Guelph Wastewater Treatment and Biosolids Management Master Plan Environmental Study Report

Document No: FES0412221124KWO
Revision No: 3

City of Guelph
2001277

Guelph Wastewater Treatment and Biosolids Management Master Plan
January 26, 2023

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Client Name: City of Guelph
Project Name: Guelph Wastewater Treatment and Biosolids Management Master Plan
Document Number: FES0412221124KWO
Project Number: CE771800
Project Manager: Jillian Schmitter, Jacobs
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Revision Number: 3
Date: January 26, 2023
File Name: CE771800_GuelphWWTBM-ClassEA-Report_FINALDRAFT_2023.01.26.docx

Document History and Status

Revision	Date	Description	Author	Checked	Reviewed	Approved
0	April 4, 2022	First Draft Report	J. Schmitter A. Schmidt J. Philpott E. Henderson	J. Schmitter (March 4, 2022)	D. Ross (March 22, 2022)	J. Schmitter (April 4, 2022)
1	September 2022	Second Draft Report for City review	J. Philpott J. Schmitter E. Henderson	J. Schmitter	J. Schmitter	J. Schmitter
2	November 4, 2022	Draft Report for informal MECP review	J. Schmitter J. Philpott	A. Schmidt	J. Schmitter	J. Schmitter
3	January 26, 2023	Final Draft Issued for 30-day Public Review	J. Philpott J. Schmitter	A. Schmidt T. Mahood	J. Schmitter T. Mahood	J. Schmitter

Distribution of Copies

Revision	Issue Approved	Date Issued	Issued to	Comments
0	J. Schmitter	April 4, 2022	T. Robertson	
1	J. Schmitter	September 22, 2022	T. Robertson	Version updated to reflect City comments.
2	J. Schmitter	November 4, 2022	T. Robertson Joan Del Villar Cuicas (MECP)	Draft Issued to the MECP.
3	J. Schmitter	January 26, 2023	T. Robertson	Final Draft ESR issued for 30-day Review

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Executive Summary

Background

In 2006, the City of Guelph (City) completed a Biosolids Management Master Plan. In 2009, the City completed a Wastewater Treatment Master Plan. These Master Plans put forward capital projects and recommendations to provide wastewater treatment and biosolids management to meet City needs. In 2020, the City initiated a Wastewater Treatment and Biosolids Management Master Plan (Master Plan) to recommend a strategy to continue to provide wastewater treatment and biosolids management to the year 2051 to align with the Provincial Growth Plan and the City's Municipal Comprehensive Review. The Master Plan scope included completion of Phases 1 and 2 of the Municipal Engineers Association (MEA) Municipal Class Environmental Assessment (EA) (Municipal Engineers Association, 2000). The project scope was expanded to a Schedule C Class EA, including the completion of Phases 3 and 4 of the Class EA process, as described by MEA Class EA process (Municipal Engineers Association, 2000). This Environmental Study Report (ESR) presents the methodology, recommended strategy, design concept, implementation plan, and communications program for the Schedule C Class EA study.

The City initiated this Class EA project recognizing its responsibility to protect the environment, and considering the importance of wastewater and biosolids as resources with the ability to provide environmental benefit. Updates to this document will be undertaken approximately every five to eight years. This ESR includes a level of detail necessary for the City to proactively adjust the implementation timing for recommended projects depending on how anticipated growth is realized over time.

To emphasize the City's focus on the resource recovery value of wastewater and commitment to continuing and maximizing resource recovery, the former Guelph Wastewater Treatment Plant was renamed to the Guelph Water Resource Recovery Centre (WRRC) in 2022. The facility will be referred to as the Guelph WRRC in this ESR.

Existing Conditions

Current Wastewater Flows

Wastewater flows entering the Guelph WRRC measured from January 2017 through December 2019 were analyzed for this study. The average daily flow during this period was 56.12 ML/d, which represents 88 percent of the plant's rated capacity (64 ML/d). Average daily flows were similar from 2017 to 2019. The design peak factor for the plant is 2.0, which is consistent with the peak factor determined through flow analysis for this Class EA and will be used to develop future flow requirements.

Current Wastewater Quality and Loadings

Concentrations and loading of key parameters in wastewater are used to determine future capacity required to achieve performance objectives. These parameters include total suspended solids (TSS) and nutrients (phosphorous and nitrogen compounds). The biochemical oxygen demand is also an important parameter that indirectly measures biodegradable organics by quantifying the amount of oxygen needed to biodegrade the organics in an aerobic environment. Average influent wastewater characteristics and loads are presented in Table ES-1.

Table ES-1. Historical Guelph WRRC Influent Concentrations and Loads (January 2017 to December 2019)

Influent Parameter	Average Concentration, mg/L	Average Day Load, kg/d [a]	Estimated Per Capita Contribution, g/cap/d [b]	Typical Range Per Capita Contribution, g/cap/d [c]
$cBOD_5$	185	10,462	74	60 to 110
TSS	252	14,041	99	60 to 115
TP	5	264	2	3 to 5
TKN	39	2,134	15	9 to 14
$cBOD_5$	185	10,462	74	60 to 110

Notes:

[a] Daily loads are calculated based on daily flow and screened influent concentration. Extreme outliers (more than two standard deviations from the average) were removed.

[b] Calculated based on the average day load and the 2019 serviced population of 141,963

[c] Adapted from Metcalf & Eddy (2014)

g/cap/day = gram per capita per day

kg/d = kilogram per day

mg/L = milligram per litre

Current Sludge and Biosolids Generation

Sludges are generated in the primary clarification and secondary biological processes. After further treatment for stabilization, the resulting material is referred to as biosolids. The Guelph WRRC uses anaerobic digestion to stabilize sludges and produce biosolids. After stabilization, biosolids are dewatered and further processed using a proprietary technology (Lystek) and are then applied to land as a fertilizer product. The Guelph WRRC generates 16,454 wet tonnes per year on average with a solids concentration of 22 percent (based on reports for 2017-2019). Biosolids are process using the Lystek process located at the WRRC or at Lytek's facility in Dundalk, Ontario.

Future Conditions

Population and Flow Projections

Population projections are important to determine the future wastewater treatment and biosolids management servicing requirements. Population projections. Population projections were provided by the City's Planning Services division and align with those identified in the Growth Plan which reflects the most recent provincial Places to Grow growth targets (Ministry of Municipal Affairs and Housing, 2020). Population projections for the City are presented in Table ES-2.

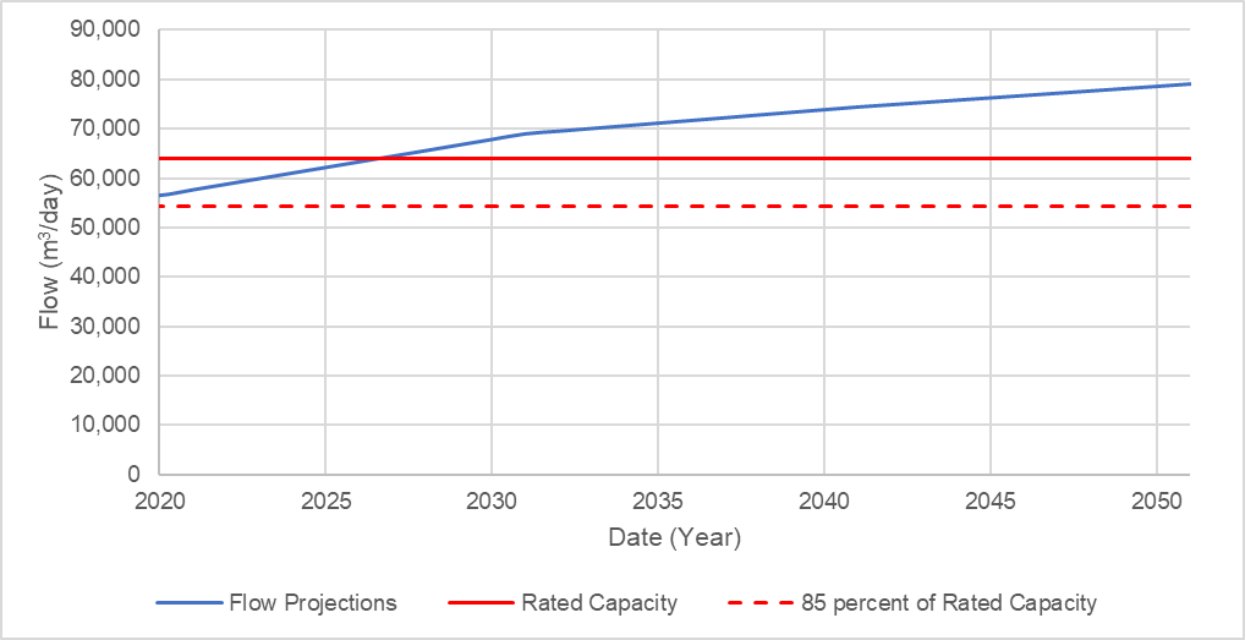
Table ES-2. City of Guelph Population Projections

Year	Projected Population
2019	141,963
2021	147,802
2026	162,401
2031	177,000
2036	184,000
2041	191,000
2051	208,000

Population statistics from the City and historical average daily flows to the Guelph WRRC from 2010 to 2019 were analyzed to determine an average per capita flow rate of 390 litres per person per day. This value was used with population projections to forecast future flows.

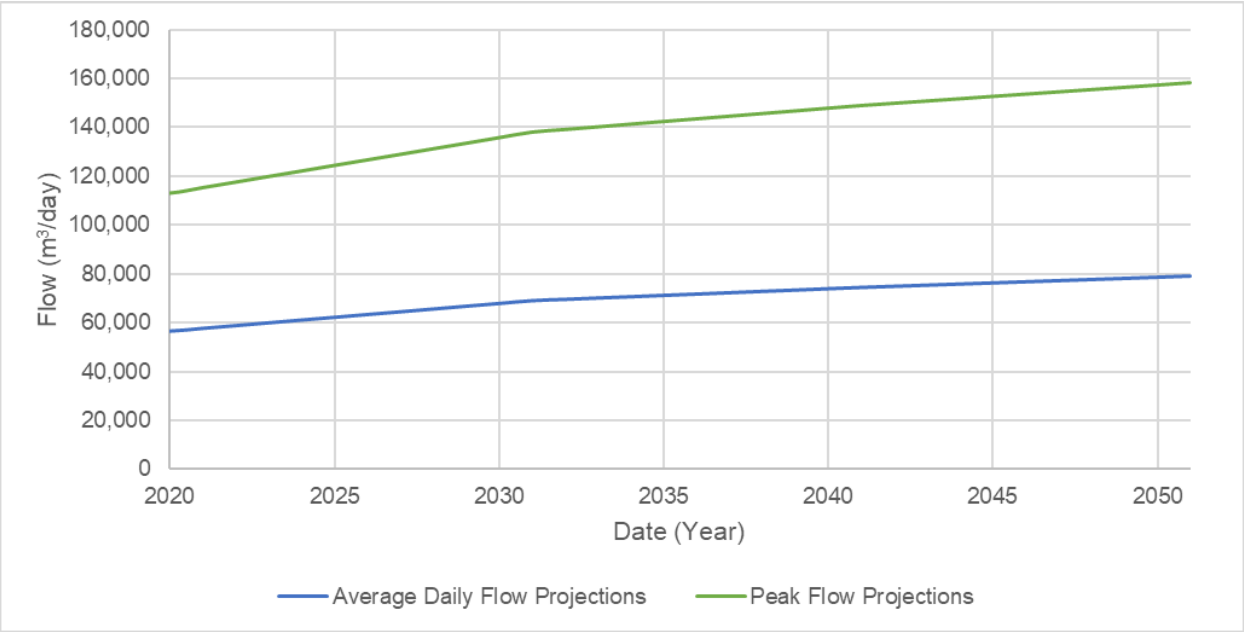
Wastewater flow projections to 2051 are presented in Figure ES-1, based on the population projections presented in Table ES-2 and the per person flow rate of 390 litres per person per day. Based on these projections, the WRRC will reach its current rated capacity in 2027, with a projected flow of 79.2 ML/d by 2051. The Guelph WRRC is currently operating above 85 percent of its ECA rated capacity. This is a driver to complete this Master Plan as a Schedule C Class EA.

Figure ES-1. Guelph WRRC Flow Projections to 2051



Peak flows were projected using a peak factor of 2.0 (Figure ES-2). This peak factor represents a 99.8 percentile flow event at the Guelph WRRC based on the analysis of flows from 2016 to 2018. A peak flow of 158.3 ML/d is projected in 2051.

Figure ES-2. Guelph WRRC Peak Flow Projections to 2051



Sludge and Biosolids Projections

A summary of predicted sludge and biosolids generation rates is presented in Table ES-3. The projected average day dewatered biosolids cake generation is 13 dry tonnes per day in 2051.

Table ES-3. Projected Guelph WRRC Sludge Generation

Parameter	2051 Projected Flow (79.2 ML/d) – Average Day Loading	2051 Projected Flow (79.2 ML/d) – Maximum Month Loading
Primary Sludge, kg/d	17,630	22,030
Secondary Sludge, kg/d	6,110	8,690
Thickened waste activated sludge, kg/d	5,200	7,380
Combined Sludge to Digestion, kg/d	22,820	29,410
Digested Biosolids, kg/d	14,150	18,200
Dewatered Cake, dry kg/d	13,020	16,750

Effluent Objectives and Criteria

The assimilative capacity study was completed to assess the existing conditions in the Speed River and to recommend future effluent criteria and objectives that will maintain or improve the health of the Speed River while Guelph WRRC flows increase within the planning period (i.e., to 79.2 ML/d) (Hutchinson Environmental Sciences Ltd., 2022).

The assimilative capacity study recommends revised effluent criteria for the Guelph WRRC under future conditions. The effluent criteria recommended in the assimilative capacity study are presented in Table ES-4. The proposed reductions in effluent limits will result in a net improvement in Speed River water quality, even at higher future flows, compared to the current approved ECA limits (Hutchinson Environmental Sciences Ltd., 2022).

Table ES-4. Recommended Effluent Criteria for the Guelph WRRC at Average Daily Flow of 69 to 83 ML/d (Hutchinson Environmental Sciences Ltd. 2022)

Parameter	Period	Objective	Compliance Limit
TP	Jan 1 to Dec 31	0.2	0.3
TSS	Jan 1 to Dec 31	3	5
$cBOD_5$	Jan 1 to Dec 31	3	5
total ammonia nitrogen	Jun 1 to Sep 30	0.75	1
	Oct 1 to May 30	2	3

These effluent targets were an important consideration during the alternative identification and evaluation, and selection of the preferred alternative solutions The findings of the assimilative capacity informed the study recommendations and the mitigation measures presented in the implementation plan.

Summary of Challenges and Opportunities

The following processes are projected to provide sufficient capacity and have remaining life (with regular maintenance and renewal investments) within the planning period:

- Influent Pumping
- Primary Treatment, provided that the secondary treatment capacity of the existing plants can be increased.
- Sidestream Treatment

The following processes are projected to require capacity upgrades or rehabilitation/replacement due to condition within the planning period:

- Screening
- Grit Removal
- Secondary Treatment
- Tertiary Filtration
- Disinfection
- Waste Activated Sludge Thickening
- Anaerobic Digestion
- Dewatering
- Biogas Utilization (Cogeneration)

Opportunities identified for this Class EA include:

- Explore alternative wastewater treatment and solids handling technologies that provide the required capacity and increase operational reliability and efficiency.
- Continue to protect water quality in the Speed River by increasing plant resiliency and reliability to avoid by-passes.
- Minimize GHG emissions as an important part of alternative evaluation.
- Increase energy efficiency and resource recovery at the Guelph WRRC.

Problem and Opportunity Statement

The purpose of the Wastewater Treatment and Biosolids Management Master Plan Class EA is to plan for the future of the wastewater and biosolids management to provide capacity for growth, in a manner that is sustainable and protects surface water and the environment.

This Class EA provides a long-term plan that guides how the City will continue to meet the demands of its growing community over the next 30 years. The decisions are driven by goals for:

- Infrastructure reliability
- Legislation
- Sustainability
- Climate change mitigation
- City's goal to use 100 percent renewable energy sources by 2050
- Minimizing impacts to the Speed River
- Meeting priorities set out through the City's Strategic Plan

The City of Guelph is committed to managing the population growth and providing the necessary wastewater treatment capacity to accommodate the City's growth in a proactive and environmentally conscientious manner. The City's philosophy is to manage wastewater and biosolids as valuable resources. This Class EA has confirmed that the Guelph WRRC will require expansion and has identified several process components nearing the anticipated end of useful life within the planning period. This presents the following challenges and opportunities for the City:

- Additional treatment capacity is needed in the near term (by 2027)
- The assimilative capacity study has identified more stringent effluent requirements which presents the opportunity for performance improvements
- Process equipment nearing the expected end of service life requires capital expenditure for renewal to allow the plant to continue providing reliable wastewater treatment and biosolids management

When addressing these challenges, there are also opportunities to reduce energy usage and increase resource recovery when processes are replaced or upgraded, which is in line with the City's sustainability policy.

Environmental Assessment Process

Overview of Study Approach

This study was completed as Schedule C Municipal Class EA, following Phases 1 through 4 of the Class EA process.

The activities completed in Phases 1 through 4 include:

- **Phase 1 - Existing Conditions and Future Needs:** This phase included development of capacity and performance requirements, assessing existing facilities and practices for wastewater treatment and biosolids management, identifying gaps in meeting future needs, and development of a Problem and Opportunities Statement.
- **Phase 2 -Identification and Evaluation of Alternative Solutions:** This phase included identification of alternative wastewater treatment and biosolid management solutions to meet future requirement or provide benefit with respect to future opportunities. Alternative solutions were subject to comparative evaluation to identify preferred solutions.
- **Phase 3 - Development of Design Concepts and Implementation Plan:** In this phase, design concepts and implementation triggers and schedule for the recommended solutions was documented, and capital costs were forecasted for the planning period. Potential impacts and mitigation measures were documented.
- **Phase 4 - Environmental Study Report (ESR):** The methodology and project recommendations are documented in this Environmental Study Report.

Decision-Making Process

A fundamental goal of this study is to document a transparent, defensible and reproduceable decision-making process such that the selected preferred solutions are technically sound and understood by the community. The decision-making framework incorporated feedback received during engagement activities conducted for this study. A multi-step evaluation approach was used to identify the preferred alternatives. The decision-making process included the following steps:

1. A **long-list** of wastewater treatment/biosolids management alternatives (technologies and strategies) were identified for each Guelph WRRC process area to address deficiencies (e.g., capacity, condition, etc.) or provide opportunity (e.g., improve energy efficiency) for each process area.

2. Alternatives on the long-list for each process area were subject to **screening** against a set of "must-meet" criteria to identify a short-list feasible for implementation at the Guelph WRRC.

   The "must-meet" screening criteria used for this exercise included:

   - **Performance**: To meet this criterion, an alternative must reliably meet the performance objectives and criteria.
   - **Proven Technology**: To meet this criterion, the alternative must have five installations with more than 5 years of operating history, with at least one full-scale installation within North America.
   - **Resiliency / Reliability**: To meet this criterion the alternative (technology, materials, biosolids management approach) must be readily available and there is an established local (Ontario) market.

3. A two-stage **detailed evaluation** was completed on the short-listed alternatives using the detailed evaluation criteria:

   a. **Stage 1**: An evaluation was completed for the short-listed alternatives based on the technical, social/cultural, and natural environment evaluation criteria. This provided a "benefit score" for each short-listed alternative. The alternatives that clearly provided less benefit than other alternatives were eliminated from consideration.

   b. **Stage 2**: Alternatives that passed Stage 1 of the evaluation were advanced for detailed concept development and costing, which were used to develop the economic score for each alternative. This provided an overall detailed evaluation score for each alternative. To establish a defensible preferred solution, multiple scoring methods were used. The alternative that received the highest detailed evaluation score was selected in each process area. If evaluation methodologies provided different outcomes, the solution that was identified in most across multiple methods was selected as the preferred alternative.

