiskey Run Golf Club	27-Hole	135
Willodell Golf Club of Niagara	18-Hole	90

8.1.6 Land Rehabilitation

Market Availability

Biosolids products can be applied to rehabilitate or reclaim land. Biosolids products have been used in the reclamation of mine tailing sites, re-vegetation of remediated environmentally contaminated sites, and in the establishment of vegetation around construction sites. From 2014 to 2018, a project at Vale Canada's Copper Cliff operation in Sudbury, Ontario, reclaimed approximately 150 hectares of Vale's tailings with 25,000 DT of biosolids (Terrapure). Under an ECA permit, biosolids were used to provide organic matter and nutrients to vegetation and to stabilize the pH of the tailings.

Demand Assessment

Although there are several mines and contaminated sites in Ontario, their number within and adjacent to the Region indicate that this a limited market. The number of active federal contaminated sites in and around the Region can be seen in Figure 8-2, with 7 active sites in the Region itself (Treasury Board of Canada Secretriat, 2020).

Figure 8-2: Federal Contaminated Sites in and around Niagara Region

8.1.7 Landfill Sites

Market Availability

Biosolids products such as compost and their feedstock biosolids could be beneficially used at landfills for routine maintenance and for establishing vegetation on the final landfill cover. As discussed previously Category B compost can be used as daily, intermediate cover at a landfill, as permitted by an ECA.

Demand Assessment

The Ontario Waste Management Association's 2018 Landfill Report estimated that Ontario's 805 most active public and private sector landfill sites had a remaining capacity of 122 million tonnes, which could be depleted by 2032 (Ontario Waste Management Association, 2018). Landfills received 8.1 million tonnes of waste in 2017, an increase of 5 % over 2016. Based on the current landfill capacity depletion rate, Ontario's available landfill capacity is expected to be exhausted in 12 years, by the year 2032. If the United States were to prohibit Ontario's waste from crossing the border, Ontario's landfill capacity could be exhausted by 2028.

Biosolids products could be used in the operation and cell closures of the following landfills located in the Niagara Region:

- Humberstone Landfill
- Niagara Road 12 Landfill
- Modern Landfill Inc. of Canada.

These facilities could be good markets for compost products and manufactured soil products Landfill sites can also be opportunities for longer term product storage, such as over winter months and as potential processing sites. There are several composting facilities constructed in open areas of active landfills.

8.1.8 Co-Management with Source Separated Organics

Market Availability

The co-management of biosolids and Source Separated Organics (SSO) is a process option more than a market. Biosolids are used with other organics and amendment types to create compost products. Biosolids and processed SSO are also co-digested to generate biogas created by volatile solids reduction in the digestion process.

As mentioned previously biosolids can be one of the feed stocks in a composting process. The carbonaceous amendment required in the process can be provided by processed yard waste or other clean wood wastes. Other compostable organic material such as food waste can also be used as a feedstock.

The various components of a compost mixture will be dependant on the material available and the desired final compost product characteristics. When biosolids are used in the mixture the resulting product is considered a biosolid product. As discussed, the Region currently contracts with Walker Environmental to compost SSO and processed yard waste that is collected from residents. It may be possible to expand this operation to include a portion of the biosolids generated in the Region. The compost product that incudes biosolids will be required to meet more stringent quality requirements. The product containing biosolids will have additional organics and may be more desirable to some users. The fact that biosolids are in the compost product may result the product being less desirable to others. This is a challenge faced by many facilities that requires continuous education and product demonstration to the public and the users.

Demand Assessment

The potential markets for compost products have been discussed in previous sections. The potential demand for co-management of biosolids and SSO material including food waste and yard waste will be dependant on the quantities available and the potential benefits realized by bringing the material together in a single operation. A single operation could generate a range of products based on the how the feedstocks where blended.

8.2 Recommended End Use Markets

The greatest potential market for biosolids products in and around the Region is the agricultural market. Biosolids products can serve to fertilize soils, increase soil organic matter, and amend soil pH, in the case of biosolids products such as alkaline stabilized and thermal-alkaline hydrolyzed products. Outlets for biosolids products in the agricultural market include land application of biosolids as a Category 3 NASM or as a biosolids product meeting CFIA fertilizer requirements.

In summary, the three potential target markets/outlets for biosolids products recommended for consideration under the 2021 Niagara BMMP Update are:

- Land application of anaerobically digested biosolids
- Soil amendment with fertilizers (biosolids products) meeting CFIA requirements.
- Composted products to be used by landscape contractors

8.3 Long List of Biosolids Technologies

There are many biosolids management practices and technologies, along with combinations of practices and technologies, available to municipalities for consideration. The Biosolids Market Assessment discussed above identified the long-term biosolids management approach of continuing beneficial use of biosolids products via land application. Below is a long list of technologies to be considered at the Garner Road Facility.

The long list of technologies is grouped based on process type as follows:

1. Biological Digestion Technologies
   a) Anaerobic Digestion

2. Thermal Hydrolysis Process (THP) Anaerobic Digestion: Currently, the existing WWTPs are equipped with anaerobic digestion and the stabilized biosolids are trucked into the Garner Road Facility for storage and beneficial use. Because the practice of anaerobic digestion at the WWTPs will continue, the most digestion technologies will not be considered as a suitable technology for use at the Garner Road facility. The only digestion technology that is considered is THP, which can be implemented downstream of conventional anaerobic digestion.

3. Thermal Drying Technologies
   a) Direct Contact (Convection)
      i. Rotary Drum
      ii. Belt Dryer
      iii. Fluidized Bed

   b) Indirect Contact (Conduction)
      i. Paddle / Disc
      ii. Solar Dryer

4. Chemical Stabilization Technologies
   a) Alkaline Stabilization
      i. Alkaline Stabilization

   ii. Alkaline Stabilization with Supplemental Heat or Acid
   iii. Alkaline Stabilization with Heat and High-Speed Mixing

5. Composting

6. Thermal Conversion Technologies
   a) Incineration
   b) Gasification
   c) Pyrolysis
   d) Wet Oxidation
   e) Hydrothermal Liquification

8.4 Screening of Biosolids Technologies

Four (4) screening criteria were established to screen the long list of technologies, as summarized in Table 8-3.

Table 8-3: Screening Criteria

Screening Criteria	Description
Maturity of Technology	The technology must have been in use for long enough that most of its initial operational issues and inherent problems have been removed or reduced by further development. It must be robust, reliable and have a successful track record.
Compatibility with existing and future site development and biosolids end use markets.	The technology must be compatible with existing infrastructure investments and be constructible given existing site conditions at the Garner Road Facility. It must also compliment the end use alternatives and markets that have been identified for the Region of Niagara.
Proven application at similar scale facilities	The technology must be able to manage biosolids at the quantities that are and will be trucked to the Garner Road Facility; furthermore, the technology must have a successful operating history at facilities of similar capacity.
Implementable	The technology must be able to address implementation challenges at the Garner Road Facility or other centralized facilities. The challenges include space constraints, impacts of side stream waste generated, regulatory changes, public concerns including traffic, air quality and odour impacts.

The results of the technology screening are presented in Table 8-4.

Table 8-4: **Technology** Screening

Criteria	Biological Digestion Technologies	Thermal Drying Technologies				Chemical Stabilization Technologies			Composting Technologies	Thermal Conversion Technologies				
	Thermal Hydrolysis Post-treatment (THP)	Direct Thermal Dryer (Drum Dryer, Belt Dryer)	Fluidized Bed Dryer	Indirect Thermal Dryer (Paddle Dryer, Disc Dryer)	Solar Dryer	Alkaline Stabilization	Alkaline Stabilization with Supplemental Heat or Acid	Alkaline Stabilization with Supplemental Heat and High-Speed Mixing	Composting (Open Technologies Aerated Static Pile and Windrow Composting)	Incineration	Gasification	Pyrolysis	Wet Oxidation	Hydrothermal Liquification
Maturity of Technology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗
Compatibility with Existing and Future site development and biosolids end use markets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Proven Applicability at similar scale facilities	✓	✓	✗	✓	✗	✓	✓	✓	✓	✓	✗	✗	✗	✗
Implement-able	✓	✓	✗	✓	✗	✗	✓	✓	✓	✓	✗	✗	✗	✗
Consider for Evaluation	✓	✓	✗	✓	✗	✗	✓	✓	✓	✓	✗	✗	✗	✗

9 Shortlisted Biosolids Management Alternative Strategies

Five (5) technologies for biosolids treatment met all four (4) of the screening criteria and were recommended to be developed into alternatives and evaluated. The technologies recommended for evaluation include:

1. Biological Digestion Technologies (at Garner Road facility)
   - ✓ THP Post-Treatment following Anerobic Digestion
2. Thermal drying (at Garner Road facility)
   - ✓ Direct Thermal Drying
   - ✓ Indirect Thermal Drying
3. Advanced Alkaline Stabilization (by third party contractor)
   - ✓ Alkaline Stabilization with Supplemental Heat or Acid
   - ✓ Alkaline Stabilization with Supplemental Heat and High-Speed Mixing.
4. Composting (at Garner Road facility)
5. Incineration (at Garner Road facility)

Following review and discussion with the Region, seven biosolids management alternative strategies were selected for development and evaluation, based on the screened technologies, as listed below and summarized in Table 9-1:

1. Conventional mesophilic anaerobic digestion and land application of liquid biosolids
2. Conventional mesophilic anaerobic digestion, dewatering and land application of biosolids cake
3. Anaerobic digestion with Advanced THP post-treatment, dewatering and land application of fertilizer grade biosolids cake
4. Conventional mesophilic anaerobic digestion, dewatering, advanced alkaline stabilization and product distribution
5. Conventional mesophilic anerobic digestion, dewatering, aerated static pile composting and product distribution
6. Conventional mesophilic anaerobic digestion, dewatering, rotary drum direct thermal drying and product distribution
7. Conventional mesophilic anaerobic digestion, dewatering, fluidized Bed Incineration with Ash Management.

Table 9-1 Short List of Biosolids Management Alternative Strategies for Detailed Evaluation

Management Alternative	Process	Product	Final User
Beneficial Use on Land	AD	Stabilized Liquid Biosolids	Land application with liquid biosolids
	AD + Dewatering	Stabilized Biosolids Cake	Land application with biosolids cake
	Advanced Digestion + Dewatering	Fertilizer quality cake	Land application of cake / un-restricted use
	AD + Dewatering + Advanced Alkaline Stabilization	Fertilizer/ soil amendment	Un-restricted use on land
	AD + Dewatering + Composting	Compost	Un-restricted use on land
	AD + Dewatering + Drying	Dried Product	Un-restricted use on land or fuel source
Thermal process	AD + Dewatering + Incineration	Ash	Manufacturing or landfill

To limit variables and reasonably compare strategies, the following assumptions were made in the development of the strategies:

- All strategies are based on an on-site centralized biosolids management facility at Garner Road. Each strategy that utilizes dewatering assumes that centralized dewatering will be implemented at Garner Road, apart from Strategy 4 for advanced alkaline stabilization that would be completed offsite by a third-party contractor, similar to existing practices.
- Biosolids produced at each WWTP prior to being trucked will be anaerobically digested.
- Concepts are based on biosolids quantities predicted to 2051 as describe in Section 2.3. Historical biosolids qualities from 2017 to 2021 at Garner Road have been used to determine existing conditions, and future biosolids volumes are projected based on a mass balance, incorporating future demand as determined through the 2021 Water and Wastewater Servicing Master Plan Update.
- Digested liquid biosolids produced at Niagara Fall WWTP will continue to be dewatered and sent directly to N-Viro facility for all strategies to continue existing contract with Walker Environmental.

Further details on each strategy are provided in the sections below.

9.1 Strategy 1: AD + Liquid Biosolids Land Application

Strategy 1 is similar to the Region’s current biosolids strategy and involves transporting anaerobically digested liquid biosolids from each of the Region’s WWTPs, with the exception of the Niagara Falls WWTP, to the Garner Road Facility.

The liquid biosolids received at the Garner Road Facility would be stored for the winter months when the biosolids cannot be land applied. The storage required for biosolids land application programs in Ontario is a minimum of 240 days. To meet this storage requirement based on the anticipated solids generation in 2051 and 2.4 % total solids concentration, the Region will require a total liquid storage capacity of 400,000 m^3 (equivalent to 240 days of storage) at the Garner Road Facility. The current facility has nine lagoons for biosolids storage, each with a capacity of 6,800 m^3 with a total volume of 61,200 m^3. A tenth lagoon is used for centrate and supernatant storage with a capacity of 6,800 m^3. In addition, there are three biosolids storage tanks, each with a capacity of 8000 m^3 for a total tank storage capacity of 24,000 m^3. Overall, the current liquid biosolids storage at the Garner Road Facility is 85,200 m^3. This volume is insufficient for future needs, anticipating an average total solids concentration of 2.4 %, and additional liquid storage would be required.

Due to lack of space on the Garner Road site for additional lagoons, additional tank storage would be required to increase liquid storage capacity. At a total solids concentration of 2 %, the additional storage volume would be over 300,000 m^3, equivalent to over thirty-seven 8000 m^3 capacity tanks, which is impractical.

A representative from Thomas Nutrient Solutions noted that the total solids concentration drawn from the lagoons, as a result of settling and decanting, is between 3 and 6 %. The difference in storage required between 2.4 and 6 % is significant.

Storage for 240 days for 39 dry tons per day at 2.4 % total solids would be over 400,000 m^3. If the total solids concentration were 4 %, the 240-day liquid storage volume would decrease by half to 200,000 m^3. This would require 15 additional storage tanks, anticipating that the new storage tanks were equal in volume, 8,000 m^3, to those currently in use at the facility. An additional eight storage tanks, each with a volume of 14,400 m^3, could also provide that required additional storage. The tank size and number of tanks would be optimized during detailed design if this strategy is selected, although eight tanks each sized for 14,400 m^3 was used as a basis of comparison, as it is a more reasonable number of tanks, and allows the required storage volume to be divided evenly. As part of this strategy, the existing dewatering facility would be decommissioned, as all biosolids from the facility would be land applied as liquid.

It is our understanding that Thomas Nutrient Solutions is currently able to decant throughout the winter except in the case of very extreme cold conditions due to ice formation. For this strategy, it is assumed that decanting can occur throughout the year, including winter months.

The process is illustrated in Figure 9-1 below:

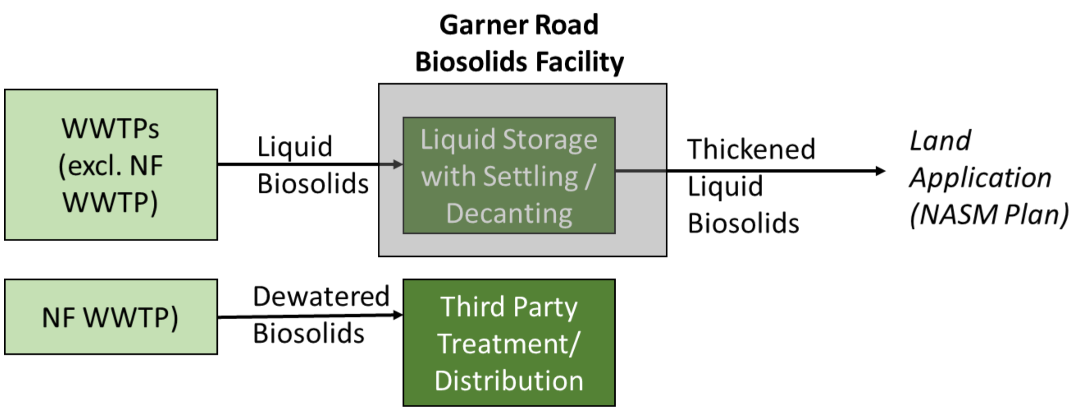


Figure 9-1: Schematic of Strategy 1

Figure 9-2 below illustrates the conceptual site plan for Garner Road under Strategy 1 showing the additional storage tanks required for thickened biosolids. The existing liquid storage lagoons would remain in place.

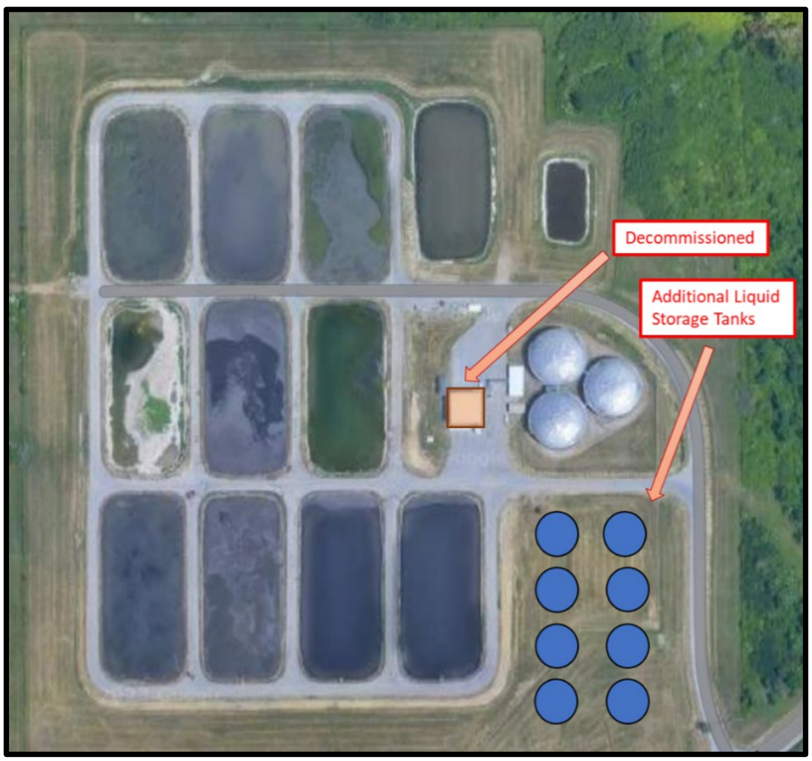


Figure 9-2: Strategy 1 – Garner Road Facility – Conceptual Site Plan

9.2 Strategy 2: AD + Dewatering + Cake Land Application

Strategy 2 involves transporting anaerobically digested liquid biosolids from each of the Region's WWTPs, with the exception of the Niagara Falls WWTP, to the Garner Road Facility.

Liquid biosolids would be dewatered and stored at the Garner Road Facility during the winter months (240 days of required storage) and land applied as cake during the growing season. Under this strategy, the existing storage tanks and lagoons would be maintained for liquid storage prior to dewatering at a new larger dewatering facility, and the existing dewatering facility would be decommissioned. A cake storage area would provide storage during winter months.

The process is illustrated in Figure 9-3 below:

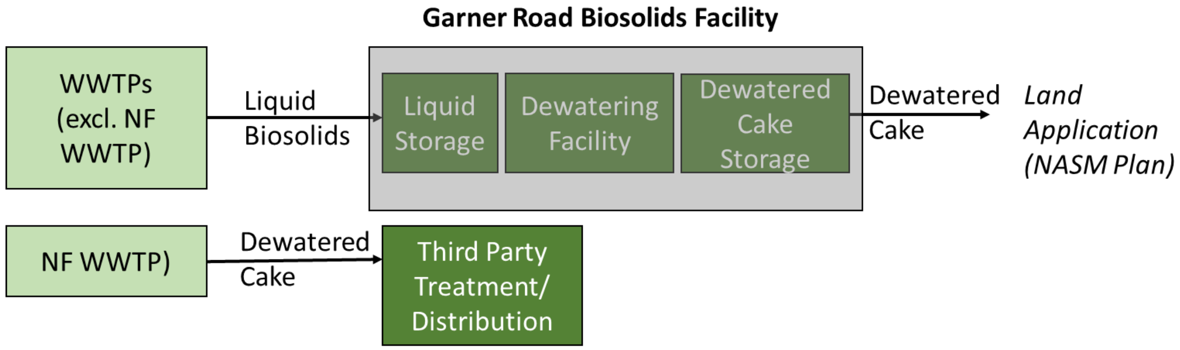


Figure 9-3: Schematic of Strategy 2

Figure 9-4 below illustrates the conceptual site plan for Garner Road under Strategy 2 showing the dewatering facility and cake storage area. The existing liquid storage lagoons would remain in place. The required storage capacity of 240 days during winter will be provided by the combination of existing lagoons, three (3) storage tanks, and the new cake storage facility.

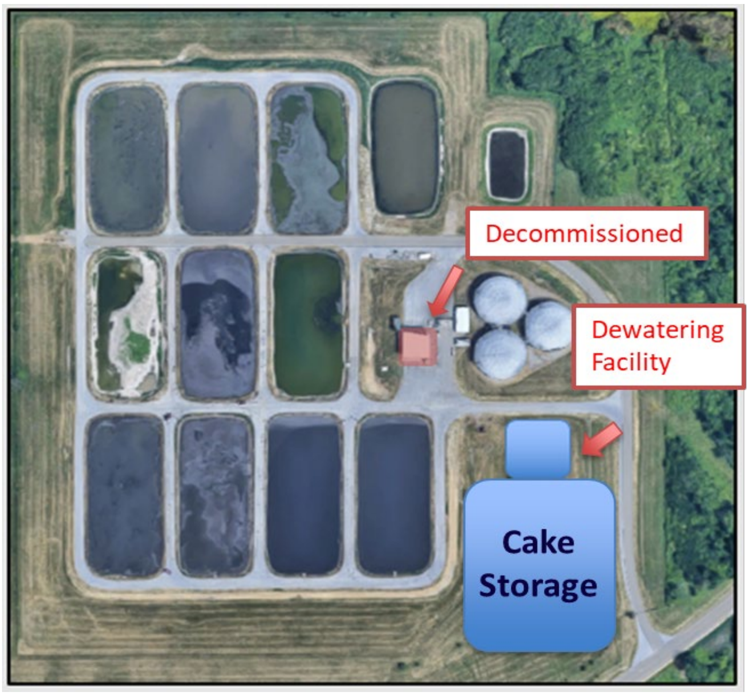


Figure 9-4: Strategy 2 – Garner Road Facility – Conceptual Site Plan

9.3 Strategy 3: AD + Advanced Stabilization + Fertilizer Quality Product

Strategy 3 involves transporting anaerobically digested liquid biosolids from each of the Region's WWTPs, with the exception of the Niagara Falls WWTP, to the Garner Road Facility.

All liquid biosolids would receive advanced stabilization treatment, followed by dewatering and storage of the CFIA fertilizer product at the Garner Road Facility. Under this strategy, the existing lagoons would be maintained for liquid storage prior to advanced treatment and dewatering in a new facility, and the existing dewatering facility would be decommissioned. The final fertilizer product would be stored in a designated area onsite to accommodate fluctuations in market demand for product.

For the purpose of comparison, it is assumed that the Cambi Thermal Hydrolysis process will be used as the advanced stabilization process, as shown in Figure 9-5 below:

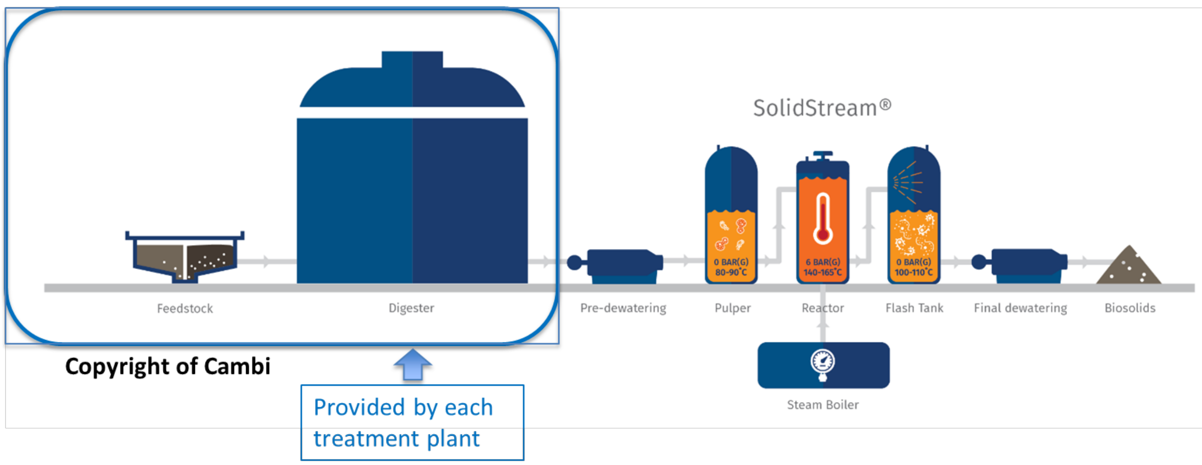


Figure 9-5: Schematic of Cambi Thermal Hydrolysis Process

If this strategy is selected, other forms of thermal hydrolysis, such as two-(2) stage digestion may be considered. The overall process for Strategy 3 is illustrated in Figure 9-6 below:

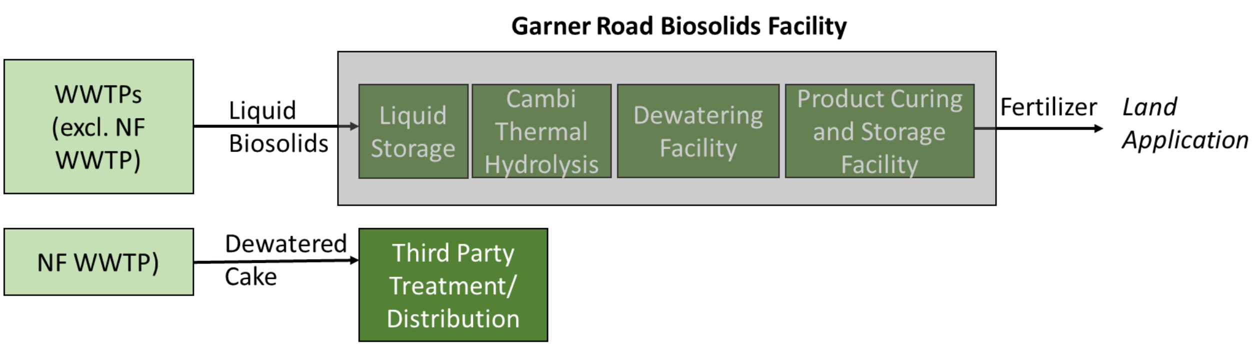


Figure 9-6: Schematic of Strategy 3

Figure 9-7 below illustrates the conceptual site plan for Garner Road under Strategy 3 showing the thermal hydrolysis and dewatering facility and fertilizer cake storage area. The existing liquid storage tanks and lagoons would remain in place.

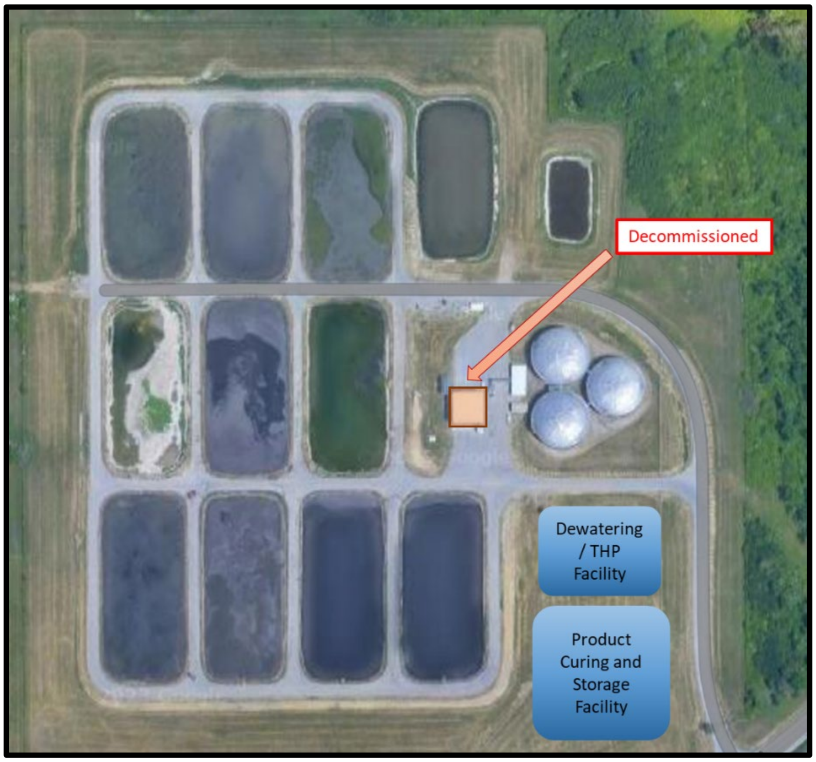


Figure 9-7: Strategy 3 – Garner Road Facility – Conceptual Site Plan

9.4 Strategy 4: AD + Dewatering + Advanced Alkaline Treatment

Strategy 4 involves transporting anaerobically digested liquid biosolids from each of the Region's WWTPs, with the exception of the Niagara Falls WWTP, to the Garner Road Facility.

All liquid biosolids would be dewatered and stored at the Garner Road Facility prior to being transported by a third-party contractor to be processed offsite using advanced alkaline stabilization to generate a fertilizer grade product. The Region would work with a third-party contractor that operates advanced alkaline stabilization processes, such as N-Viro or Lystek, to meet the requirements for certification as a fertilizer. The third-party would also manage marketing and distribution of the final fertilizer product.

Under this strategy, the existing storage tanks and lagoons would be maintained for storage prior to dewatering in a new dewatering facility, and the existing dewatering facility would be decommissioned. As a conservative approach, cake would be stored in a designated area onsite until it is picked up by the third-party vendor. If this strategy is selected, omission of the cake storage could be considered if third party hauling is available year-round. Also, the new dewatering facility could be equipped with large hoppers and a truck loading bay to allow for on-going truck loading.

The conceptual process schematic for Strategy 4 is illustrated in Figure 9-8 below.

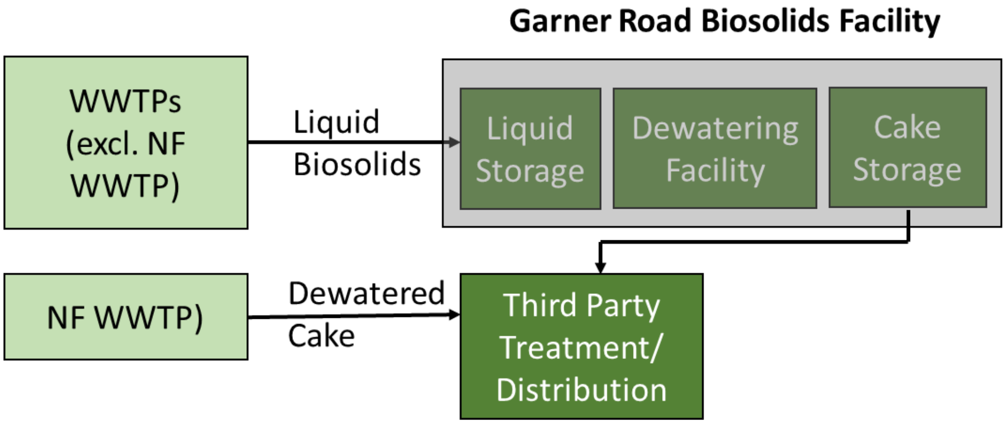


Figure 9-8: Schematic of Strategy 4

Figure 9-9 below illustrates the conceptual site plan for Garner Road under Strategy 4 showing the dewatering facility and cake storage area. The existing liquid storage lagoons would remain in place.

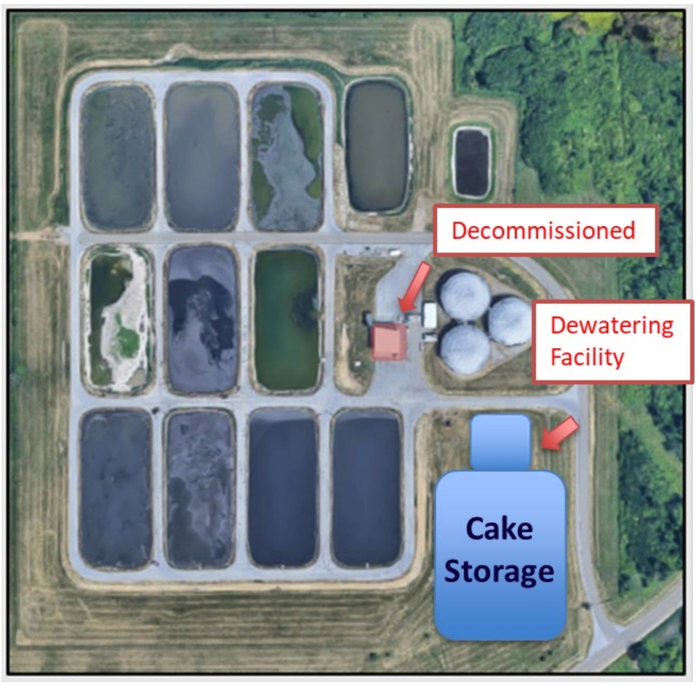


Figure 9-9: Strategy 4 – Garner Road Facility – Conceptual Site Plan

9.5 Strategy 5: AD + Dewatering + Composting + Product Distribution

Strategy 5 involves transporting anaerobically digested liquid biosolids from each of the Region's WWTPs, with the exception of the Niagara Falls WWTP, to the Garner Road Facility.

All liquid biosolids would be dewatered, blended with organic material amendments and composted at the Garner Road Facility. It is anticipated that the ASP composting process would be used for this strategy. The aerated static pile process is relatively compact and more economical compared to other processes including windrow and horizontal agitated bin composting. The aeration provided in the ASP process provides better control and product quality than conventional, non-aerated, windrow composting. The ASP composting process is less costly than the horizontal agitated bin composting system, which includes a large structure to enclose the process along with significant ventilation and odour control systems.

In the aerated static pile process, active composting will last 21 days, followed by 30 days of curing and 90 days of finished compost onsite storage. Organic amendments may consist of wood chips or processed yard waste. Some composting facilities are sized to also process SSO, which may be considered at the Garner Road Facility if this strategy is selected.

The final composted product will have a total solids concentration of approximately 60% total solids concentration and would meet fertilizer standards before distribution. The Region could work with a third-party or be responsible for marketing and distributing the product to end users which could include landscape contractors, nurseries, golf courses, departments of public works and homeowners.

The conceptual process schematic for Strategy 4 is illustrated in Figure 9-10 below.

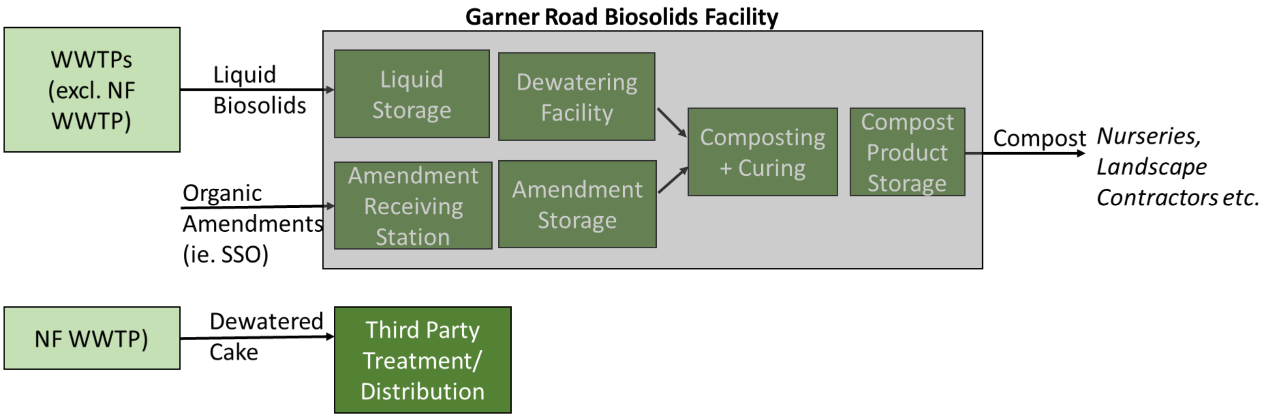


Figure 9-10: Schematic of Strategy 5

Figure 9-11 below illustrates the conceptual site plan for Garner Road under Strategy 5 showing the dewatering and composting areas. The amendment receiving station and storage would be incorporated into the 'Composting Facility' area shown. The composting facility may be located outside the area of the existing lagoons if the Region elects to maintain the lagoon storage. In this scenario, there may be other sites off the Garner Road property to locate the composting process; however, it may be difficult to locate a site in the area with reasonable buffer area. The site plan provided in Figure 9-11 allows individuals to understand the relative scale of the process. For evaluation of scenarios, it is assumed that the composting facility would be located on the existing property in the location of the existing lagoons.

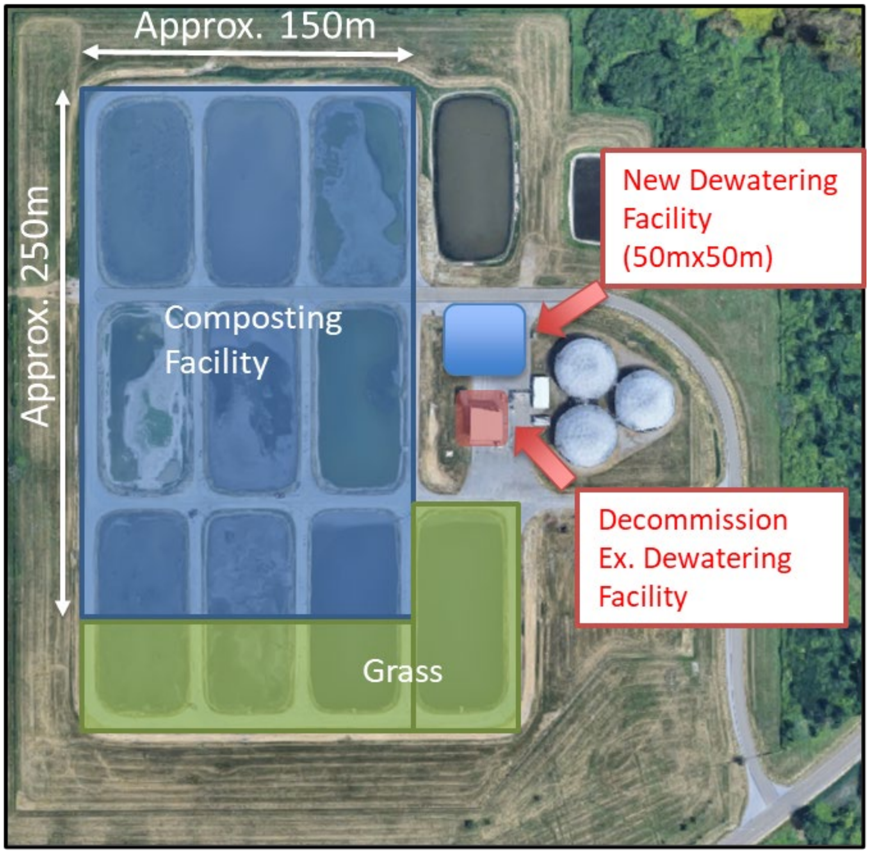


Figure 9-11: Strategy 5 – Garner Road Facility – Conceptual Site Plan

9.6 Strategy 6: AD + Dewatering + Thermal Drying + Product Distribution

Strategy 6 involves transporting anaerobically digested liquid biosolids from each of the Region's WWTPs, with the exception of the Niagara Falls WWTP, to the Garner Road Facility.

This strategy anticipates that the liquid biosolids would be dewatered and thermally dried. At least one lagoon will be maintained to receive incoming liquid biosolids that would then be pumped to the existing storage tanks, the remaining lagoons could be decommissioned if desired by the region or maintained as a contingency to allow for liquid land application.

Rotary drum direct thermal drying will be used for comparison purposes. The rotary drum process is recommended for evaluation based on the scale required to process the solids to be generated by the Region and the characteristics of the final product. Rotary drum drying can produce a hard round pellet of a consistent size that is very marketable. If this strategy is selected as the preferred alternative, other drying technologies may also be considered. The final dried product will be of fertilizer quality and have a total solids concentration of 92%. Storage will be provided in a silo for approximately 50 tons of final product; additional offsite storage would also be provided by the Region or by a third-party distributor that would market the product to end users.

Supplemental heat is required to operate the dryer facility. It is assumed that biogas will not be available at the Garner Road Facility, as there is no anaerobic digestion at this location. Therefore, supplemental heat would be supplied by natural gas. Regenerative Thermal Oxidation will be used to treat the dryer off gas. The facility will be approximately 2 ½ stories tall with a floor area of approximately 1,500 m^2.

The conceptual process schematic for Strategy 6 is illustrated in Figure 9-12 below.

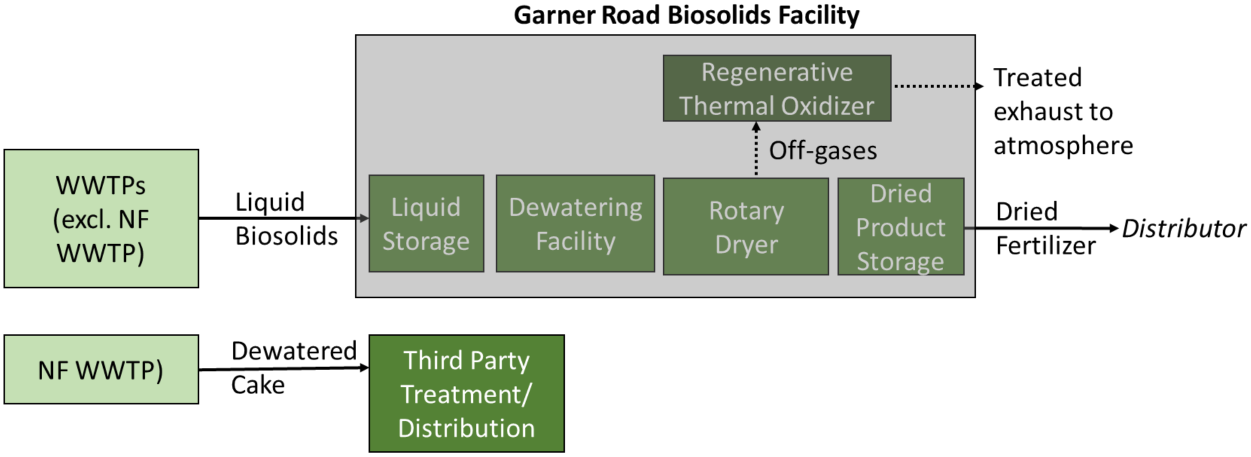


Figure 9-12: Schematic of Strategy 6

Figure 9-13 below illustrates the conceptual site plan for Garner Road under Strategy 6 showing the dewatering and drying facilities. The area where the existing lagoons are situated may be repurposed, as needed.

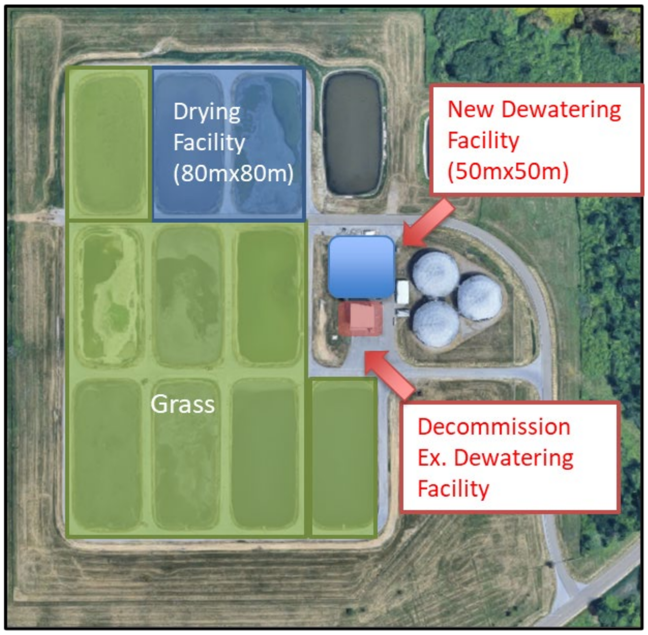


Figure 9-13: Strategy 6 – Garner Road Facility – Conceptual Site Plan

9.7 Strategy 7: AD + Dewatering + Thermal Processing

Strategy 7 involves transporting anaerobically digested liquid biosolids from each of the Region's WWTPs, with the exception of the Niagara Falls WWTP, to the Garner Road Facility.

The Region expressed an interest in thermal processing to minimize the amount of material to be managed following processing. All liquid biosolids would be dewatered and thermally processed. It is anticipated fluidized bed incineration would be used as the method of thermal processing based on the current level of development and acceptance of this technology. This is the type of process that is typically used when existing incineration facilities are upgraded. Other thermal treatments may be considered if this strategy is selected as the preferred alternative. The final ash product would be land-filled or could potentially be used in the production of concrete or bricks.

Under this strategy, the existing storage tanks would be used to receive liquid biosolids. The lagoons could be decommissioned or repurposed to serve as ash holding.

The new incineration facility would be approximately 3 stories tall with a floor area of approximately 2000 m^2. Emissions are produced from the incineration process, and emission treatment is included in the proposed strategy to ensure compliance with environmental regulations.

The conceptual process schematic for Strategy 7 is illustrated in Figure 9-14 below.

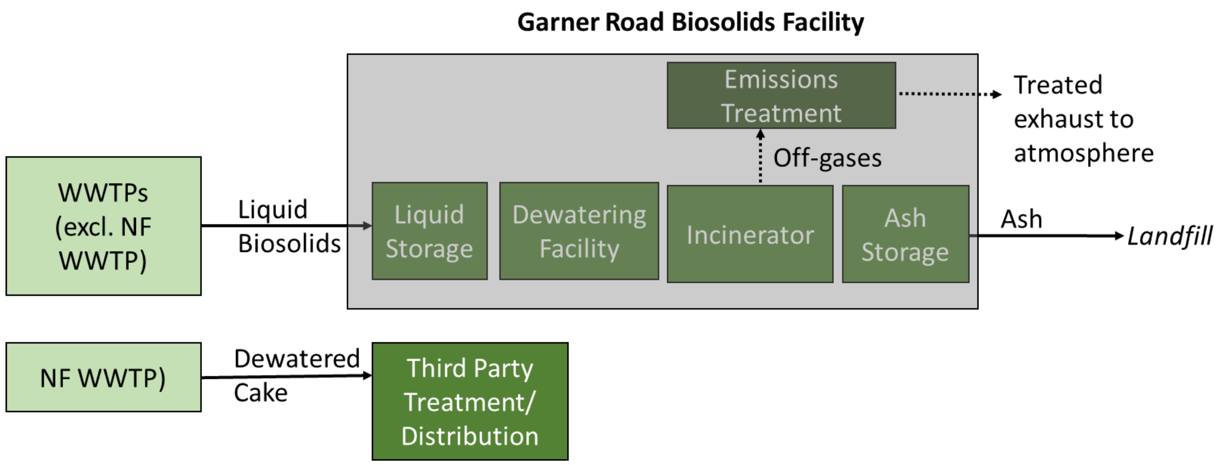


Figure 9-14: Schematic of Strategy 7

Figure 9-15 below illustrates the conceptual site plan for Garner Road under Strategy 7 showing the dewatering and incineration facilities. The area where the existing lagoons are situated may be repurposed, as needed.

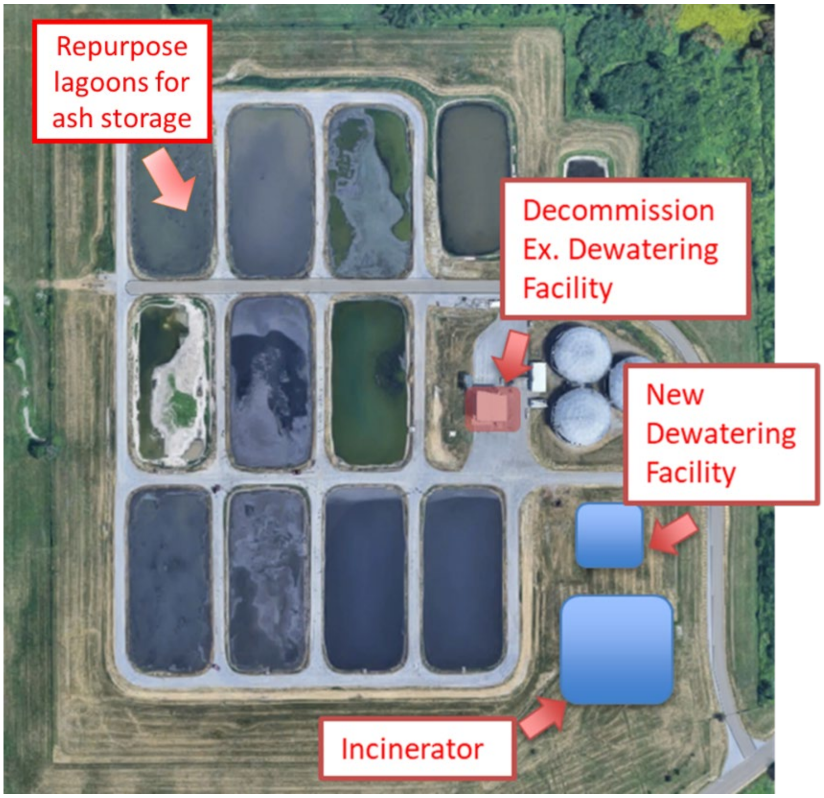


Figure 9-15: Strategy 7 – Garner Road Facility – Conceptual Site Plan

10 Detailed Evaluation of Strategies

10.1 Methodology

The methodology for evaluating the short-listed biosolids management strategies identified in the previous section is described in the following subsections.

10.1.1 Evaluation Criteria

The short-listed biosolids management strategies identified in the previous section were assessed using detailed evaluation criteria that considered all components of the environment; natural, social/cultural, technical, and economic. Each environmental category specific criteria were established. These criteria are summarized in Figure 10-1 and further described in TM 6 in Appendix A – Technical Memorandum 6.

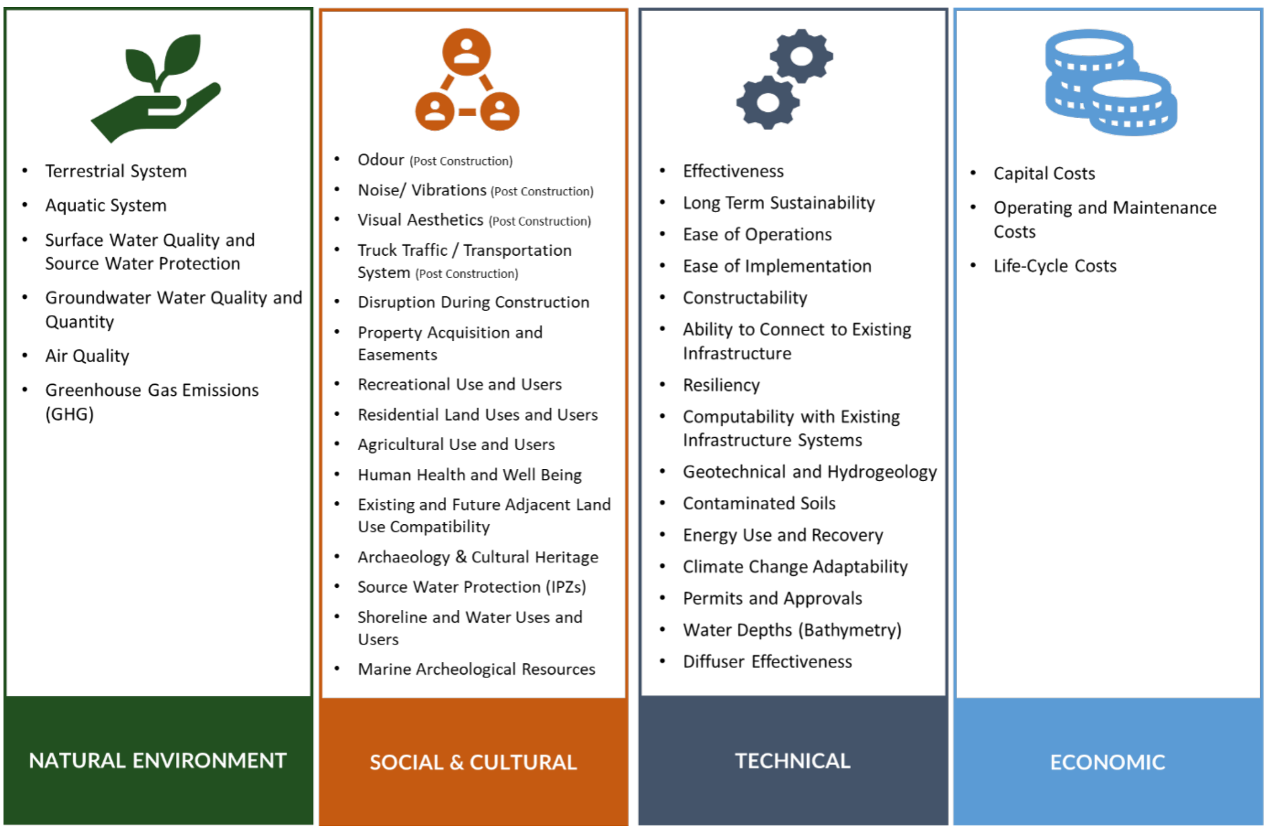


Figure 10-1: Evaluation Criteria for the Detailed Evaluation

10.1.2 Measuring Impacts and Scoring Alternatives

Alternative impacts for each criterion were scored by a team of engineers, scientists, and planners using the same rating scale of one (1) to ten (10) as shown in Table 10-1. A score of ten (10) assigned to the alternative having the least impacts and deemed most preferred and a score of 1 assigned to the alternative having the most impacts and deemed least preferred. Impacts were quantified where possible (i.e., Green House Gas (GHG) emissions, costs, and truck traffic). In assigning impact ratings, net effects (effects after mitigation) were considered.

Table 10-1: Evaluation Rating Scale

Impact Description	Impact Rating
Positive or no impact	9-10
Minor impact	7-8
Moderate impact	5-6
High impact	3-4
Severe impact	1-2

Impact ratings were summed for each criteria category and normalized, such that each category (i.e., natural, social/cultural, technical, and economic) are weighted equally at 25% each. The alternatives with the highest summed score out of 100% have the least net effects and are recommended as preferred strategies to develop in more detail.

10.1.3 Selection of Preferred Strategies

To confirm the preferred strategies, a second level of assessment was undertaken that considered the key priorities of the Region as reflected by criteria that were notably different between the strategies. These criteria are referred to as 'differentiating criteria'**.** Of the 30 total criteria, ten (10) criteria were selected that showed more variation between alternative strategies and were also considered important to the Region. These criteria, known as 'differentiating criteria' are listed below, and are each given equal weighting in this level of evaluation.