Detailed evaluation criteria were developed through a collaborative process and reflect feedback received from the community liaison group (CLG) and community through engagement activities. The detailed evaluation criteria were identified in the following four categories:

- Natural Environment
  - Minimize Greenhouse Gas (GHG) Emissions
  - Minimize Impacts on Groundwater Quality and Quantity
  - Minimize Impacts to Terrestrial Habitats and Corridors
  - Minimize Impacts to Aquatic Habitat and Fisheries
  - Minimize Floodplain Impacts
  - Minimize Impacts to Surface Water Quality
  - Minimize Impacts to Soil Quality
  - Minimize Impacts to Air Quality
  - Minimize Impacts to Wetlands

- Social and Cultural Environment
  - Maximize Compatibility with Agricultural Practices
  - Minimize Impacts to Community Health and Safety
  - Minimize Impacts to Occupational Health and Safety
  - Maximize Smart Cities Circular Food Economy
  - Minimize Noise
  - Minimize Odour
  - Maximize Positive Community Perception
  - Minimize Impacts to Transportation Systems
  - Maximize Positive Aesthetics
- Technical
  - Maximize Performance Record
  - Meet Treatment Capacity Requirements (short-term, medium-term, & long-term)
  - Maximize Ease of Implementation (Constructability)
  - Minimize Energy Requirements
  - Minimize Risks due to Regulatory Constraints
  - Maximize Operational Compatibility with Existing Processes
  - Minimize Chemical Consumption
  - Maximize Ability to Treat Emerging Contaminants of Concern
  - Minimize Maintenance Complexity
- Economic
  - Minimize Capital Costs
  - Minimize Operations and Maintenance (O&M) Cost
  - Minimize Life Cycle Cost

A three-part scale used to evaluate the level of performance for each technology or alternative. In general terms the scale is applied as follows:

- 10 – Represents the highest possible score, the alternative performs well and significantly progresses the study objectives.
- 5 – Represents an acceptable score, the alternative reflects the current situation.
- 1 – Represents an unacceptable performance, the alternative is not well aligned with the study objectives.

Wastewater Treatment Alternatives and Evaluation

The wastewater treatment processes projected to require capacity upgrades or rehabilitation/replacement due to condition within the planning period are presented in Table ES-5. Table ES-5 also presents the timeframe that the upgrades are required within.

Table ES-5. Summary of Future Needs for Wastewater Treatment

Unit Process	Upgrade Timing Requirement	Driver
Screening	Within the next 15-20 years	Capacity
Grit Removal	Within the next 5 years	Capacity/Condition
Secondary Treatment	Within the next 5 years	Capacity
Tertiary Filtration	Within the next 5 years	Capacity
Disinfection	Within the next 5 years	Capacity/Condition

Long lists of alternatives were identified for each unit process and subjected to screening using the "must-meet" screening criteria. The alternatives that passed the screening were shortlisted and carried forward for further evaluation.

While the process capacity assessment projected the Guelph WRRC to have sufficient primary treatment capacity, the inability to transfer flows between plants means that Plants 1 to 4 cannot realize their full primary treatment capacity unless their secondary treatment capacities are expanded to match. Therefore, primary treatment must also be considered when developing alternative solutions for secondary treatment. Each plant's ammonia removal capacity (through nitrification) was also a consideration, as the Guelph WRRC must provide full nitrification to meet its effluent objective for ammonia. As a result, integrated alternative solutions were developed for primary treatment, secondary treatment, and tertiary nitrification.

The shortlisted alternatives were developed and evaluated by unit process. A technology evaluation (i.e., alternative design concept development and evaluation) was completed where a new facility was identified as the preferred solution for a unit process.

Table ES-6 presents the preferred solution for wastewater treatment for this Class EA and the associated cost estimates.

Table ES-6. Preferred Solutions for Wastewater Treatment

Unit Process	Preferred Solution	Year Required	Driver	Capital Cost Estimate, million CAD
Headworks	Grit removal process expansion and rehabilitation Hydraulics improvement (to minimize bottleneck between headworks and primary treatment)	Within the next 5 years	Capacity/Condition	$6.0
Headworks	Screening process and headworks building expansion	Within the next 15 to 20 years	Capacity	$14.1
Primary Treatment, Secondary Treatment and Tertiary Nitrification	Remove RBCs and operate all plants as nitrifying conventional activated sludge	Within the next 5 years	Capacity	$12.2
Primary Treatment, Secondary Treatment and Tertiary Nitrification	If pilot testing is successful: Waste activated sludge hydrocyclones (all plants) and Plant 1 MABR retrofit	Within the next 15 to 20 years	Capacity	$13.4
Primary Treatment, Secondary Treatment and Tertiary Nitrification	If pilot testing is unsuccessful: New Plant 5 (technology selection to be re-evaluated at that time).	Within the next 15 to 20 years	Capacity	$34.7
Tertiary Filtration	New disk filter facility, demolition of East-West Tertiary Filter Facility	Within the next 5 years	Capacity	$33.3
Disinfection	New UV disinfection facility, demolition of existing CCT	Within the next 5 years	Capacity/Condition	$14.4

Biosolids Management Alternatives and Evaluation

The biosolids management processes are projected to require capacity upgrades or rehabilitation/replacement due to condition within the planning period are presented in Table ES-7.

Table ES-7. Summary of Future Needs for Biosolids Management

Unit Process	Upgrade Timing Requirement	Driver
Waste Activated Sludge Thickening	Within the next 5 years	Capacity
Anaerobic Digestion	Within the next 5 years	Capacity
Dewatering	Within the next 5 years	Condition
Biosolids Management	By 2028	Contract Expiration
Biogas Utilization	Within the next 5 years	Capacity

Long lists of alternatives were identified for each unit process and subjected to screening using the "must-meet" screening criteria. The alternatives that passed the screening were shortlisted and carried forward for further evaluation.

Waste activated sludge thickening and anaerobic digestion could not be evaluated independently, as their operation impacts one another. Sludge thickening reduces sludge volume, which in turn impacts anaerobic digestion capacity. Therefore, sludge treatment and stabilization underwent alternative development and evaluation as one unit process.

While a long-list of biogas utilization alternatives were subject to the "must-meet" screening criteria, no further evaluation was required, as the City elected to proceed with design for a cogeneration system upgrade during this Class EA. The biogas generation projections developed based on the preferred solution for sludge treatment/stabilization were used to inform the cogeneration upgrades design.

The shortlisted alternatives identified through the screening process were developed and evaluated by unit process. Table ES-8 presents the preferred solution for biosolids management for this Class EA and the associated cost estimates.

Table ES-8. Preferred Solutions for Biosolids Management

Unit Process	Preferred Solution	Year Required	Driver	Capital Cost, million CAD
Sludge Treatment and Stabilization and Biogas Usage	New Primary Sludge and Waste Activated Sludge Thickening Facility	Within the next 5 years	Capacity	$23.3
Dewatering	New Dewatering Facility	Within the next 5 years	Condition	$16.1
Biosolids Management	Enhanced Biosolids Treatment and Beneficial Reuse	2028	Contract Duration	$28.4

Engagement

Community and First Nations Engagement is an essential part of the Municipal Class EA process. An engagement plan was developed and implemented on this project. This section outlines the approach to engagement, activities conducted by the project team, and how the engagement activities informed the study.

Engagement Plan and Approach

Upon study initiation, a Community Engagement and Communications Plan developed for this Class EA, to guide the approach to engagement for the duration of the study. The goals for engagement on this study include:

1. Meet and, where possible, exceed the consultation and engagement requirements of the Municipal Class EA process.
2. Raise awareness for the ongoing City planning activities underway.
3. Incorporate community priorities and values in the study's decision-making process.
4. Be consistent with the City's Guideline for Community Engagement (City of Guelph, 2020).

The Community Engagement and Communications Plan prioritized reaching out broadly to the community and providing opportunities for input to the Class EA. This plan incorporated the goals and principles put forward in the City's Guiding Principles for Community Engagement and focused on engagement with the following groups:

- Community residents, businesses, and stakeholders
- First Nations, Indigenous, and Métis groups
- Municipal staff and elected officials
- Regulatory review agencies, such as the MECP and GRCA

A CLG was formed for this study. The CLG consisted of members of the community, the University of Guelph, regulatory agencies (MECP and GRCA), the City divisions, and serviced Township representatives. The project team met with the CLG at key points throughout the study to provide members with an update on study findings and progress and receive feedback.

The City's approach to First Nation, Indigenous, and Métis group engagement was guided by the stated wishes of each of the individual groups and based on foundational principles of long-term relationship building. The City coordinated the engagement activities across all of the City's ongoing master planning projects including the Wastewater Treatment and Biosolids Management Class EA. Where feedback was provided on other ongoing City projects that feedback was reflected in this project.

Engagement Activities

Engagement is a key component of the Municipal Class EA process. Exceeding the minimum consultation requirements of the Class EA process was key objective of the engagement completed for this study. The engagement approach was informed by the City's Guiding Principles for Community Engagement.

The following provides an overview of the engagement activities completed for this Class EA:

- Project Notices
  - Notice of Commencement
  - Notices of Open Houses
  - Notice of Study Completion
- Community Liaison Group (three meetings)
  - **CLG Meeting 1:** Was held on October 18, 2020, before the first Open House. The purpose of this meeting was to introduce the project background, and decision-making approach to the CLG members. CLG members were provided with opportunities to provide feedback throughout the meeting.
  - **CLG Meeting 2:** Was held on April 27, 2021, before the second Open House. The purpose of this meeting was to present the identified alternatives and present the preliminary preferred solutions to the CLG members.

  - **CLG Meeting 3:** Was held on January 19, 2022, before the third Open House. The purpose of this meeting was to notify the CLG that the project team had decided to complete the assignment as a Schedule C Class EA (rather than a Schedule B) and to present the Implementation Plan developed in accordance with the Class EA process. CLG members were invited to provide feedback and ask questions throughout the meeting.
- Public Open Houses (three open houses)
  - **Open House 1** was held virtually from October 28, 2020 to December 10, 2020. The objective of this open house was to introduce the study, existing condition, and future needs and to provide the opportunity for the community to provide feedback. This POH received 173 unique visitors, 27 of whom completed surveys, and 16 provided additional comments to the project team.
  - **Open House 2** was held virtually from May 12, 2021 to June 22, 2021. The objective of this open house was to present the identified alternatives, evaluation process, and present the preliminary preferred alternatives and to provide the opportunity for the community to provide feedback. This POH received 177 unique visitors, 18 of whom completed surveys, and 16 provided additional comments to the project team
  - **Open House 3** was held virtually from March 14, 2022 to April 4, 2022. The objective of this open house was to present the identified alternatives, evaluation process, and present the preliminary preferred alternatives and to provide the opportunity for the community to provide feedback. This POH received 33 unique visitors, none of whom completed surveys, and no additional comments to the project team.

How the Preferred Solution Incorporates Engagement Feedback

The engagement conducted throughout the study resulted in the team receiving valuable feedback at key stages in the study. The team identified the following common themes in the feedback received across the engagement activities:

1. **Wastewater is a resource.** Feedback received through engagement activities consistently emphasized the view that wastewater is a resource containing nutrient and organic material that could be used beneficially on agricultural land. This is consistent with the City's Smart Cities Initiative to support a circular food economy. The organic material removed from wastewater can also be stabilized, which produces biogas that can be captured and used for energy generation and heat recovery. These themes are reflective of the processes and strategies previously implemented at the Guelph WRRC and form the basis for future innovation. Feedback received from the public confirmed this as a priority for the City's approach to municipal planning.

2. **Energy efficiency.** Feedback received through the engagement activities emphasized that energy efficiency at the WRRC should be a priority for the City. The feedback received included concerns around GHG emissions, but also related to opportunities for energy efficiency throughout the facility.

3. **Protecting the Speed River.** The Speed River is an important natural feature of the City, supporting aquatic and natural habitats. The selected technologies were selected to treat effluent to a standard beyond those identified in Table ES-4.

The feedback received through the engagement process impacted the decision-making on this study can be summarized as follows:

1. **Evaluation Framework:** Feedback received early in the project related to the community's values including resource recovery and energy efficiency were incorporated into the detailed evaluation framework. The criteria related to GHGs, beneficial reuse of biosolids (compatibility with agricultural practices), and energy requirements were also shaped by feedback received through engagement activities. In addition, the feedback received through the engagement activities provided important context for the project team during the scoring and evaluation of alternatives project phase.

2. **Confirmation of the short-listed alternatives and preferred solutions:** Engagement activities prioritized, presented, and sought feedback on the decision-making process throughout the study. The feedback received during these activities confirmed the decision-making process reflected the community's priorities and values. The study team received feedback supporting the identified preferred solutions and indicated that the community priorities identified through earlier engagement activities were reflected in the recommendations.

3. **Assimilative Capacity of the Speed River:** Feedback through engagement activities indicated that protection of the Speed River was a priority. At the time of the study commencement the City was undertaking an assimilative capacity study of the Speed River as a separate study. Based on the feedback received and the timing of the future needs for treatment capacity identified through the technical work, the decision to complete this project as a Schedule C Class EA (rather than a Schedule B Class EA). This change in approach included incorporating the findings of the Assimilative Capacity study directly in this study. Treatment technologies identified considered the findings of the assimilative capacity by continuing to exceed the effluent objectives identified through the assimilative capacity study.

4. **Chloride Concentrations in the Speed River:** Feedback through engagement activities with the CLG and public, highlighted concerns related to chloride concentrations in the Speed River. Water softener salt is a primary source of chlorides in treated effluent and the most effective mitigation strategy is through upstream management of chlorides. Expansion of the City's influent and effluent monitoring program to include chlorides is included in the Class EA recommendations. This will enable the City to monitor chloride concentrations discharged to the Speed River.

Recommendations

General Recommendations

The following general recommendations have been identified throughout the Class EA through conversations with City staff and through feedback received through engagement activities:

- Complete a Wastewater Treatment and Biosolids Management Master Plan update every 5 to 8 years. This will allow the City to adjust its capital expenditure plan based on an increased or decreased growth rate and continue to provide reliable wastewater treatment and biosolids management.
- Opportunistically implement green energy technologies (i.e., solar energy and wind energy-related technologies) as new facilities are constructed.
- Continue to collaborate with the Water Services Department to identify any potential impacts to future flow projections due to water conservation measures. It is recommended that the City update its Water Efficiency Strategy to quantify any potential reductions in water usage, wastewater generation, and anticipate changes in wastewater concentration that may impact WRRC processes.
- Continue to collaborate with the Engineering Division to identify any potential impacts to future flow projections due to the implementation of inflow and infiltration reduction measures.
- Continue to explore and implement, where feasible, approaches to reuse treated effluent. It is expected that effluent reuse will be driven through water supply planning activities.

Recommended Solutions

A summary of the recommended solutions for wastewater treatment and biosolids management in the City of Guelph for the planning period to 2051 is presented in Table ES-9.

Table ES-9. Summary of Preferred Solution for Guelph Wastewater Treatment and Biosolids Management Master Plan Class EA

Unit Process	Preferred Solution	Year Required	Supportive Studies	Capital Cost, $ million
Screening	Screening process and headworks building expansion	By 2038	Schedule A	$14.1
Grit Removal	Grit removal process expansion and rehabilitation Hydraulic improvements	By 2027	Schedule C [a,b]	$6.0
Primary Treatment, Secondary Treatment and Tertiary Nitrification	Construct 2 new secondary clarifiers in Plant 2 Removal of RBCs and operate all plants as nitrifying CAS	By 2027	Schedule C [a,b]	$12.2
Primary Treatment, Secondary Treatment and Tertiary Nitrification	Construct a new Plant 5	By 2038	Schedule C	$34.7
Tertiary Filtration	Construct a new disk filter facility Demolish the East-West filter building	By 2027	Stage 2 Archaeological Assessment [c] Schedule C [a,b]	$33.3
Disinfection	Construct a new UV disinfection facility Demolish the CCT	By 2027	Stage 2 Archaeological Assessment [c] Schedule C [a,b]	$14.4
Sludge Treatment/ Stabilization	New Primary Sludge and Waste Activated Sludge Thickening Facility	By 2027	Schedule B [a,b]	$23.3
Dewatering	New Dewatering Facility	By 2027	Schedule B [a,b]	$16.1
Biosolids Management	Enhanced Treatment with Beneficial Reuse	2028	Schedule A	$28.4

Notes:

[a] EA requirements are satisfied by this Class EA.

[b] Project is required as part of an overall capacity expansion.

[c] Project will require a Stage 2 Archaeological Assessment to be completed ahead of detailed design.

Implementation Plan

This section presents the implementation plan for the recommendations from this Class EA in accordance with the MEA Municipal Class EA process for Schedule C Class EA's. Further details of the implementation plan are presented in Appendix A-3.

The treatment capacity at the Guelph WRRC will be expanded in two phases during the planning period, as follows:

- **Phase 1: Expansion from 64 ML/d to 72.5 ML/d by 2027**: By constructing two new secondary clarifiers in Plant 2 and operating all four plants as nitrifying CAS plants (and removing the RBCs), the total nitrification capacity will increase to 72.5 ML/d. This upgrade is required by 2027, which is the year that the existing rated capacity (64 ML/d) is projected to be exceeded. This rated capacity increase also requires a tertiary filter expansion, new UV disinfection system, new primary sludge/waste activated sludge thickening facility and dewatering upgrades.
- **Phase 2: Expansion from 72.5 ML/d to 79.2 ML/d by 2038**: To increase treatment capacity beyond 72.5 ML/d (projected to be exceeded in 2038), process intensification of existing plants (via waste activated sludge hydrocyclones and/or MABR retrofits) or construction of a new Plant 5 is required. The second phase expansion at Guelph WRRC will increase capacity from 72.5 ML/d to 79.2 ML/d, which is the average daily flow projected in 2051. At that time, new growth projections may dictate a larger expansion to provide capacity beyond 2051.

Table ES-10 presents the upgrades required in Phase 1 (needed to be in service by 2027), and Table ES-11presents the upgrades required in Phase 2, or in service by 2038.

It is noted that a Master Plan update with an extended planning horizon (i.e., beyond 2051) will be completed prior to the Phase 2 upgrades and as a result, the preliminary requirements identified through this Class EA may change. The cost for a new Plant 5 will be carried forward for budgetary purposes, although the timing for a new Plant 5 may be deferred if process intensification can be achieved within the existing plants.

In addition to the projects listed in the following tables, a new biosolids management contract and/or potential on-site enhanced biosolids treatment capacity expansion (capital cost estimate of $28,400,000) is required by 2028 when the existing contract expires.

Table ES-10. Guelph WRRC Phase 1 Expansion and Upgrade - Required by 2027

Project	Capital Cost, $ million
Rehabilitate and expand the grit removal system and address hydraulic bottlenecks	$6.0
Construct 2 new secondary clarifiers in Plant 2, remove RBCs and operate all plants as nitrifying CAS plants	$12.2
Expand tertiary treatment with new disk filter facility and decommission the East-West filter building	$33.3
Construct a new UV disinfection facility and demolition of existing chloring contact tank	$14.4
Construct a new dewatering facility with biosolids storage	$16.1
Construct a new primary sludge thickening and waste activated sludge thickening facility	$23.3
Total	$105.3

Table ES-11. Guelph WRRC Phase 2 Expansion and Upgrade - Required by 2038

Project	Capital Cost, $ million
Expand the screening system	$14.1
Construct a new Plant 5 [a]	$34.7
Total	$47.8

Notes:

[a] There is potential for capital expenditure to be delayed if process intensification can be achieved within the existing plants. Pilot testing to demonstrate the potential for process intensification is recommended prior to 2038

It is recommended that projects within the same general plant area be packaged into one contract. The suggested short-term contracts are as follows:

- **Contract 1:** Solids Upgrades (Dewatering, Sludge Thickening Facility)
- **Contract 2:** Grit Removal Upgrades and Address Hydraulic Bottleneck
- **Contract 3:** Primary/Secondary/Tertiary Upgrades (Plant 2 Secondary Clarifiers, Tertiary Filter Expansion and UV Facility)

The packaging of future upgrade contracts can be assessed in the future (biosolids management, screening upgrades and plant retrofit/new Plant 5).

It is recommended that the City update the cost estimates presented in this Class EA as each project is undertaken. The COVID-19 pandemic has resulted in significant escalation of capital project costs throughout Ontario due to supply chain issues and increasing material costs. It is unknown at this time if these issues will continue in the future and as such, it is expected that cost estimates will need to be revised.