1. Greenhouse Gas Emissions
2. Nutrient Recovery and Potential for Beneficial Reuse by Agricultural users
3. Proven Performance
4. Odour at Garner Road Facility
5. Truck Traffic
6. Long Term Sustainability
7. Ease of Operation
8. Resiliency
9. Ease of Implementation
10. Life Cycle Cost

The evaluation was performed again using only the "differentiating criteria". The strategies that had the most positive impacts or lowest negative impacts based on the above ten (10) criteria were selected as preferred and carried forward for further detailed development.

10.2 Detailed Evaluation of Alternative Strategies

The Alternative Evaluation Matrix used to compare the alternatives is included as TM 7 in Appendix A**.** The matrix provides scoring for each alternative relative to Environmental, Social–Cultural, Technical, and Economic Criteria. Details on the assessment are described in the following sub-sections.

10.2.1 Natural Environment

10.2.1.1 Terrestrial and Aquatic Systems

All alternative strategies will use the Garner Road property as a centralized facility for biosolids management. As this property has been previously disturbed, it has little potential for terrestrial or aquatic habitats or species at risk. Minimal impacts are expected due to facility construction and can be mitigated.

All alternative strategies will meet applicable land application and fertilizer regulations. However, liquid biosolids managed under NASM will have slightly higher risks to aquatic systems, followed by direct land application of dewatered biosolids. Land application of fertilizer quality product has the lowest potential for aquatic system impacts, so Strategies 3, 4, 5, and 6 score higher. Incineration products have negligible aquatic impacts, as the ash will not be land applied.

10.2.1.2 Surface Water Quality and Groundwater Systems

Additional biosolids management facilities at Garner Road are not expected to have major impacts on surface water quality for all alternatives. However, open pile composting (Strategy 5) and incinerator ash storage lagoons (Strategy 7) may result in higher risk of runoff requiring more mitigation to control impacts (e.g., lining, directing runoff to the sanitary sewer system). Biosolids being land applied have potential to impact surface water systems through runoff into watercourses, with liquid biosolids managed under NASM having highest impacts, followed by direct land application of dewatered biosolids, and fertilizer quality land application. None of the alternatives are expected to significantly impact groundwater quality if land applied in accordance with NASM plan outside of Source Water Protection Areas. Composting leachate and ash lagoons would require containment to prevent infiltration for Strategies 5 and 7, accordingly.

Overall, the scores for surface and groundwater quality impacts are comparable for all strategies.

10.2.1.3 Soil Quality

Biosolids being land applied have potential to positively impact soil quality, with fertilizer products having the most benefits for soil quality (Strategies 3, 4, 5 and 6). Incineration will not affect soil quality. NASM products have a lower value than fertilizer quality products and are ranked lower.

10.2.1.4 Air Quality and Greenhouse Gas (GHG) Emissions

All alternatives would be designed to include emission controls such that all air quality standards are met, and impacts are mitigated. Trucking is a source of air quality impacts. As such, alternatives with the most volume of product will require the most trucks (e.g., Strategy 1 – digested liquid product and Strategy 5 - composted product) and potentially have more impacts on air quality.

GHG emissions were calculated using the Biosolids Emissions Assessment Model (BEAM) as developed by the CCME, and consider three (3) components:

- Scope 1 – Direct Emissions, which could include emissions related to fugitive methane from anaerobic digestion, or natural gas heating, or other types of fuel combustion
- Scope 2 – Indirect Emissions associated with electricity used at the facility, and
- Scope 3 – All other indirect emissions, such as fuel burned for transportation of materials. Scope 3 also includes credits to offset fertilizer production when biosolids are land applied.

GHG emissions calculations for each strategy are summarized in the table below:

Table 10-2: Greenhouse Gas Emissions Estimates

Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5	Strategy 6	Strategy 7
AD + Liquid Biosolids Land Application	AD + Dewatering + Cake Land Application	AD + Advanced Stabilization (THP) + Fertilizer Quality Product	AD + Dewatering + Advanced Alkaline Treatment	AD + Dewatering + Composting + Product Distribution	AD + Dewatering + Thermal Drying + Product Distribution	AD + Dewatering + Thermal Processing
-759 mg CO2 eq/ mg dry solids	-11,083 mg CO2 eq/ mg dry solids	-11,083 mg CO2 eq/ mg dry solids	-11,083 mg CO2 eq/ mg dry solids	-11,083 mg CO2 eq/ mg dry solids	-3,724 mg CO2 eq/ mg dry solids	5,354 mg CO2 eq/ mg dry solids

The GHG calculation for each strategy does not incorporate the emissions related to transporting the liquid biosolids from the WWTPs and WTPs to Garner Road, as these would be the same for each strategy. The calculations also do not incorporate the emissions related to transporting the final products by truck to their end use markets. GHG emissions from trucking are considered in a qualitative manner under this criterion, while the social implications of truck traffic are considered under the "truck traffic" criterion under the "Social and Cultural Impacts" category described in the next section.

Incineration has the greatest potential to produce GHG emissions (Strategy 7) as it involved burning a product that directly releases carbon dioxide (CO_2). However, it will have less GHG emissions associated with trucking the final products. Liquid land application (Strategy 1) has the second highest impacts due to the highest trucking volumes and associated vehicle fuel combustion. Thermal drying (Strategy 6) has the next highest impact due to the heating requirements and associated natural gas consumption. All strategies with the exception of Incineration (Strategy 7) include GHG credits for offsetting fertilizer production needs when biosolids are land applied. Overall, due to these credits, Strategies 1 through 6 are expected to have a net benefit (i.e., negative net GHG emissions value) based on the assumptions stated above.

10.2.2 Social and Cultural Impacts

10.2.2.1 Odour, Noise and Vibrations at Garner Road Facility During Operation

Composting (Strategy 5) has the greatest potential to generate odour at the Garner Road Facility, followed by long term cake storage of anaerobically digested cake at the facility (Strategy 2) and the thermal drying process (Strategy 6) if the process odour control is not operating properly. The thermal drying process uses regenerative thermal oxidation to treat the process air to reduce the chance of onsite odours. Overall, odour generated for each of the strategies can be reasonably contained and treated. The Garner Road Facility is also located away from sensitive receptors.

Noise and vibrations from operations will be minimal and controlled for all alternatives.

10.2.2.2 Truck Traffic

Strategies that transport larger volumes of biosolids will result in increased truck traffic and score lower. Liquid land application (Strategy 1) requires the largest volume of hauling and scores the lowest. Composting (Strategy 5) requires the addition of aggregate product (75 % of total volume), which increases the hauling volumes to and from the Garner Road Facility.

10.2.2.3 Construction Disruptions

Minimal construction disturbances are expected for each strategy due to construction being isolated to the Garner Road Facility which is away from residential and commercial areas. The scoring is consistent for each strategy.

10.2.2.4 Property Acquisition and Easements, and Adjacent Land Use Compatibility

Given the assumptions in developing each alternative, the Garner Road site has sufficient space to accommodate each of the proposed strategies. However, composting requires large tracks of land and the area for composting may require additional land if liquid lagoon storage is to be maintained at the Garner Road Facility. As such, Strategy 5 scores lower.

Garner Road is zoned HI (heavy industrial) surrounded by HL (hazard land) that borders environmental protected areas. Prestige industrial zoned land is to the south. All alternatives are compatible with current zoning, and there is no difference in scoring.

10.2.2.5 Nutrient Recovery and Beneficial Use for Agricultural Land Users

Except for incineration, agricultural users will benefit from all of the biosolids products evaluated, those that are anaerobically digested and those that have been further processed to achieve fertilizer quality certification. They all provide essential plant nutrients and organics to improve soil quality. The products that achieve the fertilizer certification rank higher because they have a higher total nutrient concentration.

Advanced Stabilization (THP) (Strategy 3) and Thermal Drying (Strategy 6) reduce soil compaction associated with spreading. Advanced Alkaline Stabilization (Strategy 4) includes lime addition which is a benefit to many agricultural programs. Compost product, Strategy 5, could also be used in agriculture, but has a higher volume requirement to provide the same amount of nitrogen to the soil when compared with the other products. Incinerator ash is not applicable for use on agricultural lands and scores the lowest.

10.2.2.6 Archaeological and Cultural Heritage

None of the strategies are expected to impact cultural heritage or archaeological resources; Individual projects will have site specific archaeological and cultural heritage assessments, if required.

10.2.2.7 Other Social Impacts

None of the strategies will impact recreational uses, as Garner Road is not near any recreational facilities.

Regulations are present to protect human health and all strategies meet these requirements.

Composting and open lagoons have higher potential for visual impact than the other strategies. However, the impacts are expected to be minimal given that the Garner Road Facility is not easily viewed by the public. Thermal drying, dewatering and thickening operations would be enclosed in a building for minimal visual impacts.

10.2.3 Technical Considerations

10.2.3.1 Proven Performance

All strategies would be designed to effectively treat and manage biosolids. All processes are proven at a scale similar to Niagara Region with the exception of THP, which does not currently have any installations post-digestion in North America.

10.2.3.2 Long Term Sustainability

While all biosolids products considered can be marketed, the products that meet fertilizer certification criteria can be marketed with no regulatory requirements outside of the processing facility. Thermally dried product has the highest marketability of the products considered. There is a strong demand in the agricultural and public markets. As such, Strategy 6 ranks the highest for sustainability.

Anaerobically digested biosolids, liquid and dewatered, can be marked to the agricultural community which has a significant demand in the Golden Horseshoe area. Advanced alkaline stabilized product also has a strong demand in the agricultural market which is boosted by the products ability to impact the soils pH. The product of advanced digestion, using THP, would be most suitable for the agricultural community, based primarily on its total solid concentration of approximately 40%. Compost can be marketed to the public, but the total demand is lower than that of agricultural and is strongest in the spring and fall horticultural seasons. Strategies 1, 2, 3, 4, and 5 are comparable in sustainability. The market for Incinerator ash is different: the market is with brick and block producers and not with the agricultural community or the general public. This market has lower predictability in the long term and Strategy 7 is ranked lowest for sustainability.

10.2.3.3 Ease of Operation

The Region can operate the processes considered in each of the alternative strategies. Technologies that the Region is currently operating, or are familiar with, were ranked the highest (Strategies 1, 2, and 4). The alternatives which include complex technologies, or require specific certifications, were ranked lower. Strategy 3 ranked the lowest, as it requires operators to have the Stationary Engineer certification to safely operate the facility. Staff with this qualification may be difficult to find, and additional training or hiring would be required.

10.2.3.4 Resiliency

Strategies that can generate products with a demand from multiple markets ranked higher, as they are more resilient to market fluctuations through diversification. The Region may consider a biosolids management program that has more than one outlet, such as land application and distribution to the public. As a result, strategies that have multiple market outlets or complement each other, for example those that include dewatering, ranked higher. Also, the ability to manage the material through all seasons was considered in the scoring. For example, the disposal of incineration ash for Strategy 7 can be done throughout the year, and is not seasonally dependent, such as liquid or cake which can only be land applied during the warmer months.

10.2.3.5 Ease of Implementation

The strategies that can be implemented without disturbing the current biosolids management program ranked higher. Alternatives that require additional storage at the Garner Road Facility or at a third-party managed location scored lower, partly due to the difficulty to move away from a specific third-party contractor without the equivalent storage identified at another location. Facilities with smaller footprints scored higher as did those that would not require significant changes to the infrastructure current serving the Garner Road Facility. Composting (Strategy 5) has the largest footprint and may require additional lands and scored the lowest. In addition, alternatives that do not have a proven market in Niagara for their products scored lower (i.e., incineration). Thermal drying also scored lower because it is a significant change to the facility layout and the biosolids management program would be significantly different.

10.2.3.6 Compatibility with Existing Infrastructure

The alternative treatment processes associated with each strategy, if implemented at the Garner Road Facility, are compatible with infrastructure in the area. However, thermal hydrolysis (Strategy 3), thermal drying (Strategy 6), and thermal processing (Strategy 7) require additional power and natural gas at the site.

10.2.3.7 Energy Use and Recovery

All strategies considered retaining the use of anaerobic digestion at the WWTPs. The biogas generated in the digestion process can be recovered and used. Since the Garner Road Facility is "remote" to the treatment facilities it will not be able take advantage of that gas. The alternatives that use the least amount of power at the Garner Road Facility were ranked higher.

10.2.3.8 Climate Change Adaptability

Climate change, and associated wet weather flows, severe weather events and the like will not impact the operation of the proposed strategies for a period long beyond the study period (2051). Severe wet weather events may limit the ability to apply biosolids on agricultural land. Also, open pile composting (Strategy 5) is more likely to be impacted by heavy rainfall as it is conducted outdoors.

10.2.3.9 Permits and Approvals

All strategies can be approved for construction and permitted for operation. Some will require additional site permitting based on the alternatives' level of pathogen reduction. Incineration (Strategy 7) would require a higher degree of review associated with air quality. Some may be required to perform a pilot operation to allow the Region and the Ministry to witness successful operation (i.e., Strategy 3 with thermal hydrolysis). Strategies that require additional actions to obtain required permits will score lower.

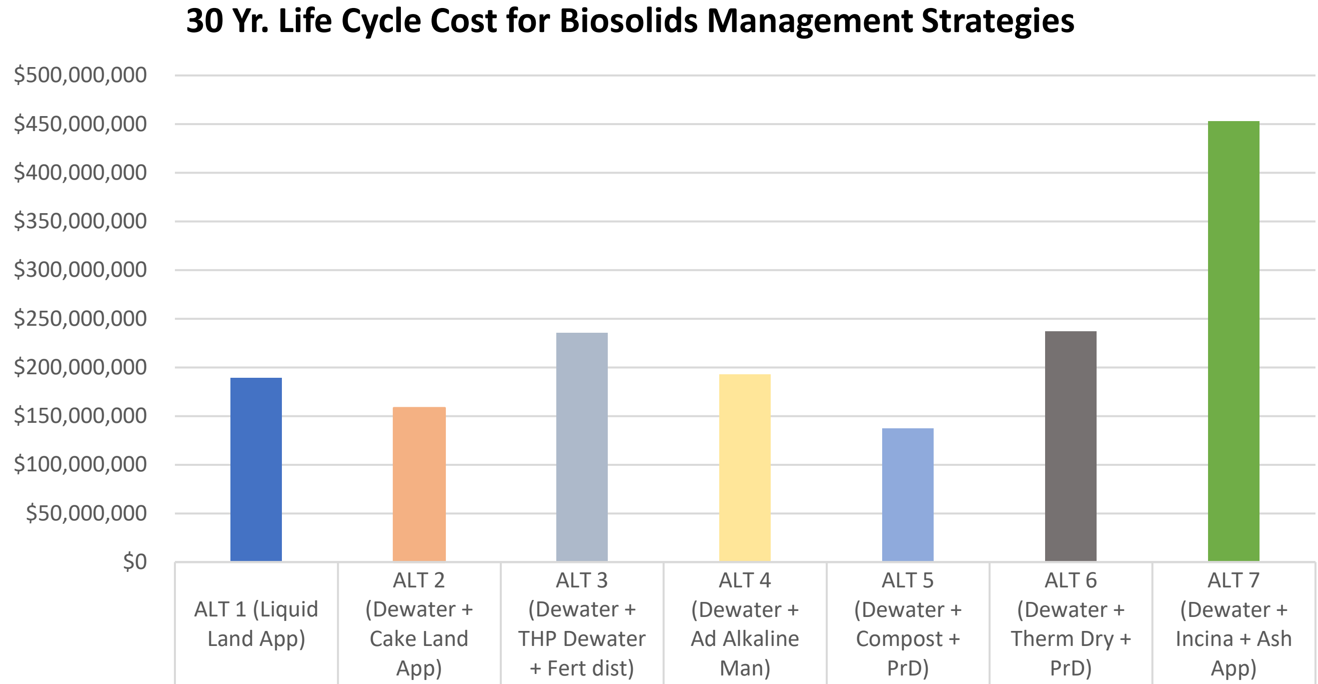
10.2.4 Economic Considerations

For each of the seven strategies, the capital, operating and maintenance (O&M) and 30-year life cycle cost were calculated for comparison purposes. The costing was based on the scope of work for each strategy described in Section 5. Table 10-3 summarizes the estimated costs for each alternative. Figure 10-2 graphically compares the 30-year life cycle cost for each strategy.

Table 10-3: Cost Comparison of Biosolids Management Strategies

	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5	Strategy 6	Strategy 7
	AD + Liquid Biosolids Land Application	AD + Dewatering + Cake Land Application	AD + Advanced Stabilization (THP) + Fertilizer Quality Product	AD + Dewatering + Advanced Alkaline Treatment	AD + Dewatering + Composting + Product Distribution	AD + Dewatering + Thermal Drying + Product Distribution	AD + Dewatering + Thermal Processing
Capital Cost*	$ 122 M	$ 44 M	$ 112 M	$ 35 M	$ 55 M	$ 92 M	$ 274 M
Annual O&M Cost	$ 3.6 M	$ 5.9 M	$ 6.3 M	$ 8.1 M	$ 4.2 M	$ 7.4 M	$ 9.4 M
Life Cycle Cost	$ 189 M	$ 158 M	$ 236 M	$ 193 M	$ 137 M	$ 237 M	$ 453 M

*Capital cost excludes any land acquisition costs.



	ALT 1 (Liquid Land App)	ALT 2 (Dewater + Cake Land App)	ALT 3 (Dewater + THP Dewater + Fert dist)	ALT 4 (Dewater + Ad Alkaline Man)	ALT 5 (Dewater + Compost + PrD)	ALT 6 (Dewater + Therm Dry + PrD)	ALT 7 (Dewater + Incina + Ash App)
30 Yr. Life Cycle Cost	$189,301,000	$158,324,000	$235,647,000	$192,708,000	$137,309,000	$236,896,000	$453,251,000

Figure 10-2: Estimated 30 Year Life Cycle Cost for Biosolids Management Strategies

Overall, Composting (Strategy 5) has the lowest life cycle cost. Strategies 1, 2, 3, 4 and 6 have relatively similar life cycle costs. Incineration (Strategy 7) has the highest life cycle cost that is significantly higher than all other strategies. Refer to Appendix B for a detailed breakdown of costing for each strategy.

10.3 Results of Detailed Evaluation of Strategies

Based on the detailed evaluation described above and as shown in the evaluation matrix in TM 7 in Appendix A, the strategy scores and rankings are summarized in Table 10-4.

Table 10-4: Summary of Detailed Evaluation Results Using All Criteria

	Strategy 1 AD + Liquid Biosolids Land Application	Strategy 2 AD + Dewatering + Cake Land Application	Strategy 3 AD + Advanced Stabilization (THP) + Fertilizer Quality Product	Strategy 4 AD + Dewatering + Advanced Alkaline Treatment	Strategy 5 AD + Dewatering + Composting + Product Distribution	Strategy 6 AD + Dewatering + Thermal Drying + Product Distribution	Strategy 7 AD + Dewatering + Thermal Processing
Environmental	16.8	18.2	20.4	20.4	18.9	19.6	17.5
Socio-Cultural	19.5	19.8	20.5	20.5	17.7	20.2	19.5
Technical	19.4	19.2	15.0	20.0	16.7	16.7	15.3
Economic	15.8	18.3	13.3	16.7	19.2	13.3	6.7
Total Score	71.6%	72.7%	69.1%	76.1%	72.7%	69.9%	59.0%
Ranking	3	2	5	1	2	4	6

Based on the detailed evaluation using all criteria and equal weighting for each of the four criterion types, the highest ranked strategy is Strategy 4 that uses anaerobic digestion with dewatering and advanced alkaline treatment prior to land application as a fertilizer quality product. Strategies 2 and 5 are tied for second, with Strategies 1, 3 and 6 ranked just slightly below Strategies 2 and 5.

As the strategy scores are relatively close for the top six (6) strategies (strategies 1, 2, 3, 4, 5 and 6), a second level evaluation was undertaken that focused on differentiating criteria that were also deemed to be important to the Region as listed in Section 10.1.1.2.

The results of this second level of evaluation are summarized in the table below:

Table 10-5: Summary of Detailed Evaluation Results Using Only Differentiating Criteria

	Strategy 1 AD + Liquid Biosolids Land Application	Strategy 2 AD + Dewatering + Cake Land Application	Strategy 3 AD + Advanced Stabilization (THP) + Fertilizer Quality Product	Strategy 4 AD + Dewatering + Advanced Alkaline Treatment + Fertilizer Quality Product	Strategy 5 AD + Dewatering + Composting + Product Distribution	Strategy 6 AD + Dewatering + Thermal Drying + Product Distribution	Strategy 7 AD + Dewatering + Thermal Processing
Total Score	69%	72%	63%	75%	61%	66%	54%
Ranking	3	2	5	1	6	4	7

Based on the second level evaluation using only the differentiating criteria, Strategies 4 is still ranked the highest, with strategies 2 and 1 ranked second and third, respectively. There is a greater range of scores resulting from the second level of evaluation. The results also reinforce the top two ranked strategies, which are the same as the first level of evaluation considering all criteria. Each of the top three strategies include anaerobic digestion, with two of the three strategies also including dewatering. Strategy 4 includes advanced alkaline stabilization to create a fertilizer quality product, while Strategy 2 includes direct land application of the dewatered cake. Strategy 1 is similar to the Region's current approach with land application of liquid biosolids. As each of these strategies use anaerobic digestion, they are compatible with each other, and could be implemented together to increase diversification of biosolids management, which still utilizing some of the Region's existing infrastructure.

Strategy 2, the second highest ranked strategy, includes dewatering followed by direct land application of cake. Although dewatering is currently done in by the Region, direct land application of the cake has not been done. As such, there is some uncertainty as to whether agricultural landowners that currently receive liquid biosolids would be open to receiving a cake product. To better understand the market and logistics of managing a cake land application program, the Region is planning a cake land application pilot program during the summer of 2024.

Overall, it is recommended that Strategies 2 and 4 be developed further, with consideration for continuing with liquid land application (Strategy 1) in combination with Strategy 4 if the cake land application pilot described above does not receive sufficient buy-in from farmers or encounters other operational issues. Liquid storage and provisions for liquid land application could also be maintained to ensure program diversification, considering liquid storage is already in place and the land being used for storage is not required to implement strategies 2 or 4.

11 Development of Preferred Strategies

Section 10 previously identified the following three (3) preferred strategies as outline above:

- **Strategy 4:** Anaerobic Digestion + Dewatering + Advanced Alkaline Treatment to produce a fertilizer product for land application
- **Strategy 2:** Anaerobic digestion + Dewatering + Cake Land Application
- **Strategy 1:** Anaerobic Digestion + Liquid Biosolids Land Application

Strategy 1 involves continuing with the existing processes at the Garner Road facility. Strategies 2 and 4 involve dewatering to reduce hauling requirements and associated community impacts, GHG emissions and transportation costs. Dewatering is currently in place at Niagara Falls WWTP and the Garner Road facility.

To develop these strategies further the following were examined in detail:

1. Dewatering Opportunities at the WWTPs
2. Upgrade Options at the Garner Road Facility
3. Storage Reduction Opportunities at the Garner Road Facility
4. Other Optimization Opportunities for Biosolids Management in Niagara.

The above are detailed in the following sections, and the results form the basis of the implementation strategy presented in Section 13.

11.1 Dewatering Approach

To develop the preferred strategies that involve dewatering, the potential to add dewatering at each of the WWTPs in the Region is reviewed, and a preferred dewatering approach identified. Not only will this reduce hauling but could reduce biosolids storage requirements at the Garner Road facility.

11.1.1 Screening of WWTPs for Dewatering

Dewatering was only considered at WWTPs in the Region that have sufficient space; have a large enough rated capacity to justify the investment; and are far enough from the Garner Road facility to incur a notable decrease in truck traffic. The screening criteria used are defined in Table 11-1 below:

Table 11-1: Screening Criteria for Evaluation of Feasibility of Dewatering at WWTPs

Screening Criteria	Description
1. Available Space Onsite	Is there available space onsite for dewatering that has not be allocated for other planned upgrades?
2. WWTP Capacity	Is the WWTP capacity (rated or solids volume) such that it warrants consideration of additional solids treatment? Plant with capacity <20MLD will be screened out.
3. Distance from Garner Road	Is the WWTP far enough from Garner Road that haulage is a substantial contributor to GHG and cost? WWTPs within 20km of Garner Road will be screened out.

The results of the screening level evaluation are summarized in Table 11-2 below.

Table 11-2: Screening Level Evaluation for Determining Feasibility of Dewatering at WWTPs

WWTP	Space on Site	Plant Rated Capacity (MLD)	Distance from Garner Road (km)	Result
Screening Threshold (required to pass)	--	>20 MLD	>20 km	
Baker Road WWTP	**Yes**	**31.3**	**47 km**	**Space, capacity to dewater, far from Garner - Carry Forward**
Port Dalhousie WWTP	**Yes**	**61.4**	**27 km**	**Space, capacity to dewater, far from Garner - Carry Forward**
Port Weller WWTP	**Yes**	**56.2**	**29 km**	**Space, capacity to dewater, far from Garner - Carry Forward**
Niagara-on-the-Lake WWTP	Yes	8	28 km	Capacity too small – Screen out
Queenston WWTP	No	0.5	22 km	Space and capacity too small - Screen out
Niagara Falls WWTP	**n/a**	**68.3**	**14 km**	****Dewatering in place – Carry Forward to detailed evaluation, even though <20km from Garner Road**
South Niagara Falls WWTP (Future)	Yes	60	~7 km	Too close to Garner Road Facility – Screen out
Anger Ave WWTP	**Yes**	**24.5**	**25 km**	**Space and capacity to dewater - Carry Forward**
Crystal Beach WWTP	No	9.1	26 km	Space too small - Screen out
Stevensville-Douglastown Lagoons	Yes	2.7	16 km	Capacity too small, not a mechanical plant, close to Garner Road – Screen out
Welland WWTP	Yes	54.6	15 km	Too close to Garner Road Facility - Screen out
Seaway WWTP	Yes	19.6	24 km	Small capacity plant, 2051 flows much less than rated capacity – Screen out

Overall, Baker Road WWTP, Port Dalhousie WWTP, Port Weller WWTP, Niagara Falls WWTP and Anger Avenue WWTP pass the screening and are carried forward for completion of a cost-benefit analysis to determine if dewatering should be proposed.

11.1.2 Cost-Benefit Analysis of WWTPs that Passed Screening

To determine if dewatering should be pursued at Baker Road, Port Dalhousie, Port Weller, and Anger Avenue WWTPs or continued at Niagara Falls WWTP, a cost analysis for dewatering is completed for the following four (4) areas as described in the following sections. The four (4) areas are shown in Figure 11-1 below. Detailed transportation calculations for each dewatering scenario are provided in Appendix A – Technical Memorandum 5.