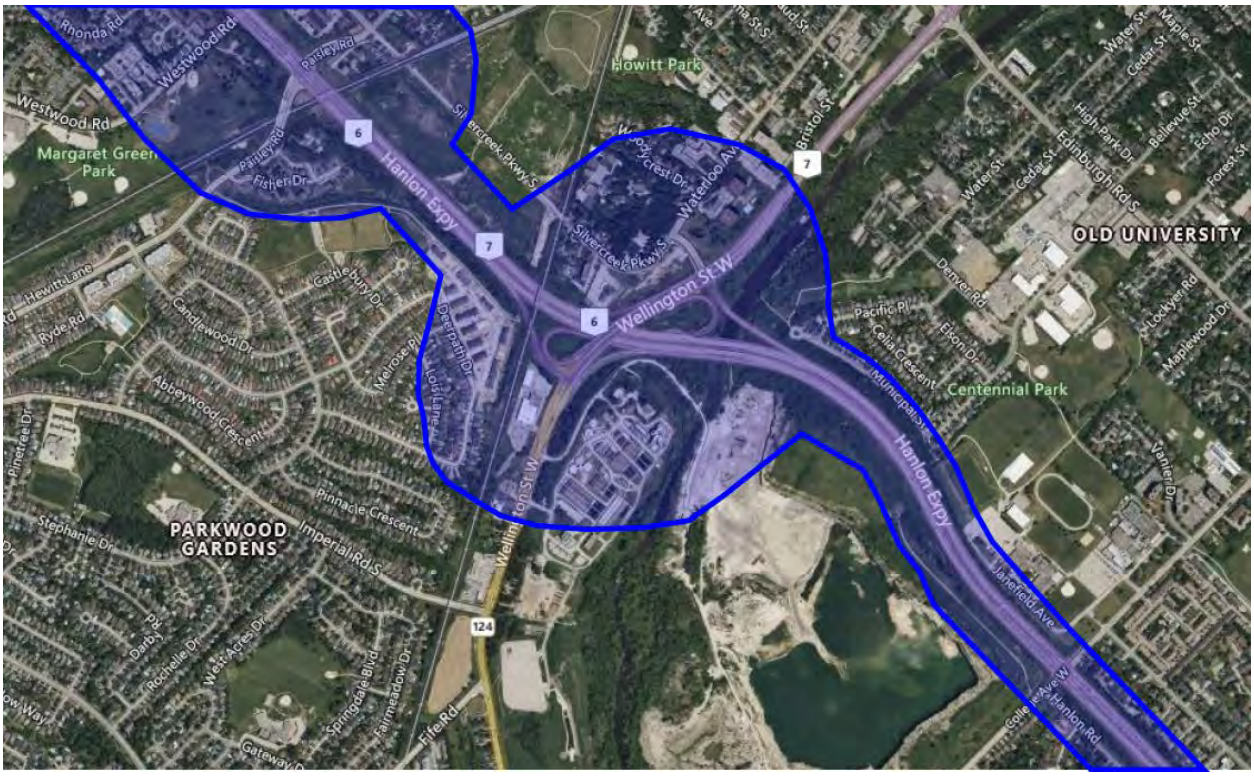
Permits and Approvals

Authorization or review by Fisheries and Oceans Canada (DFO) is likely not required given in-water works within the Speed River and work within the ordinary high-water mark are not required.

A permit under *O. Reg. 150/06, Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses* is required for construction or development within the GRCA regulated area (GRCA, 2022).

The Guelph WRRC is within the MTO controlled Area (shown in Figure ES-3) for impacts to highway systems. The MTO encourages pre-consultation and engagement and is responsible for providing comments under the Planning Act to help facilitate construction project within the corridor. Permit types include Building and Land Use, Entrance, Sign, and Encroachment. For proposed land development, construction or other activities within MTO Controlled Areas, the review process is managed by the Highway Corridor Management Office, including MTO Permit issuance and administration. The recommended solutions will not impact on sight lines along the Hanlon Parkway and associated interchange ramps.

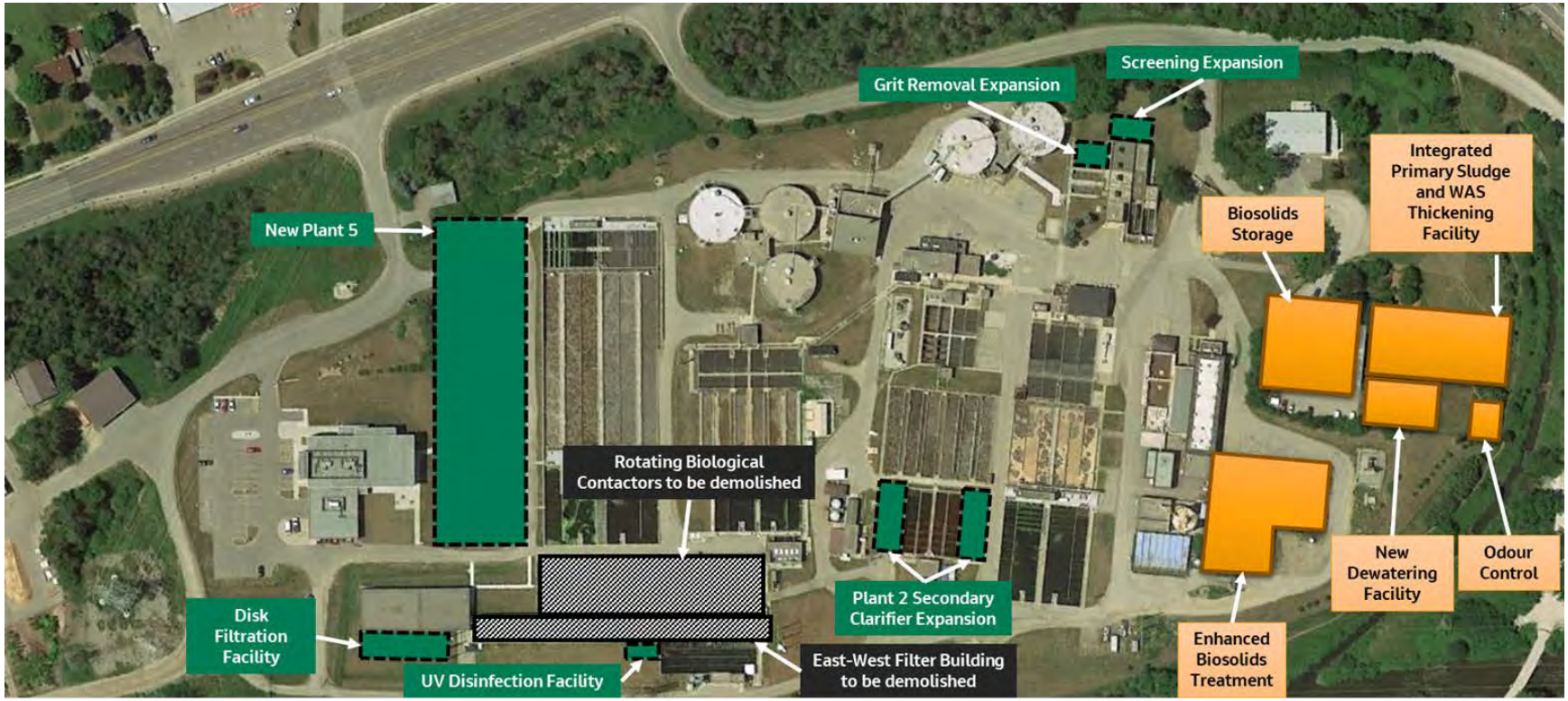
Figure ES-3. MTO Controlled Area



Future Site Plan

Figure ES-4 presents a preliminary concept for the Guelph WRRC site plan in 2051, based on treating a future average daily flow of 79.2 ML/d. Capacity needs and the associated footprint for the new Plant 5 are likely to change following the next Master Plan update.

Figure ES-4. Preliminary Concept for Future Site Plan in 2051



Potential Effects, Benefits, and Mitigation Measures

The recommendations from this Class EA are expected to provide a range of benefits related to serving the City's strategy for growth, reducing GHG emissions and protecting the Speed River. Potential effects from construction and operation of the preferred solution are identified in this section along with the appropriate mitigation measures and benefits that are expected to occur because of study recommendations.

Natural Environment

Construction and operation of the preferred solution are not anticipated to interact with the physical environment. A negligible increase in air emissions is expected from construction vehicles and equipment which will be short-term in duration (i.e., the construction schedule). An increase in air emissions during ongoing operation of the WRRC is not anticipated.

Potential effects from construction and operation of the preferred solution on water quality, terrestrial habitat and wetlands may occur. To protect the natural environment during construction and long-term operation, the following future studies are recommended and associated mitigation measures will be adopted:

- An Environmental Impact Study (EIS), species at risk assessment, and arborist surveys (if required) will be completed the detailed design stage, and measures will be identified and implemented to protect species at risk and associated habitat during construction activities.
- The project will be screened by MECP for species at risk occurrences to determine setback or restricted activity periods
- Vegetation removal, grading, and heavy equipment use will only occur within the project footprint where these areas have been previously demarcated and construction works is approved. Silt fencing will be erected, where appropriate.
- A site-specific Erosion and Sediment Control Plan will be developed by a qualified person and updated as required.
- Stockpiled material will be covered to prevent erosion and potential sedimentation into natural features. Staging access areas are planned to be located primarily within existing open and disturbed areas.
- Access and movement of vehicles and equipment will be controlled to limit the introduction and spread of invasive species. Vehicles and equipment will be inspected prior to entering and leaving the construction site to verify the equipment is clean and free of invasive species. Equipment will be inspected and used only if in good working order by the contractor.
- A designated and lined refuelling area with appropriate spill containment will be established a minimum of 30 m from any watercourse. A spill response team member (from the contractor's team) will be appointed as a point of contact in the case of an accident or spill to verify the proper and timely implementation of site response controls as required.
- Absorbent materials and equipment required to control and clean up spills of deleterious substances will be available onsite. Spills and leaks of deleterious substances will be immediately contained and cleaned up in accordance with regulatory requirements and reported immediately to the Ontario Spills Action Centre (SAC) at 1.800.268.6060, as well as the necessary site contacts (i.e., City project manager).
- If possible, tree and shrub removal, and vegetation clearing will be avoided from early April to late August, conforming to the general nesting period at the site, corresponding to the MBCA (Government of Canada, 2018).

Concerns regarding chloride concentrations in the Speed River were raised by members of the CLG and the community through engagement activities. It is recommended that the City expand its effluent monitoring program to include chloride concentration sampling.

Natural Environment Benefits

- Energy use will reduce due to selection of newer, more efficient technologies, and by maximizing energy recovery from biogas; both reducing GHG emissions.
- Resource (nutrient and organics) recovery from biosolids will be maximized by continuing beneficial re-use of biosolids as a fertilizer product on agricultural land.
- An assimilative capacity study was completed to recommend new treated effluent contaminant loading limits that will maintain the health of the Speed River with increased effluent flows. Treatment technologies were selected so that the Guelph WRRC effluent will continue to exceed the effluent objectives.

Plant Operations Benefits

- **Training:** Training and opportunities for continuing education for WRRC operators will be provided as recommended solutions are implemented, particularly where new processes are part of the recommended solutions.
- **Expertise:** The recommended solutions and continued operations of the WRRC require experienced operators with expertise in the processes to continue to provide environmental benefit through process controls that are proactive and reflect best practices. It is recommended that the City continue to update hiring practices to attract operators with the necessary expertise.

Social, Economic and Cultural Environment

Potential effects from construction and operation of the preferred solution on the social, economic and cultural environment are generally expected to be negligible and short-term in duration.

The following measures will be taken to mitigate potential impacts to the community from the recommendations, both during and following construction:

- **Community Health and Safety:** Development and construction activities may increase the type and volume of traffic on surrounding roadways (e.g., construction vehicles and equipment) or introduce additional hazards to the environment (e.g., material spill). Vehicles and equipment used during construction will follow traffic laws and multi-passenger vehicles will be used, when possible, to reduce traffic associated with construction activities.
- **Noise:** Construction noise will be temporary and short-term in nature. Construction activities will generally be carried out during the day where traffic and human activity along Wellington Street West (e.g., gas station, hardware store) are occurring. A negligible increase in noise at the existing Guelph WRRC is expected during ongoing operation of the plant. The technologies that were selected for upgrades are not expected to result in off-site noise impacts on the surrounding community.
- **Odour:** Existing odour control and treatment facilities will continue to operate, and a new odour control facility will be constructed to mitigate potential odours from the new solids handling processes. Odour is not expected to increase substantially during construction.

- **Infrastructure and Services:**
  - Traffic: In general, Guelph WRRC traffic has not been a notable issue due to the location of the facility entrance off a main road (Wellington Road) near Highway 6. During construction, a small increase in traffic to and from the Project footprint is anticipated to transport crews and equipment. No increase in traffic is expected during operations. Eliminating the need for disinfection chemicals by implementing an ultraviolet disinfection system is expected to reduce traffic in the future.
  - Utilities: Additional utilities may be needed to support the operation of the preferred solution. In the event existing utilities are disrupted during construction activities, it is expected that this will be short-term in duration, temporarily disturbing services. Ontario One-Call locates will be done prior to construction to reduce the potential for service disruptions.
  - Services: All waste materials from operation of the plant, such as screenings and grit, will be disposed of off-site in accordance with applicable legislation and guidelines. Construction and operation of the preferred solution is not anticipated to increase demand on local or regional services (e.g., emergency or health care services).
- **Viewshed:** Permanent infrastructure changes within the existing site may present a negligible change to the existing viewshed considering these changes will be made within the Guelph WRRC site adjacent to existing buildings and aboveground structures. MTO approval is required for upgrades that are visible from provincial roads (i.e., Highway 6).
- **Cultural Heritage:** Before a development project can proceed, an archaeological assessment of all lands that are part of the project is required where land has a known archaeological site or the potential to have archaeological sites (Ministry of Heritage, Sport, Tourism and Culture Industries, 2022). A Stage 1 Archaeological Assessment was completed for the study area by Archaeological Research Associates Ltd. (PIF #P007-1342-2022). The Stage 1 Archaeological Assessment Report identified some locations within the study area of archaeological potential a Stage 2 Archeological Assessment is recommended for these areas. Master Plan recommendations where a Stage 2 Archaeological Assessment is required are indicated in Table ES-9.

  Construction within a previously disturbed site reduces the potential to uncover archaeological resources during construction. However, ground disturbance (e.g., soil handling, grading) may uncover previously unidentified artifacts. Disturbing these resources in a controlled, scientific excavation is considered an acceptable, and in some cases, the only method to collect in situ information to add to the historic record. The removal of these resources is offset by the recovery of knowledge about the site when catalogued and preserved in compliance with provincial guidelines. In the event an artifact is encountered during construction, work should be suspended, and the Ministry of Tourism, Culture and Sport should be contacted. Construction and City personnel are not permitted to collect or disturb artifacts in accordance with the Ontario Heritage Act R.S.O. 1990 c 0.18.

  The Stage 1 Archaeological Assessment Report identifies the following recommendations and mitigation measures:

  - The Stage 1 assessment determined that the study area comprises a mixture of areas of archaeological potential, areas of no archaeological potential and previously assessed lands of no further concern. The potential modelling results are presented in Map 9–Map 10 in Appendix A-4 (Stage 1 Archaeological Assessment Guelph WRRC, 2022). It is recommended that all areas of archaeological potential that could be impacted by the project be subject to a Stage 2 property assessment in accordance with Section 2.1 of the 2011 S&Gs. The identified areas of no archaeological potential and previously assessed lands of no further concern do not require any additional assessment. (Stage 1 Archaeological Assessment Guelph WRRC, 2022)
  - The grassed areas shown in green (in Map 9 – Map 10 in Appendix A-4) in the southeast must be assessed using the test pit survey method. A survey interval of 5 metres will be required due to the proximity of the lands to the identified features of archaeological potential. Given the likelihood that the grassed areas shown in yellow were previously impacted, a combination of visual inspection and test pit survey should be utilized to confirm the extent of disturbance in accordance with

Section 2.1.8 of the 2011 S&Gs. This will allow for the empirical evaluation of the integrity of the soils and the depth of any impacts. If disturbance cannot be confirmed, then a test pit survey interval of 5 m must be maintained. (Stage 1 Archaeological Assessment Guelph WRRC, 2022)

- Each test pit must be excavated into at least the first 5 centimetres of subsoil, and the resultant pits must be examined for stratigraphy, potential features and/or evidence of fill. The soil from each test pit must be screened through mesh with an aperture of no greater than 6 millimetres and examined for archaeological materials. If archaeological materials are encountered, all positive test pits must be documented, and intensification may be required. (Stage 1 Archaeological Assessment Guelph WRRC, 2022)

Social Benefits

- Operation of the Guelph WRRC ultimately contributes to community health and safety by wastewater treatment, which contributes to a high-quality effluent discharged to the Speed River.
- Capacity to service growth to 2051 will be provided, allowing the City to meet the growth objectives outlined in its Places to Grow document (Ministry of Municipal Affairs and Housing, 2020).
- Overall reliability will improve by replacing infrastructure that is at or nearing its end of life.

Economic Benefits

Use of existing infrastructure will be maximized to avoid expansion where possible and reduce capital cost.

Climate Change

The preferred solution will be designed and constructed in accordance with current applicable building standards and best available technology and operated according to best practices to protect infrastructure from future climate change risks.

It is anticipated that the implementation and operation of the preferred solution will provide for additional cogeneration capacity that will reduce greenhouse gas emissions. Construction equipment and vehicles will be maintained in good working order. Energy efficiency and greenhouse gas emissions were a major factor in alternative solution development and evaluation for preferred solution, with the purpose of reducing the plant's carbon footprint. Primary sludge thickening implementation is expected to provide significant benefits related to energy efficiency and greenhouse gas emissions by reducing digester heating requirements and increasing biogas production, which will increase the energy and heat production from the plant's cogeneration system.

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Acronyms and Abbreviations

Acronym	Definition
CAS	conventional activated sludge
CCT	chlorine contact tank
City	City of Guelph, Ontario
$cBOD_5$	5-day carbonaceous biochemical oxygen demand
DFO	Fisheries and Oceans Canada
ECA	Environmental Compliance Approval
ESR	Environmental Study Report
GHG	greenhouse gas
IPZ	Intake Protection Zone
MABR	membrane aerated biofilm reactor
MECP	Ministry of Environment, Conservation, and Parks
mg/L	milligrams per litre
ML/d	megalitres per day
O&M	operations and maintenance
POH	Public Open House
RBC	rotating biological contactor
Rockwood	Village of Rockwood, Ontario
THP	thermal hydrolysis pretreatment
TSS	total suspended solids
TP	total phosphorous
TKN	total Kjeldahl nitrogen
WRRC	Water Resource Recovery Centre

1. Introduction and Background

1.1 Background

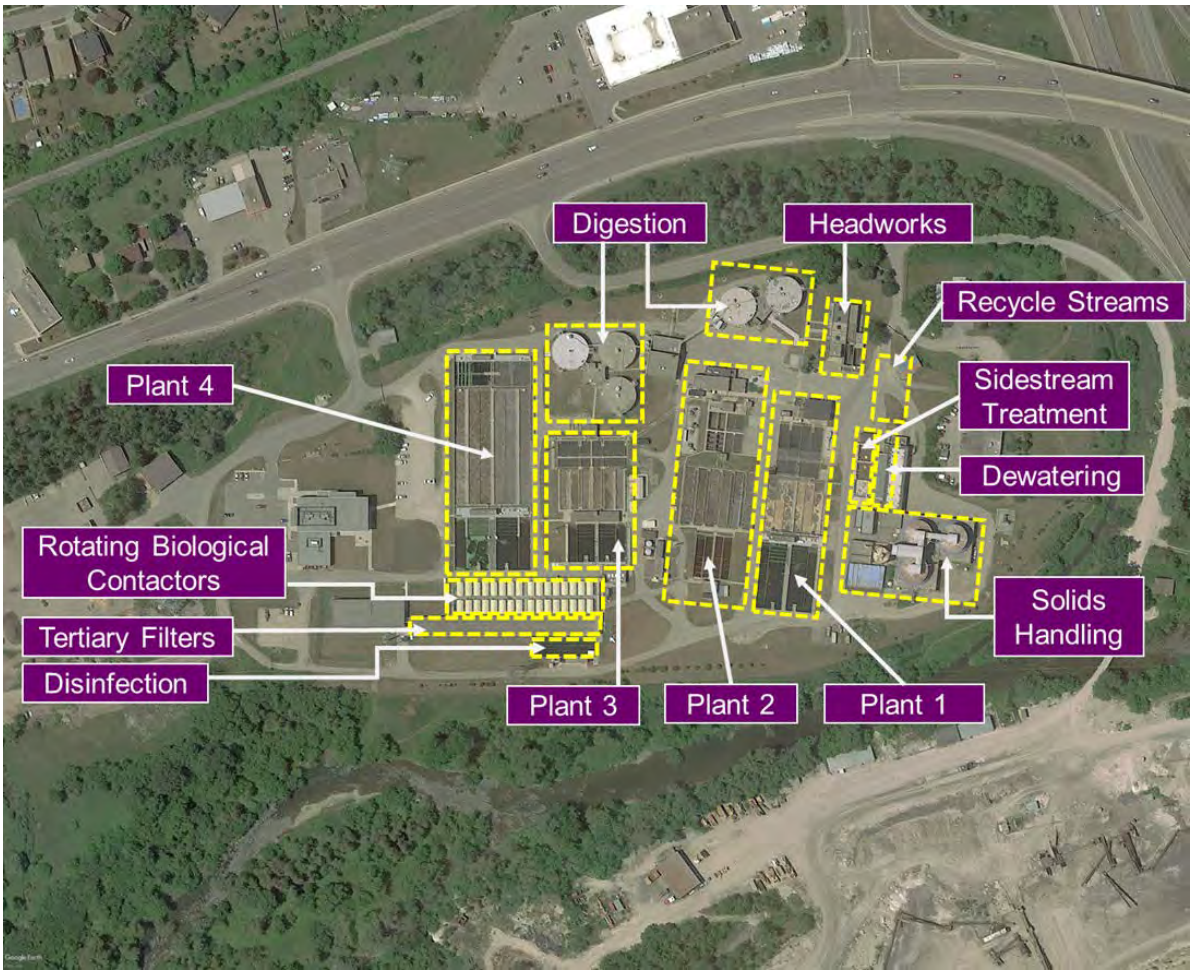
The Guelph Wastewater Treatment Plant (WRRC) is located within the City of Guelph (City) along the Speed River at 530 Wellington Street West. The Guelph WRRC is owned and operated by the City and receives domestic, institutional, commercial, and industrial wastewater from the City, a portion of the Village of Rockwood (Rockwood), and the Gazer-Mooney subdivision (located north of the City in the Township of Guelph Eramosa).

The Guelph WRRC provides capacity to treat an average daily wastewater flow of 64 megalitres per day (ML/d) and discharges treated and disinfected and de-chlorinated effluent to the Speed River. The treatment process generates residuals that have nutrient and energy value, both of which are recovered by current practices, which include:

- Biogas with energy value (from the treatment of residual solids) is used as fuel to generate electricity and heat in a cogeneration process
- Biosolids receive enhanced treatment to produce a Canadian Food Inspection Agency approved fertilizer (from treating residuals) that is beneficially reused via land application.

Figure 1-1 provides an aerial view of the Guelph WRRC and provides an overview of treatment processes.

Figure 1-1. Guelph WRRC Aerial View



To emphasize the City's focus on the resource recovery value of wastewater and commitment to continuing and maximizing resource recovery, the former Guelph Wastewater Treatment Plant was renamed to the Guelph Water Resource Recovery Centre (WRRC) in 2022. The facility will be referred to as the Guelph WRRC in this report.

1.2 Study Purpose and Approach

The City of Guelph's Wastewater Treatment and Biosolids Management Master Plan (Master Plan) was initiated in 2020 to recommend a strategy to continue to provide wastewater treatment and biosolids management to the year 2051. The Master Plan scope included completion of Phases 1 and 2 of the Municipal Engineers Association (MEA) Municipal Class Environmental Assessment (EA) (Municipal Engineers Association, 2000). The project scope was expanded to a Schedule C Class EA, to include Phases 3 and 4 of the Class EA process, as described by MEA Class EA process (Municipal Engineers Association, 2000). This Environmental Study Report (ESR) presents the methodology, recommended strategy, design concept, implementation plan, and communications program for the Schedule C Class EA study.

The City previously completed a Wastewater Treatment Master Plan in 2009 and a Biosolids Management Master Plan in 2006. This Class EA represents an update of the previous plans and represents a unified plan for capital expenditures at the Guelph WRRC to 2051. This ESR presents a recommended strategy

and implementation plan that is adaptable to advances in technology development and changes in the rate of growth over the planning period.

The City initiated this Class EA project, recognizing its responsibility to protect the environment, and considering the importance of wastewater and biosolids as resources with the ability to provide environmental benefit. Updates to this document will be undertaken approximately every five to eight years. This ESR includes a level of detail necessary for the City to proactively adjust the implementation timing for recommended projects depending on how anticipated growth is realized over time.

The City was committed to encouraging meaningful engagement throughout the Class EA study. Due to the COVID-19 pandemic, the City's plan for public engagement was implemented so that meaningful engagement activities could occur in a safe and accessible manner. The feedback received from residents, Treaty Rights Holders, stakeholders, and First Nations communities throughout the study informed the study approach and how decisions were made to develop recommendations presented in this ESR.

1.3 Report Structure

This Environmental Study Report (ESR) is structured as follows:

- **Section 1: Introduction and Background** provides and overview of the Master Plan development process.
- **Section 2: Ontario Environmental Assessment Process** describes how the environmental assessment process has informed the development of this Class EA.
- **Section 3: Project Context** describes the project purposes, history of wastewater treatment and biosolids management within the City, and presents the regulations and policies that inform and shape the Master Plan development.
- **Section 4: Methods and Approach** details the approach to engagement and decision-making process.
- **Section 5: Study Area Existing Conditions** details the existing conditions establishing foundation for understanding the City's future wastewater and biosolids management needs.
- **Section 6: Future Conditions** projects the anticipated future conditions within the planning horizon, forming the basis for the Class EA problem and opportunity statement.
- **Section 7: Problem and Opportunity Statement** defines the problems and opportunities identified through the documentation of the existing conditions and future needs in accordance with the Class EA process.
- **Section 8: Wastewater Treatment Process Alternatives Development and** identifies the wastewater treatment alternatives to address future needs identified in Section 6, the results of the detailed evaluation approach applied to the alternatives, and identifies the preferred solutions.
- **Section 9: Biosolids Processing and Management Alternatives Development and Evaluation** identifies the biosolids management alternatives to address the future needs identified in Section 6, the results of the detailed evaluation approach applied to the alternatives, and identifies the preferred solutions.
- **Section 10: Public, Agency, and First Nations Consultation and Engagement** details the engagement activities conducted throughout the Master Plan development and how the feedback received through engagement activities informed the Class EA.
- **Section 11: Recommendations** presents the recommended projects and actions resulting from the Class EA findings.
- **Section 12: Implementation Plan** describes the project schedule, triggers, and capital cost forecast for implementing the Class EA recommended projects. This section also details the potential effects, benefits, and mitigation measures necessary to reduce the likelihood of impacts from implementation of recommendations.

1.4 Project Contact

Primary contacts for the project are as follows:

City of Guelph

Tim Robertson, Division Manager
Wastewater Services, Environmental Services
519-822-1260 x 2964
tim.robertson@guelph.ca

Jacobs Engineering Group

Jillian Schmitter, P.Eng., Project Manager
jillian.schmitter@jacobs.com

Anelisa Schmidt, M.A.Sc., PMP, Associate Project Manager
anelisa.schmidt@jacobs.com

The project team has, and will continue to, implement the City's Guiding Principles for Community Engagement, which includes involving the community as early as possible in the engagement process so that stakeholders have time to learn about the project and actively participate (City of Guelph, 2020). Project consultation is intended to address all comments received during the consultation period and resolve any outstanding concerns with the project team. In the event there are outstanding concerns that relate to the potential adverse impacts to constitutionally protected Indigenous and treaty rights, a Part II Order request on those matters (only) should be addressed in writing to:

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

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

If other concerns with the ESR and/or EA process are made known to the minister, or determined following a review of the document, the Minister reserves the right to issue an order on his or her own initiative within a specified time period.

2. Ontario Environmental Assessment Process

2.1 Environmental Assessment Act

The objective of the Ontario *Environmental Assessment Act* R.S.O. 1990, c. E. 18 is to consider the possible effects of projects early in the planning process, when concerns may be most easily resolved, and to select a preferred alternative with the fewest identified impacts.

The *EA Act* requires the study, documentation, and examination of the environmental effects that could result from projects or activities.

The *EA Act* defines "environment" very broadly as follows:

- Air, land, or water
- Plant and animal life, including human life
- 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
- Any part or combination of the foregoing, and the interrelationships between any two or more of them, in or of Ontario

In applying the requirements of the EA Act to projects, two types of EA planning and approval processes are identified:

1. Individual EAs (Part II of the EA Act): Projects have terms of reference and individual EAs, which are carried out and submitted to the MECP for review and approval.
2. Class EAs: Projects are approved subject to compliance with an approved Class EA process; provided that the appropriate Class EA approval process is followed, a proponent will comply with the requirements of the *EA Act*.

2.2 Environmental Assessment Process

The Class EA process is a decision-making framework that effectively meets the requirements of the *EA Act* and is comprised of the following phases.

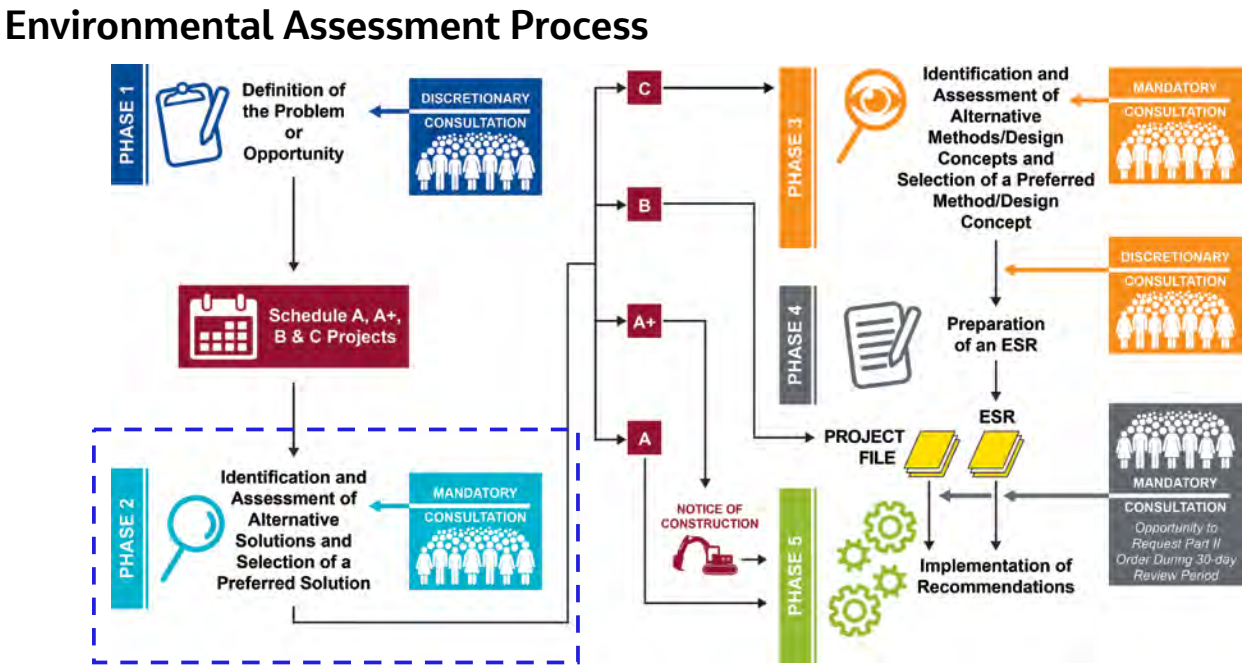
1. Identify the problem or opportunity
2. Identify alternative solutions and establish a preferred solution
3. Examine alternative methods of implementing the preferred solution that will minimize negative effects and maximize positive effects
4. Prepare an ESR
5. Implement the preferred solution

This study was completed as a Schedule C Class EA, including Phases 1 through 4 of the Municipal Engineer's Class EA process, as shown on Figure 2-1.

A Part II Order is the legal mechanism in which the status of an undertaking can be elevated before the project can progress. The study's planning and design process allows for concerns to be identified and resolved throughout the course of the project; however, a Part II Order request can be submitted to MECP

in the event there are outstanding concerns that relate to the potential adverse impacts to constitutionally protected Indigenous and treaty rights.

Figure 2-1. MEA Process



3. Project Context

3.1 Study Area

The study area is the area within the spatial boundaries defined for the assessment. These spatial boundaries vary based on the distribution, movement patterns or potential zones of interaction between the proposed activities (e.g., construction and operation of the preferred solution) and the natural or social environment. The spatial boundaries are shown on Figure 3-1 and include:

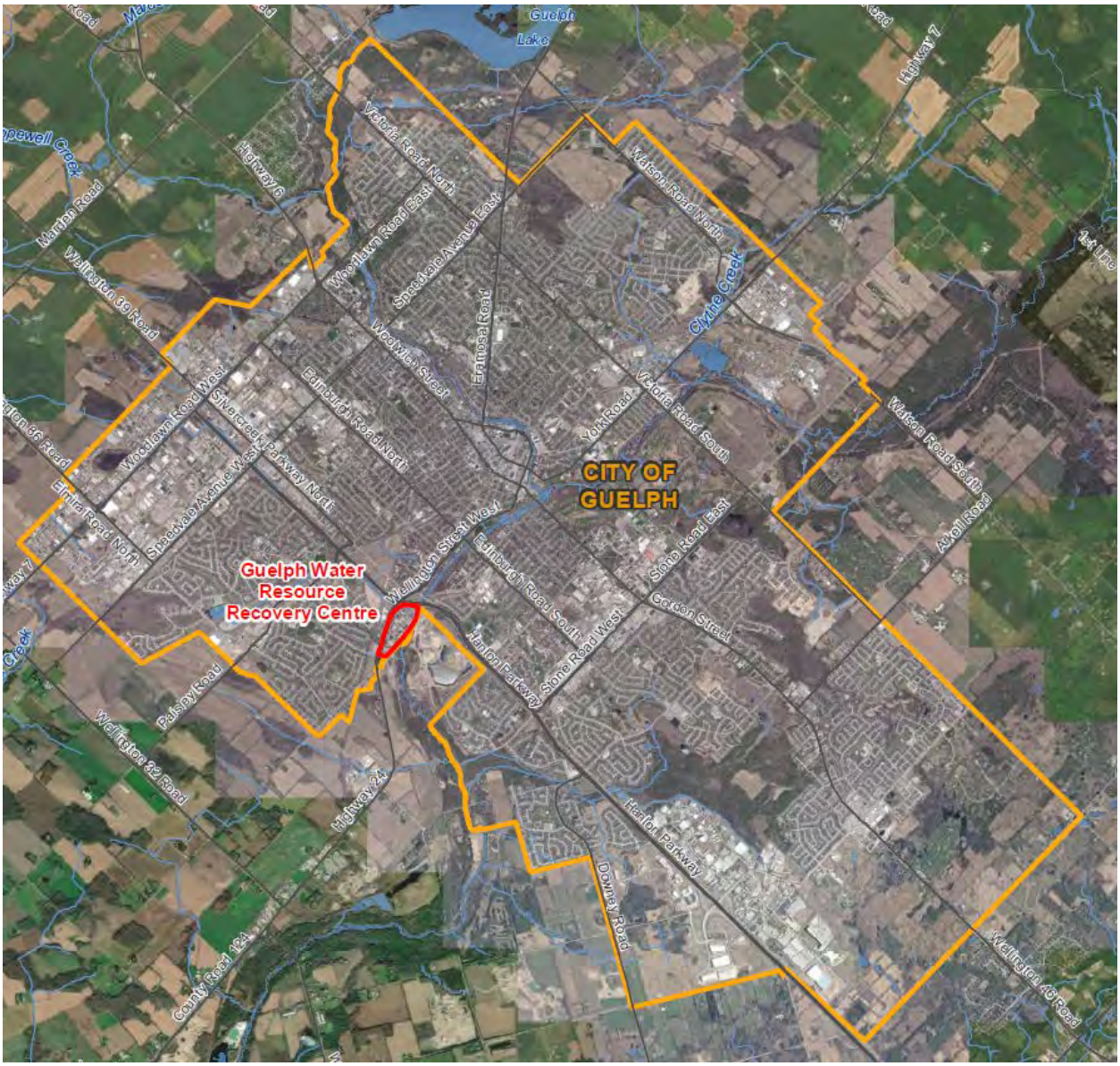
- a project footprint which includes areas at the existing Guelph WRRC that may be directly disturbed by implementation of the preferred alternative
- a local study area which extends beyond a project footprint, up to and including the boundaries of land owned by the City as well as the Speed River
- a regional study area where effects may be experienced in a broader context which includes the Guelph WRRC service area

The service area includes the City, a portion of the Village of Rockwood (Rockwood), and the Gazer-Mooney subdivision (located north of the City in the Township of Guelph Eramosa). The boundaries of the City are shown on Figure 3-2.

A description of existing conditions within these spatial boundaries is provided in Section 5 of this ESR.

Figure 3-1. Study Area Spatial Boundaries

Figure 3-2. City of Guelph Boundaries



3.2 Guelph Water Resource Recovery Centre

3.2.1 Overview

The Guelph WRRC receives domestic, institutional, commercial, and industrial wastewater from the City, a portion of the Village of Rockwood (Rockwood), and the Gazer-Mooney subdivision (located north of the City in the Township of Guelph Eramosa).

The Guelph WRRC provides capacity to treat an average daily wastewater flow of 64 megalitres per day (ML/d) and discharges treated and disinfected effluent to the Speed River. The treatment process

generates residuals that have nutrient and energy value, both of which are recovered by current practices. The facility currently yields the following:

- High-quality treated effluent that protects the quality of the Speed River
- Biogas with energy value (from the treatment of residuals in the anaerobic digesters), which is used to generate electricity and heat in a cogeneration process
- A Canadian Food Inspection Agency approved fertilizer (from treating residuals) that is beneficially reused via land application

Figure 1-1 provides an aerial view of the Guelph WRRC and provides an overview of treatment processes.

3.2.2 Wastewater Treatment

Wastewater flows into the plant through the City's sanitary sewer system and arrives at the Guelph WRRC headworks. This section provides an overview of treatment processes. Detailed descriptions are included in Appendix A.

The wastewater flow receives preliminary treatment through a screening and degritting process, and then is split between four treatment trains for primary clarification (settling) and secondary biological treatment using conventional activated sludge (CAS) processes, with addition of chemical to precipitate phosphorus. The four treatment trains are referred to as Plants 1, 2, 3, and 4. The secondary effluent from Plants 1, 2, and 3 combines before being treated in rotating biological contactors (RBCs), which provide ammonia removal through nitrification. Plant 4 secondary effluent is directed to the RBCs for ammonia removal when Guelph WRRC flows are less than 55 ML/d. When flows are greater than 55 ML/d, Plant 4 secondary effluent is directed to the tertiary filters.

All flow is treated in tertiary filters to remove solids and phosphorus, and then disinfected by chlorination (using sodium hypochlorite). After the necessary chlorine contact time, treated effluent is dechlorinated (using sodium bisulphite) before it is discharged through an outfall into the Speed River.

3.2.3 Wastewater Solids Treatment

Biological sludge from secondary treatment (referred to as waste activated sludge) is thickened using a rotating drum thickener process. The thickened waste activated sludge is combined with sludge from the primary clarifiers (referred to as primary sludge) and the combined stream is stabilized in an anaerobic digestion process. Following anaerobic digestion, the stabilized solids are referred to as biosolids.

The City collects the biogas generated by the digesters, which is about 50 percent methane, treats the captured gas, and uses it to fuel cogeneration system. The cogeneration engines produce electricity and heat, both of which are used within the plant to offset purchase of electricity and natural gas.

Biosolids from the secondary digesters are dewatered using belt filter presses, the dewatered biosolids (sometimes referred to as cake) is then further processed using the Lystek process, either at the Guelph WRRC or at an offside Lystek facility. This process converts biosolids into a nutrient-rich fertilizer product that is used as an agricultural fertilizer under a Canadian Food Inspection Agency label. The Lystek product generated from the City's biosolids is beneficially reused via land application on agricultural land.