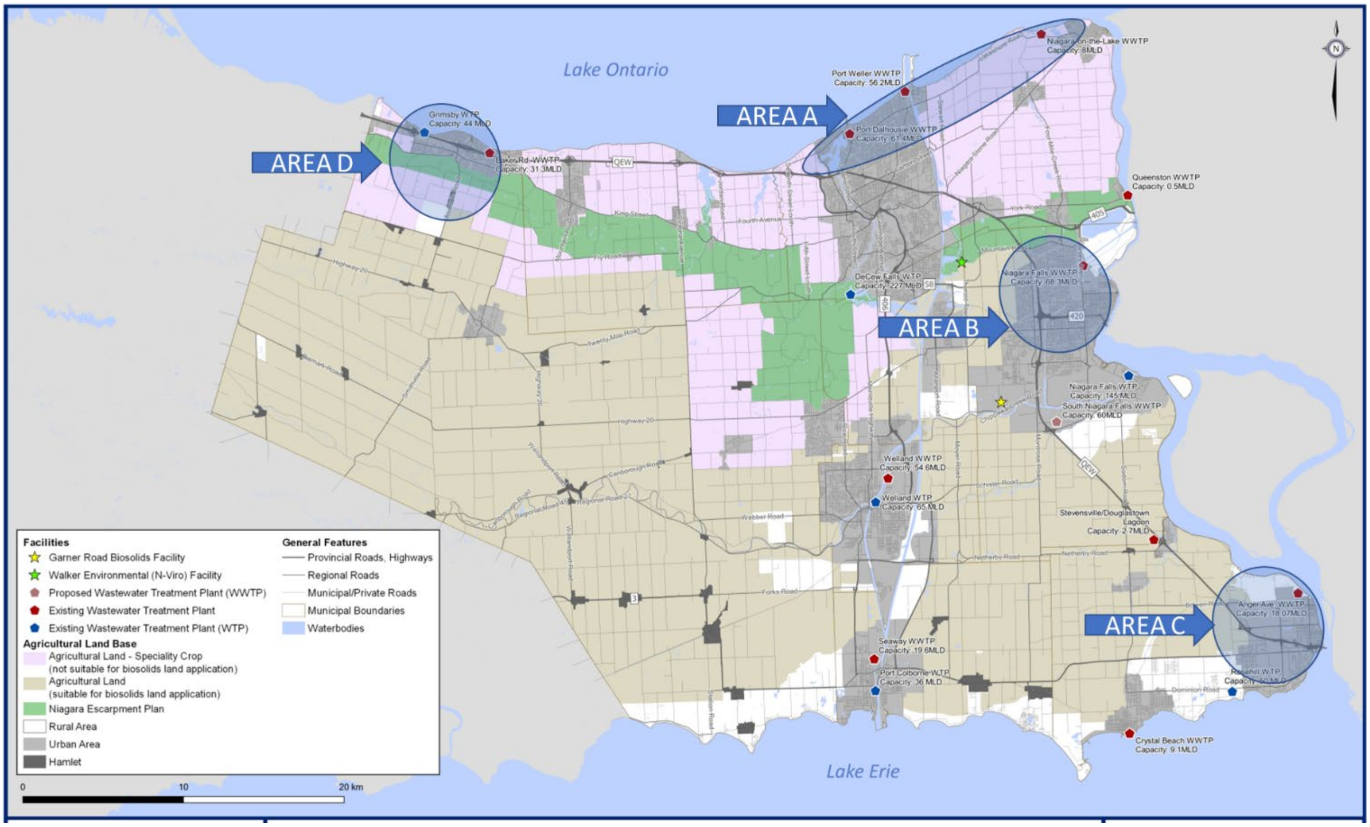


Figure 11-1: Areas Within Region with WWTPs Under Consideration for Dewatering

11.1.2.1 Dewatering Scenarios in Area A - Northeastern WWTPs

Area A consists of Port Dalhousie, Port Weller and Niagara-on-the-Lake WWTPs. Both Port Dalhousie and Port Weller WWTPs passed the screening level evaluation, as they are larger capacity WWTPs and more than 20 km from Garner Road. Because Port Dalhousie and Port Weller are near each other (approximately 7 km apart), a centralized facility at one (1) of these two (2) plants would be more cost effective than dewatering at each plant separately, due to the lower capital investment. Port Weller WWTP was selected as the location for the centralized facility as it is located between Port Dalhousie and Niagara-on-the-Lake WWTPs, although Port Dalhousie could also potentially be the centralized location.

Two (2) scenarios were developed to manage biosolids for the northeastern WWTPs, as shown below. Scenario 1 involves continuing with the existing management approach to year 2051, which is to continue transporting liquid biosolids from the WWTPs in Area A to Garner Road. Scenario 2 involves implementing dewatering at the Port Weller WWTP and transporting liquid biosolids from the Port Dalhousie and Niagara-on-the-Lake WWTPs to the Port Weller WWTP for dewatering. The cake would be transported to the Garner Road facility for storage and management. The Region could also consider having the dewatered cake transported by Walker Environmental to their alkaline stabilization facility for alkaline stabilization under their current agreement for additional stabilization and product marketing. The two (2) scenarios developed are presented in shown in Figure 11-2.

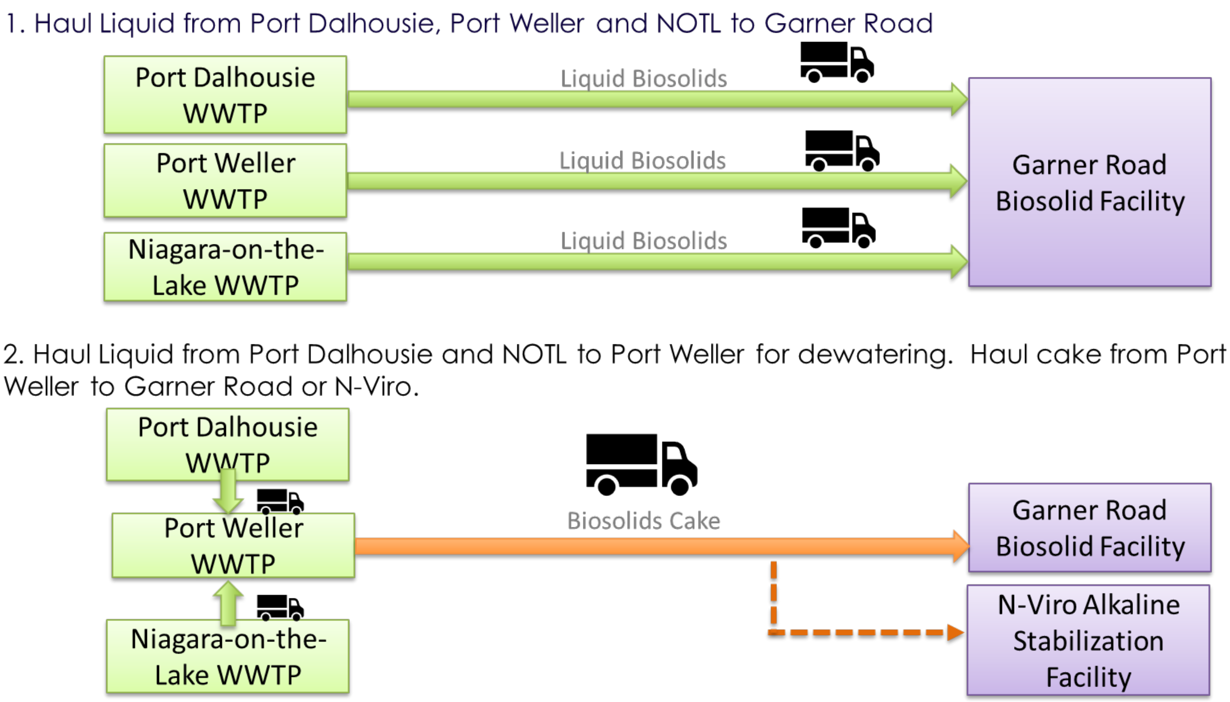


Figure 11-2: Area A Northeastern WWTPs Scenarios for Dewatering

Table 11-3 summarizes the results of the cost-benefit analysis for Area A scenarios, including a comparison of hauled volumes, number of truck trips and costing. Note that the cost or Scenario 2 is based on cost to haul cake to Garner Road, rather than hauling cake to the N-Viro facility to reduce the number of variables in the comparison. A detailed cost breakdown is provided in Appendix B.

Table 11-3: Cost Benefit Analysis of Area A Scenarios

	1. Haul Liquid from Port Dalhousie, Port Weller and NOTL to Garner Road	2. Haul Liquid from Port Dalhousie and NOTL to Port Weller for dewatering. Haul cake from Port Weller to Garner Road
Annual Volume Hauled	217,854 m^3 (liquid)	140,900 m^3 (liquid) 24,200 m^3 (cake)
Annual Haul Distance[1]	281,700 km	182,322 km
Annual # of Trucks Trips (1 way)	5,066	3,968
O&M Cost	$1.24 Million / year	$1.17 Million / year
Capital Cost	Nil – continue current operations	$13.5 Million
30 Year Life Cycle Cost	**$24.2 Million**	**$36.3 Million**

Notes:

1. Includes distance from WWTP to Garner Road, not to final land application or N-Viro facility
2. Unit liquid haul cost based on Thomas NS contract.
3. Number of trucks based on 43m^3 tanker truck for liquid hauling and 35m^3 dump trailer for cake hauling

Scenario 2, which incorporates dewatering at Port Weller WWTP, has a 30-year life cycle cost approximately 150% that of continuing with liquid hauling from northeastern WWTPs to Garner Road. This is partially due to the additional capital investment to construct dewatering at Port Weller. Although Scenario 2 has approximately 35% reduction in distance hauled per year, the operational cost savings are partially offset by the increase in O&M for dewatering operation. Based on the large cost differential between the two (2) scenarios, it is recommended to continue hauling liquid biosolids from the northeastern WWTPs to Garner Road.

11.1.2.2 Dewatering Scenarios in Area B – Niagara Falls WWTP

Niagara Falls WWTP currently dewaters the biosolids generated at their WWTP onsite. Walker Environmental transports the dewatered cake directly from the Niagara Falls WWTP to their N-Viro facility for advanced stabilization and product sale and marketing. The Region requested that the evaluation consider the option to remove dewatering from Niagara Falls WWTP and instead haul liquid to the Garner Road facility for storage and liquid land application or storage and dewatering at Garner Road before transportation by Walker Environmental for further stabilization. These two scenarios are presented in Figure 11-3 below. Although the dewatering equipment at Niagara Falls WWTP can achieve greater than 30% total solids (TS), to be conservative in the analysis, it was assumed that dewatering at Niagara Falls WWTP achieves 22% TS, which is the minimum required solids concentration to allow the biosolids cake to be accepted by Walker Environmental. If a higher TS percentage can be achieved, the amount of hauling for Scenario 2 below will be reduced further.

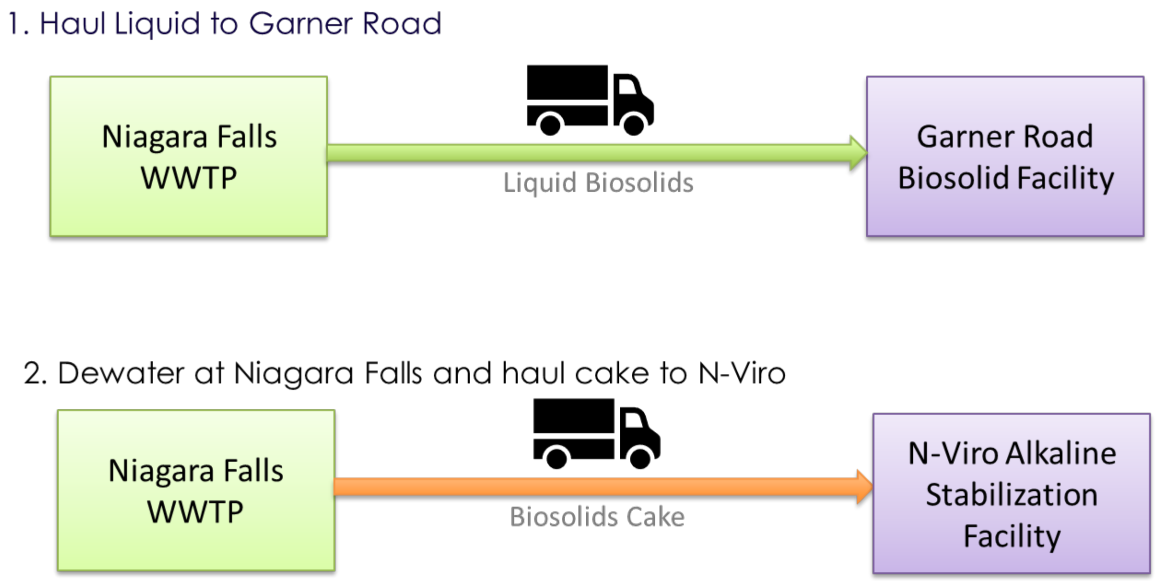


Figure 11-3: Area B Scenarios for Dewatering

Table 11-4 summarizes the results of the cost-benefit analysis at Niagara Falls WWTP, including a comparison of hauled volumes, number of truck trips and costing.

Table 11-4: Cost Benefit Analysis of Area B Scenarios

	1. Haul Liquid to Garner Road	2. Dewater at Niagara Falls and haul cake to N-Viro
Annual Volume Hauled	118,600 m^3 (liquid, 2.2% TS)	11,800 m^3 (cake, 22% TS)
Annual Haul Distance[1]	82,760 km	10,100 km
Annual # of Trucks Trips (1 way)	2,760	340
O&M Cost	$0.62 Million / yr	$0.50 Million / yr
Capital Cost	Nil – assume existing equipment repurposed	Nil – continue current operations
30 Year Life Cycle Cost	**$12.2 Million**	**$9.8 Million**

Notes:

1. Includes distance from WWTP to Garner Road or N-Viro, not to final land application
2. Unit liquid haul cost based on Thomas NS contract.
3. Number of trucks based on 43m^3 tanker truck for liquid hauling and 35m^3 dump trailer for cake hauling

Based on the cost analysis, it is more economical to continue transporting dewatered cake from Niagara Falls WWTP to N-Viro compared to hauling liquid biosolids to Garner Road. This is the case even when the cost to decommission the existing centrifuge at Niagara Falls is excluded from the capital cost. Furthermore, there is a more significant reduction in hauled volume by dewatering at Niagara Falls (approximately 90% reduction). Based on discussions with the Region, the centrifuge at Niagara Falls is performing well and resulting in a cake that is dryer than 22% (assumed TS % in life cycle cost analysis) which could further reduce transportation costs should the Region choose to land apply the material directly from the WWTP.

However, Region staff have also indicated that the centrifuge at Niagara Falls WWTP is nearing the end of its useful life. There are advantages to discontinuing dewatering at Niagara Falls once the existing equipment reaches the end of its useful life, and centralizing dewatering at the Garner Road facility. This approach would simplify operations, and potentially reduce labour costs.

11.1.2.3 Dewatering Scenarios in Area C – Anger Avenue WWTP

Anger Avenue WWTP is located in Fort Erie in the southeastern corner of the Region. Overall, dewatering is not economical at this plant due to the high solids concentration that is achieved with the use of their gravity belt thickener upstream of the digester. The transportation savings projected by transporting dewatered cake do not justify the capital and operating cost projected for dewatering. Another method considered to reduce the cost of liquid transport from Anger Ave to Garner Road is the direct land application of the liquid biosolids from Anger Avenue. Anger Avenue has liquid storage capacity that could support this approach. The scenarios for Area C, Anger Avenue WWTP, are shown in Figure 11-4 below.

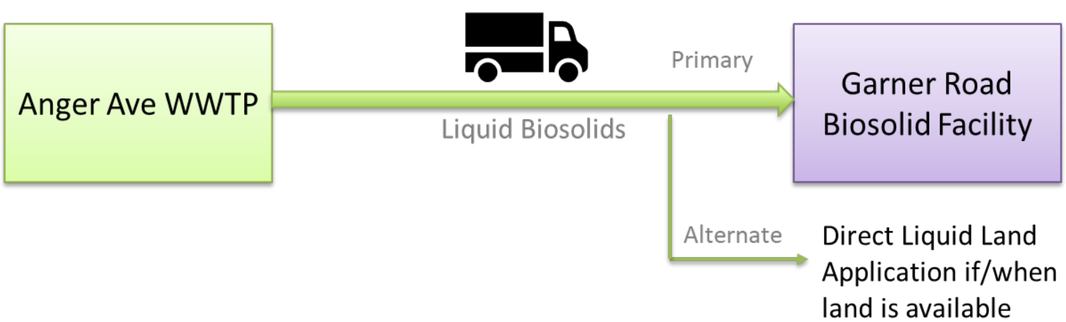


Figure 11-4: Area C Scenarios for Dewatering

Based on discussions with the Region, it is understood that, while there is considerable agricultural land in the vicinity of the Anger Avenue WWTP, currently there is limited use of biosolids to provide nutrients and organics to the soil on this land. It is recommended that the Region reach out the biosolids management firms and the agricultural community to determine if there is a market for this product. Once a market is developed, the direct land application of the biosolids generated at the Anger Avenue WWTP in the southern portion of the Region would save transportation costs and reduce truck traffic. It is recommended to continue transporting liquid biosolids from Anger Avenue WWTP to the Garner Road Facility, while exploring opportunities to land apply biosolids in the area.

11.1.2.4 Dewatering Scenarios in Area D – Baker Road WWTP

Baker Road WWTP is the plant located the furthest from the Garner Road Facility, and also has available space for dewatering. Furthermore, this plant has significant population growth forecast within the 2051-time horizon with rated capacity to increase from its current level of 31.3 MLD to 48 MLD by 2051. The biosolids quantities are anticipated to increase accordingly. Scenarios considered for Area D, Baker Road WWTP, are summarized in Figure 11-5.

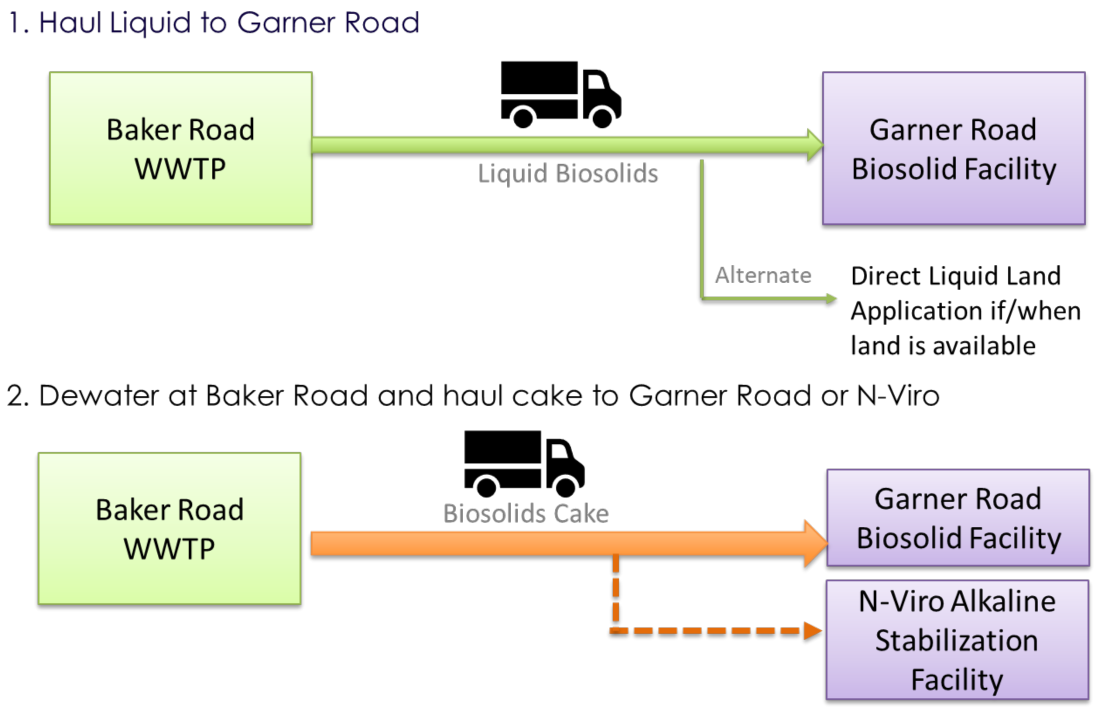


Figure 11-5: Area D Scenarios for Dewatering

Table 11-5 summarizes the results of the cost-benefit analysis at Baker Road WWTP, including a comparison of hauled volumes, number of truck trips and costing.

Table 11-5: Cost Benefit Analysis of Area D Scenarios

	1. Haul Liquid to Garner Road	2. Dewater at Baker Road and haul cake to Garner Road
Annual Volume Hauled	109,600 m^3 (liquid)	11,300 m^3 (cake)
Annual Haul Distance[1]	239,600 km	30,340 km
Annual # of Truck Trips (1 way)	2,550	320
O&M Cost	$1.07 Million / yr	$0.80 Million / yr
Capital Cost	Nil – continue current operations	$13.0 Million
30 Year Life Cycle Cost	**$21.0 Million**	**$28.7 Million**

1. Includes distance from WWTP to Garner Road, not to final land application or N-Viro
2. Unit liquid haul cost based on Thomas NS contract.
3. Number of trucks based on 43m³ tanker truck for liquid hauling and 35m³ dump trailer for cake hauling

Scenario 1 (continuing to haul liquid to Garner Road) has a lower 30-year life cycle cost than Scenario 2 (providing dewatering at Baker Road). However, Scenario 2 has the additional benefit of significantly reducing the annual number of truck traffic, thereby reducing truck traffic in a growing community, as well as reducing GHG emissions. There is approximately a 90% reduction in the total distance travelled by trucks carrying biosolids from Baker Road WWTP if dewatering is added at Baker Road WWTP. However, decentralizing dewatering would add complexity to operations. Furthermore, Baker Road WWTP is located closer to residential developments than Garner Road Biosolids facility and odour control requirements would likely be higher. Note that costing shown in Table 11-5 does not include the cost of odour control, so the total lifecycle cost for Scenario 2 would likely be higher than stated. Overall, dewatering at Baker Road WWTP should be considered due to the potential savings in transportation costs and associated greenhouse gas emissions.

11.1.3 Dewatering Recommendations

Based on the assessment above, our recommendations for dewatering are as follows:

1. Continue hauling liquid biosolids from northeastern WWTPs (Port Weller, Port Dalhousie, Niagara-on-the-Lake) to Garner Road Biosolids facility
2. Maintain dewatering at Niagara Falls WWTP. When dewatering equipment at Niagara Falls WWTP reaches the end of its useful life, consider liquid hauling from Niagara Falls WWTP to Garner Road for dewatering or liquid land application.
3. Continue hauling liquid biosolids from Anger Avenue and consider direct liquid land application from the WWTP is land becomes available.
4. Consider adding dewatering at Baker Road WWTP due to higher potential for reduction in cost and hauling.

Adding dewatering at Baker Road WWTP will impact the storage and long-term dewatering requirements at the Garner Road facility. Therefore, before confirming whether dewatering should be implemented at the Baker Road WWTP, a more detailed evaluation of the impacts on future upgrade and expansion needs at Garner Road was undertaken and presented in the following section.

11.2 Development of Upgrade Alternatives for Garner Road Facility

As recommended in Step 3, the biosolids within the lagoons at the Garner Road Facility can be thickened by decanting to consistently achieve a TS concentration between 3.5 and 4.0 %. This thickening through decanting will reduce the cost to transport solids for land application and increase the amount of solids that can be stored in the existing lagoons and storage tanks.

Implementing dewatering at Baker Road WWTP and managing the resulting cake either through the Region’s existing contract with Walker Environmental for additional processing and marketing or through a land application program operated by a third-party contractor, would also reduce total liquid storage required at Garner Road. As there is a capital investment to install dewatering at Baker Road, consideration should also be given to increasing dewatering capacity at Garner Road only and maintaining this as a centralized facility for dewatering.

Two (2) alternatives were developed and evaluated for Garner Road:

Alternative 1: Continue transporting liquid biosolids from all WWTPs to Garner Road excluding the Niagara Falls WWTP and decant the Garner Road lagoons and storage tanks to achieve biosolids TS concentration of 3.5%. A TS of 3.5% was selected as it is at the lower end of the expected TS range of 3.5% to 4% and provides a more conservative estimate of future liquid storage requirements. This alternative anticipates that no dewatering is added at any the Region's WWTPs, including Baker Road WWTP. The dewatering capacity at Garner Road will increase under this alternative to accommodate increased biosolids production over time while continuing to meet Walker Environmental contractual obligations.

Alternative 2: Haul liquid biosolids from all WWTPs to Garner Road, excluding the Niagara Falls and Baker Road WWTPs. The biosolids generated at the Niagara Falls and Baker Road WWTPs will be dewatered at those two WWTPs. The resulting dewatered cake from both WWTPs will be transported by Walker Environmental to their N-Viro processing facility. The lagoons and storage tanks at the Garner Road Facility will be decanted to achieve 3.5% biosolids TS. An increase in dewatering capacity will still be required at Garner Road under this alternative, but this can be done at a later time compared to Alternative 1.

11.2.1 Review of Impacts of Alternatives

Figure 11-6 illustrates the impacts of increased lagoon decanting on liquid storage requirements at Garner Road under the two (2) alternatives described above.

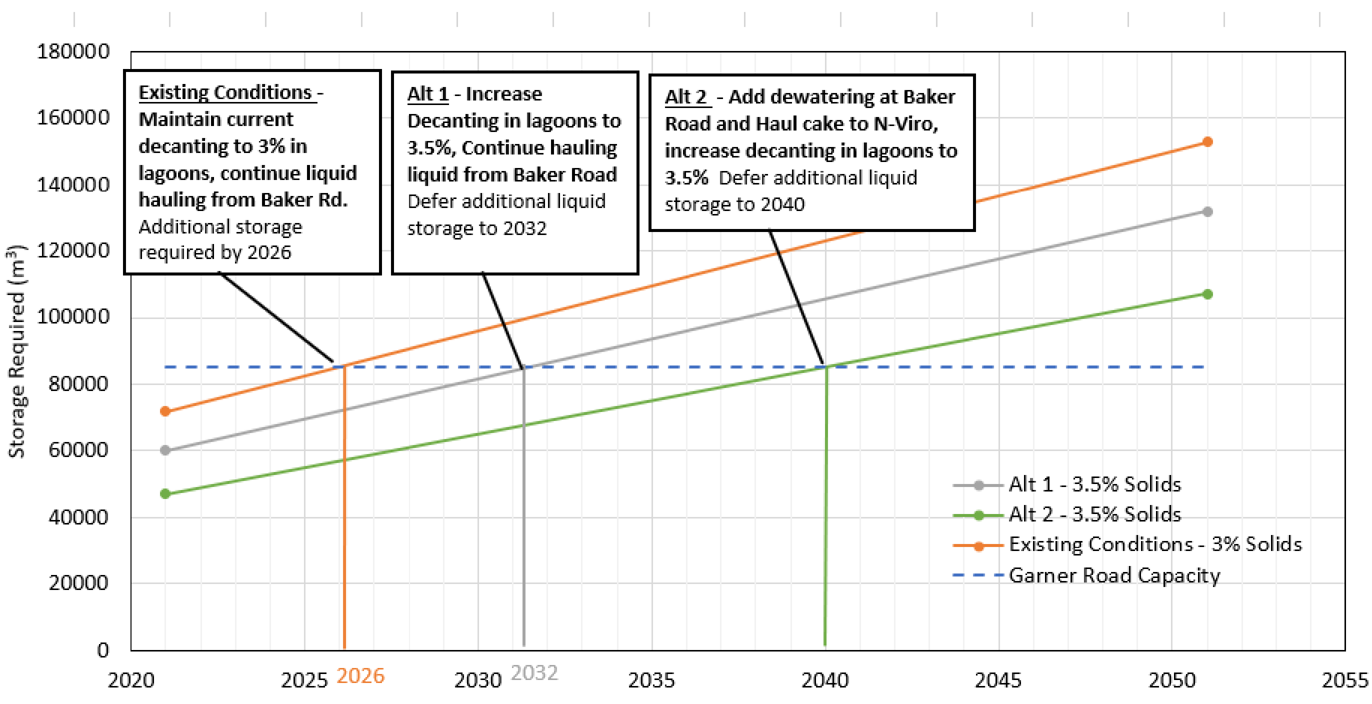


Figure 11-6: Impacts of Dewatering at Baker Road WWTP and Increasing Lagoon Decanting at Garner Road on Liquid Storage Requirements at Garner Road

As shown in Figure 11-6, if the current strategy is continued without increasing decanting, liquid storage at Garner Road will be insufficient by 2026. If decanting is increased to achieve 3.5% total solids in the lagoons, and liquid biosolids from Baker Road continue to be hauled to Garner Road (alternative 1), liquid storage at Garner Road will be insufficient by 2032. By implementing dewatering at Baker Road WWTP and diverting this volume of biosolids from Garner Road WWTP to N-Viro, in combination with increased decanting (alternative 2), the existing liquid storage capacity at Garner Road will be sufficient until approximately 2040. Overall, increasing decanting at Garner Road and dewatering at Baker Road WWTP would both contribute to delaying the need for increased storage and dewatering at the Garner Road facility.