3.2.4 History of Wastewater Treatment and Biosolids Management in Guelph

The Guelph WRRC was originally constructed in the early 1900s with one conventional activated sludge (CAS) treatment train. The following bullets present the timeline of major capital projects undertaken throughout the plant's history, which demonstrate the City's history of adopting technology to promote environmental protection and resource recovery:

- In 1902, Dr. Howitt, the City's Medical Officer of Health, recommended a sewage collection and treatment system be put in place in the City. The system consisted of two septic tanks with a combined capacity of 200,000 gallons and discharged to a one acre gravel infiltration bed. Separate sanitary and stormwater systems were recommended, with storm water draining to the Speed River and the sanitary sewers flowing to the "sanitary farm". The system was operational in late 1903. (DenHoed & Robertson, 2003)
- In 1907 two septic tanks and two filter beds were added to the previously existing system. (DenHoed & Robertson, 2003)
- In 1922 the existing septic tanks were converted to aeration tanks, thereby implementing an activated sludge process. A settling tank was constructed downstream of the aeration tanks, collecting solids which were either returned to the aeration tanks or sent to the sludge drying beds (formerly the gravity filter beds). The watery effluent from the settling tank was discharged to the Speed River. This system had a capacity of 11.3 ML/d (2.5 mgd). (DenHoed & Robertson, 2003)
- In 1934 the plant was increased to 18.2 ML/d (4 mgd) to meet the needs of the growing community. This expansion included four new aeration tanks and two new settling tanks. Influent works were upgraded to improve grit removal and screening. (DenHoed & Robertson, 2003)
- Plant 2 was constructed in 1957, marking the first major expansion to include planning for forecasted future growth (DenHoed & Robertson, 2003). These upgrades increased the plant's rated capacity to 27.3 ML/d (6 mgd). A new administration building and two primary digesters (Digesters 1 and 2) were also constructed. A chlorine disinfection process was constructed in 1964. (DenHoed & Robertson, 2003)
- Plant 3 was constructed in 1968, increasing the plant's rated capacity to 45.4 ML/d (10 mgd). One primary digester (Digester 3) and one secondary digester (Digester 4) were also constructed.
- In 1987, tertiary nitrification and filtration were introduced at the plant. Eight rotating biological contactors (RBCs) and two sand filters (now referred to as the East-West Filter Building) were constructed. At the time this represented one of the largest RBC installations in North America (DenHoed & Robertson, 2003).
- A new facility for screening and degritting (referred to as Headworks) and a biosolids dewatering facility were constructed in 1983. The dewatering facility was expanded in 1992.
- The original Plant 1 was demolished and replaced with a new, larger Plant 1 in 1987, with a rated capacity of 16 ML/d. This increased the plant's total capacity to 55 ML/d.
- The existing digesters were upgraded, and a new energy facility was constructed in 1995. The energy facility contained boilers and a cogeneration system for biogas utilization.
- Plant 4 was constructed in 2003, increasing the plant's capacity to 64 ML/d, which is its current rated capacity. A headworks expansion and a tertiary sand filter expansion (new building referred to as the North-South Filter Building) were also completed as part of this contract.
- A new primary digester (Digester 5) was constructed in 2009. The existing cogeneration system was also upgraded.
- A new sidestream deammonification system was constructed in 2017 to treat dewatering filtrate prior to its return to the Headworks, with the purpose of reducing ammonia loadings to the aeration tanks

and therefore reducing energy requirements. This is the first full-scale installation of a sidestream deammonification process in Canada.

3.3 Legislative Framework

The City must operate within the administrative, legislative, and financial framework established by high levels of government. Key provincial, federal, and municipal initiatives and regulations provide directives and guidance for the planning process. These regulations and initiatives are described in the following sections and will guide the development of this Class EA.

3.3.1 Wastewater Treatment

Wastewater treatment processes must meet the requirements of the following environmental protection legislation and regulations:

- Ontario *Water Resources Act*, as amended by the Safeguarding and Sustaining Ontario's Water Act, 2007 is the legal foundation of Ontario's water policy and an important law governing water quality and quantity in Ontario. This Act prohibits the discharge of polluting material in or near water, prohibits or regulates the discharge of sewage, facilitate orders requiring measures to prevent, reduce or alleviate impairment of water quality, enables the designation and protection of sources of public water supply, and regulates water taking more than 50,000 litres a day.
- Ontario *Safe Drinking Water Act*, S.O. 2002, c. 32: is intended to protect human health through the control and regulation of drinking water systems and drinking water testing. Wastewater systems need to be located, designed, constructed, maintained, and operated in accordance with applicable standards so that drinking water is protected, safe, clean and reliable.
- Ontario *Clean Water Act* requires that communities, through local Source Protection Committees, protect municipal drinking water supplies (and non-municipal supplies if added by the municipality of Minister) from overuse and contamination, now and into the future. This Act aims to prevent contaminants from entering sources of drinking water, including lakes, rivers and aquifers.
- Grand River Source Protection Plan: includes plans and policies that apply to activities that are identified as drinking water source threats. The following policies are relevant to the Guelph WRRC:
  - Policy CG-MC-11 is applicable to existing and future sewage treatment plants located in vulnerable areas where the activities are or would be a significant drinking water threat, the MECP is to see that the Environmental Compliance Approval (ECA) governing the sewage treatment plant includes appropriate terms and conditions to ensure that these activities cease to be and/or do not become a significant drinking water threat.
  - Policy CG-MC-12 is applicable to existing and future sewage treatment plants located in vulnerable areas where the activities are or would be a significant drinking water threat, the MECP is to see that the ECA governing the sewage treatment plant includes appropriate terms and conditions to ensure that these activities cease to be and/or do not become a significant drinking water threat.
  - Policy CG-CW-13 governs sewage treatment plant effluent discharges (including lagoons) to see that they cease to be a significant drinking water threat related to a sewage treatment plant, the City of Guelph shall encourage the existing Industrial/ Commercial/ Institutional Sector to complete the Waste Survey Report as part of a new education and outreach program.
- O.Reg. 435/93: Water Works and Sewage Works applies to wastewater collection and treatment facilities, licensing of facility operators and operating standards.
- *Greenbelt Act*: Connections to the Paris Galt moraine through the Speed River in the urban area of Guelph is one urban river valley under consideration for Greenbelt expansion. Therefore, The Greenbelt Plan (Ministry of Municipal Affairs and Housing, 2017) should be considered for future wastewater treatment developments.

- Canada *Fisheries Act*: manages and protects Canada's fisheries resources prohibiting the deposit of all deleterious substances that may degrade or alter water quality in a manner that directly or indirectly harms fish, fish habitat or the use of fish by humans. The Wastewater Systems Effluent Regulations (include mandatory minimum effluent quality standards) apply in respect of a wastewater system that deposits effluent as part of a wastewater system. Effluent containing deleterious substances will follow the requirements and standards outlined in this regulation.

3.3.2 Biosolids Management

Transport and infrastructure planning for biosolids management must meet the requirements of the following environmental protection legislation and regulations:

- Ontario *Environmental Protection Act*, R.S.O. 1990, c. E. 19 is the main pollution control legislation in Ontario, prohibiting discharge of any contaminants into the environment that cause or are likely to cause adverse effects while approved contaminants must not exceed limits prescribed by the regulations. Biosolids and products incorporating biosolids used for non-agricultural purposes can be managed within the restrictions of the *Environmental Protection Act*. Applicable regulations under this Act include:
  - O. Reg. 347: General Waste Management: Biosolids and incineration ash are defined as a non-hazardous organic waste under this Regulation. Compost that meets the requirements for Category A is exempt from O. Reg. 347.
  - O. Reg. 419/05: Air Pollution – Local Air Quality: Guideline A-7: Air Pollution Control, Design and Operation guidelines for Municipal Waste Thermal Treatment Facilities
  - Ontario *Water Resources Act*, R.S.O. 1990, c. O.40 Management of biosolids on agricultural land in Ontario is governed by the Ontario *Water Resources Act*.
  - Ontario *Safe Drinking Water Act*, S.O. 2002, c. 32 is described in subsection 3.3.1.
  - Ontario *Clean Water Act*, S.O. 2006, c. 22 is described in subsection 3.3.1.
  - Ontario *Nutrient Management Act*, 2002, S.O. 2002, c. 4 governs the transport and land application of biosolids. Dewatered residuals need to be stabilized to reduce pathogen levels in order to fall into Non-agricultural Source Material Category 3, specifically as 'sewage biosolids from large treatment works' (Section 98.0.2 (1)) (Ontario Government, 2002) which can only be applied to land if the concentration of regulated metals and *Escherichia coli* (*E. coli*) bacteria do not exceed the threshold levels specified. In general, this Act requires generators (i.e., the City of Guelph) are responsible for sampling and analysis of the biosolids, haulers of biosolids must have a Waste Systems ECA from MECP, and, agricultural land application of biosolids must be applied by a business licensed by OMAFRA. The MECP is responsible for the compliance and enforcement of the provisions set out under the Nutrient Management Act. OMAFRA is responsible for all required approvals of the plans, certifications, and licenses under the Nutrient Management Act and O. Reg. 267/03.
- Ontario Compost Quality Standards (MECP, 2021): governs biosolids composting which applies to aerobic composting of non-hazardous organic materials (including biosolids) for the purpose of producing a humus-like material intended for use as a soil conditioner. This Standard is regulated by the MECP through issuance of ECAs.
- Environmental Compliance Approval (ECA) for individual landfills sites: can restrict the quantity of certain materials from being disposed at the site, including biosolids.
- Canada *Fertilizers Act*, R.S.C., 1985, c-F-10: the distribution of fertilizer product is governed by this Act. Biosolids compost can be registered as a fertilizer product under this Act. The City uses Lystek which has a Canadian Food Inspection Agency label indicating it can be used the same as other commercial fertilizers. Canadian Fertilizers Regulation (C.R.C., c. 666) addresses the registration, form, and composition; packaging and labelling; sampling and analysis; and safeguarding of fertilizers and supplements.

3.3.3 Provincial Policy Statement

The Provincial Policy Statement (PPS) came into effect May 1, 2020 under section 3 of the Planning Act. The purpose of the PPS is to provide direction on matters of provincial interest related to land use planning and development and to set the foundation for policy regarding the regulation of development and use of land (Province of Ontario, 2020). The PPS supports a comprehensive, integrated, and long-term approach to planning, and recognizes linkages among policy areas. Municipal official plans (described in the subsection that follows) are considered the most important "vehicle" for implementation of the PPS. Policies applicable to the Project are described.

Section 1.1.1: Healthy, livable, and safe communities are sustained by promoting development and land use patterns that conserve biodiversity and prepare for regional and local impacts of climate change.

Section 1.2.1: A coordinated, integrated, and comprehensive approach should be used when dealing with planning matters within municipalities, including managing natural heritage, water, agricultural, mineral, cultural heritage, and archaeological resources.

Section 1.2.2: Planning authorities shall engage with Indigenous communities and coordinate on land use planning matters.

Section 1.6.6.1: Planning for sewage and water services shall: accommodate forecasted growth in a manner that promotes the efficient use and optimization of existing municipal sewage services; ensure that these systems can be sustained by water resources and prepare for the impacts of climate change; and, promote water conservation and water use efficiency.

Section 1.6.6.7: Planning for stormwater management will: be integrated with planning for sewage and water services; minimize or prevent increases in contaminant loads; minimize erosion or changes in water balance; prepare for climate change impacts; and, promote stormwater management best practices.

3.3.4 Official Plan

The City's Official Plan (City of Guelph, 2021), *Envision Guelph*, outlines several conditions to guide wastewater treatment and management.

The City has an objective to protect, maintain or restore the quality and quantity of water upstream and downstream of the WRRC. The City will provide sustainable wastewater treatment that supports planned development. Objectives and policies from the Official Plan (City of Guelph, 2021) that are applicable to the Project include:

- Construction of new or expansion of existing wastewater systems should only be considered when strategies for water conservation and other water demand management initiatives are implemented, and plans are serving growth in a manner that supports the achievement of intensification and density targets on the Official Plan.
- The City will implement design and development standards in consideration of climate change impacts on public works and infrastructure.
- Energy will be conserved through the implementation of programs that support infrastructure renewal and operational efficiencies for treatment and conveyance.
- The City will continue to implement a wastewater treatment strategy that promotes proactive industrial wastewater management practices through enforcement of the City's sewer-use bylaw, encourages wastewater reduction and on-going upgrades to the treatment facility.
- In support of creating sustainable and energy efficient infrastructure, building infrastructure will include long-term community-based strategies to conserve wastewater.
- The Wastewater Treatment and Biosolids Management Master Plan will generally be updated at five-year intervals

3.3.5 Strategic Plan

The City's Strategic Plan (City of Guelph, 2019) outlines priorities and actions that reflect community ambitions and is intended to prepare Guelph for the future. Specifically, the City's 'sustaining our future' priority includes care for the local environment, response to climate change and preparing Guelph for a net-zero-carbon future. Protection for woodlands, wetlands, watercourses, and other elements of Guelph's natural heritage system is included in this priority. Criteria used to evaluate the alternative solutions will consider impacts to the natural environment (e.g., water quality, natural heritage system) when determining a preferred solution for wastewater and biosolids management, supporting the City's initiatives presented in the Strategic Plan.

3.3.6 Smart Cities Challenge

The Government of Canada's Smart Cities Challenge empowers communities to adopt a smart cities approach to improve the lives of residents. The City of Guelph and Wellington County were awarded $10M in support of the first technology-enabled Circular Food Economy, where "waste" becomes a valuable resource.

The City's wastewater treatment plant uses biosolids which undergo enhanced treatment in a Lystek process to produce, a Canadian Food Inspection Agency licensed fertilizer product. This Class EA will evaluate alternatives with an emphasis on resource recovery, supporting circular food economy concept and the City's overall Smart Cities initiative.

3.3.7 A Place to Grow: Growth Plan for the Greater Golden Horseshoe

A Place to Grow: Growth Plan for the Greater Golder Horseshoe (Ministry of Municipal Affairs and Housing, 2020) guides growth and development by supporting economic prosperity, protects the environment, and helps communities achieve a high quality of life. This plan outlines several policies for infrastructure to support growth specific to wastewater systems and environmental protection. Specifically, the requirement for a comprehensive wastewater master plan, or equivalent, must be prepared to demonstrate that effluent discharges and water takings associated with the system will not negatively impact the quality and quantity of water.

3.3.8 First Nations, Indigenous, and Métis Communities

Meaningful engagement with Indigenous groups, including First Nations and Métis communities, are important to the success of municipal projects. Under the Municipal Class EA process there is a duty to consult with the City's Treaty Partners.

The 2020 Provincial Policy Statement encourages meaningful engagement and coordination with Indigenous communities on planning activities (Province of Ontario, 2020). The MECP has confirmed its delegation of the procedural aspects of rights-based consultation for the Project.

First Nations and Métis groups in the local area may have an interest in the Guelph Wastewater and Biosolids Master Plan. These groups include:

- Six Nations of the Grand River
- Mississauga's of the New Credit
- Haudenosaunee Confederacy Chiefs Council
- Métis Nation of Ontario

A request may be made to MECP for an order requiring a higher level of study (i.e. requiring an individual/comprehensive EA approval before being able to proceed), 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 Indigenous and treaty rights. Requests on other

grounds will not be considered. Requests should include the requester contact information and full name for the ministry.

3.4 Climate Change Strategy and Energy Initiatives

In 2018, the City updated its Community Energy Initiative to include a target of becoming a net zero carbon community by 2050, as well as for the City's corporate operations to be powered by 100 percent renewable energy (City of Guelph, 2018). Improving energy efficiency and reducing greenhouse gas consumption at the Guelph WRRC is a major component of this plan, given the amount of electricity and natural gas consumed at the plant on an annual basis (summarized in Section 5.6). The City is continuously exploring options to optimize energy usage at the plant. This initiative is a driver for the ongoing Guelph WRRC Aeration Upgrades project, where the existing multi-stage centrifugal blowers are being replaced with more energy-efficient high-speed turbo blowers. Energy efficiency and greenhouse gas emissions will be a major factor in alternative solution development and evaluation for this Class EA, with the purpose of reducing the plant's carbon footprint where feasible and contributing to the goals set in the Community Energy Initiative.

3.5 Related Studies and Master Plans

3.5.1 Overview

The City is currently undertaking several water-related master plan updates. These include:

- Water Supply Master Plan (project webpage located at https://www.haveyoursay.guelph.ca/wsmp)
- Water and Wastewater Servicing Master Plan (project webpage located at https://www.haveyoursay.guelph.ca/water-and-waste-water-master-plan-update)
- Stormwater Management Master Plan (project webpage located at https://www.haveyoursay.guelph.ca/storm-water-master-plan-update)

The City and project team have coordinated planning activities for these studies, including the development of population growth forecast, which is the primary driver for establishing capacity needs for each study. In addition to coordinating technical aspects of the projects, the project teams shared feedback received by the public to inform a common understanding of concerns of community members. Public feedback received through the engagement activities for the Wastewater Treatment and Biosolids Management Master Plan Class EA is documented in Section 10 of this ESR.

The City is also currently undertaking an update to the City's Sewer Use By-law concurrent to this Class EA. The sewer-use bylaw update will continue to allow the City to maintain relatively consistent influent quality throughout the planning period for this Class EA.

The following sections provide additional detail on how these studies are relevant to this Class EA.

3.5.2 Water Supply Master Plan

The Water Supply Master Plan reviews the City's drinking water sources and identifies priorities for water supply for the planning horizon. The Water Supply Master Plan report provides short-, mid-, and long-term water supply options to meet the demands of the City's growing population. (AECOM, Matrix Solutions Inc., Gauley Associates, 2021). The teams developing the Wastewater Treatment and Biosolids Management Master Plan Class EA and Water Supply Master Plan coordinated the population projections used for both studies. The water demand projections were provided to the Wastewater Treatment and Biosolids Management Class EA study team for coordination purposes.

3.5.3 Water and Wastewater Servicing Master Plan

The Water and Wastewater Servicing Master Plan is ongoing and will update the City's 2008 Master Plan. The objective of the Water and Wastewater Servicing Master Plan is to identify where improvements to the City's water distribution (pipes, pump stations, and reservoirs) and wastewater collection (pipes and pump stations) systems are necessary to maintain a state of good repair and meet anticipated needs due growth to growth. Coordination between the study teams focused on wastewater generations rates, which are used to determine if the wastewater system can convey future flows, and to evaluate the Guelph WRRC capacity to treat future flows. In addition, the study teams coordinated to include any potential impacts of inflow and infiltration reduction on future flows to the Guelph WRRC. Inflow and infiltration refers to clear water flows entering the conveyance system.

3.5.4 Stormwater Management Master Plan

The Stormwater Management Master Plan is ongoing and will update the City's 2012 Master Plan (AMEC Environment & Infrastructure, 2012). The purpose of the Stormwater Management Master Plan is to manage stormwater from rain and snowmelt to protect properties and the environment from flooding impacts. This study will identify developments in stormwater management best practices, areas vulnerable to flooding, and ways to protect local waterways and groundwater resources. The Stormwater Management Master Plan will guide the City's stormwater management practices for the next 25 years. The City's stormwater conveyance and management infrastructure is separate from the City's sanitary collection system and therefore, for the purposes of this Class EA, both studies prioritize the continued protection of local water courses.

3.5.5 Sewer Use By-law Study

The City's Sewer-Use Bylaw (1996)-15202 was adopted in 1996 and was last amended in 2006. In 2021, the City initiated a sewer-use bylaw update to align with the latest industry standards and best management practices, and to comply with federal and provincial regulations (City of Guelph, 2021).

The sewer-use bylaw sets standards for allowable discharges into the sewer. Maximum concentrations are set for various contaminants and, if exceeded, the discharger may be subject to surcharge fees. These fees cover additional operations and maintenance that is required due to high-strength wastewater entering the City's sanitary system.

The sewer-use bylaw update will continue to allow the City to maintain relatively consistent influent quality throughout the planning period for this Class EA, which is an important consideration in assessing capacity and developing alternative solutions for the future of the Guelph WRRC.

3.5.6 Effluent Reuse Study

Reuse of treated effluent from the Guelph WRRC has been explored in previous studies, including Reclaimed Wastewater Reuse in the City of Guelph: A Feasibility and Implementation Study (AquaTech, 2009), York Trunk Sewer and Paisley-Clythe Feedermain Municipal Class EA – Technical Memorandum – Effluent Reuse System "Purple Pipe System" (GENIVAR, 2011), Water Reuse and Demand Substitution Technologies (C3 Water, 2019), and Guelph Water Reclamation Feasibility Study Report (Black and Veatch, 2020). The most recent report focused solely on evaluating alternatives for effluent reuse for sewer flushing, with this being the preferred strategy for effluent reuse in the City.

In addition to sewer flushing, the following effluent water reuse opportunities were explored in these studies:

- Street cleaning
- Construction activities (i.e., dust control)
- Municipal irrigation
- Golf course irrigation
- Urban applications

Two preferred alternatives for effluent water reuse for sewer flushing were identified (Black and Veatch, 2020); one short-term solution and one long-term solution. In the short-term, it was recommended that the City install a submersible pump that draws water from the chlorine contact tank, to convey it to a yard hydrant and ultimately a sewer flushing truck. In the long-term, it was recommended that the effluent water system be upgraded, and an elevated storage tank be installed. This upgrade will require MECP approval.

The Water Supply Master Plan reviewed the opportunity for effluent reuse during the review of alternate water supplies. This study identified that technologies will make effluent reuse more attractive in the future, but suggested that there are barriers to wide-spread acceptance of the practice (AECOM, Matrix Solutions Inc., Gauley Associates, 2021). These include:

- Community acceptance
- Potentially higher unit costs
- Environmental concerns including the impacts to terrestrial and aquatic habitats through reduced flows to the Speed River
- Regulatory barriers
- Public and private capital expenditures necessary to implement a municipal system

4. Methods and Approach

4.1 Overview of Study Approach

This study was completed as Schedule C Municipal Class EA, following Phases 1 through 4 of the Class EA process. Community Engagement is an important component of the Class EA process. The approach to community engagement is presented in Section 4.2.

The activities completed in Phases 1 through 4 include:

- **Phase 1 - Existing Conditions and Future Needs:** This phase included development of capacity and performance requirements, assessing existing facilities and practices for wastewater treatment and biosolids management, identifying gaps in meeting future needs, and development of a Problem and Opportunities Statement.
- **Phase 2 -Identification and Evaluation of Alternative Solutions:** This phase included identification of alternative wastewater treatment and biosolid management solutions to meet future requirement or provide benefit with respect to future opportunities. Alternative solutions were subject to comparative evaluation to identify preferred solutions.
- **Phase 3 - Development of Design Concepts and Implementation Plan:** In this phase, design concepts and implementation triggers and schedule for the recommended solutions was documented, and capital costs were forecasted for the planning period. Potential impacts and mitigation measures were documented.
- **Phase 4 - Environmental Study Report (ESR):** The methodology and project recommendations are documented in this Environmental Study Report.

The following sections provide additional details on the approach to each phase.

4.2 Engagement Plan and Approach

Upon study initiation, a Community Engagement and Communications Plan developed for this Class EA, to guide the approach to engagement for the duration of the study. The Community Engagement and Communications Plan is provided in Appendix B (Community Engagement).

The goals for engagement on this study include:

1. Meet and, where possible, exceed the consultation and engagement requirements of the Municipal Class EA process.
2. Raise awareness for the ongoing City planning activities underway.
3. Incorporate community priorities and values in the study's decision-making process.
4. Be consistent with the City's Guideline for Community Engagement (City of Guelph, 2020).

The Community Engagement and Communications Plan prioritized reaching out broadly to the community and providing opportunities for input to the Class EA. This plan incorporated the goals and principles put forward in the City's Guiding Principles for Community Engagement and focused on engagement with the following groups:

- Community residents, businesses, and stakeholders
- First Nations, Indigenous, and Métis groups
- Municipal staff and elected officials
- Regulatory review agencies, such as the MECP and GRCA

Safe engagement opportunities accessible to the community were provided due to the COVID-19 pandemic, when in-person engagement was restricted. For this reason, many of the originally planned in-person engagement opportunities occurred virtually and included extended time for feedback.

A community liaison group (CLG) was formed for this study. The CLG consisted of members of the community, the University of Guelph, regulatory agencies (MECP and GRCA), the City divisions, and serviced Township representatives. The project team met with the CLG at key points throughout the study to provide members with an update on study findings and progress and receive feedback.

The City's approach to First Nation, Indigenous, and Métis group engagement was guided by the stated wishes of each of the individual groups and based on foundational principles of long-term relationship building. The City coordinated the engagement activities across all of the City's ongoing master planning projects including the Wastewater Treatment and Biosolids Management Class EA.

More details on the engagement activities, feedback, and outcomes are provided in Section 10 (Public, Agency, and First Nations Consultation and Engagement) of this Class EA.

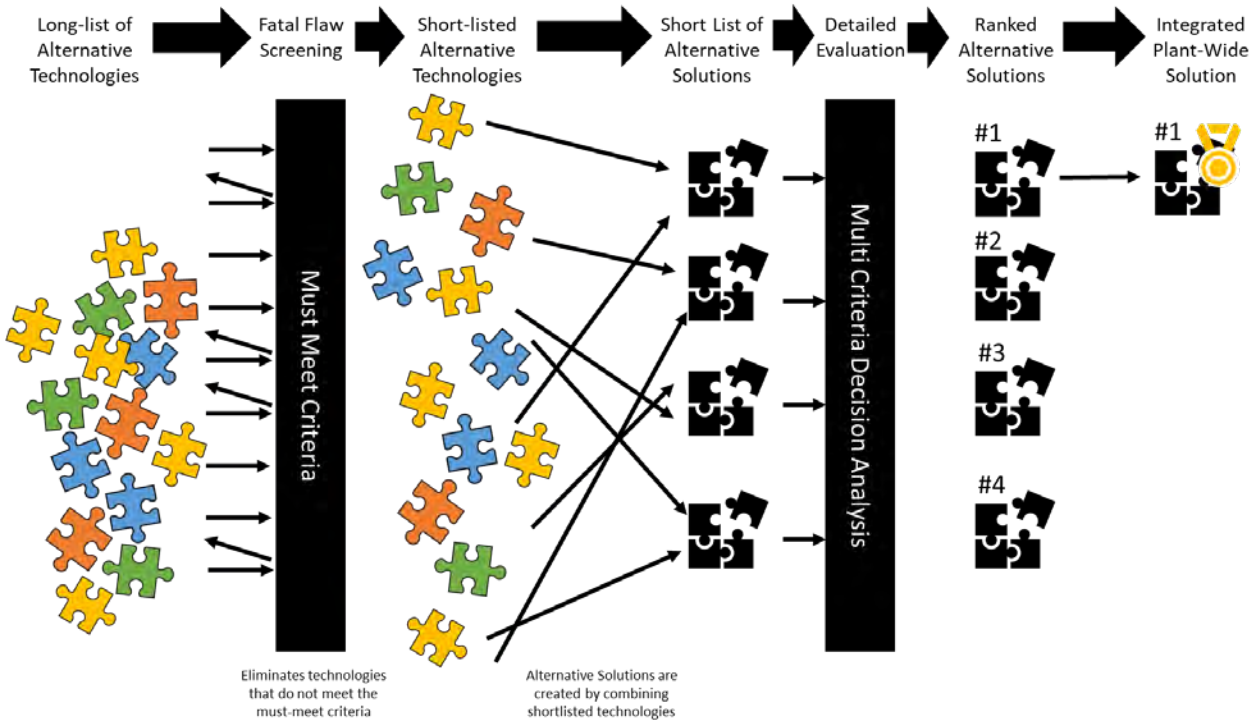
4.3 Decision-Making Process

Identification of preferred solutions for wastewater treatment and biosolids management to 2051 required decisions to be made, based on comparing alternatives to identify a preferred solution. A fundamental goal of the decision-making framework is to be transparent, defensible and reproduceable. The detailed project decision-making framework is provided in Appendix A-2.

The decision-making framework incorporated feedback received during early engagement activities. A multi-step evaluation approach was used to identify the preferred alternatives. The decision-making process included the following steps (presented in Figure 4-1):

1. A **long-list** of wastewater treatment/biosolids management alternatives (technologies and strategies) were identified for each process area to address deficiencies (e.g., capacity, condition, etc.) or provide opportunity (e.g., improve energy efficiency) for each process area.
2. Alternatives on the long-list for each process area were subject to **screening** against a set of "must-meet" criteria to identify a short-list feasible for implementation at the Guelph WRRC.
3. A two-stage **detailed evaluation** was completed on the short-listed alternatives using the detailed evaluation criteria presented in Table 4-1:
    a. **Stage 1**: An evaluation was completed for the short-listed alternatives based on the technical, social/cultural, and natural environment evaluation criteria. This provided a "benefit score" for each short-listed alternative. The alternatives that clearly provided less benefit than other alternatives were eliminated from consideration.
    b. **Stage 2**: Alternatives that passed Stage 1 of the evaluation were advanced for detailed concept development and costing, which were used to develop the economic score for each alternative. This provided an overall detailed evaluation score for each alternative. To establish a defensible preferred solution, multiple scoring methods were used. The alternative that received the highest detailed evaluation score was selected in each process area. If evaluation methodologies provided different outcomes, the solution that was identified in most across multiple methods was selected as the preferred alternative.

Figure 4-1. Decision Making Process



4.3.1 Screening Criteria

Alternatives in the long list were screened using a set of "must-meet" criteria using a pass or fail score. Those alternatives not meeting any single criterion were removed from future consideration. The objective of this screening exercise was to identify feasible solutions with demonstrated performance. Screening also identified emerging technologies or strategies with future potential; recommendations for monitoring these are made, however, they were not considered further for implementation to meet future needs.

The "must-meet" screening criteria used for this exercise included:

- **Performance**: To meet this criterion, an alternative must reliably meet the performance objectives and criteria.
- **Proven Technology**: To meet this criterion, the alternative must have five installations with more than 5 years of operating history, with at least one full-scale installation within North America.
- **Resiliency/Reliability**: To meet this criterion the alternative (technology, materials, biosolids management approach) must be readily available and there is an established local (Ontario) market.

4.3.2 Detailed Evaluation Framework

The feasible alternatives were evaluated using a set of criteria intended to be consistent with the Class EA process and reflecting the City's goals and priorities. Criteria were identified for the following four categories:

- Natural Environment
- Social and Cultural Environment
- Technical
- Economic

The detailed evaluation criteria developed for this Class EA are described in Table 4-1. These were developed in collaboration between the City and reflect feedback received from the CLG and community through the first public open house (POH).

A three-part scale used to evaluate the level of performance for each technology or alternative. In general terms the scale is applied as follows:

- 10 – Represents the highest possible score, the alternative performs well and significantly progresses the study objectives.
- 5 – Represents an acceptable score, the alternative reflects the current situation.
- 1 – Represents an unacceptable performance, the alternative is not well aligned with the study objectives.

Table 4-1. Detailed Evaluation Criteria and Scoring Scale

Category	Criterion and Definition	Definition of Scoring Scale
Natural Environment	**Minimize Greenhouse Gas (GHG) Emissions:** The potential for the alternative to minimize GHG emissions.	10 – The alternative will make a significant contribution for the City's goals to reduce GHG emissions, with the potential to provide a net positive contribution. 5 – The alternative will make a modest contribution to the City's goal to reduce GHG emissions. 1 – The alternative will not make a measurable contribution to the City's goal to reduce GHG emissions.
	Minimize Impacts on Groundwater Quality and Quantity: The potential to impact sensitive groundwater resources in the City of Guelph and protect overall groundwater quality and quantity.	10 – The alternative provides the greatest level of protection to sensitive groundwater resources and to the overall groundwater quality and quantity. 5 – The alternative provides an acceptable level of protection to sensitive groundwater resources and to overall groundwater quality and quantity. May require careful monitoring over the long-term to maintain protection. Contingency measure may be required. 1 – The alternative poses unacceptable risks to the protection-sensitive groundwater resources and to the overall quality and quantity of groundwater.
	Minimize Impacts to Terrestrial Habitats and Corridors: The potential impacts to terrestrial habitats and corridors.	10 – The alternative will avoid terrestrial habitats and corridors. 5 – The alternative may require special measures to protect terrestrial habitats and corridors. 1 – The alternative will result in an unacceptable loss of terrestrial habitats and corridors.
	Minimize Impacts to Aquatic Habitats and Fisheries: The potential for the alternative to protect or enhance aquatic habitats and fisheries.	10 – The alternative will protect aquatic habitats and fisheries and has the potential to provide enhancements. 5 – The alternative may require special measures to protect aquatic habitats and fisheries. 1 – The alternative will result in an unacceptable loss of aquatic habitat and fisheries.
	Minimize Floodplain Impacts: The potential impacts to existing flood plain and reduction of flood volume capacity in the Speed River.	10 – The alternative will maintain the existing floodplain and flood volume capacity. 5 – The alternative will require specials measures to maintain the existing floodplain and flood volume capacity. 1 – The alternative will result in an unacceptable loss of floodplain and will require significant measures to replace lost flood volume capacity.

Category	Criterion and Definition	Definition of Scoring Scale
Natural Environment	**Minimize Impacts to Surface Water Quality:** The potential impact to contaminant loadings in the Speed River.	10 – The alternative will provide a high degree of protection to the water quality of the Speed River all year, and treated effluent can be readily assimilated. 5 – The alternative will provide a high degree of protection to the water quality of the Speed River for most of the year, and treated effluent may require seasonal discharge conditions to meet assimilation requirements. 1 – The alternative may present a threat to the water quality of the Speed River during low flow periods, and there may be significant restrictions to treated effluent discharge conditions.
	Minimize Impacts to Soil Quality: The potential impact to soil as a result of biosolids end-use.	10 – The alternative has the potential to improve the quality and/or productivity of the soil. 5 – The alternative provides for similar quality or productivity of the soil. 1 – The alternative has the potential to reduce the quality and/or productivity of the soil.
	Minimize Impacts to Air Quality: The potential impact to the quality of the air.	10 – The alternative has the potential to improve the air quality. 5 – The alternative provides for similar air quality. 1 – The alternative has the potential to reduce the air quality.
	Minimize Impacts to Wetlands: The potential for the alternative to protect and maintain wetlands.	10 – The alternative will avoid wetlands. 5 – The alternative may require special measures to maintain wetland protection. 1 – The alternative will result in an unacceptable threat to wetlands.
Social / Cultural Environment	**Maximize Compatibility with Agricultural Practices:** The potential for the alternative to be compatible with current and developing agricultural practices over the long term.	10 – The alternative provides added value to current practices and developing practices 5 – The alternative is compatible with current and developing practices 1 – The alternative is not compatible with existing and developing practices; modifications may be required to achieve compatibility
	Minimize Impacts to Community Health and Safety: The potential for the alternative to minimize risk to community health and safety.	10 – There are no risks to community health and safety. 5 – There are minor risks to community health and safety that can be properly managed. 1 – There are significant risks to community health and safety which require significant measures and risk management plans to minimize risks to acceptable levels.

Category	Criterion and Definition	Definition of Scoring Scale
Social / Cultural Environment	**Minimize Impacts to Occupational Health and Safety:** The potential for the alternative to minimize risks to occupational health and safety (operations, maintenance and during construction).	10 – There are no risks to occupational health and safety. 5 – There are minor risks to occupation health and safety that can be properly managed. 1 – There are significant risks to occupation health and safety which require significant training and or risk management plans to minimize risks to acceptable levels.
	Maximize Smart Cities Circular Food Economy: Align with the City's Smart Cities Circular Food Economy initiative.	10 – The alternative adds value to City's circular food economy initiative. 5 – The alternative is compatible with the City's circular food economy. 1 – The alternative is not compatible with the City's circular food economy initiative.
	Minimize Noise: The potential for the occurrence of noise events.	10 – The alternative has little or no potential to produce noise. 5 – The alternative has moderate potential to produce noise; noise control measures may be needed to prevent migration off site. 1 – The alternative has a high potential to produce noise; significant mitigation would be needed to control migration off site.
	Minimize Odour: The potential of the occurrence of odour events.	10 – The alternative has little or no potential to produce odour. 5 – The alternative has moderate potential to produce odour; odour control measures may be needed to prevent migration off site. 1 – The alternative has a high potential to produce odour; significant mitigation would be needed to control migration off site.
	Maximize Positive Community Perception: The potential of the alternative to receive community support for wastewater treatment and biosolids management.	10 – The alternative has the potential to receive a high level of support and endorsement from the public. 5 – The alternative has the potential to receive a moderate level of support and endorsement from the public. 1 – The alternative has the potential to receive little to no support and endorsement from the public.
	Minimize Impacts to Transportation systems: The potential for the alternative to avoid increased demands on the transportation systems (patterns, volumes, and infrastructure requirements).	10 – The alternative will reduce demands on the transportation system. 5 – The alternative will place similar demands on the transportation system. 1 – The alternative will increase demands on the transportation system.

Category	Criterion and Definition	Definition of Scoring Scale
Social / Cultural Environment	**Maximize Positive Aesthetics:** The potential for the alternative to support the City's design standards and community aesthetics	10 – The alternative is consistent with and supports the City's design standards and community aesthetics. 5 – The alternative requires special measures to be consistent with the City's design standards and community aesthetics. 1 – The alternative is not consistent with the City's design standards and community aesthetics.
Technical Environment	**Maximize Performance Record:** The ability of the alternative to perform with a high degree of reliability and predictability in both process operations and effluent quality and/or biosolids quality.	10 – The alternative includes proven technology with a high degree of reliable performance. 5 – The alternative includes newer technology with a growing record of demonstrated performance reliability. 1 – The alternative includes innovative technology with a limited performance record and unconfirmed reliability – requires further testing/demonstration to determine feasibility for Guelph.
	Meet Treatment Capacity Requirements (short-term, medium-term, & long-term): The ability of the alternative to provide the wastewater treatment requirements for short-, medium-, and/or long-term needs.	10 – The alternative can provide short-, medium-, and long-term treatment requirements. 5 – The alternative can provide short-term and may provide medium-term requirements. 1 – The alternative may only provide short-term requirements.
	Maximize Ease of Implementation (Constructability): The ability of the alternative to be implemented with minimal disruption to existing wastewater treatment operations during implementation; minimal need to require system modifications.	10 – The alternative can be implemented with no disruption to existing service. 5 – The implementation of the alternative may result in minor disruptions to existing service. 1 – The implementation of the alternative may require significant or periodic disruptions to existing service.
	Minimize Energy Requirements: The energy required from all sources (electricity, natural gas, fuel)	10 – The alternative requires less energy than the existing system. 5 – The alternative requires less energy than the existing system. 1 – The alternative uses more energy than the existing system
	Minimize Risks due to Regulatory Constraints: The ability of the alternative to be approved with minimal, if any, conditions.	10 – The alternative can be readily approved. 5 – The alternative can be approved with minimal conditions. 1 – The alternative can be approved with significant or onerous conditions.

Category	Criterion and Definition	Definition of Scoring Scale
Technical Environment	**Maximize Operational Compatibility with Existing Processes:** The alternative's compatibility with current existing process operations and its ability to integrate within the existing site.	10 – The alternative is very compatible and compliments current processing units. It can be integrated into current plant operations with minimal impact. 5 – The alternative is somewhat compatible and complimentary to current processing units; it can be integrated; but will have some impact. 1 – The alternative is not compatible or complementary to current processing units and integration may be difficult.
	Minimize Chemical Consumption: The degree to which the alternative requires chemical usage.	10 – The alternative uses less chemicals than the existing system, by less than 20%. 5 – The alternative uses the same amount of chemicals as the existing system, plus or minus 20%. 1 – The alternative uses more chemicals than the existing system, by greater than 20%.
	Maximize Ability to Treat Emerging Contaminants of Concern: The ability of the alternative to treat emerging contaminants of concern.	10 – The alternative has a high removal efficiency for emerging contaminants of concern relative to the current technologies at the plant. 5 – The alternative has the same removal efficiency for emerging contaminants of concern relative to the current technologies at the plant. 1 – The alternative has a poor removal efficiency for emerging contaminants of concern relative to the current technologies at the plant.
	Minimize Maintenance Complexity: The degree of maintenance complexity associated with implementation of the alternative.	10 – The alternative will result in minor or no increase in maintenance complexity compared to the existing processes. 5 – The alternative will result in a moderate increase in maintenance complexity compared to the existing processes. 1 – The alternative will result in a significant increase in maintenance complexity compared to the existing processes.
Economic Environment	**Minimize Capital Costs:** The relative costs of land, equipment, and facilities when compared to other alternatives.	10 – The alternative has the lowest capital costs relative to other alternatives. 5 – The alternative is in the mid-range of capital costs relative to other alternatives. 1 – The alternative has the highest capital costs relative to other alternatives.
	Minimize Operations and Maintenance (O&M) Costs: The relative Operations and Maintenance (O&M) when compared to other alternatives.	10 – The alternative has the lowest O&M costs relative to other alternatives. 5 – The alternative is in the mid-range of O&M costs relative to other alternatives. 1 – The alternative has the highest O&M costs relative to other alternatives.