A comparison of scope, community impacts, haulage, staffing requirements and costing of the two alternatives is shown in Table 11-6. For comparison purposes, continuing with the existing biosolids strategy is included in Table 11-6. This includes dewatering up to 6000 dt/year of biosolids and hauling to the N-Viro Alkaline stabilization facility to meet requirements of the Region’s current contract with Walker Environmental. The remaining biosolids would continue to be hauled to Garner Road and then land applied as a liquid product. Under the existing strategy, capital upgrades would still be required at Garner Road to meet capacity requirements for liquid storage to 2051.

Table 11-6: Scope and Costing of Dewatering Alternatives

	Continue Existing Strategy; Dewater between 4700 and 6000 dt/year of Biosolids to meet Current Contract Obligations to Walker Environmental, with remaining biosolids land applied as liquid; Increase Decanting in Lagoons to 3.5% TS	**ALT 1 – Dewater ALL Biosolids in Region for Direct Cake Land Application OR Alkaline Stabilization; Increase Decanting in Lagoons to 3.5% TS, Continue dewatering at Niagara Falls WWTP and Garner Road Facility Only**	**ALT 2 – Dewater ALL Biosolids in Region for Direct Cake Land Application OR Alkaline Stabilization; Increase Decanting in Lagoons to 3.5% TS, Add dewatering at Baker Road WWTP and Continue dewatering at Niagara Falls WWTP and Garner Road Facility**	
Scope of Upgrades	Garner Road Upgrades: 3 Centrifuges, 2 duty Rated for 11.2 dt/d 8 additional liquid storage tanks (14,000 m^3 each) Cake from Niagara Falls and additional biosolids from Garner Road required to provide 4700 to 6000 dt /yr to be transported and processed by Walker at $584/dt	Garner Road Upgrades: 6 Centrifuges, 5 duty Rated for 39.3 dt/d 25,000 m^3 cake storage All cake land applied by 3rd party at $85/m^3, except for cake from Niagara Falls which is transported and processed by Walker and the remaining solids required to meet the 6,000 dt /yr maximum contract requirements at $584/dt	Garner Road Upgrades: 5 Centrifuges, 4 duty Rated for 32.5 dt/d 23,000 m^3 cake storage 926 dt/yr of cake processed by Walker at $128.5/m^3 ($584.10/dt). Remaining cake land applied by 3rd party at $85/m^3.	Baker Road Upgrades: 2 Centrifuges, 1 duty Rated for 6.8 dt/d No storage at Baker Rd WWTP All cake from Baker Rd hauled/processed by Walker at $128.50/m^3 ($584.10/dt).
Community Impacts / Haulage	Existing haulage routes avoid sensitive communities to the greatest extent possible. Haulage through existing routes will continue. Highest truck traffic due to higher volumes associated with liquid biosolids hauled to land application compared to cake.	Existing haulage routes avoid sensitive communities to the greatest extent possible. Haulage through existing routes will continue. Reduced hauling from Garner Road to land application compared to ALT 0 due to increased volumes of cake compared to liquid biosolids.	Reduce # of trucks by trucks per day compared to Alt 1; no different haulage routes expected	
Additional Regional Staffing Requirements	2 additional staff expected	2 additional staff expected	3.5 additional staff expected	
Capital Cost	$ 91.2 M	$ 41.6 M	$ 51.1 M	
Annual Operation, Maintenance and Hauling Cost	$ 0.65 M (dewatering O&M, labour) + $ 3.8 M (liquid to Garner) + $ 2.4 M (liquid to land app) + $ 3.5 M (Walker Hauling/processing) = $ 10.4 M / year	$ 1.4 M (dewatering O&M, labour) + $ 3.8 M (liquid to Garner) + $ 0.4 M (cake to land app) + $ 3.5 M (Walker Hauling/processing) = $ 9.1 M / year	$ 1.5 M (dewatering O&M, labour) + $ 2.8 M (liquid to Garner) + $ 0.4 M (cake to land app) + $ 3.9 M (Walker Hauling/processing) = $ 8.2 M / year	
Life Cycle Cost (3%, 30 year)	$ 290.2 M[2]	$220.1 M	$211.7 M	

Notes:

1. Centrifuge capacities listed are based on operating 5 days per week, one 8hr shift/day.
2. Life cycle cost is based on sending 6000 DT/year to Walker Environmental. If only 4700 dt/year is sent, the annual O&M for liquid to land application will increase and the annual O&M for dewatering and Walker Hauling/processing will decrease

Overall, adding dewatering at Baker Road WWTP will save approximately 8 million dollars over a 30-year life cycle period when compared to liquid transport and dewatering all the solids at Garner Road. This is approximately a 4% savings, which is within the margin of error of this estimate. Dewatering at both facilities would require an additional centrifuge but saves over $900,000 per year due to reduced transportation cost between the Baker Road WWTP and the Garner Road Facility. More additional staff will be required to operate dewatering at both Garner Road and Baker Road WWTP, compared to operating dewatering at only Garner Road.

Continuing with the Region's current approach of liquid land application and dewatering and sending to Walker Environmental has the highest life cycle cost. This is due to both a higher capital cost to install additional liquid storage at Garner Road, as well as additional dewatering capacity to produce up to 6000 dt/year of cake for Walker Environmental. Annual costs to continue the existing strategy are also highest due to hauling cost of large volumes of liquid biosolids.

If dewatering is implemented at Baker Road WWTP, this will delay the need for liquid storage upgrades at Garner Road. Nevertheless, Garner Road upgrades would be required prior to 2051, regardless of whether dewatering is added at Baker Road in order to address increasing biosolids volumes over time associated with population growth.

Additional liquid storage would not be required at Garner Road if dewatering capacity is increased to allow all liquid biosolids sent to Garner Road to be dewatered and land applied as cake. If land application of cake is pursued, cake storage would be required at Garner Road between February and April, when land application is not possible. This storage would allow for a stockpile of cake to form, ensuring adequate quantities for spring land application, while not exceeding a storage time of 90 days.

Additional dewatering at Garner Road with cake storage should be considered to further reduce hauling and associated operating costs. There are some advantages to adding dewatering at Baker Road WWTP due to reduced community impacts through reduced truck traffic, reduced greenhouse gas emissions, and a lower operating cost. To minimize potential odour impacts on surrounding residences, the dewatering processes would be designed to include odour control measures as well.

Although the life cycle costs for Alternative 1 and 2 are not significantly different, Alternative 2 will delay the need for major capital upgrades at Garner Road and will reduce overall truck traffic in the Region. However, because of current operational issues with the centrifuges at the Garner Road facility, short-term upgrades are required to allow accessibility for maintenance. As such, it is preferable to add more dewatering capacity at the Garner Road facility in the short-term and delay the potential addition of dewatering at Baker Road WWTP. This will avoid the need for two large scale capital dewatering upgrades in the short-term.

11.3 Storage Reduction Opportunities and Storage Approaches at Garner Road Biosolids Facility

Storage at Garner Road has been historically adequate; however, with the population expected to increase 40% by 2051, the facility will face a storage constraint. Furthermore, in recent years, the Region has needed to truck excess water offsite on multiple occasions during wet weather conditions due to limited liquid storage and the inability to land apply during wet weather. Although there is a centrate pumping system that will discharge excess water to a forcemain that discharges into the Niagara Fall WWTP catchment, this system has limited capacity to meet pumping needs during wet weather events. This section first examines methods to reduce the total volume of biosolids requiring storage at Garner Road. Potential types of biosolids storage will then be reviewed.

11.3.1 Methods to Reduce Storage Requirements

Reducing storage requirements at Garner Road will help reduce upgrade and expansion needs at the facility. This section describes methods to reduce storage requirements at Garner Road and recommends approaches for reducing storage.

11.3.1.1 Increase Dewatering at WWTPs

The preferred dewatering strategy is to continue dewatering at the Niagara Falls WWTP and add dewatering capacity at Baker Road WWTP. Adding a capacity at Baker Road will reduce the liquid biosolids sent to Garner Road for storage and reduce storage requirements at Garner Road.

11.3.1.2 Modify Supernatant Management at Garner Road Facility

Currently a third-party contractor is responsible for the supernating of the lagoons. Supernatant is then pumped from Garner Road lagoons through a forcemain to the Niagara Falls WWTP sanitary catchment. In practice, the solids content of the land applied biosolids has been decreasing over a three-year period (4.48% to 3.59%). Optimal solids content for land application is between 4% to 6%; the five (5)-year average of the solids content is 4.2%. Increasing supernating at Garner Road would decrease the volume that must be stored at the facility. This technique would also ensure that the solids content of the biosolids that are land applied are within the desired solids content range.

This optimization would put more strain on the WWTPs that receive the supernatant from Garner Road. Under normal conditions, supernatant is discharged to the Niagara Falls WWTP sanitary system via forcemain. When this forcemain is not available, supernatant is hauled to a maintenance hole (MH) within the Port Weller WWTP catchment. Receiving WWTPs will have to receive more supernatant, even if Garner Road maintains current solids content output, due to the anticipated increased flows. Further analysis, beyond the scope of this Master Plan, would be required to ensure the WWTPs have the ability to receive Garner Road supernatant, and that the forcemain from Garner Road has the capacity to receive increasing supernatant pumping.

11.3.1.3 Mechanical Thickening at Garner Road Facility and Wastewater Treatment Plants

Mechanical thickening prior to the biosolids entering storage at Garner Road could help decrease the storage requirements at the facility. This process reduces the water content of the biosolids, allowing a lower volume to be stored, and subsequently increasing the solids content, achieving a higher quality land application product. With this solution, there could be a rotary drum thickener or other mechanical thickening equipment implemented at Garner Road that would thicken the biosolids prior to storage. Furthermore, it would be possible to reduce the total volume of liquid biosolids entering the Garner Road facility by thickening WAS at the WWTPs prior to digestion. This has the added benefit of potentially increasing digester performance. Currently, only Anger Avenue and Niagara-on-the-Lake using thickening upstream of their digesters. Based on space currently available at the remaining WWTPs, there is an opportunity to add mechanical thickening at Port Dalhousie, Port Weller and Welland WWTPs.

Mechanical thickening, such as rotary drum thickening, is preferred over gravity thickening as higher solids content can be reliably achieved. Mechanical thickening can reliably achieve greater than 4% solids content. In addition to mechanical thickening, there is also an opportunity to increase supernating of the digesters at the WWTPs to increase the solids concentration in the final liquid biosolids product that will need to be hauled to Garner Road.

It is likely that storage of the biosolids, prior to mechanical thickening, would be required, as thickening may not be operated every hour of each day.

11.3.1.4 Dewatering at the Garner Road Facility

Dewatering at the Garner Road facility is likely to increase as the flows to the facility increase. To account for the increase in flow entering the facility, the centrifuges will likely have to be run longer to accept at minimum 780 m^3/d, if not more

The centrifuges are producing quality cake that is sent to Walker Environmental for N-Viro processing. The current contract between the Region and Walker Environmental provides incentive to Garner Road to send higher solids content cake as the Region is charged less for this material, versus cake with a low solids content. Therefore, with the expected increased flows to Garner Road, it would be beneficial to the Region to keep the quality of cake high as this could result in significant savings over time.

As previously noted, an issue that has hindered the Garner Road facility is the reliability of the centrifuges. Garner Road has two centrifuges and often one is shutdown for maintenance or repair. To improve the efficiency of the dewatering practices at Garner Road, implementation of a back-up third centrifuge (mobile), or a new dewatering centrifuge facility with additional redundancy will help improve the reliability of the dewatering process as sludge flow increases.

To increase capacity of the existing centrifuges without capital upgrades, increasing the daily run-time could be considered, which would require additional hours for operations staff.

11.3.2 Recommendations to Reduce Storage Requirements

To reduce required storage volume, it is proposed that increased supernating (decanting) of the lagoons be taken as a first step. This can be done in a gradual manner to assess impacts on the downstream WWTPs. Capacity of the forcemain from Garner Road may require upgrades to accommodate expected decanting flows for current and future conditions depending on the increased level of decanting implemented. Mechanical thickening may also be considered in future if the limits of decanting are reached, in order to hold-off investment in additional storage capacity.

11.3.3 Identify Storage Approach

Even if upgrades or operational optimization are undertaken to reduce the total volume required to be stored at Garner Road, additional storage capacity will be required to meet 2051 biosolids quantities. This section provides a review of types of storage and recommends the preferred storage approach.

Three (3) main storage types are available for the facility: tank storage, lagoon storage, and cake storage.

11.3.3.1 Lagoon Storage

Lagoon storage is the prevalent technology used at the Garner Road Biosolids and Dewatering Facility. Lagoons are a simple technology that require little work to construct and operate; however, they take up large plots of land.

Table 11-7 highlights the advantages and disadvantages of the lagoon technology.

Table 11-7: Lagoon Storage Advantages and Disadvantages

Advantages	disadvantages
• **Simple installation** • **Effective at removing BOD_5, TSS, pathogens, fecal coliform, and ammonia** • **Low capital and O&M costs**	• Periodic dredging of lagoon bottom required • Large footprint • Strong odour during spring & fall turnovers • Colder climates limit lagoon effectiveness due to freezing • Breeding ground for mosquitos and other insects • Difficult to ensure mixing • Must monitor for leakage

Increasing the number of lagoons at the facility is an option to increase the storage capacity at the facility. This option is largely dependent on the amount of available land around the facility as lagoons tend to require large plots of land. Lagoons typically have a depth that does not exceed 2.5 m to 3 m, thus the footprint must be large to account for the lack of depth that they can utilize.

This storage option is practical, as lagoons are cheap to construct and are low maintenance once built. Lagoons do not hold as much volume as storage tanks when considering equal footprints, thus this is likely not a viable alternative option to help with the future storage constraint that the Garner Road facility will face by 2051.

11.3.3.2 Tank Storage

Garner Road currently has three (3) storage tanks (glass fused to steel tanks) with a volume of 7736 m^3 each. These tanks offer more storage than the lagoons (each lagoon can store 6830 m^3), while also having a smaller footprint. If the facility has limited access to additional land, storage tanks could be a viable option as they have a smaller footprint than the lagoon alternative.

This storage option also provides more flexibility to Garner Road. These tanks can be increased in height, instead of footprint, to add storage, making them an efficient option. Several tanks could be placed on the same sized area as a lagoon while adding two (2) to three (3) times more storage than a lagoon of the same footprint.

This leads to the option of adding additional tank storage. This would allow for increased storage at the facility, while minimizing footprint.

Table 11-8 below highlights the advantages and disadvantages of tank storage.

Table 11-8: Tank Storage Advantages and Disadvantages

Advantages	Disadvantages
• Low O&M costs • Weather has negligible effects on the contents of the container • Tanks provide odour reduction • Smaller footprint • Construction is quick and reliable • Expansion and relocation are simple • Anti-corrosive properties	• High capital cost • Insulation may be preferable to prevent freezing, adding cost • Tanks can chip & crack • Leaks may develop without proper design & installation • Tanks will require inspection every few years

11.3.3.3 Cake Storage (Stockpiled)

Cake storage could be implemented at Garner Road to allow for cake land application. Ontario Design Guidelines for Sewage Works (2008) provides guidelines on cake storage at a WWTP; although the Garner Road Biosolids Facility is not a WWTP, this guideline is used as reference. The guideline suggests that cake storage on a concrete slab should only be considered for cake with a solids concentration greater than or equal to 35%. For dewatered biosolids that are below a solids content of 35%, it should be stored in a steel or concrete container.

The length of storage time recommended in the Design Guideline also varies depending on the solids content of the biosolids. If the solids content is greater than or equal to 35%, the biosolids can be stored for up to 90 days onsite, while the storage time is decreased to 7 days if the solids content is below 35%.

To conform to the Design Guideline recommendations, cake storage at Garner Road would need to be limited to 90 days for solids concentrations 35% or greater or limited to 7 days for solids content below 35%. This could be achieved by storing the biosolids in liquid form until approximately February or 90 days before land application can begin in spring. An SOP could be devised for the start of dewatering to stockpile cake and prepare for the beginning of land application season. Cake production and storage would then be on demand after this reserve is depleted until the end of the land application season, when this process must be repeated.

However, the current solids content of the dewatered biosolids produced at Garner Road is 32.1%; it is not practical to consistently achieve greater than 35% TS, considering the large quantities of polymer required. The Environmental Protection Agency (EPA) Guide to Field Storage of Biosolids (2000) also provides recommendations for storage of biosolids as both liquid and cake. For dewatered biosolids, defined as 12 – 30% solids in the guide, either storage on a concrete pad or within an enclosed building are suggested.

Table 11-9 illustrates the advantages and disadvantages, assuming the stockpile storage technique can be implemented.

Table 11-9: Cake Storage Advantages and Disadvantages

Advantages	Disadvantages
• Cake storage for up to 90 days if solids >35% • Stockpile storage technique, easy to implement • Allows for direct cake land application	• Precipitation must be diverted from pile • Odour potential • Requires discussions with MECP to determine feasibility of storage cake <35% onsite longer than 7 days.

If cake storage is implemented at the Garner Road facility, the preferred storage type would be a covered concrete slab with containment curb or low side walls, allowing the cake to be stockpiled while remaining protected from precipitation. Keeping the pile open to the air reduces anaerobic conditions to help control odour and removes the need for active ventilation. To maintain handleability of the biosolids, it is proposed that biosolids be dewatered to at least 22% TS and preferably >30% before storing. This will also meet the minimum solids concentration required by Walker Environmental, so the cake could potentially be hauled to the N-Viro facility if direct cake land application is not readily available, adding flexibility to the program.

There are also several examples of cake storage facilities in Ontario that store cake for longer than 7 days (i.e., through the winter) using fully enclosed, or simply covered facilities. This practice is used at the Oxford County Biosolids Storage Facility in Salford, ON, and the Mississippi Mills WWTP in Lanark County.

Regardless, additional consultation with the MECP will be required to confirm acceptability of this approach, and the opportunity to store cake with a solids content <35% for longer than 7 days onsite. As a conservative approach, the Region should consider indoor, ventilated cake storage with active odour control that is more likely to be approved by the MECP.

11.3.4 Recommended Storage Approach

For liquid storage, it is recommended that the existing lagoons and tanks be maintained and continue to be utilized at the Garner Road Facility to maintain existing liquid storage capacity. Additional liquid storage is required at the Garner Road Facility within the 2051-time horizon; installation of tank storage for liquid biosolids is recommended due to the smaller footprint, containment of odour, and resilience to wet weather events when compared to lagoon storage.

Cake storage on a covered concrete pad or within an enclosed, ventilated building is recommended if direct cake land application is pursued.

The combination of both liquid and cake storage will provide increased operational flexibility at the Garner Road Facility.

11.4 Further Opportunities for Optimization of the Region's Biosolids Management Program

Along with the recommendations presented above, there are additional operational considerations that can help Niagara optimize their biosolids management program. These are reviewed in this section.

11.4.1 Centrate Management

There are two (2) avenues for centrate management at Garner Road, either the centrate is pumped to the sewer system via a forcemain for treatment at the receiving Niagara Falls WWTP, or it is stored on-site in a lagoon designated for centrate storage. As the facility expands and the centrifuges are run more often, larger pumps may need to be installed to pump the centrate to the sewer system or the lagoon to account for the increased flow that will be experienced. An upgrade of the forcemain may also be required to ensure adequate capacity to accept larger future centrate flows. The Region is currently planning an upgrade to this forcemain where the detailed design can account for potential additional flows.

11.4.2 Waste Activated Sludge (WAS) Thickening

WAS thickening can be considered at Port Dalhousie, Port Weller and Welland WWTPs to provide additional digester capacity and reduce hauled liquid volume to Garner Road. These plants are candidates for WAS thickening due to their larger capacities and requirement for digester expansion. Currently the plants use co-thickening for the PS and WAS. This process generates a biosolids with approximately 2% total solids, while if the sludges were separated 3-3.5% total solids could be expected.

The available footprint available at these sites allow for construction of WAS thickening or additional tank volumes to be implemented. From a biosolids management perspective, dedicated WAS thickening will reduce the number of trucks and hauling from the facilities. The implementation can be confirmed at the time of digester expansion to best suite each individual site.

11.4.3 Upgraded Forcemain at Garner Road

An option to reduce hauling and optimize the Region's overall biosolids management strategy is to consider increasing the capacity of the forcemain at Garner Road so that supernatant does not have to be hauled to WWTPs for treatment, which is currently done on an intermittent basis as required. Currently, if the forcemain is unavailable, the supernatant from Garner Road must be hauled to a MH in the Port Weller WWTP catchment, creating truck traffic. If the forcemain were to be upgraded, such that it can handle more flow, this would limit the number of trucks that must be used to transport supernatant from Garner Road. Upgrades are planned in the short-term to bring the forcemain back to its rated capacity, which will allow higher flows of decanted liquid from the lagoons to be discharged. As part of the Region's longer term plan strategy, the feasibility of expanding the existing forcemain should be considered.

11.4.4 Biosolids Training Program

Training programs are important for any facility as these programs ensure that competent people are working on site, such that minimal mistakes are made, and the facility can run efficiently. The Garner Road facility echoes this view and requires training for all staff that work on-site. The following sections describe the training practices for staff, comparing these to industry best practices, along with identifying opportunities for the optimization of the Region's training program.

11.4.4.1 Staff Training Practices

The municipality requires that all persons who work at the Garner Road facility are trained and receive refresher training according to Condition 17.3 of the training manual. Condition 17.3 states:

- The Municipality shall maintain a training manual covering at a minimum a list of employee functions and the type of training required to fulfil that job function with respect to the operation, management, inspection, record keeping requirements, contingency plan, monitoring, and maintenance of this Site.
- The training plan shall be reviewed on an annual basis, at a minimum, and updated as required to reflect any changes in equipment, operational procedures, or Site conditions.
- A copy of the training manual shall be available at the Site for review by a Provincial Officer upon request.

Other municipalities of comparable size, with similar operations, share similar training regiments for their employees. Various training programs are offered and subsequently required by the employee's depending on the scope of their responsibilities at the facility.

These training requirements have led Garner Road to follow the best practices of the industry, ensuring that all staff on-site are competent workers, who could respond accurately and timely to an adverse situation.

11.4.4.2 Opportunities for Training Optimization

Throughout the lifetime of Garner Road, and other similar facilities, different situations will arise that have not been covered in training, thus making the staff react and respond in the best possible manner they can in that moment. Only after the situation has been rectified, can it be reviewed and discussed to determine how the response could have been improved and more streamlined. Therefore, an annual review, at a minimum, of the facilities training programs is important. To optimize the training received by staff, a bi-annual revision of the training programs at the facility could be done, or mandatory training to all on-site personnel once an adverse situation has occurred and an appropriate response to the situation has been determined.

The facility has in place refresher training for training courses that are given to employees. To optimize the efficiency of these refresher courses, occurrence every year would ensure that the staff retains the training knowledge and is always up to date with the current industry best practices.

11.4.5 Material Quantity Measurement

It has been assumed that each truck either bringing biosolids into Garner Road, or hauling biosolids from Garner Road, are filled to their capacity. This cannot be verified as there are no material quantity measurement practices in place at the Region. Having a system in place to correctly measure the quantities of biosolids that are being hauled around the Region would improve the granular data that is provided to the Region, allowing them to make more accurate predictions of storage requirements at Garner Road.

The material quantity measurement could take place as a weigh scale that trucks must pass through when they are entering or leaving Garner Road. This would allow the Region to accurately calculate the volume of biosolids that each truck contains, improving the reliability of the haulage volumes and data. Additionally, material quantity measurements could also take place to track the biosolids leaving the site that are being used for land application as well.

11.4.6 Security Protocols

Security at Garner Road is of top priority such that anyone on site remains safe, to ensure that people outside of the facility can not enter without proper access, and to ensure no un-authorized disposals are occurring. By keeping everyone informed with signage and proper operating procedures, the security protocols are in place only to promote proper operation of the facility. The existing security protocols along with recommendations for future improvements to the security protocols are discussed in the following sections.

11.4.6.1 Existing Protocols

The existing security protocols of the Garner Road Biosolids and Dewatering Facility are as follows:

- The Municipality shall ensure that a competent person is on site at all times during loading and unloading at this Site. No loading, unloading or transfer shall occur unless a competent person supervises the loading or unloading.

- The Municipality shall ensure the area of the Site bounded by the fence is locked and secured by a minimum 1.8-m-high lockable security fence at all times when a competent person is not present.
- The Municipality shall ensure the Site is adequately lit at all times during loading and unloading
- The Municipality shall post a sign at the site, readable at a distance of 25 m from the public roadway bordering the site, identify the name of the Site, the Municipality's name and emergency telephone number.

In 2021 to 2022, the facility added the following new upgrades to their security system:

- Addition of two (2) new automated security gates
- Addition of security card swipes for entry at the new security entry gates
- Addition of security cameras at each of the new security gates

With the future upgrades to the security system, and the existing protocols already in place, Garner Road facility meets industry best practices and will continue to have adequate security protocols in place when the upgrades are complete.

11.4.6.2 Recommendations for Improvement of Security Protocols

Further improvement to the facility may include the addition of cameras throughout the grounds of the facility, to ensure that all equipment and storage are constantly monitored. These cameras would ensure that any unwanted visitors that access the facility away from the main gate are captured on tape, and the necessary steps could be taken. However, the current and future security protocols that are, and will be, in place at Garner Road are adequate and little improvement to the protocols is likely required for the facility.

11.4.7 Diversify and Optimize Biosolids Disposal

Two (2) main biosolids disposal options are currently employed at Garner Road; liquid land application and sending dewatered biosolids to Walker Environmental for alkaline stabilization. A third alternative disposal method is also recommended, direct land application of dewatered biosolids cake, as discussed further in Appendix A – Technical Memorandum 7 under biosolids management Strategy 2. Overall, it is recommended that multiple disposal methods be implemented to maintain a diverse program, including liquid land application, cake land application and alkaline stabilization to create a fertilizer product for beneficial use on land.

The Region should continue to work with their third-party contractors to optimize their disposal land application program. Haulage routes should be continually reviewed so that the most efficient routes are select to minimize distance and impacts to communities.

The feasibility of direct land application from WWTP with storage capacity and that are furthest from Garner Road may help the Region reduce storage requirements at the Garner Road facility, as well as decrease haulage requirements. The Region's current contract with Thomas Nutrient Solutions has provisions for hauling liquid biosolids from WWTPs that have storage tanks directly to land application rather than first hauling to Garner Road. The intention is to reduce the total distance liquid biosolids need to be hauled in the Region. At this time, only Anger Avenue WWTP in Fort Erie and Baker Road WWTP in Grimsby have liquid storage tanks for biosolids. However, there is not the demand for liquid products in the vicinity of the Anger Rd. WWTP, so all liquid biosolids from this plant are currently hauled to Garner Road Biosolid Facility. As part of their overall Biosolids Management Strategy, the Region should review the market potential for liquid land application at different areas within the Region and adjust their program accordingly. Increased decanting from the existing storage tanks could be considered to increase gravity thickening of digested biosolids before hauling to land.

Appendix A – Technical Memorandum 10 presents a review of existing third party biosolids management contracts and will discuss potential opportunities for land application in more detail.

11.4.7.1 Liquid Land Application

Disposing of the biosolids through liquid land application has been the Region's preferred historic disposal option. This is a practical disposal method as the lagoons and storage tanks at Garner Road can be easily supernated to achieve the correct solids content for land application.

To continue with this disposal option, the storage at Garner Road must be increased to cope with the anticipated increase in flows that are expected as the Region's population increases, unless cake storage and direct cake land application is implemented. Furthermore, the volume increase required at Garner Road will be dependent upon the implementation of increased decanting or pre-thickening at the facility.

11.4.7.2 Hauling to Walker Environmental

Another disposal option currently used for the facility is to haul the dewatered biosolids produced from the centrifuges to Walker Environmental's N-Viro Facility for Alkaline Stabilization. The Region's contract with Walker Environmental states that the Region is to provide a minimum of 4700 DT/year to Walker Environmental up to a maximum of 6000 DT/year. If the current approach of sending 50% of biosolids to Walker Environmental is maintained, this limit must be increased as the flow to Garner Road increases. Opportunities for existing third-party contracts are discussed further in Appendix A – Technical Memorandum 10.

11.4.7.3 Cake Land Application

To reduce the volume of biosolids hauled to land application, the biosolids could be land applied as a dewatered cake, rather than a liquid product. Similar to land application of liquid biosolids, biosolids cake is regulated as a Non-Agricultural Source Material (NASM) through the Nutrient Management Act and O.Reg.267/03. Different types of vehicles are required for hauling cake and land applying it, so moving to cake land application will require discussions with the third-party haulers and agriculture end users. A pilot program for cake land application was conducted the fall of 2024 and results are pending.

11.4.8 Centralized Anaerobic Digestion Facility

Existing aerobic digesters at the Region's WWTPs are aging and many require upgrades in the short term to address current operational issues and/or meet future capacity requirements. Due to the scale of the individual WWTPs, there is more limited opportunity to utilize the biogas produced from the digesters as a form of renewable energy. The Region should assess the feasibility of a centralized anaerobic digestion facility located at the Garner Road site to generate more substantial quantities of renewable biogas. This biogas could be combusted to generate energy to power a portion of the facility or provide heating. It is also possible to upgrade the biogas sufficiently to sell it to the natural gas utility. Sludge thickening at the WWTPs should still be considered prior to hauling to a centralized AD facility to reduce hauling requirements. There may be opportunities to repurpose digesters at the WWTPs into settling tanks to achieve some thickening prior to hauling. Further review is required, outside the scope of this Master Plan, to understand the cost-benefits and carbon footprint impacts of a centralized facility, to align with the Region's Corporate Climate Action Plan.

12 Water Treatment Residuals Management

As part of the Biosolids Management Master Plan Update, the Region is reviewing their current practices and long-term options for the management of the water treatment plant residuals. This section evaluates alternatives to address the water treatment residuals generated in the Region.

It is recommended that the Region continue the current practice of combining the water treatment residuals generated in the Region with biosolids and beneficially using them rather than landfilling or drying followed by incineration. Further details on the screening process are provided in TM 8 (Appendix A). For each WTP, three (3) alternatives for managing the water treatment residuals were considered.

Alternative 1: Haul thickened residuals to the Garner Road Biosolids Facility and blend with biosolids prior to beneficial use on land (either liquid land application or dewatering and transport to alkaline stabilization facility and distribution as a fertilizer product).

Alternative 2: Convey residuals to a WWTP through the wastewater collection system and treat the residuals along with the wastewater. Blended biosolids/residuals would then be hauled as liquid to Garner Road for either liquid land application or dewatering and transported to an alkaline stabilization facility and distribution as a fertilizer product.

Alternative 3: Haul thickened residuals to a WWTP with dewatering, and blend with biosolids prior to dewatering. Blended dewatered biosolids/residuals would then be transported to the N-Viro alkaline stability facility for distribution as a fertilizer product.

Key considerations when determining the preferred alternative for each WTP are:

- Potential for impacts to the downstream WWTP if residuals are sent to sewer which is influenced by:
    - Volume of residuals produced; a larger volume of residuals has a greater potential to overwhelm the local sewer system.
    - Ability of WTP effluent (including residuals) to meet current sewer use by-law.
- Proximity of WTP and closest WWTP to Garner Road Facility; this will impact hauling requirements. WTPs that are located closer to Garner Road than the closest WWTP would reduce total hauled distance by hauling their residuals directly to Garner Road.
- Availability of dewatering at the nearest WWTP; Alternative 3 above would only be feasible if a nearby WWTP has dewatering or plans to implement dewatering in the future.

A comparison of water treatment plants and proposed alternatives moving forward are presented in Table 12-1. The proposed approaches noted apply to normal operation, and do not apply to periodic clean-outs that result in higher volumes of residuals in a short time frame.

Table 12-1: Current and Proposed Approach to Convey Water Treatment Residuals

Water Treatment Plant	Local WWTP	Dewatering at Local WWTP	Current Approach	Residual Volumes, Historical (2019-2021) / 2051 Estimated (dry kg/year)	WTP REsidual % of total RESIDUAL produced at All Region WTP's (2019-21 / 2051)	Current Ability To Meet Sewer Use By-Law	WTP Distance from Garner Road (km)	Local WWTP Distance from Garner Road (Km)	Proposed Approach	Justification
Decew WTP	**Port Dalhousie WWTP**	No	**Alternative 1**: Thicken and haul to Garner Road	685,790 / 896,148	40% / 38%	n/a	19 km	27 km	**Alternative 1**: Continue thickening and hauling to Garner Road	Significantly shorter haul distance from Decew WTP to Garner Road than from Port Dalhousie to Garner Road. Thickening equipment already in place.
Niagara Falls WTP	**Niagara Falls (Stanley Ave) WWTP**	Yes	**Alternative 1:** Thicken and Haul to Garner Road	409,858 / 544,982	24% / 23%	n/a	11 km	13 km	**Alternative 1**: Continue thickening and hauling to Garner Road	Distance is minimal and process upsets observed at Niagara Falls WWTP when sent to sewer.
Welland WTP	**Welland WWTP**	No	**Alternative 2:** Send to sewer (Welland WWTP)	262,155 / 375,585	15% / 16%	Discharged residuals are meeting sewer use by-law for TP and TKN, exceedances for TSS.	14 km	16 km	**Alternative 2:** Continue sending to sewer (Welland WWTP)	Welland WWTP has capacity to process the additional solids
Grimsby WTP	**Baker Road WWTP**	Recommended	**Alternative 1:** Thicken and Haul to Garner Road (~10 – 20%) or Baker Road WWTP (~80 – 90%) (and discharge into headworks)	185,500 / 311,491	11% / 13%	n/a	53 km	47 km	**Alternative 1:** Thicken and Haul to Baker Road WWTP headworks or Garner Road. Consider Alternative 3 in future if dewatering is added at Baker Road WWTP, by blending residuals with digested sludge and dewater blended solids before hauling offsite to N-Viro facility	Reduce total hauling by dewatering residuals with biosolids at Baker Road before hauling offsite. Reduces solids load on Baker Road WWTP by not sending to local sewer or head of WWTP.
Rosehill WTP	**Anger Avenue WWTP**	No	**Alternative 2:** Send to sewer (Anger Ave WWTP)	123,897 / 169,725	7% / 7%	Discharged residuals are currently meeting sewer use by-law	27 km	27 km	**Alternative 2:** Continue sending to sewer (Anger Ave WWTP)	Discharged residuals are currently meeting sewer use by-law. Volumes are small.
Port Colborne WTP	**Seaway WWTP**	No	**Alternative 2:** Send to sewer (Seaway WWTP)	53,820 /62,853	3% / 3%	Discharged residuals are meeting sewer use by-law for TP and TKN, exceedances for TSS.	23 km	23 km	**Alternative 2:** Continue sending to sewer (Seaway WWTP)	Seaway WWTP has capacity to process the additional solids. Volumes are small.

WTP cleanout operations that occur intermittently through the year result in very high load of residuals for a short duration. For WTPs that directly discharge to the sewer system, these events can result in higher solids loading to downstream WWTPs. Historically, residuals from Niagara Falls WTP were discharged into the local sewer system and received by Niagara Falls WWTP. During clean-out events, this resulted in process upsets at the Niagara Falls WWTP, and the practice of sending Niagara Falls WTP residuals to the sewer was discontinued. Residuals from Niagara Falls WTP are now hauled to Garner Road to be mixed with biosolids and land applied.

The Region is currently using a portable centrifuge to dewater residuals at Decew WTP during cleanout operations. This approach is intended to reduce the cost of transporting the liquid residuals and reduce the operation and maintenance costs associated with processing the water treatment residuals at a WWTP before transport to the Garner Road facility.

A similar approach could be considered for the other WTPs if this pilot is successful to manage higher residuals loads produced during clean-out operations.

In summary, for management of water treatment plant residuals, it is recommended that:

- The three water treatment facilities that discharge their residuals to the local wastewater collection systems continue that practice;
- Decew and Niagara Falls water treatment facilities continue to transport their residuals to the Garner Road Facility for dewatering and management along with the Region’s biosolids.
- If dewatering is added at Baker Road WWTP in the long term, blend Grimsby WTP residuals with digested sludge at the Baker Road Wastewater Treatment Facility upstream of dewatering. The blended dewatered biosolid and residuals would then be hauled to Walker Environmental or Garner Road.

13 Proposed Implementation Plan

This section presents the overall implementation plan including proposed capital projects and phasing, implications for existing third-party contracts, contingency planning and permit/approval requirements.

13.1 Proposed Capital Projects and Phasing

Overall, it is recommended that dewatering upgrades be implemented at the Garner Road Biosolids Facility in the short-term to provide a centralized dewatering centre for all the Region's biosolids. The Region has piloted direct cake application in collaboration with a third party biosolids transportation and land application firm to determine the feasibility of this approach in practice. The results of this pilot program support implementation of a direct cake land application program.

Upgrades at the Garner Road Facility should include:

- A new building with dewatering equipment with capacity to manage all the Region's biosolids expected to 2041 with room to expand to meet needs to 2051 and potentially beyond
- An enclosed cake storage facility to allow temporary storage of cake prior to land application or advanced treatment offsite using the N-Viro process. This storage facility could be incorporated into the same building as the dewatering equipment
- Odour control system to treat air from the cake storage and dewatering areas
- Addition of security cameras and a weigh scale to improve security and accuracy of measurements to ensure accurate service costs for Third Party firms.
- Expanded parking and truck loading area

Under the proposed upgrades above, the existing dewatering building would be decommissioned. The Region may also consider repurposing and modifying this building to house the new dewatering equipment and biosolids storage, although more limited space is available for future expansion in this area.

Existing liquid storage tanks and lagoons should be maintained to allow for temporary storage of liquid biosolids prior to dewatering, and to allow for the opportunity to directly land apply liquid biosolids to increase program flexibility. To maintain sufficient liquid storage capacity in the short-term, additional liquid storage tanks should be considered, particularly if a new dewatering and cake storage facility cannot be completed until beyond 2031.

It is recommended that dewatering at Niagara Falls WWTP continue in the interim, with cake transported to the N-Viro facility for processing and distribution, until the dewatering equipment at Niagara Falls WWTP reaches the end of its useful life or additional dewatering capacity is available at the Garner Road facility, whichever comes first. The Region may also choose to send liquid biosolids from Niagara Falls WWTP to Garner Road for dewatering immediately if liquid storage capacity is available, which will vary based on the time of year.

To reduce hauling in the Region, WAS thickening should be considered at Port Dalhousie, Port Weller and Welland WWTPs to reduce liquid volume hauled to Garner Road. Timing of WAS thickening upgrades could be matched with other required upgrades at these WWTPs. The potential to land-apply stabilized biosolids directly from the Anger Ave WWTP should be investigated further.

Details of the recommended studies, operational modifications and upgrades, including phasing, are detailed below.

Very Short Term (within 3 years):

- Extend operating hours per day for centrifuges at Garner Road to increase capacity as needed;
- Confirm requirements for cake land application with MECP including odour classification of product after 7 to 30 days storage;
- Work with Third Party Biosolids Management Contractor to reduce liquid storage and transportation requirements, by optimizing decanting of Garner Road storage lagoons which will increase the total solids concentrations of liquid biosolids hauled offsite for land application.
- Maintain contract with a biosolids management firm that uses advanced alkaline stabilization process to manage a portion of biosolids generated at the Region's WWTPs.
- Continue to enforce sewer use by-law and work with industrial dischargers to address more frequent quality exceedances.
- Complete a feasibility study to assess the potential to construct a centralized anaerobic digester system at the Garner Road Facility to process all the Region biosolids as well as source separated organics that are currently composted at the Walker Facility in Thorold. The study should include the following elements:
    - Complete cost-benefit and life cycle cost analyses comparing the options to 1) upgrade existing digesters at WWTPs and 2) construct a centralized digestion facility to replace WWTP digesters.
    - Review potential for decommissioning or retrofitting the existing anaerobic digesters at each WWTP and incorporating solids thickening.
    - Review potential for biogas utilization, and implications for greenhouse gas emissions and carbon footprint for each alternative.
    - Review feasibility of different biogas utilization methods at a centralized facility, including but not limited to combined heat and power, and renewable natural gas
    - Consider alignment with the Region's latest Official Plan objectives related to Climate Change Mitigation including transitioning to net zero emissions by 2051.
    - Review the option of maintaining aerobic digestion at Baker Road WWTP and adding dewatering at this location to reduce transportation costs and environmental impacts.

Short-Term (by 2031):

- Design and construct a new dewatering facility at Garner Road that can serve as a centralized dewatering facility for the entire Region; size the dewatering facility structure to house the centrifuges needed to dewater ***all*** biosolids produced in Region to 2051 (or all biosolids excluding those from Baker Road WWTP, pending results of study). Initial dewatering equipment capacity could be set to match forecasted biosolids volumes to 2041, with additional process units phased in to increase capacity as flows increase over time.
- Design and construct new cake storage at Garner Road
- Maintain existing liquid storage facilities (lagoons and tanks)
- Security upgrades at Garner Road, and addition of weigh scale

- Decommission centrifuge at Niagara Falls WWTP at the end of its useful life, and haul to centralized dewatering facility at Garner Road.

Long Term (by 2051):

If the results of the centralized digestion facility feasibility study described above are favourable, the Region should work to develop this concept through design and construction, which should consider Public-Private Partnership opportunities with private contractors that could be involved in design, construction and/or operation of the facility. A centralized digestion facility at the Garner Road site is compatible with proposed interim dewatering upgrades at Garner Road.

Furthermore, by increasing dewatering capacity in the Region, which is a required pre-treatment for several other biosolids processing technologies including advanced alkaline stabilization, composting, drying, and incineration, the Region will be in a better position to implement further biosolids stabilization processes in the future, if deemed favourable under future conditions.

Regarding service delivery opportunities, the Region should continue using a third-party contractor to haul liquid biosolids from the WWTPs to the Garner Road Facility, as well as haul biosolids offsite for agricultural land application. The Region should also maintain a contract with Walker Environmental for processing a portion of the Region's biosolids at Walker's N-Viro Alkaline Stabilization Facility to further advance program diversification.

An overview of the proposed work is illustrated in Figure 13-1 below.

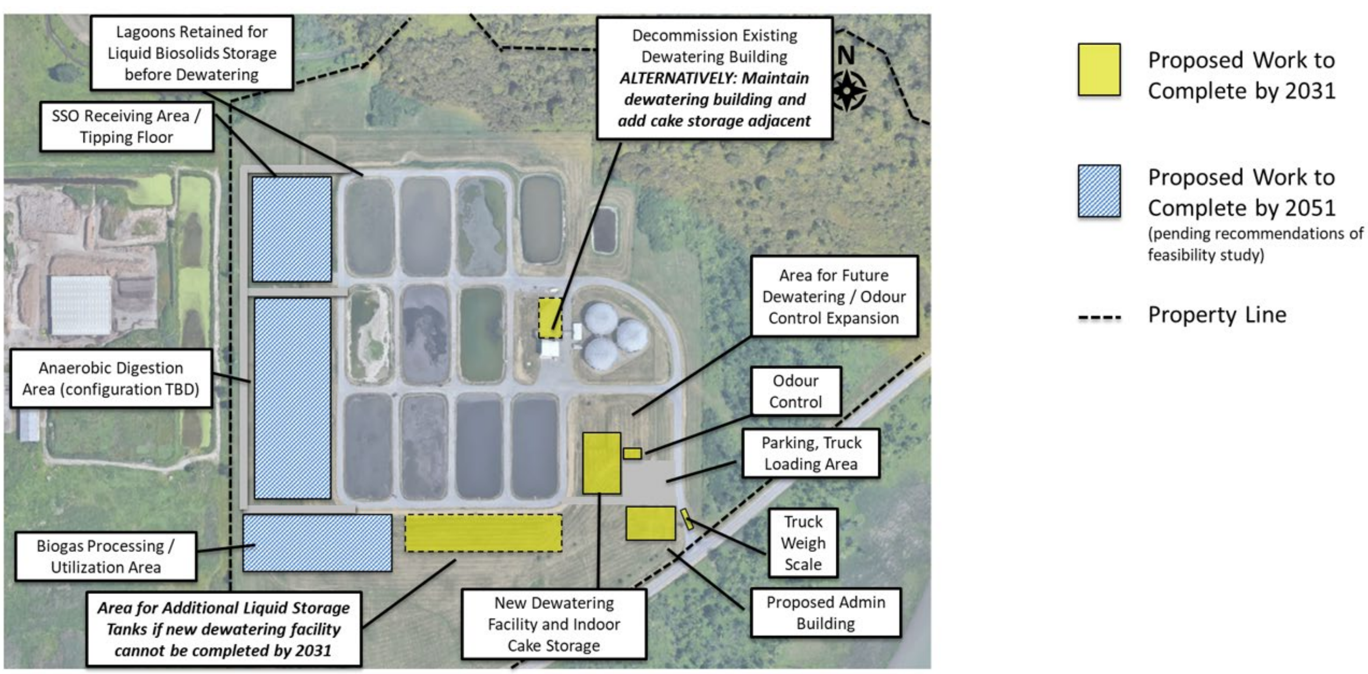


Figure 13-1: **Proposed Build-out of Garner Road Biosolids Facility**

Table 13-1 below summarizes the recommendations, capital cost estimate and proposed timeline.

Table 13-1: Summary of Recommended Capital Projects

Capital Project	Budget (2024 $)	Timeline
1. Feasibility Study for Centralized Digestion Facility at Garner Road	$0.3 Million	2025 - 2026
2. New Dewatering Facility at Garner Road, cake storage at Garner Road, weigh scale and increased security	$38.9 Million	2027 – 2031
3. Decommission Centrifuge at Niagara Falls WWTP	$0.8 Million	2031 – 2033
4. Sludge Thickening at Port Dalhousie WWTP, Port Weller WWTP, and Welland WWTP	$18.7 Million	By 2051
5. Centralized Digester Facility at Garner Road, including decommissioning existing digesters at WWTPs	TBD pending results of feasibility study (item 2)	By 2051

Figure 13-1 shows the proposed timeline of capital projects and studies, as well as periods when current contracts will expire.

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13.2 Impacts to Third Party Contracts

The BMMP presented herein will have implications for the Region's existing third-party contracts with Thomas Nutrient Solutions and Walkers Environmental. This section provides a review of the current work performed by these contractors and identify opportunities to improve the service delivery model in alignment with the biosolids management program recommendations. Further details on service delivery opportunities are included in TM 10 in Appendix A.

13.2.1 Thomas Nutrient Solutions

13.2.1.1 Overview of Existing Contract for Management of Liquid Biosolids

On October 1, 2020, Niagara Region contracted Thomas Nutrient Solutions to provide the followings services to manage liquid biosolids within the Region:

- Haul liquid biosolids from Region WWTPs and residuals from Decew, Grimsby and Niagara Falls WTPs to the Garner Road Biosolids Facility
- Transport biosolids and residuals between Region facilities as required
- Manage, operate and maintain Garner Road Biosolids Facility including decanting lagoons to achieve 4 – 6 % total solids, transfer of liquid biosolids between lagoons and storage tanks, mixing of lagoons and general grounds keeping. Region of Niagara staff operate and maintain the dewatering centrifuges at Garner Road Biosolids Facility.
- Implement and maintain a land application program for up to 50% of annually generated biosolids in the Region, in compliance with the Nutrient Management Act. This includes working with agricultural landowners to apply Non-Agricultural Source Material (NASM) on farmland and maintaining an appropriately sized land bank.
- Emergency response and after-hours transportation of liquid biosolids as required.

This contract expires on December 31, 2024, and this contract is being re-tendered ahead of this expiry date.

The Region pays a specific unit rate per volume of biosolids hauled, that varies based on the locations it is being transferred between, and on an estimated quality of biosolids set at the time of contract tender. The rates are adjusted annually to account for inflation.

13.2.1.2 Future Liquid Biosolids Management Requirements

Although the total biosolids produced in the Region will increase within the planning horizon to 2051, based on the recommended updates to the biosolids program, proposed increases in the portion of total biosolids undergoing dewatering will reduce the volume of liquid requiring hauling overall.

Specifically, if dewatering is added at Baker Road WWTP as recommended for consideration in the long term, liquid hauling from Baker Road to Garner Road will no longer be required, except as a continency measure.

Furthermore, liquid from the other WWTPs will continue to be hauled to Garner Road, including potentially adding liquid hauling from Niagara Falls WWTP to Garner Road in the future. If the proposed cake land application pilot is successful, a smaller portion of biosolids will be land applied as a liquid, and the majority of biosolids would be dewatered and either land applied as cake or sent to the N-Viro facility for further processing. Overall, it is expected that the total hauled volume of liquid biosolids will decrease.

13.2.1.3 Alternative Approaches to Managing Liquid Biosolids

Currently a third-party contractor, Thomas Nutrient Solutions, manages transfer and hauling of all the liquid biosolids in the Region, including land application of approximately 50% of the biosolids produced in the Region. Alternative approaches for managing liquid biosolids are listed in Table 13-2, with advantages and disadvantages identified.

Table 13-2: Alternative Approaches to Managing Liquid Biosolids

Alternative	Advantages	Disadvantages	Recommendation
1. Continue using third party to haul and transfer liquid biosolids (Existing Condition)	• Currently working well • Allows specialist contractor to manage liquid biosolids and NASM plans with agricultural end users, outside of Region staff expertise • Transfers risk of operations to a third party	• On-going cost, potentially higher than a Region-operated program • Less control over biosolids management, and solids concentration in lagoons • Some risk to rely solely on private company whose financial situation or ownership may change	**Recommended.** Specialized work should be outsourced. Updates to existing contract terms should be implemented at time of renewal or when contract is retendered.
2. Issue separate contracts to manage: **a) All liquid biosolids (Hauling from WWTP, lagoon management, hauling to land application)** **b) Land application of cake**	• Allows for greater competition and potentially lower cost, as contractors will not need to have equipment for both cake and liquid hauling. • Opportunity for cake land application contractor to find alternative uses (i.e., drying, composting at facilities outside of Region)	• Onus is on Region to coordinate work of different contractors. • Less flexibility in how to split production of cake and liquid biosolids in order to meet contractual obligations to different land appliers	**Do not pursue.** Challenging to coordinate and less flexibility on end uses of biosolids to meet contractual requirements

Alternative	Advantages	Disadvantages	Recommendation
3. Issue separate contracts to manage: **a) Hauling of liquid from WWTPs, lagoon management** **b) Land application of liquid and cake**	• Potentially more lucrative to land application haulers, as there are more potential end uses leading to larger potential land bank • Separates management of lagoons from liquid land application, and removes potential conflict and reduced thickening in lagoons • Land application contractor can optimize split between cake and liquid land application to minimize costs.	• Onus is on Region to coordinate work of different contractors, and ensure contractor managing lagoons meets needs of land application contractor • May be harder to find a contractor with equipment to haul both liquid and cake	**Recommended.** Consider implementing at end of existing contract to reduce conflict of interest and increase competition
4. Region takes over management of hauled liquid biosolids	• Reduced reliance on third-party contractor • Greater control of operations	• Significant capital investment for hauling fleet • Staff labour cost and training • Responsible for NASM agreements and contracts with farmers	**Do not pursue.** Cost and additional risk to manage NASM contracts outweighs potential benefits.
5. Region takes over management of lagoon decanting only	• Greater control over solids concentration in liquid biosolids prior to land application • Removes the needs for a sampling/verification program to ensure sufficient decanting is being completed by 3rd party contractor	• Increased labour/operations costs • Greater coordination required between Region and 3rd party contractor responsible for hauling	**Alternate Recommendation.** Consider if Alternative 3 is not pursued to better control solids concentration in liquid biosolids being land applied. Will require additional review of feasibility.

13.2.1.4 Recommendations

Overall, it is recommended to continue contracting management of liquid biosolids to a third-party contractor. This reduces the labour and capital investment requirements of the Region.

Currently, the Region uses one contractor for the management of liquid biosolids which includes trucking of sludge from the wastewater and water treatment plants to the Garner Road facility, management of lagoon operation at the Garner Road facility, and liquid land application. At the end of the current contract, the Region should consider breaking out this work into two (2) contracts:

Contract 1 – Transport liquid biosolids from WWTPs and WTPs to Garner Road, and manage decanting in lagoons

Contract 2 – Transport and land application of cake and liquid biosolids from Garner Road, including management of NASM contracts with end users.

This arrangement would allow for a wider pool of contractors to bid on the work and increase potential for competitive bidding. It would also remove the potential conflict of interest that exists when the contractor responsible for managing gravity thickening in the lagoons is also responsible for hauling the liquid biosolids to land application and are paid on a volume basis.

Alternatively, if the existing liquid biosolids management contract scope is maintained, a different strategy would be needed to better control solids concentration in liquid biosolids being land applied. This could be accomplished by:

a) Region implementing a sampling program to verify solids concentrations in lagoons prior to land application; or
b) Region taking over decanting of the lagoons to control thickening (Alternative 5 in Table 2-2).