Category	Criterion and Definition	Definition of Scoring Scale
Economic Environment	**Minimize Life Cycle Cost:** The relative life cycle costs (including Operations and Maintenance [O&M] and Depreciation/Replacement) when compared to other alternatives.	10 – The alternative has the lowest lifecycle costs relative to other alternatives. 5 – The alternative is in the mid-range of lifecycle costs relative to other alternatives. 1 – The alternative has the highest lifecycle costs relative to other alternatives.

4.4 Cost Estimate Basis

Cost estimates were developed for the short-listed alternatives to support the detailed evaluation process.

4.4.1 Capital Cost Estimates

Capital cost estimates were developed for the short-listed alternatives presented in Section 8 based on the future projected average daily flow to the Guelph WRRC in 2051 (presented in Section 6. The following sources were used to develop the capital cost estimates:

- Jacobs' Conceptual and Parametric Engineering System (CPES) tool, which uses a database of previously completed projects and quantity take-offs to develop conceptual cost estimates.
- Vendor quotations for process equipment.
- Reference projects completed by Jacobs in Ontario.
- The capital cost estimates presented in this ESR have an accuracy level of approximately plus 50 percent to minus 30 percent, which is a typical accuracy level used at the concept development phase (i.e., a Class D cost estimate). Cost estimates include the following markups and adjustment factors:
- 10 percent contractor overhead.
- 15 percent contractor profit, mobilization, demobilization, insurance, and bonding.
- 30 percent design contingency.
- 20 percent design and engineering fees.
- 2 percent location adjustment factor.

4.4.2 O&M Cost Basis

O&M cost estimates were developed for each alternative based on the following components:

- **Electricity:** The average electricity cost at the Guelph WRRC in cents per kilowatt hour, based on billing records provided by the City, between 2017 and 2020 was used when developing annual operating costs.
- **Natural Gas:** The average natural gas cost at the Guelph WRRC in cents per kilowatt hour, based on billing records provided by the City, between 2017 and 2020 was used when developing annual operating costs.
- **Chemicals:** Chemical costs can be affected by macroeconomics and by local supply and demand, therefore, it is difficult to project the chemical cost in the long-term future. For the purpose of this study, chemical costs were based on recent bills provided by the City.
- **Labour:** The additional labour costs related to operating and maintaining the processes were estimated for each alternative. A typical local market labour rate of $50 per hour was used for the purposes of this study.

Unit costs for individual O&M components are presented in Appendix A-2.

4.4.3 Lifecycle Cost Basis

Lifecycle costs (25-year) estimates include capital costs and the 25-year net present value O&M costs, if not specified otherwise. The lifecycle costs were developed using the annual flow, loading, and sludge generation projections between year 2020 and 2051.

Buildings and process equipment have different useful life spans (e.g., typically greater than 50 years for buildings and 15 to 25 years for equipment depending on technology and operating model). Equipment or material replacement costs were included in the lifecycle O&M cost depending on the short-listed technologies. If major equipment replacement such as diffusers, membranes, or media replacement was expected within the planning period, those costs were included.

5. Study Area Existing Conditions

The purpose of this section is to describe the natural and social environment within the spatial boundaries defined for the Study (refer to Section 3.1), through information available from existing literature, government databases and online resources, and feedback collected during community engagement. The level of detail provided in this section is corresponds to the nature and scale of the predicted effects and public feedback related to the Study. This information supports the identification of the detailed evaluation framework and the selection of alternatives.

5.1 Natural Environment

The local study area and adjacent lands exist within a mix of utility, agricultural, residential, and natural areas. The Guelph WRRC is dominated by utility and open areas, with treed areas along the northwest side, along Wellington Street West. Most of the local study area and adjacent lands to the south are within the Grand River Conservation Authority (GRCA) Regulated Area (GRCA, 2022).

5.1.1 Physical Environment

Guelph is located within the Mixedwood Plains Ecozone where surficial conditions are generally gently undulating to rolling terrain, and within the Manitoulin-Lake Simcoe Ecoregion where there are clayey gleysolic and grey-brown luvisolic soils (Ministry of Natural Resources, 2009).

The Guelph area was once dominated by deciduous forest; however, the landscape is now generally flat with interspersed rolling moraines because of extensive clearing for farming throughout the nineteenth century. The local surficial geology is largely glacial in origin and consists of loam till, outwash gravels and sands. Surficial geology at the existing Guelph WRRC are a mix of gravel, sand, and silt (GRCA, 2022). Guelph is located at the south end of the Paris-Galt Moraine Complex which is covered in outwash gravels and sands.

There are no steep slopes or areas of ground instability known to occur at the project footprint. Construction activities may present a negligible effect on the physical environment; therefore, additional detailed information is not warranted.

5.1.2 Groundwater Quality and Quantity

The City is located within the Grand River watershed, which drains into Lake Erie and is southern Ontario's largest watershed with six subwatershed areas.

The City is the largest in Canada to rely on groundwater for its drinking water supply. The City is located above two aquifers that provide the City with high-quality water. There are 21 operational groundwater wells, deep bedrock aquifers and one shallow groundwater collector system comprised of a series of underground perforated pipes that collect shallow groundwater (City of Guelph, 2021). Water is pumped from the Eramosa River into an engineered infiltration pond and trench where it replenishes the groundwater supplies. Water from these wells and the collector system is treated and distributed to the community (City of Guelph, 2021). The groundwater that supplies the City is used by the residents of Guelph and the surrounding County and Townships as well as the natural environment.

More information regarding groundwater supply sources in Guelph is detailed in the City of Guelph Water Supply Master Plan Update (AECOM, Matrix Solutions Inc., Gauley Associates, 2021).

The local study area is within a Wellhead Protection Area 'B' with a vulnerability value of 10 meaning that the area contributes source water to a drinking water system (Ministry of Environment, Conservation and Parks, 2022). The northern portion of the Guelph WRRC is is within an Issue Contributing Area which means that activities and conditions resulting from past activities have or are likely to contribute to elevated contaminant levels, such as trichloroethylene at this site (Ministry of Environment, Conservation and Parks,

2022). The Guelph WRRC is not located within a significant groundwater recharge area or highly vulnerable aquifer (Ministry of Environment, Conservation and Parks, 2022).

Risks to the existing groundwater system include drought conditions, loss of an operating well (e.g., contamination, failure, loss of supply) and regulatory permitting changes (e.g., permit to take water).

5.1.3 Surface Water Quality

The Grand River watershed is the largest in Southern Ontario at approximately 6,800 km^2 in area, originating from Dufferin and Grey counties and draining into Lake Erie. The major contributing tributaries of the Grand River are the Conestogo River and the Nith river on the west side of the watershed, while the Speed River and the Eramosa River drains to the northeast side of the watershed (Zammit, 2019).

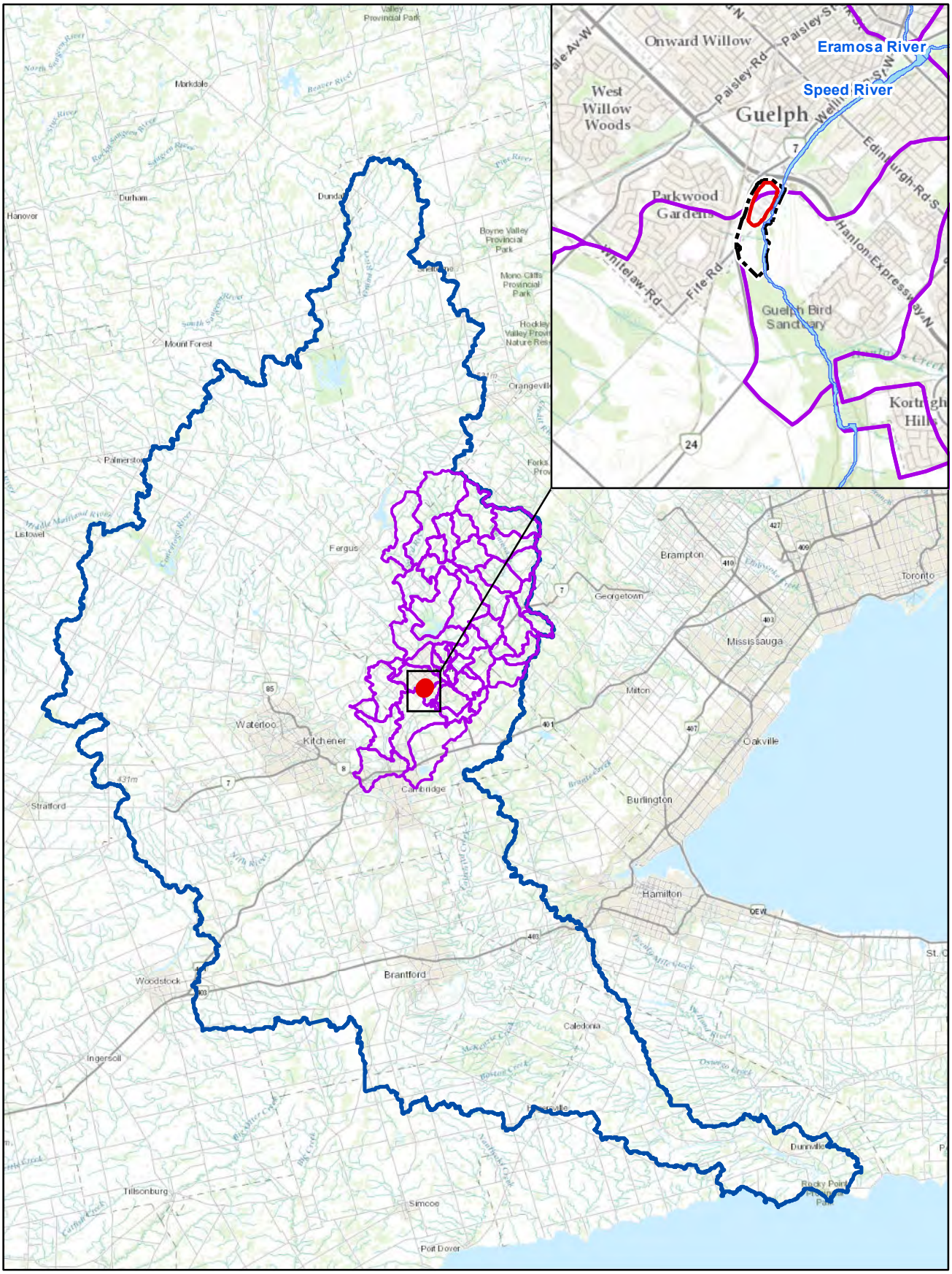
The Speed River and its tributary, Eramosa River, join at the City, below the Guelph Dam. The Speed River joins the Grand River in the City of Cambridge (Cambridge). Discharge from the Guelph Dam regulates the flow of the Speed River and is responsible for flood control (Lake Erie Source Protection Region Technical Team, 2008). The Speed River subwatershed, which covers an area of approximately 780,076 hectares, is known for its high total amount of forest cover at approximately 18,546 hectares (Lake Erie Source Protection Region Technical Team, 2008). The Speed River subwatershed is shown on Figure 5-1.

The central portion of the Grand River, which includes the lower Speed River, tends to be a portion of the watershed with poor water quality, predominantly due to agricultural production and runoff, urban development, and wastewater treatment plant effluent. High levels of phosphorus and nitrogen runoff contribute to increased aquatic plant growth and lower dissolved oxygen levels (Lake Erie Source Protection Region Technical Team, 2008).

An assimilative capacity study was conducted in 2021 to characterize the existing conditions in the Speed River, identify the impacts of the Guelph WRRC effluent on the water quality and ecology of the Speed River, and to identify the potential impacts of increased future flows. The assimilative capacity study included water quality modelling to recommend future effluent criteria for the Guelph WRRC based on the future flow projections, and the Speed River flow, quality, and aquatic biota. The intent of these recommendations is to mitigate impacts on the downstream environment (Hutchinson Environmental Sciences Ltd., 2022). The impacts identified in the assimilative capacity study have been incorporated into this Class EA. Understanding these impacts informed the development of the detailed evaluation framework identified in Section 4 and the identification of alternatives task in Sections 8 and 9 of this report.

The assimilative capacity study found that the WRRC was performing well and that concentrations of regulated parameters are within the existing ECA effluent objectives (Hutchinson Environmental Sciences Ltd., 2022). During summer conditions, treated effluent from the Guelph WRRC can represent as much as 50 percent of Speed River flow and that the effluent is typically better quality than the objectives and criteria in the ECA. The Speed River flows are lower upstream of the outfall and provide limited capacity for dilution. The study identifies that the downstream environment is enriched (above the Provincial and Canadian Water Quality Guidelines) with phosphorous, nitrates, and chloride compared to the concentrations upstream. This enrichment is characterized by the organisms found downstream. The study found shifts in the benthic macroinvertebrate and fish communities to more tolerant species, indicative of reduced water quality (Hutchinson Environmental Sciences Ltd., 2022). The study found that phosphorous, nitrate, and chloride concentrations in the Speed River are greater than the Provincial Water Quality Objectives and the Canadian Water Quality Guidelines for up to seven kilometres downstream of the outfall. Future effluent objectives and criteria identified through the assimilative capacity are presented in Section 6.3. (Hutchinson Environmental Sciences Ltd., 2022)

In 2017 the GRCA established voluntary effluent performance targets for wastewater facilities discharging within the watershed (including the Guelph WRRC). The intention of these targets is to improve water quality in the Grand River and its tributaries (which include the Speed River). The City strives to meet these voluntary effluent performance targets and has been awarded a Silver level recognition in 2017, 2018, and 2019 by the GRCA for their efforts in reducing pollutant loads to the Grand River (and its tributaries) (Hutchinson Environmental Sciences Ltd., 2022) In 2021, the WRRC met the gold standard.



Notes:
2. Basemap Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Figure 5-1
Speed River Watershed
Environmental Study Report
City of Guelph
Guelph, Ontario

Jacobs

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5.1.4 Source Water Protection

The Guelph WRRC is within the Grand River Source Protection Area and is located within a surface water Intake Protection Zone (IPZ) (IPZ-3 with a vulnerability score of 5) (Ministry of Environment, Conservation and Parks, 2022). The study area is also located within a groundwater protection zone (well head protection area [WHPA] B with a vulnerability score of 5), as discussed in Section 5.1.2.

Portions of the facility parcel intersect with an issue contributing area for trichloroethylene or another dense non-aqueous phase liquid and with a significant groundwater recharge area. Based on these facts and according to circumstance P2.8.3 of the 2021 Technical Rules, the Guelph WRRC is considered a significant drinking water threat.

As detailed in Section 3.3.1, source protection policies CG-MC-11, CG-MC-12 and CG-CW-13 apply to activities at the Guelph WRRC and will be considered as part of the implementation stage for the preferred solution. These policies are generally related to ECA condition requirements that include appropriate terms and conditions to see that on-site activities (i.e., effluent discharge into the Speed River) do not become significant drinking water threats.

Source protection policies related to the handling and storage of fuel also apply at the Guelph WRRC, as diesel is stored on-site for use in standby generators during power outages. Policies CG-CW-33 and CG-CW-34 apply and are generally related to Technical Standards and Safety Authority Compliance, proper storage methods and risk management. The City currently follows these policies for all on-site fuel storage.

Source protection will be considered during implementation of the preferred solution for this Class EA where required.

5.1.5 Aquatic Habitat and Fisheries

The Speed River is immediately adjacent to and south of the existing Guelph WRRC where potential construction activities will happen. Within the regional study area, the Speed River flows through the rural areas of Wellington County and into the Guelph Lake Reservoir, which is created by the Guelph Dam. The river then continues through Guelph and eventually drains to the Grand River in Cambridge (Grand River Conservation Authority, 2022).

The Speed River and the Eramosa River are both considered to be cold water fish habitat (Zammit, 2019). The following fish species are known to occur in the Speed River (Grand River Conservation Authority, 2022).

- above Guelph Lake:
  - brook trout (*Salvelinus fontinalis fontinalis*)
  - smallmouth bass (*Micropterus dolomieu*)
  - white sucker (*Catostomus commersonii*)
- below Guelph Dam:
  - smallmouth bass
  - largemouth bass (*Micropterus salmoides*)
  - northern pike (*Esox lucius*)
  - brown bullhead (A*meiurus nebulosus*)
  - common carp (*Cyprinus carpio*)

Most of the Speed River flows through private land where landowner permission is required to access the river. Recreational fishing is known to occur in certain areas such as the area below Guelph Lake where smallmouth bass, largemouth bass, common carp, and norther pike are caught (Hook Line and Sinker, 2022).

There is no in-water work required; however, indirect effects may occur during construction activities.

5.1.6 Wetlands

Based on desktop review, the Speed River Wetland Complex is locate approximately 12 m southeast of the Guelph WRRC site, adjacent to the Speed River (Ministry of Natural Resources and Forestry, 2022) (GRCA, 2022). This is a Provincially Significant Wetland classified as a swamp. Direct disturbance to the wetland is not expected; however, according to the GRCA Wetlands Policy (Grand River Conservation Authority, 2003), an Environmental Impact Statement may be required for development within 120 m of the Provincially Significant Wetland.

5.1.7 Floodplain

The existing Guelph WRRC is in a One Zone Floodplain (GRCA, 2022). The GRCA is responsible for forecasting floods and issuing flood warning for the City. The Grand River system has a long history of flooding in all seasons including during spring melt, following major rainstorms in summer and fall, and during a rapid melt or ice jam in the winter (Grand River Conservation Authority, 2022).

Controlling development in flood-prone areas reduces the potential for effects of infrastructure damage. The location of the floodplain with respect to the Guelph WRRC and any new buildings on site will be an important consideration during the evaluation of alternatives. The GRCA manages restrictions within regulated areas, including floodplains, to ensure any activities that may impair the hydrological function of waterways such as placing fill in a floodplain, and altering or blocking the flow of water. A permit from GRCA may be require for construction or development within the regulated area to ensure the proposed activity complies with regulations and policies. According to the City's Official Plan, no development is permitted within One Zone Floodplain area with the exception of minor additions or alterations to existing buildings or structures or in accordance with the GRCA regulations (City of Guelph, 2021).

5.1.8 Areas of Natural and Scientific Interest (ANSI)

There are no ANSIs located within the local study area or within 120 m of the local study area (Ministry of Natural Resources and Forestry, 2022) (GRCA, 2022).

5.1.9 Terrestrial Habitat

The local study area abuts major road systems and residential areas to the northwestern side of the WRRC along Wellington Street West. Minor treed areas and cultural meadows (i.e., open fields created or maintained by anthropogenic disturbances) are interspersed throughout the local study area. The Speed River and adjacent riparian habitat are immediately east. Swamp wetland habitat occurs along both banks of the Speed River, with steep valleys noted along the right bank.

Considering that operational activities will occur within the Guelph WRRC, potential effects are generally limited to the construction phase.

5.1.10 Wildlife and Wildlife Habitat

The local study area is generally comprised of open and disturbed cultural and industrial areas, which can provide wildlife corridors to Speed River, the Speed River Wetland Complex, and nearby forested areas. The combination of these features provides suitable habitat for numerous wildlife species.

Background data obtained for wildlife included a review of the Ontario Breeding Bird Atlas (OBBA), which provides information on avifauna occurrences based on a 10 km^2 area. The 2nd Atlas of the OBBA includes data collected from 2001 to 2005. The Project and adjacent lands occur within OBBA Square Summary 17NJ51 Region # 47: Wellington. iNaturalist online was also accessed.