Although the above approaches would allow for better control of thickening levels in the lagoons, they would also require additional Region staffing and coordination with contractors. If Alternative 3 is not pursued, a further feasibility analysis is recommended to determine the best approach to control solids concentrations in liquid biosolids land application, to ultimately reduce hauling volumes.

13.2.2 Walker Environmental

13.2.2.1 Overview of Existing Contract

The Region's current contract with Walker Environmental, which was last renewed in March 2017, currently requires the Region to supply a minimum of 4700 DT and up to a maximum of 6000 DT of dewatered biosolids to Walker Environmental. The current contract has a term of ten (10) years, which expires in March 2027. After this point, there is an option to extend the contract an additional five (5) years.

Walker Environmental hauls the dewatered cake from both the Garner Road facility and Niagara Falls WWTP and processes it to create a fertilizer product using advanced alkaline stabilization.

Walker Environmental requires biosolids from the Region to have a total solids content between 22 and 40%, and pricing is on a dry tonne unit basis with a unit rate that increases for lower total solids concentrations.

The contract also requires Walker Environmental to allocate enough of their plant capacity to handle at least 85% of the biosolids produced by the Region per year. Walker Environment is responsible for marketing and selling the final 'N-Rich' fertilizer product and maintaining compliance with their facility's ECA.

13.2.2.2 Future Dewatered Biosolids Management Requirements

This BMMP recommends adding dewatering at Garner Road Facility and potentially at Baker Road WWTP in the long term as part of the updated biosolids management program in the Region. In this case, a larger volume of dewatered cake will be produced in the Region each year. Some of this dewatered cake will continue to be sent to the N-Viro facility, and some will be land applied directly as cake if sufficient buy-in is obtained from local farmers. The program should allow for flexibility in quantities that will be land applied and sent to the N-Viro facility.

By incorporating direct land application of cake, the Region would increase diversity in their program and become less reliant on Walker Environmental to process their dewatered biosolids in the future. This will also provide a third outlet for biosolids in the Region and increase resilience if there are any conditions that arise which prevent Walker Environmental from receiving biosolids.

13.2.2.3 Alternative Approaches to Managing Dewatered Biosolids

Currently all dewatering is performed by Niagara Region, with Walker Environmental hauling and processing the cake at their N-Viro facility. Alternative approaches for managing biosolids cake, to incorporate the recommended direct cake land application program, are listed in the table below, with advantages and disadvantages identified.

Table 13-3: Alternative Approaches to Managing Dewatered Biosolids

Alternative	Advantages	Disadvantages	Recommendation
1. Continue using N-Viro to process between 4700 and 6000 dt/year of biosolids and directly land apply remainder as cake	• No changes required to volumes in current contract • Region is able to consistently produce 4700 dt/year	• Max allowable quantity is less than 50% of future biosolids amount, although if cake land application pilot is successful, this may not be a concern as other end uses of cake will be available	**Alternative Approach.** Maintaining existing quantities is acceptable if cake land application pilot is successful, and some cake can be diverted away from N-Viro. Recommend pursuing if alternative 2 below cannot be agreed to in Walker Environment contract
2. Increase maximum volume of dewatered biosolids sent to N-Viro to 8000 dt/year and maintain minimum of 4700 dt/year; directly land apply remainder as cake	• Greater program flexibility, which allows for increased quantities to N-Viro if cake land application is not always available	• Requires contract update, although changes will improve consistency of contract terms • This additional capacity may not be available, or may be committed to other municipalities	**Preferred Approach.** Request increase in reserved quantity for Niagara Region upon contract renewal to match 85% of biosolids already in contract. Do not change minimum required quantity.
3. Maintain maximum volume of dewatered biosolids sent to N-Viro as 6000 dt/year and decrease minimum volume to <4700 dt/year, and directly land apply remainder as cake	• Greater program flexibility; allows Region to directly land apply a greater quantity of cake if demand is there, reducing program costs	• Requires contract update • Less likely to be acceptable to Walker without giving up reserved Region capacity at N-Viro facility (i.e.. reducing max. allowable quantity)	**Not recommended.** Region should not have issue meeting this target, particularly as biosolids quantities increase, and additional dewatering capacity is added.

Alternative	Advantages	Disadvantages	Recommendation
4. Stop sending dewatered cake to N-Viro, and directly land apply all biosolids as cake	• Lower cost due to less material processing	• Lower quality end product • Demand for cake may not be high enough (to be confirmed with Pilot) • N-Viro facility is already functioning and part of local economy; removing business would be detrimental	**Not recommended.** Too much reliance on cake land application, and less program flexibility and resiliency. Reduces support of existing local industry.
5. Hire third-party contractor to operate centralized dewatering facility at Garner Road and manage contract with Walker Environmental	• Reduced number of Region staff required • Transfers risk to third party for solids content	• Reliant on third party to manage Walker Environmental contract; difficult to control how much is sent to N-Viro vs. liquid land application vs. direct cake land application • Region would not have direct control of solids content and would be in the middle of two contractors and would have to manage disputes • Higher claims risk from Walkers	**Not recommended.** Challenging to control costs and how biosolids are processed (dewatered vs liquid land application)

13.2.2.4 Recommendations

Overall, it is recommended to revise the terms of the Region's contract with Walker Environmental to allow for an increase in the reserved quantity of biosolids. This will allow for greater program flexibility, particularly as total biosolids quantities in the Region increase over time. The quantities of dewatered biosolids that are land applied verses sent to the N-Viro facility should be flexible in the contract language, while still meeting minimum commitments to third party contractors.

13.3 Contingency Plan

13.3.1 Existing Contingency Plan

The Region's existing contingency plan is consistent with recommendations made during the 2010 Biosolids Management Master Plan Update and is based on the diversification inherent within the current program of land applying approximately 50 %of the Region's biosolids as a liquid and sending the other 50 % to the Walker Environmental facility for further processing and management as a fertilizer product.

Historically, if wet weather prevented land application of liquid biosolids, the Region would use temporary dewatering equipment to create a cake that could be sent to a landfill for disposal. The Region has not landfilled biosolids or water treatment residuals in over a decade. After centrifuges were installed at the Garner Road facility and the Region contracted Walker Environmental to process approximately 50 % of the Region's biosolids, the practice of the Region using temporary dewatering and sending cake to landfill was discontinued except under specific 'emergency' type conditions.

While landfilling is not practiced by the Region, the Region should maintain the option as a contingency measure should biosolids materials not meet the NASM standards. Conditions where landfilling may be required include:

1. Biosolids quality for land application is not met;
2. Operational interruptions at the N-Viro processing facility preventing them from receiving biosolids; or
3. Liquid land application is unavailable due to prolonged wet weather, labour disruptions, including strikes, lockouts, labour disruptions and so on along with storage conditions at the site.

Under most circumstances, either liquid land application or processing at N-Viro will be available, and biosolids storage is available at Garner Road. This flexibility in the Region's program allows the potential to need landfilling to remain low. As mentioned above, it is recommended that the Region maintain landfill option as a contingency measure.

13.3.2 Contingency Plan Alternatives

Updates to Niagara Region's Biosolids Management Program recommended through this Master Plan serve to increase the reliability and resilience of the Region's biosolids management program, reducing risks associated with biosolids management. Contingency planning will further protect the Region and ensure their continued ability to manage biosolids under a wide range of conditions. The contingency plan alternatives and recommendation, described in this section, consider both processing methods and end use alternatives for biosolids.

13.3.2.1 Contingency Processing Alternatives

Overall, current technologies used to process Niagara biosolids, post anaerobic digestion are:

- Dewatering
    - 1 centrifuge at Niagara Falls WWTP
    - 2 centrifuges at Garner Road Biosolids Facility
- Alkaline Stabilization (N-Viro Facility)

The dewatering centrifuges at The Niagara Falls WWTP and Garner Road are typically operated 8 hours per day, five (5) days per week. Centrifuge operation is not limited in the ECA for Garner Road or Niagara Falls WWTP, so additional run time can be practiced to increase cake production as required. Longer run times result in fewer starts and stops of equipment, reducing wear and tear and increasing useful life.

Under the recommended biosolids management strategies, the same treatment technologies will be used, and centrifuges will continue to be used at Garner Road.

A partial list of failure scenarios and the alternative contingency measures that can be taken to reduce failures related to biosolids process treatment at Garner Road are presented in Table 13-4.

Table 13-4: Biosolids Processing Failure Scenarios and Contingency Measure Alternatives

Failure Scenario	Contingency Measure Alternatives
1. Partial loss of dewatering capacity at Garner Road	• Continue running other operating centrifuges to maintain capacity, increasing daily operating hours if required • Increase volume sent to liquid land application
2. Total loss of dewatering capacity at Garner Road	• Seasonally land apply all biosolids as liquid • Seasonally land apply any stored cake to minimize potential odours • Maintain sufficient storage to accommodate loss of dewatering (i.e., to handle liquid land application of 100% of Region biosolids for set duration)

Failure Scenario	Contingency Measure Alternatives
3. Power Failure at Garner Road (short duration)	• As a preventive measure, review quality of power supply and consider filtering mainline power to reduce short-term power fluctuations that may impact dewatering operations • Run essential equipment only on back-up power generator (i.e., pumps to discharge supernatant and avoid overfilling lagoons), and cease dewatering operations • Land apply all biosolids as liquid
4. Power Failure at Garner Road (longer duration)	• Run essential equipment and 1 centrifuge on back-up power generator to provide more operational flexibility for longer term shutdowns (i.e., longer than 1 or 2 days) • Land apply biosolids as liquid or cake, or transport cake to Walker Environmental
5. Walker Environmental Facility is not available to receive any dewatered cake (i.e., due to equipment failure or power outage)	• Transport dewatered cake from Baker Road WWTP to Garner Road for storage or direct land application • Continue to land apply biosolids stored at Garner Road Facility, liquid, or dewatered cake. • If biosolid land application is not available (i.e., during winter months or wet weather and storage is also not available, dewatered biosolids at Garner Road and transport to landfill disposal until the Walker Environmental facility can accept biosolids.
6. Run out of liquid storage due to lengthy wet weather conditions where land application is not possible	• Increase decanting • Dewater greater quantities to be processed by N-Viro
7. Labour disruptions with Region Operations staff that reduce available staff to manage dewatering facility	• Reduce or temporarily stop dewatering based on alternative (management) personnel availability • Land apply biosolids as a liquid using third-party contractor

Overall, the expansion of the Region's dewatering capacity will increase the biosolids management program flexibility, redundancy, resilience and ability to maintain the operations under adverse conditions.

13.3.2.2 Contingency End Use Alternatives

A variety of end use markets are available for biosolids as described in TM 9 (Appendix A). The end use products recommended are:

1. Land application of anaerobically digested biosolids meeting NASM Standards and the Nutrient Management Act as a liquid or dewatered cake.
2. Soil amendment with fertilizers (biosolids products) meeting CFIA requirements

The recommended biosolids management strategies identified in TM 7 (Appendix A) result in product types 1 and 2, namely:

- Anaerobically digested liquid biosolids (up to 6% total solids), applied on agricultural land
- Anaerobically digested dewatered cake biosolids (22 – 35% total solids), applied on agricultural land
- N-Rich fertilizer produced by Walker Environmental at the N-Viro facility, sold as fertilizer for use as a soil amendment

The proposed end uses involve land application. Specific quality standards must be met to land apply biosolids in conformance the Nutrient Management Act (for liquid and cake biosolids applied on land) and the Canadian Food Inspection Agency (CFIA) Fertilizers Act (for N-Rich). Other factors could also prevent land application, including season of year and weather conditions that result in variations in agricultural demand as well as labour disruptions.

Table 13-5 provides a partial list of failure scenarios for biosolid end uses and the alternative contingency measures that could be undertaken.

Table 13-5: Biosolids End Use Failure Scenarios and Contingency Alternatives

Failure Scenario	Contingency Measure Alternatives
1. Biosolids brought to Garner Road do not meet quality standards required by N-Viro contract or NASM contracts managed by Thomas Nutrient Solutions so product cannot be land applied.	• Review any recent exceedances of Sewer-Use By-law by private dischargers, and look into additional enforcement • Modify operations at WWTPs, if possible/applicable to improve sludge quality • If acceptable, land apply at a lower rate to meet quality requirements (to be managed by Thomas Nutrient Solution) • Dewater and send to landfill directly
2. If dewatering is implemented at Baker Road WWTP in future, quality of residuals from Grimsby WTP exceed limits such that that when they are blended with biosolids at Baker Road WWTP, the dewatered cake does not meet quality requirement from Walker Environmental.	• Dewater and send to landfill until the biosolids quality issues are resolved. • If the Grimsby WTP residuals issue will be long term, the Region can purchase a portable dewatering unit for the Grimsby WTP, and send dewatered residuals directly to landfill

Failure Scenario	Contingency Measure Alternatives
3. Land application as NASM material is not available (i.e., winter season, wet weather conditions)	• Utilize liquid storage at Garner Road until land application can resume (maintain a minimum 240 days of liquid storage onsite) • Dewatering portion of biosolids and send to N-Viro facility for processing, adjusting the volume as needed based on available liquid storage at Garner Road

Overall, the core recommended biosolids program has multiple product outlets that can be used if one (1) is temporarily unavailable. Storage capacity at the Garner Road facility allows for further flexibility and delays in land application. A full description of the contingency approach is available in TM 11 in Appendix A.

13.4 Permits and Approvals

13.4.1 Class Environmental Assessment Approvals

This BMMP completes Phases 1 and a significant portion of Phase 2 under the MCEA process.

Exempt Projects (formerly Schedule A, and A+ projects) identified in this BMMP Update can proceed to implementation without further Class EA requirements. Exempt projects generally cover improvements to operational processes and upgrades to existing treatment processes on existing property up to the current rated capacity. Some projects are classified as exempt only if they pass an archaeological screening. Projects classified as Exempt with Screening may also proceed to Schedule B or Schedule C at the proponent's discretion.

Schedule B projects require Phases 1 and 2 of the Class EA process be completed prior to implementation, which includes additional assessment, consultation with applicable stakeholders and submission of a project file report.

Schedule C projects require Phase 1, 2, 3, and 4 of the Class EA process be completed before the Region can proceed to implementation, including completion of an Environmental Study Report.

The anticipated MCEA schedule that would apply to proposed projects recommended through this Master Plan Update are summarized in Table 13-6. Anticipated schedules are based on the 2023 Amendments to the MCEA Process, and Project Tables provided in Appendix 1 of this document.

Table 13-6: Anticipated Projects and Class Environmental Assessment Schedules

Capital Project	Anticipated Class EA Schedule
1. Operational modifications at the Garners Road Facility, including increasing decanting without exceeding current capacity of discharge forcemain, additional security, weigh scale	Exempt
2. Addition of thickening equipment at WWTPs	Exempt
3. Decommission dewatering equipment at Niagara Falls WWTP	Exempt
4. Installation of additional liquid biosolids storage tanks at Garner Road	Exempt
5. Installation of new dewatering and cake storage facility at Garner Road Facility, including odour control	Schedule B
6. Installation of new centralized aerobic digestion facility at Garner Road Facility (pending results of feasibility study)	Schedule B

13.4.2 Environmental Compliance Approval – Sewage

Upgrades to the Garner Road Facility or any of the WWTPs, including additional of new storage, dewatering facility or WAS thickening equipment will require an amendment to the facility's existing ECA.

13.4.3 Environmental Compliance Approval – Air and Noise

Additional of dewatering or thickening processes at the WWTPs or the Garner Road facility would require a new ECA for air and noise or amendment to an existing ECA. This is to account for the potential for odour generation from these process operations.

13.4.4 Permit to Take Water

In order to construct a new dewatering facility at Garner Road, excavation is expected that may require dewatering. The Region should undertake a hydrogeological investigation to confirm ground water conditions and determine if a Permit to Take Water or Environmental Activity and Sector Registry (EASR) registration will be required from the MECP.

13.4.5 Local Municipality Permits

Construction of a new dewatering facility at Garner Road including a new building and site works would require a Site Plan Approval and Building Permit from the City of Niagara Falls. Similarly, if a dewatering facility is added at Baker Road WWTP, a Building Permit will be required at a minimum. Site Plan Approval may also be required pending pre-consultation with Town of Grimsby.

13.4.6 Conservation Authority Permits

For any work conducted within an area regulated by the Niagara Peninsula Conservation Authority (NPCA), a permit is required. Portions of the Garner Road Facility property at the north of the site are within the NPCA regulated area. The western portion of the Baker Road WWTP, near the existing digesters, is also within the NPCA regulated area. The NPCA should be consulted once extents of construction are known to determine if a permit will be required, and associated mitigation measures. The Region should aim to site new infrastructure outside of the regulation area whenever possible.

13.4.7 Non-agricultural Source Material (NASM) Plans

Under the Nutrient management Act, a NASM plan is required for all non-agricultural source material being applied to land, including liquid biosolids and cake. Under this Master Plan Update, it is recommended that direct cake land application be implemented, which will required new NASM plans be established with Agricultural end users. Liquid land application can continue through the NASM plans currently in place. The Region currently uses a third-party contractor to manage all NASM plans, and this BMMP update recommends that this approach be continued for all future biosolids land application for both liquid and cake.

13.4.8 Archaeological and Cultural Heritage Assessments

Under the OHA, an Archaeological Assessment is required where there is a known archaeological site or potential for an archaeological site within the proposed project area. Portions of the Garner Road Facility site are undisturbed and have archaeological potential. At a minimum, a Stage 1 Archaeological Assessment should be completed prior to work at this site, which will identify the need for any further Archaeological Assessment. As the proposed dewatering building and cake storage facility at Garner Road will trigger a Schedule B Class EA, the Archaeological Assessment can be incorporated as part of the Class EA.

The Baker Road WWTP is pre-disturbed; therefore, an Archaeological Assessment is not expected for any work at this site, although this needs to be confirmed prior to project initiation.

Under the Ontario Heritage Act, cultural heritage resources, including facilities and heritage lands, must also be protected. Although it is not expected that cultural heritage resources will be impacted as a result of the proposed works, a Cultural Heritage Screening should be completed as part of the Schedule B Class EA to confirm.

13.4.9 Natural Environment Studies

As the Garner Road Facility does contain natural features, included a wooded area at the north edge of the property, a natural environment study should be conducted as part of the Schedule B Class EA to be completed for this site. This will identify potential for Species at Risk, habitat lands, wetlands and other sensitive natural features that should be protected during construction. Approvals under the Species-at-Risk Act and Fisheries Act will be received if necessary.

13.4.10 Niagara Escarpment Commission (NEC) Permit

A Niagara Escarpment Commission (NEC) permit is required for construction with lands designated under the Niagara Escarpment Plan. Both Baker Road WWTP and the Garner Road Facility are outside of the NEC plan area and would not require a permit for construction.

14 Risk Management Analysis and Recommendations

The Region's Biosolids Management Program has inherent risks that must be identified, evaluated and mitigated where possible.

A detailed risk register was developed and is included within TM 11 in Appendix A. Each risk was assigned a probability, cost impact, schedule impact and reputational impact rating to determine a risk score. The risk score was calculated by multiplying the probability score by the highest of the cost impact, schedule impact and reputational impact score. This score represented the perceived risk at the initiation of the BMMP. It was then decided to either mitigate, transfer, or accept each risk, and associated measures that were applicable to mitigate the risks. A target risk score was also developed, which represented the level of risk that the Region was targeting at the completion of the BMMP.

The legends presented in Table 14-1 and Table 14-2 below describe how risks were evaluated and scored:

Table 14-1: Risk Scoring Method

	Very Low (1)	Low (2)	Medium (3)	High (4)	Extreme (5)
Probability	< 5%	< > 5- 20%	< > 20 – 35%	< > 35 – 50%	> 50%
Cost Impact	< $500K	$500K - $1M	$1M - $2.5M	$2.5M - $5M	> $5M
Schedule Impact	< 3 months	< > 3 – 6 months	< > 6 – 12 months	< > 12 – 18 months	> 18 months
Reputational Impact	Minor	2	3	4	Major

Table 14-2: Risk Classification Legend

Risk Level	Legend
Immaterial / Low	<5
Medium	5-10
High	11-16
Extreme	>16

The risks were organized into the following categories for evaluation:

- Operational Risks
- Contractual Risks
- Social and Community Risks
- Environmental, Site Conditions and Health & Safety Risks
- Compliance Risks
- Project Management and Cost Risks

The following sections provide details on each category of risk, a list of each risk identified, scoring, strategy to manage the risk, and the risk response at this stage of the BMMP. Risks that do not currently meet the risk target score will be reviewed at the completion of the 30-day public review period and re-assessed.

14.1 Operational Risks

Operational risks are those related to operation and maintenance of the biosolids management equipment used to maintain required biosolids quantities and quality, and implications of failure of this equipment.

Table 14-3: Summary of Operational Risks and Management Approaches

Description	Initial Risk Score	Risk Phase 2 Update	Target Score	Strategy	Risk Response
Garner Road Operations	**25**	**4**	**4**	**Mitigate**	**Restore forcemain capacity. Increase dewatering and storage capacity at Garner Road. New dewatering equipment and building will facilitate access for maintenance.**
Increasing wet weather events due to climate change	**20**	**8**	**8**	**Mitigate**	**Increase dewatering and storage at Garner Road and increase maximum quantity of cake that can be sent to N-Viro facility.**
Water residuals sent to sewer cause upsets at WWTPs	12	4	4	Mitigate	Continue hauling residuals to Garner Road from WTPs that have historically caused process upsets (i.e., Niagara Falls). Consider portable centrifuge to dewater residuals during clean-outs and haul to landfill
Failure of digester boiler system / heat exchanger	12	3	3	Mitigate	Continue monitoring performance and plan for replacement
Dewatering / centrifuge failure at Niagara Falls WWTP	12	3	3	Mitigate	Plan for centrifuge replacement at Garner Road. Use portable centrifuge as emergency back-up.
Market Availability	9	2	2	Transfer	Market assessment completed in TM 9 verified availability of sufficient land bank to receive biosolids in Region to meet future needs to 2051. Responsibility for final disposal is transferred to third-party contractors. Increasing biosolids storage at Garner Road will also help mitigate this risk.
Recommendation of new biosolids treatment or stabilization technology	9	3	3	Avoid	Master Plan does not recommend implementing a new technology after detailed review of alternative technologies.
Failure of digester mixing system	9	3	3	Mitigate	Include redundancy, alternate mixer designs to increase reliability

Description	Initial Risk Score	Risk Phase 2 Update	Target Score	Strategy	Risk Response
Sludge thickening operational issues at WWTPs	8	2	2	Mitigate	Include redundant thickening units and polymer system upgrades
Changes to population forecasts and flows	4	8	8	Accept	This BMMP is based on the population growth and flow forecasts identified in the 2021 Water and Wastewater Master Plan. Bill 23 was passed during the BMMP process, increasing the Region's rate of population growth. While this will not affect the overall strategy, it may require specific projects be implemented earlier than anticipated.

***Most Critical Risks are Bolded**

Operation of the Garner Road Facility poses the greatest risk, along with weather conditions that limit the ability to land apply during periods of the year. Specific operational risks at Garner Road include:

- Accessibility issues when maintaining the dewatering centrifuges, requiring a longer shutdown period and reliance on liquid storage
- Liquid storage limitations during times of the year when land application is more restricted; liquid storage shortfalls are more significant when dewatering equipment is also down for maintenance
- Limited forcemain capacity to remove supernatant / stormwater from lagoons
- No cake storage, requiring trucks from Walker Environmental to wait onsite while being loaded over several hours. This limits the volume of cake that can be transported offsite per day as the truck loading is restricted from 7:00 am to 9:00 pm
- Walker Environmental not accepting cake if the total solids concentration of the dewatered cake is below 22 % or other quality requirements are not met.

This Biosolids Management Master Plan update recommends the following upgrades at the Garner Road Facility, which act to mitigate operational risks associated with the facility:

- New dewatering facility with improved accessibility for maintenance of equipment, and increased capacity to allow for generation of larger volumes of cake
- New cake storage facility to be used prior to and during growing season, which allows for an increase in dewatering output, reducing reliance on liquid storage
- Restore the capacity of the forcemain from Garner Road that conveys decanted water from the lagoons and dewatering sidestream flows into Niagara Falls WWTP wastewater collection system.
- Maintain the existing liquid storage lagoons and storage tanks along with increased decanting of lagoons to increase their effective capacity. This requires the use of the full forcemain capacity. Monitor impacts of increased decanting on Niagara Falls WWTP performance and adjust decanting as necessary to reduce impacts until upgrades at Niagara Falls WWTP are complete. Maintaining liquid storage along with cake storage increases the diversity of product outlets, and better ensures the ability to move material offsite in a timely manner.

- Maintain the contract with Walker Environmental to provide an alternative biosolids management strategy when direct land application of biosolids is not possible.
- Maintain one (1) or more third party contractors to manage liquid biosolids hauling and land application.

Additional details of the proposed recommendations for the Garner Road Facility can be found in TM 5 in Appendix A. Details of contract recommendations can be found in TM 10 in Appendix A.

14.2 Contractual Risks

Contractual risks are those arising from contractual obligations with third-party contractors. As mentioned, the Region currently has contracts with Thomas Nutrient Solutions and Walker Environmental to manage portions of their biosolids. Generally, contractual risks can be mitigated through contract language updates and maintaining a good relationship with third-party contractors. Further details on recommendations for improvements to third-party contracts are discussed in TM 10 in Appendix A.

Table 14-4 provides an overview of the contractual risks associated with biosolids management including risk identification, scoring and response.

Table 14-4: Summary of Contractual Risks and Management Approaches

Description	Initial Risk Score	Risk Phase 2 Update	Target Score	Strategy	Risk Response
Reliance on Existing Third-Party Contractors	**20**	**4**	**4**	**Mitigate**	**Update terms of contract as noted in TM 10 (Appendix A). Consider breaking biosolids transportation into multiple contracts (i.e., separate contracts for hauling to Garner Road and land application). Provide quality product to third-party contractors to increase ability of third-party contractors to provide quality product to end users.**
Existing Contractual Obligations	**20**	**4**	**4**	**Mitigate**	**Potential improvements to existing contracts are identified in TM 10 (Appendix A), including incentives to increase decanting of biosolids in lagoons to reduce hauling costs.**
Third-party contractor acquisition / consolidation, reducing competition	**20**	**12**	**8**	**Mitigate**	**Monitor the market and maintain good relationships with contractors. Maintain fair contracts that are attractive to contractors once current contract expires. Consider utilizing multiple contracts for different services (i.e., liquid biosolids hauling, cake hauling) to add diversity and reduce reliance on a single entity.**

***Most Critical Risks are Bolded**

Since the Region currently relies on third-party contractors to manage the distribution of all biosolids produced by the WWTPs serving their population, the risk classification level associated with these contracts is considered high. Currently, a single contractor, Thomas Nutrient Solutions, is responsible for managing transport of liquid biosolids between each WWTP and the Garner Road Biosolids facility, managing the liquid storage lagoons at Garner Road, transporting liquid biosolids to land application, and managing contracts with agricultural end users for land application. Please refer to Appendix A – Technical Memorandum 10, which provides recommendations for updating the contract with TNS to reduce risks to the Region.

It is recommended that the Region increase the flexibility of their contracts with these firms to maintain diverse product outlets and increase allocation of processing capacity for Niagara Region. As part of the contract reviews it is recommended that the Region increase the quantity of solids that can be managed at the Walker Environmental Facility. Contract updates should also incentivize increased thickening and dewatering of biosolids before transport to land application. The Region should also consider separate contracts for hauling liquid biosolids to Garner Road for storage and land application. Updates to the existing contracts are recommended once the current contract period expires. These recommendations are discussed further in TM 10 in Appendix A.

14.3 Social and Community Risks

Social risks are those related to community and human impacts of the biosolids program. Social risks are generally mitigated through a strong planning process and on-going communication with key stakeholders. Biosolids management strategies were evaluated against multiple criteria, including social impacts. The recommended strategies aim to reduce community impacts by increasing dewatering to reduce hauling and associated truck traffic.

Biosolids also present a risk of odour generation that must be properly managed. Odour prevention is preferred to odour treatment and can be accomplished by building facilities away from residential land. A summary of the Social and Community Risks identified along with recommended management approaches are presented in Table 14-5.

Table 14-5: Summary of Social and Community Risks and Management Approaches

Description	Initial Risk Score	Risk Phase 2 Update	Target Score	Strategy	Risk Response
Local farming community opposition to changes in biosolids end use	**20**	**8**	**4**	**Transfer**	**Pilot cake land application in collaboration with Thomas Nutrient Solutions, Agricultural Landowners and Region to obtain buy-in. Continue providing liquid biosolids meet existing needs. Farming community acceptance will be determined through pilot study, and still remains a moderate risk at this time.**
New vendors opposition	16	9	4	Mitigate	A long list of technologies was considered and reviewed in TM 7, and proposed strategies are clearly justified and have been communicated through PIC 2 and stakeholder meetings. Risk remains moderate until after 30-day review

Description	Initial Risk Score	Risk Phase 2 Update	Target Score	Strategy	Risk Response
					period.
Truck traffic complaints	15	4	4	Mitigate	Current contracts clearly identify acceptable truck traffic routes to limit community impacts. Overall, truck traffic will be reduced with the recommended biosolids program as dewatering will reduce volumes that need to be hauled.
Odour generation at Garner Road or WWTPs leading to complaints	10	3	3	Mitigate	Continue providing clear method to allow for complaints to be received, filed and responded to. Consider acquiring property adjacent to Garner Road if it becomes available (i.e., through 'first right of refusal' agreement with current landowner). Contain odour and treat once new dewatering building is constructed.
Opposition from Indigenous Groups	10	8	2	Mitigate	Indigenous groups were notified of the project early on, and additional letters were sent prior to PIC 2 to provide an additional opportunity to engage/comment on the study. Risk is moderate until completion of 30-day review period.
Local community / public opposition	9	6	6	Mitigate	Consultation with the public and agencies, and indigenous engagement have been on-going through the Master Plan Study. Preferred alternative strategies will reduce impacts to communities through reduced truck traffic. Based on increased public awareness of PFAS being land applied and potential dissent, this risk has increased since the Phase 2 update, although could be maintained at a moderate level following the 30-day review period.
Future development encroachment	9	4	4	Mitigate	Meet with local municipality to discuss future development implications. Consider acquiring property adjacent to Garner Road if it becomes available.

***Most Critical Risks are Bolded**

The most critical social and community risk is lack of buy-in from local farmers to receive biosolids. There is also a risk that the application of dewatered biosolids cake will not be acceptable. To address this risk, a pilot study is being initiated in the summer of 2023 with Thomas Nutrient Solutions, select area farmers and the Region to determine the feasibility of a cake land application program. This pilot will also clarify operational requirements and considerations to ensure the success of this program.

Further details on the cake land application pilot are found in TM 5 in Appendix A.

14.4 Environmental, Site Conditions and Health & Safety Risks

Risks in this category include environmental and health and safety risks associated with the biosolids management program, as well as limiting site conditions that may restrict opportunities for biosolids management. The environmental risks identified are presented in Table 14-6.

Table 14-6: Summary of Environmental, Site Conditions and Health & Safety Risks and Management Approaches

Description	Initial Risk Score	Risk Phase 2 Update	Target Score	Strategy	Risk Response
Lack of space at WWTPs for dewatering facilities	**20**	**4**	**4**	**Mitigate**	**Consider dewatering upgrades at WWTPs that have sufficient space only, and consider option to expand dewatering at Garner Road rather than at WWTPs**
Climate Change and Greenhouse Gas Emissions	16	6	3	Mitigate	Recommended strategy reduces hauling by increasing dewatering and introducing of a cake land application program. Success of cake land application will determine final risk level.
Biosolids spill into environment during truck loading /unloading	4	4	4	Mitigate	Provide spill containment at truck loading/unloading area
Groundwater and surface water impacts from continued land application of biosolids	4	4	4	Transfer	Third-party contractor will continue being responsible for ensuring all land applied biosolids are in conformance with NASM plan to reduce ground water and surface water impacts to acceptable level. Use tanks for any liquid storage to reduce risk of soil impacts through infiltration

***Most Critical Risks are Bolded**

Many of the Region's WWTPs are space-constrained and cannot easily accommodate a new facility for dewatering or thickening. This Master Plan recommends adding dewatering or thickening only at WWTPs that can accommodate this additional equipment. Additional dewatering is proposed at Garner Road in the short term and should be considered at Baker Road WWTP in the long term. Further, it is recommended that thickening be considered at Port Dalhousie, Port Weller and Welland WWTP, where space is available, especially considering new property recently acquired at Welland WWTP. Recommendations for dewatering and thickening upgrades are discussed in more detail in TM 5 in Appendix A.

The recommended strategy also reduces environmental impacts by reducing transportation and the associated greenhouse gas emissions. Further risks to the environment will be identified and mitigated for individual projects during subsequent Class EA and design works.

14.5 Compliance Risks

Compliance risks, including those identified in Table 14-7 below, are situations that will impact the Region's ability to manage the solids generated in their WWTPs in accordance with current and future Federal and Provincial regulations associated with biosolids management. This focuses on the ability to meet quality requirements to ensure biosolids can continue to be land applied.

Table 14-7: Summary of Compliance Risks and Management Approaches

Description	Initial Risk Score	Risk Phase 2 Update	Target Score	Strategy	Risk Response
Sludge Quality Issues	15	6	3	Mitigate	Do not pursue co-digestion of biosolids with SSO. Continue to work with industrial dischargers to reduce exceedances, protecting the characteristics of the Region's Biosolids.
Changes to future regulations	15	12	12	Mitigate	In May 2023, Environment and Climate Change Canada, as well as Health Canada released a draft 'State of PFAS Report', and Canadian Food Inspection Agency is initiating a process to implement interim standards biosolids contaminated with PFAS sold in Canada as commercial fertilizers. Stakeholder consultation is beginning in Fall 2023. Region of Niagara should provide feedback on impacts of this change to their operation. It is possible that Ministry of Agriculture, Food and Rural Affairs (OMAFRA) or MECP may follow with similar restrictions in future, so continued discussions are essential.
Impacts of PFAS and other emerging contaminants	12	9	6	Mitigate	Continue conversations with regulatory bodies and promote tighter regulations on products that produce PFAS. Consider including PFAS limits in sewer use by-laws, when future regulations become clearer.
Section 16 Order Request	10	8	2	Mitigate	Amendment to Municipal Class EA process in March 2023 only allows Part 2 orders from a person with concerns pertaining to potential adverse impacts to Aboriginal or treaty rights and cannot be issued to stop or delay the project for other reasons. Maintain active engagement with Indigenous peoples. Moderate risk until after 30-day review period.

Description	Initial Risk Score	Risk Phase 2 Update	Target Score	Strategy	Risk Response
Biosolids quality impacts due to winery waste	6	1	1	Mitigate	Send winery waste to WWTPs with capacity to handle additional loads. Currently most of the winery waste is sent to Niagara-on-the-Lake WWTP, and no process upsets have been reported.

As noted in Table 14-7, the most notable risk to the current and proposed biosolids program is the CFIA implementing a higher quality standard related to PFAS in biosolids sold as commercial fertilizers. The recommended changes to the regulation have undergone a public review period, although the final report with recommendations is still pending as of November 2023. If these changes move ahead, it is possible that OMAFRA may implement a similar limit for PFAS for land application of digested biosolids. Continued discussions with regulatory agencies are critical, and support of regulating or banning manufacture of products containing PFAS is recommended.

14.6 Project Management and Cost Risks

Project Management and cost risks, summarized in Table 14-8, are those that impact the delivery of the current study, as well as subsequent recommended capital projects.

Table 14-8: Summary of Project Management and Cost Risks and Management Approaches

Description	Initial Risk Score	Risk Phase 2 Update	Target Score	Strategy	Risk Response
Obtaining consensus from Project Team on preferred alternative	16	1	1	Mitigate	Development of criteria was done with full Region input through workshop survey. Sensitivity analysis was completed for detailed evaluation to determine impacts of weightings and reach a balanced and representative outcome.
Economic uncertainty, supply chain disruptions and inflation impacting cost of capital investments	15	12	12	Mitigate	Budget estimates will include a more conservative inflation estimate.
Delays to Critical WWTP Upgrades while BMMP updated is completed	12	4	4	Mitigate	Majority of projects at WWTPs are not impacted by the recommendations of the Master Plan and are continuing as planned.
Third-party Contracts may not be providing best value for Region	12	4	4	Mitigate	Potential improvements to existing contracts are identified in TM 10 (Appendix A). Includes renegotiating terms.

Description	Initial Risk Score	Risk Phase 2 Update	Target Score	Strategy	Risk Response
Delays in completing Master Plan	8	4	1	Mitigate	Multiple workshops have been held with Region to ensure ongoing engagement with steering committee, allowing decisions to be made in a timely manner.

Project Management risks related to schedule have been managed throughout the project through clear communication with the steering committee, and key workshops to allow for decision making. Cost implications of future projects due to the inflation are difficult to control, but cost estimates should be more conservative to account for economic uncertainty.

14.7 Summary

Overall, the Region can reduce the likelihood of risks through strategic mitigation measures as noted above. Of particular note, monitoring anticipated changes to polyfluoroalkyl substance (PFAS) regulations related to land application of biosolids will be particularly important, as the Region's current and recommended strategies all involve land application of biosolids as a NASM material or fertilizer.

15 Public, Agency, Stakeholder and Aboriginal Consultation

15.1 Mailing List

A mailing list for the study area was developed during Phase 1 based on the project team's knowledge of the study area and has been continuously updated throughout the process to include any and all relevant agencies, stakeholders, and interested parties including indigenous communities, government agencies, utilities, and other special interest groups. The mailing list is provided in Appendix B.

All stakeholders were kept informed throughout the study through notices and PICs at key milestones in the Class EA. Meetings and discussions were also held with the following local area municipalities and government agencies:

- Town of Lincoln
- Town of Fort Erie
- Town of Niagara-on-the-Lake
- Ministry of the Environment, Conservation and Parks
- Infrastructure Ontario
- Ministry of Agriculture, Food and Rural Affairs
- Niagara Parks Commission
- Niagara Escarpment Commission
- Niagara Peninsula Conservation Authority

As identified by the MECP at the initiation of the study, the following indigenous communities were consulted with and engaged with:

- Mississaugas of the Credit First Nation
- Six Nations of the Grand River (Elected Council and Haudenosaunee Confederacy Chiefs Council with a copy to Haudenosaunee Development Institute)

15.2 Notifications

Notices were used to rely key public consultation events and milestones of the Class EA process. Notifications were distributed through digital and print medial in the following papers:

- Niagara Falls Review
- St. Catharines Standard
- Welland Tribune
- Niagara This Week, All Zones
- Fort Erie Observer
- News Now (Grimsby, Lincoln, West Lincoln)
- Niagara-on-the-Lake Local
- The Lake Report
- Voice of Pelham
- Thorold News
- Regional Website

15.2.1 Notice of Commencement and Notice of Public Information Centre No. 1

A combined Notice of Commencement and Notice of PIC No. 1 was issued via mail and email to the stakeholder identified on the mailing list on May 24, 2022 and distributed through the papers identified in Section 15.2.

The MECP was notified directly through the filing of Notice of Commencement to elicit important project information such as the identification of key Indigenous communities in the study area.

The Notice of Commencement and Notice of PIC No.1, tear sheets for local newspaper advertising and associated MECP response can be found in Appendix B.

15.2.2 Notice of Public Information Centre 2

A Notice of PIC No. 2 was issued was issued via mail and email to the stakeholders identified on May 4, 2023 and distributed through the papers identified in Section 15.2. The Notice of PIC No. 2 and tear sheets for local newspaper advertising can be found in Appendix B.

15.2.3 Notice of Completion

A Notice of Completion was issued via mail and email to stakeholders in November 2024 to notify the public that the BMMP was being placed on the “public record” for the required 30-day review period. A copy of the notice is provided in Appendix B.

During the review period, the MCEA entitles interested persons Indigenous Communities, or government agencies who have significant concerns which cannot be resolved to request the MECP to issue a Section 16 Order under the EA Act.

If there are concerns regarding the study, a request may be made to the Ministry of the Environment, Conservation and Parks for an order requiring a higher level of study (i.e., requiring a Schedule C Class EA or Individual/ Environmental Assessment), or that conditions be imposed (e.g., require further studies), only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered. Requests should include the requester contact information and full name for the Ministry.

Requests should specify what kind of order is being requested (request for additional conditions or a request for an individual/comprehensive environmental assessment), how an order may prevent, mitigate or remedy those potential adverse impacts, and any information in support of the statements in the request. This will ensure that the Ministry is able to efficiently begin reviewing the request.

Requests should be sent by email or in writing to:

Minister of the Environment, Conservation and Parks
Ministry of Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto ON M7A 2J3
mailto:minister.mecp@ontario.ca

Director, Environmental Assessment Branch
Ministry of Environment, Conservation and Parks
135 St. Clair Ave. W, 1st Floor
Toronto ON, M4V 1P5
EABDirector@ontario.ca

15.3 Public Information Centres

15.3.1 Public Information Centre #1

PIC No. 1 was held as a virtual session to encourage attendees to review the presentation and display boards. The purpose of PIC No. 1 was to present and receive feedback on:

- Introduce the study (including background)
- Describe the Class EA process
- Identity the problem and opportunity statement
- Present biosolids servicing alternatives being considered; and
- Evaluation approach that will be used to select the short list of recommended strategies to be developed.

The PIC was held virtually which included virtual PIC display materials, video presentation, a link to an interactive ESRI StoryMap along with a questionnaire. The PIC display materials were made available on the Region's project website beginning Wednesday June 8, 2022. This was followed by a two (2) week period to submit comments to the project team through the project website.

A summary of PIC No. 1 and its materials is provided in Appendix B.

15.3.2 Public Information Centre #2

PIC No. 2 was also held as a virtual session to encourage stakeholders to review the presentation and display boards. The purpose of PIC No. 2 was to present and receive feedback on:

- Present the Region's biosolids management approach and provide insight to future needs
- Provide a progress update on the BMMP and work completed to date; and
- Obtain feedback on the list of alternatives biosolids management strategies, detailed evaluation of these strategies and preliminary recommendations.

The PIC material made available included virtual PIC display materials, video presentation along with a questionnaire.

A summary of PIC No. 2 and its materials is provided in Appendix B.

15.4 Stakeholder Meetings and Consultation

Key approval agencies were communicated with throughout the Class EA. Details on these communications are provided in the following sections, while documentation of the agency consultations is provided in Appendix B.

15.5 Agency and Municipal Stakeholder Consultation

A virtual meeting was held on April 21, 2023 with representatives from surrounding municipalities and approval agencies, which included the following:

- Town of Lincoln
- Town of Fort Erie
- Town of Niagara-on-the-Lake
- Ministry of the Environment, Conservation and Parks
- Infrastructure Ontario
- Ministry of Agriculture, Food and Rural Affairs
- Niagara Parks Commission
- Niagara Escarpment Commission
- Niagara Peninsula Conservation Authority

The purpose of this meeting was to provide an update on the Region's 2021 BMMP, present the biosolids management strategies, evaluation and preferred approach and obtain feedback on the preferred strategy.

On July 11, 2023, during this meeting the preliminary results of the BMMP were presented to the Niagara Region Public Works Committee to allow for questions and comments before submitting the Master Plan Report for approval. Comments and questions from this meeting and provided responses are included in Table 15-1. A copy of the presentation and meeting minutes can be found in Appendix B, the recording of the presentation is available on the Region's website.

15.6 Aboriginal Consultation

In their response letter to the Notice of Commencement (June 3, 2022), the MECP provided direction as to the appropriate Indigenous communities to engage and the protocols for engaging these communities. The MECP identified the following communities:

- Mississaugas of the Credit First Nation
- Six Nations of the Grand River (Elected Council and Haudenosaunee Confederacy Chiefs Council with a copy to Haudenosaunee Development Institute)

Each community was contacted at the beginning of the study in June 202 via email and mail to notify them of the study and give them an opportunity to provide feedback. The Region engaged with each community again in May 2023 by sending a letter (via email and mail) to let the communities know about the ongoing study and provide an update on the selected preliminary preferred strategies. Copies of the letter that was sent to each of the indigenous communities are provided in Appendix B.

No responses were received directly from the letters, so the project team followed up with each community to elicit additional feedback on the study. If there are any comments, questions or concerns, the project team will engage further with each individual community.

15.7 Comments and Reponses

Table 15-1 provides a summary of comments received during the study and how the project team addressed each comment.

Table 15-1: Summary of Stakeholder Comments and Responses

#	Comment	Response
1	Stakeholder noted concerns regarding Per- and Polyfluoroalkyl Substances (PFAS) within the biosolids that are land applied on Niagara farmland. The resident also inquired if the Region is testing or would consider testing for PFAS in biosolids before land application and if this will be addressed within the BMMP.	The Region explained that biosolids are applied as non-agricultural source materials (NASM) following strict regulations under the Nutrient Management Act or as a commercial fertilizer under the Federal Fertilizer Act of the Canadian Food Agency and highlighted that there has been no evidence of adverse impacts to the environment or health of people / animals. The Region highlighted that the government has been proactive in researching PFAS and setting policies to protect human health and the environment and noted that they have been phasing out PFAS compounds in various consumer products. The Region also noted that the Canadian Food Inspection Agency (CFIA) has started to implement an interim standard for domestic and imported biosolids contaminated with PFAS sold in Canada as commercial fertilizers. The CFIA is working to develop a plan for standards and a detailed guide for importers, producers and commercial users of biosolids. The Region described that they are committed to providing water and wastewater treatment that meets or betters provincial requirements and noted that the preferred BMMP is diverse and flexible to meet potential future environmental and legislative changes (i.e., biosolids quality and land application requirements).

#	Comment	Response
2	Stakeholder noted concerns regarding the perceived increase in biosolids truck traffic (estimating around 120 transports/day) through Cooks Mills and requested consideration of alternative routes. The resident also inquired who determines the routes that the biosolids hauling trucks take.	The Region described that they are looking to minimize impacts of the biosolids hauling on local communities while also providing a direct route to farmers' fields to minimize environmental impacts. The Region noted that biosolids hauling trucks are to stay on Provincial Highways and Regional roads and they are required to apply best management practices while transporting and applying biosolids to the land. The Region described that as part of the BMMP study, it has been recommended that the Region increases dewatering of biosolids which will result in a reduced total volume of biosolids needing to be hauled, therefore decreasing truck traffic.
3	Stakeholder questioned if a wide range of biosolids technologies have been reviewed as a part of this study.	The Region noted that a long list of biosolids treatment technologies were considered and screened based on critical factors. As well as considering the currently used technologies (dewatering, anaerobic digestion, alkaline stabilization), an additional four new technologies to the Region were evaluated in detail (thermal oxidation, thermal drying, composting, and thermal hydrolysis). The Region's review of technologies was extensive and comprehensive.
4	Stakeholder was interested in the return on investment related to Biosolids Management Master Plan Recommendations.	A capital, life cycle and operating cost was determined for each strategy considered under the detailed evaluation. All strategies require an investment, and on-going O&M costs. Cost was one factor considered in the detailed evaluation, and strategies with a lower cost ranked higher in this criterion.
5	Stakeholder wanted to know if sufficient land is available within Niagara Region to land apply biosolids.	TM 9 involved an evaluation of end use markets. The available land bank with Niagara Region is more than adequate to receive biosolids produced within the Region with in the 2051-time horizon.

16 Summary of Recommendations

16.1 General Recommendations

1. Complete feasibility study for a centralized anaerobic digestion facility at the Garner Road site.

2. Extend operating hours at Garner Road Facility in the short term to maintain dewatering capacity.

3. Initiate implementation of Garner Road Dewatering and Cake Storage Facility design and construction.

4. Review opportunity to decommission centrifuge at Niagara Falls WWTP and dewater liquid biosolids from this plant at the Garner Road Facility.

5. Complete annual review of Garner Road Facility training program, and provide annual refresher to staff.

6. Consider adding WAS thickening at Port Dalhousie, Port Weller and Welland WWTPs to reduce hauling requirements and improve digester performance.

7. Implement weigh scale at Garner Road to better quantify materials entering and leaving the site for volume tracking.

8. Add surveillance cameras through the grounds of the Garner Road Facility to improve site security.

9. Continue hauling liquid biosolids from Anger Avenue to Garner Road Facility, and consider direct liquid land application from the WWTP is land becomes available

10. Consider adding dewatering at Baker Road WWTP in long term due to higher potential for reduction in cost and hauling.

16.2 Biosolids Storage Recommendations

1. For liquid storage, it is recommended that the existing lagoons and tanks be maintained and continue to be utilized at the Garner Road Facility to maintain existing liquid storage capacity.

2. Optimize decanting of lagoons to better utilize volume and increase solids concentration in material to be dewatered or land applied.

3. If additional liquid storage is required at the Garner Road Facility within the 2051-time horizon; installation of tank storage for liquid biosolids is recommended due to the smaller footprint, containment of odour, and resilience to wet weather events when compared to lagoon storage.

4. Install cake storage on a covered concrete pad or within enclosed, ventilated space with odour control.

16.3 Water Residual Management Recommendations

For management of water treatment plant residuals, it is recommended that:

1. The three water treatment facilities, Rosehill, Port Colborne, and Welland WTPs, that discharge their residuals to the local wastewater collection systems should continue that practice;

2. Decew and Niagara Falls water treatment facilities to continue to transport their residuals to the Garner Road Facility for dewatering and management along with the Region's biosolids.

3. If dewatering is added at Baker Road WWTP in the long term, blend Grimsby WTP residuals with digested sludge at the Baker Road Wastewater Treatment Facility upstream of dewatering. The blended dewatered biosolid and residuals would then be hauled to Walker Environmental or Garner Road.

16.4 Sewer Use By-Law Recommendations

To reduce impacts of sewer discharge streams on biosolids quality now and in the future, the following updates to the Niagara Region's Sewer Use By-Law should be considered:

1. Continue to Enforce By-Law: Region should continue to track industrial users and enforce by-law limits to improve compliance with existing SUB.

2. Continue to work with industrial discharger to address more frequent exceedances, including those related to BOD_5, FOG and TSS.

3. Monitor status of PFAS regulations: As WWTP effluent discharge limits are expected to be implemented for PFAS compounds, sometimes referred to as 'forever chemicals', the Region should continue to monitor status of regulatory changes and consider updating their Sewer Use By-Law to reduce PFAS inputs into the system once changes are confirmed.

No changes to Region's SUB limits are proposed at this time, as the current limits are close to the CCME limits. Lowering them further will likely result in more exceedances, as additional treatment for metals by industries is difficult given limitations in available technologies and is not cost effective. No changes to the lower-tier municipalities' SUBs are required as they all reference the Regional By-law.

16.5 Service Delivery Recommendations

The following are recommendations related to service delivery of biosolids management through third party contractors for both liquid and dewatered biosolids:

1. Continue using third-party contractor to manage liquid biosolids; consider developing separate contract for land application of biosolids or under one contract if sufficient competition is available in the market.

2. Continue allowing for liquid biosolids to be hauled directly to land application from Anger Avenue, Niagara Falls, Port Weller, Port Dalhousie, and Welland WWTPs to maintain flexibility, and provide a contingency measure if Garner Road storage is temporarily unavailable. Consider requesting pricing for direct land application of liquid biosolids from other WWTPs (Baker Road, Niagara-on-the-Lake, Seaway, Crystal Beach) to increase flexibility in future contract.

3. Improve control over solids concentration in lagoons through decanting with a target minimum concentration of 4% total solids in the land applied biosolids. This will reduce the volume of liquid biosolids hauled to land application and the associated costs, which are on a volume basis. This can be achieved by:

   a. The Region implementing a sampling program to periodically verify solids concentrations in the lagoon being removed for land application. As an incentive, the Region could consider introducing a discounted unit price ($/m^3) to haul liquid biosolids from Garner Road to land application if total solids are less than 4%. This alternative is preferred as long as the current contract scope is maintained.
   b. The Region taking over managing of the lagoons and associated decanting. This alternative should be considered before renewing current contract.

4. Update expected biosolids quantities in contract to reflect current values and expected changes in hauling.

5. Require that contractor demonstrates that they have a sufficiently sized land bank for estimated quantity of biosolids plus 30% to allow for increases over course of the contract.

6. If dewatering is still being used at Niagara Fall WWTP upon contract renewal, update contract terms to allow for provisional hauling of dewatered cake from Niagara Falls WWTPs to Garner Road or direct land application in the scenario where Walker Environmental cannot receive the cake; also including hauling price for cake from Garner Road to direct land application.

7. Continue contract with Walker Environmental, with proposed contract revisions, including increasing maximum quantity of biosolids reserved for Niagara from 6000 dt/year to 8000 dt/year. Maintain minimum required biosolids quantity of 4700 dt/year to N-Viro to ensure incentive to Walker Environmental.

8. Engage a third-party contractor to haul cake from Garner Road to direct land application. This may or may not be the same contractor that manages liquid land application.

16.6 Risk Mitigation Recommendations

Additional measures that should be taken to manage risk include:

1. Review and update the risk matrix and mitigate high and medium ranked risks where possible.

2. Closely monitor anticipated changes to regulations related to PFAS levels in land applied biosolids and plan for these changes accordingly, which could involve updates to the Sewer Use By-Law. Maintain a strong relationship with OMAFRA and MECP to stay current on changes.

3. Update formal contingency plan based on new proposed biosolids program once implemented.

17 Conclusion

As defined in the previous sections, the 2021 BMMP objective was to refine the overall biosolids strategy for all communities within Niagara Region while considering changes to the population forecasts, regulations, policies, as well as infrastructure works completed since the filing of the previous 2011 BMMP. The 2021 BMMP has satisfied the requirements of Phases 1 and 2 of the Class EA process and has incorporated the five (5) key principles of environmental planning, as previously identified and described within Section 2.2. of this report. As stated, various proposed projects have been recommended through this BMMP update and are summarized in Table 13-6. The projects that have been identified as Exempt Projects (formerly Schedule A and A+ projects) can proceed without further approval, while the projects that have been identified as Schedule B and Schedule C projects will require further assessment and consultation before they can proceed to design and construction.

Additionally, the Region is committed to reviewing and updating this BMMP every ten (10) years to ensure that the plan continues to meet the Region's needs, regulations, market demands and considered new technologies.

18 References

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