Construction activities may increase sensory disturbance to wildlife species that use the existing infrastructure or surrounding areas. Effects during future operations at the WRRC are not anticipated. Therefore, additional detailed information is not warranted.

5.1.11 Species at Risk

According to the NHIC 1 km^2 areas mapping (Ministry of Natural Resources and Forestry, 2022), Fisheries and Oceans Canada (Fisheries and Oceans Canada, 2022), OBBA 10 km^2 (Bird Studies Canada, 2009) and iNaturalist (iNaturalist, 2022), species at risk that may occur within the vicinity of the local study area are listed in Table 5-1. The presence of species at risk within the local study area or at the Project footprint has not been verified in the field for this Class EA. It is the City's responsibility that SAR are not impacted through on-site activities or implementation of recommendations.

While the species or associated habitat from Table 5-1 have the potential to occur within either the local and regional study area, field verification and species at risk-specific surveys are recommended at the detailed design stage for all projects that will be implemented as a result of this Class EA, to confirm presence or absence of species at risk or associated habitat, and to inform mitigation strategies. Once these surveys are complete, consideration under the *Endangered Species Act (ESA)*, as administered by the MECP, is required.

If site activities cannot be completed in a manner that does not impact protected species and their habitats, the City must apply for authorization under the ESA.

Table 5-1. Potential Species at Risk and Rare Species Occurrences

Common Name	Scientific Name	Type	S Rank [a]	SARO [b]	COSEWIC [c]	SARA [d]
northern bobwhite	*Colinus virginianus*	bird	S1?B	END	END	END
least bittern	*Ixobrychus exilis*	bird	S5B	THR	-	-
black tern	*Chlidonias niger*	bird	S3B, S4M	SC	NAR	-
common nighthawk	*Chordeiles minor*	bird	S4B	SC	SC	THR
eastern whip-poor-will	*Antrostomus vociferus*	bird	S4B	THR	THR	THR
chimney swift	*Chaetura pelagica*	bird	S3B	THR	THR	THR
red-headed woodpecker	*Melanerpes erythrocephalus*	bird	S3	SC	END	THR
olive-sided flycatcher	*Contopus cooperi*	bird	S4B	SC	SC	THR
eastern wood-pewee	*Contopus virens*	bird	S4B	SC	SC	SC
bank swallow	*Riparia*	bird	S4	THR	THR	THR
barn swallow	*Hirundo rustica*	bird	S4B	THR	THR	THR
wood thrush	*Hylocichla mustelina*	bird	S4B	SC	THR	THR
Canada warbler	*Cardellina canadensis*	bird	S5B	SC	SC	THR
grasshopper sparrow	*Ammodramus savannarum*	bird	S4B	SC	SC	-
bobolink	*Dolichonyx oryzivorus*	bird	S4B	THR	THR	THR
eastern meadowlark	*Sturnella magna*	bird	S4B, S3N	THR	THR	THR
black-crowned Night-heron	*Nycticorax nycticorax*	bird	S3B, S2N, S4M	-	-	-
canvasback	*Aythya valisineria*	bird	S1B, S3N, S4M	-	-	-
great egret	*Ardea alba*	bird	S2B, S3M	-	-	-
peregrine falcon	*Falco peregrinus*	bird	S4	SC	-	-
redhead	*Aythya americana*	bird	S2B, S4N, S4M	-	-	-
eastern milksnake	*Lampropeltis triangulum*	reptile	S4	-	SC	SC
midland painted turtle	*Chrysemys picta marginata*	reptile	S4	-	SC	-
snapping turtle	*Chelydra serpentina*	reptile	S4	SC	SC	SC
Blanding's turtle	*Emydoidea blandingii*	reptile	S3	THR	END	-
Adjutant Wainscot	*Leucania adjuta*	insect	S2	-	-	-

Common Name	Scientific Name	Type	S Rank [a]	SARO [b]	COSEWIC [c]	SARA [d]
four-toothed mason wasp	*Monobia quadridens*	insect	S2?	-	-	-
monarch	*Danaus plexippus*	insect	S2N, S4B	SC	END	SC
yellow-banded bumble bee	*Bombus terricola*	insect	S3S5	SC	SC	SC
-	*Euodynerus crypticus*	insect	S1	-	-	-
American burying beetle	*Nicrophorus americanus*	insect	SH	EXP	EXP	EXP
black ash	*Fraxinus nigra*	plant	S4	-	THR	-
blue ash	*Fraxinus quadrangulata*	plant	S2?	THR	THR	SC
Culver's root	*Veronicastrum virginicum*	plant	S2	-	-	-
cup plant	*Silphium perfoliatum*	plant	S2	-	-	-
tall boneset	*Eupatorium altissimum*	plant	S1	-	-	-

Notes:
[a] NHIC Subnational Rank
[b] Species at Risk Ontario (SARO)- = Not at Risk
[c] Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
[d] Species at Risk Act (SARA)
? = more data required
B = Status qualifier; breeding
END = Endangered
H = Status qualifier; possibly extirpated
M = Status qualifier; migrant species
N = Status qualifier; non-breeding
S#S# = Range given due to uncertainty
S1 = Critically Imperiled (often 5 or fewer occurrences)
S2 = Imperiled (often 20 or fewer occurrences)
S3 = Vulnerable (restricted range with relatively few populations - often 80 or fewer
S4 = Uncommon but not rare; some cause for long-term concern due to declines or other factors
S5 = Secure species, common, widespread, and abundant
SC = Special Concern
THR = Threatened

5.1.12 Atmospheric Environment

The climate in Ecoregion 6E is mild and moist with an average annual daily temperature of 7°C. Annual precipitation is 916.5 millimetres with an annual average rainfall of 776.8 millimetres and average annual snowfall of 159.7 centimetres. Average wind speed is 12.6 kilometres per hour (Environment and Climate Change Canada, 2021).

Natural hazards that may occur in the study area with potential effects on project-related infrastructure or on the environment include extreme weather events (e.g., high winds, heavy or persistent precipitation, extreme temperatures) and changing climate trends (e.g., long-term changes in precipitation levels or temperatures).

An increase in air or greenhouse gas emissions as a result of the study is not anticipated; therefore, additional detailed information is not warranted.

5.1.13 Land Use

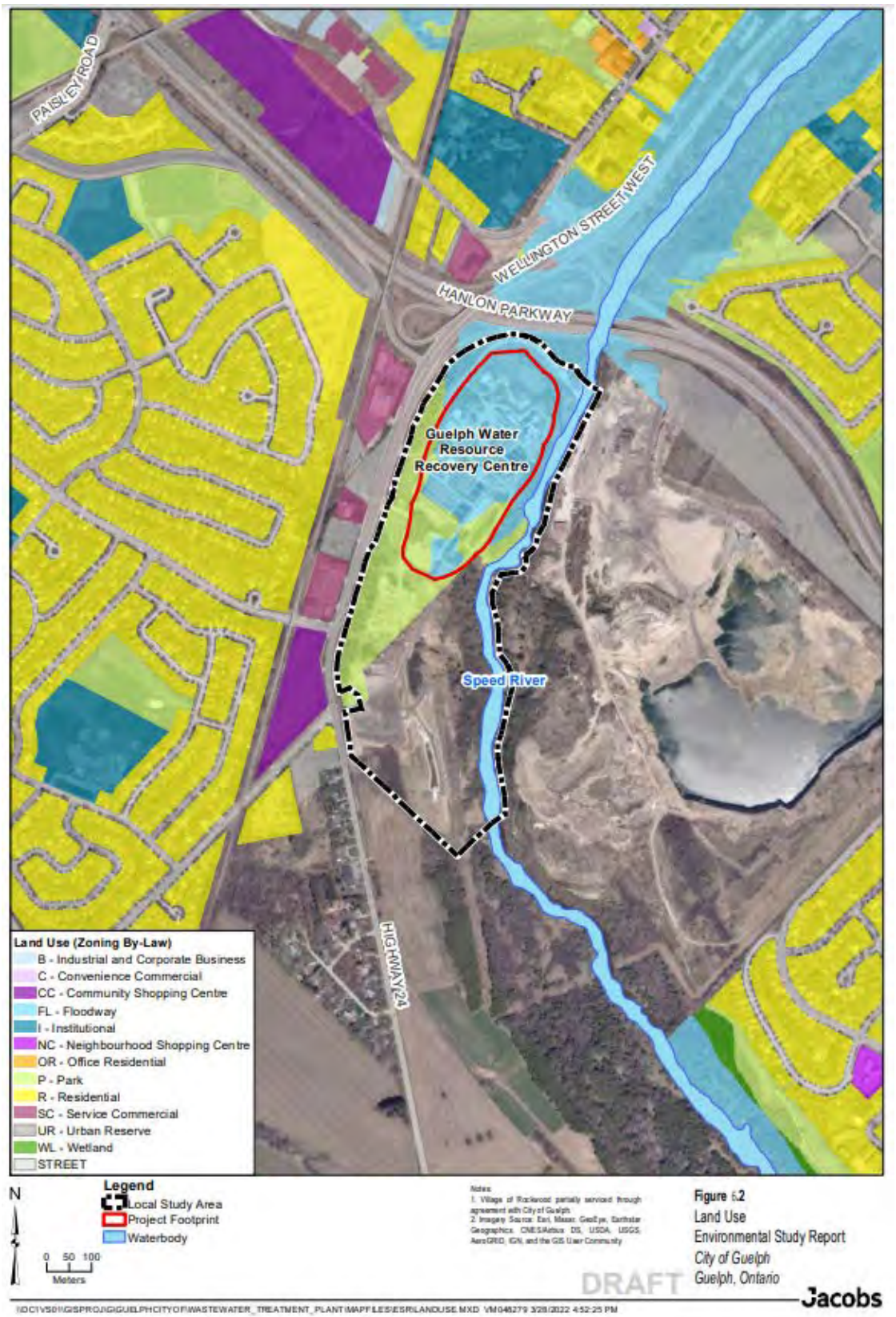
The local study area abuts major road systems and residential areas to the northwestern side of the Guelph WRRC along Wellington Street West.

Lands at the Guelph WRRC are zoned as Floodway and Park, and surrounding land use includes Service Commercial, Urban Reserve and Community Shopping Centre (City of Guelph, 2022). Land Use is shown on Figure 5-2. Development activities within floodways are allowed subject to provisions within the Official Plan (City of Guelph, 2021).

Recreational use within the local study area includes the Speed River Hiking Trail, located east of the Guelph WRRC along the Speed River, and the Speed River. Recreational use of the Speed River is possible (e.g., paddling, kayaking, swimming) although generally limited in practice.

Within the regional study area, Guelph has several agricultural operations and facilities. There are no agricultural activities within the local study area; however, at the Guelph WRRC, biosolids are dewatered and further processed using a proprietary technology (Lystek) at a facility in Dundalk or at the Guelph WRRC and are then beneficially reused as a fertilizer product for agricultural purposes. The application of Lystek supports horticulture and agriculture practices and aligns with the City's Circular Food Economy initiative.

Figure 5-2. Land Use



5.2 Social and Cultural Environment

In 2021, the population of Guelph was 143,740, an increase of approximately 9 percent over the past five years (Statistics Canada, 2022). The Province updated the Growth Plan targets for municipalities located in the Greater Golden Horseshoe to plan for growth to 2051. The City's Growth Management Strategy plans for an estimated population of approximately 208,000 by 2051 (City of Guelph 2022).

5.2.1 Community Health and Safety

Construction, equipment and infrastructure have the potential to increase human exposure to potential community health and safety risks. Development and construction activities may increase the type and volume of traffic on surrounding roadways (e.g., construction vehicles and equipment) or introduce additional hazards to the environment (e.g., material spill). Since the projects recommended through this Class EA are located within the existing Guelph WRRC site, which is surrounded by existing, paved roadways, it is not anticipated that there will be substantial changes to community health and safety during construction of recommended projects.

Operation of the Guelph WRRC ultimately contributes to community health and safety by through treatment, which also contributes to a clean drinking water system. The Official Plan includes objectives to minimize conditions that may be hazardous to human life or may cause significant property damage within lands zoned as Floodway.

5.2.2 Noise

Noise in the local study area is influenced by traffic and human activity on surrounding roadways, ongoing operation of the Guelph WRRC and, to a lesser extent, recreational use along the Speed River. Construction noise will be temporary and short-term in nature. Construction activities will generally be carried out during the day where traffic and human activity along Wellington Street West (e.g., gas station, hardware store) are occurring. A negligible increase in noise at the existing Guelph WRRC is expected during ongoing operation of the plant.

5.2.3 Odour

Odour in the local study area is primarily influenced by the existing Guelph WRRC operations and, to a lesser extent, vehicle exhaust from surrounding roadways, gas stations and mechanical repair shops. Odour is not expected to increase during construction. Alternative solutions will include consideration for odour control and treatment facilities to mitigate potential odours emitted from new processes.

5.2.4 Infrastructure and Services

Transportation infrastructure surrounding the Guelph WRRC includes Wellington Street West and provincial highway 6 (Hanlon Parkway). Existing local roads are used to access the existing Guelph WRRC. During construction, a small increase in traffic to and from the Project footprint is anticipated to transport crews and equipment. No increase in traffic is expected during operations. Therefore, additional detailed information regarding the existing transportation infrastructure is not warranted.

There are several utility lines surrounding the existing Guelph WRRC. Alternative solutions identified in the Study do not require additional utilities to the site; therefore, additional detailed information regarding existing utilities is not warranted. During construction, an interruption of services may occur because of an accident; however, Ontario One-Call locates will be done prior to construction.

The Project is not anticipated to increased demand on local or regional services (e.g., emergency, health care, waste management). Therefore, additional detailed information regarding local or regional services is not warranted.

5.2.5 Viewshed

Project activities will be conducted within the existing Guelph WRRC which can be seen from surrounding roadways (e.g., Wellington Street West, provincial highway 6) and waterway or recreational users along the Speed River. The local study area is surrounded by residential, and commercial and industrial development (e.g., auto shops, hardware stores, gas station) separated by Wellington Street West.

Permanent infrastructure changes within the existing site may present a negligible change to the existing viewshed considering these changes will be made within the Guelph WRRC site adjacent to existing buildings and aboveground structures. Therefore, additional detailed information regarding the local viewshed is not warranted.

5.2.6 Cultural Heritage

Heritage resources include artifacts, buildings or structures (e.g., bridges, monuments), landscapes (e.g., parks, trails) and archaeological sites. There are no known buildings, structures, landscapes or archaeological sites located within the project footprint. To date, consultation with Indigenous communities does not indicate that there are any traditional use sites at the project footprint or within the local study area.

Archaeological potential is considered to be high since the Speed River and a secondary water source (i.e., wetland) within 300 m of the project footprint (Ministry of Tourism and Culture, 2022). Marine archaeological potential is considered to be low (Ministry of Tourism, Culture and Sport, 2022).

A Stage 1 Archaeological Assessment was conducted for the WRRC site. The Stage 1 assessment included background research on the geography, history, current land use, and previously completed archaeological field work. In addition to the desktop research, a site inspection was preformed. The detailed findings of the Stage 1 Archaeological Assessment can be found in Appendix A-4.

The desktop research found that large portions of the site had been previously assessed and have Stage 1 and 2 Archaeological Assessments completed previously. These areas are identified as having no archaeological potential and are of no further concern. The site inspection confirmed that large portions of the WRRC site have been previously disturbed by past construction activities. The study identifies several site features which may have archaeological potential and are subject to further empirical study to confirm previous disturbance and archaeological potential. The Stage 1 Archaeological Assessment Report provides mapping which outlines areas recommended for empirical investigation to confirm archaeological potential (located in Appendix A-4). (Stage 1 Archaeological Assessment Guelph WRRC, 2022)

Under the Ontario Heritage Act (R.S.O. 1990, c 0.18) it is an offense for a party other than a licensed archaeologist to make alterations to a known archaeological site or to remove an artifact or other physical evidence of past human use or activity until a licensed archaeologist has completed field work and reported to the minister that the site no further archeological potential.

5.3 Guelph Water Recovery Resource Centre Flows, Loadings and Performance

This section presents an overview of the current flows, loadings, and performance at the Guelph WRRC. A detailed analysis is presented in Appendix A-1.

Wastewater flows often vary by season, day of the week, and hour of the day, and depend on the water infiltration into collection pipes. The characterization of these variations is important to understanding flow patterns and determine future treatment capacity required.

Understanding how much flow can exceed the average flow is key to good plant operation and important for process capacity analysis. These parameters are called “peak factors” and represent how much the

highest daily flow or the highest hourly flow exceeds the average wastewater flow. Peak factors are important because they are one of the bases of treatment process design.

Wastewater flows entering the Guelph WRRC measured from January 2017 through December 2019 were analyzed for this study. The average daily flow during this period was 56.12 ML/d, which represents 88 percent of the plant's rated capacity (64 ML/d). Average daily flows were similar from 2017 to 2019. The design peak factor for the plant is 2.0, which is consistent with the peak factor determined through flow analysis for this Class EA and will be used to develop future flow requirements. Detailed information on historical flow analysis is presented in Appendix A-1.

5.4 Current Wastewater Quality and Loadings

Concentrations and loading of key parameters in wastewater are used to determine future capacity required to achieve performance objectives. These parameters include total suspended solids (TSS) and nutrients (phosphorous and nitrogen compounds). The biochemical oxygen demand is also an important parameter that indirectly measures biodegradable organics by quantifying the amount of oxygen needed to biodegrade the organics in an aerobic environment.

Influent characterization is understood through the 5-day carbonaceous biochemical oxygen demand ($cBOD_5$), total suspended solids (TSS), total phosphorous (TP), and total Kjeldahl nitrogen (TKN) concentrations in the wastewater. These parameters are measured and reported at the Guelph WRRC at least once per week.

Average influent wastewater characteristics and loads are presented in Table 5-2. The contribution per person (also known as "per capita") for each parameter was calculated using the average daily loading at the plant, which is the concentration times the flow, divided by the 2019 serviced population. The estimated per capita contributions for $cBOD_5$ and TSS are within the typical range (Metcalf & Eddy, 2014), with the estimated per capita contributions for TP and TKN slightly outside of the typical range.

Table 5-2. Historical Guelph WRRC Influent Concentrations and Loads (January 2017 to December 2019)

Influent Parameter	Average Concentration, mg/L	Average Day Load, kg/d [a]	Estimated Per Capita Contribution, g/cap/d [b]	Typical Range Per Capita Contribution, g/cap/d [c]
$cBOD_5$	185	10,462	74	60 to 110
TSS	252	14,041	99	60 to 115
TP	5	264	2	3 to 5
TKN	39	2,134	15	9 to 14
$cBOD_5$	185	10,462	74	60 to 110

Notes:

[a] Daily loads are calculated based on daily flow and screened influent concentration. Extreme outliers (more than two standard deviations from the average) were removed.

[b] Calculated based on the average day load and the 2019 serviced population of 141,963

[c] Adapted from Metcalf & Eddy (2014)

g/cap/day = gram per capita per day

kg/d = kilogram per day

mg/L = milligram per litre

5.5 Current Sludge and Biosolids Generation

Sludges are generated in the primary clarification and secondary biological processes. After further treatment for stabilization, the resulting material is referred to as biosolids. The Guelph WRRC uses anaerobic digestion to stabilize sludges and produce biosolids. After stabilization, biosolids are dewatered and further processed using a proprietary technology (Lystek) and are then applied to land as a fertilizer product.

The reported average biosolids generation at the Guelph WRRC between January 2017 and December 2019 was 16,454 wet tonnes per year with an average solids concentration of 22 percent. This reported value represents the total dewatered biosolids generated and processed using the Lystek process either on-site or at Lystek's facility in Dundalk, Ontario.

5.6 Current Energy Usage & Greenhouse Gas Emissions

This section presents a summary of the current energy usage and greenhouse gas emissions at the Guelph WRRC. A detailed analysis is presented in Appendix A-3.

5.6.1 Electricity and Natural Gas Utilization

The reported electricity consumption at the that the Guelph WRRC from 2017 to 2018 was 14,600 megawatt hours per year, of which approximately 1,752 megawatt hours per year was produced by the plant's cogeneration system. Electricity used, in kilowatt hours per megalitre of wastewater treated (810 kilowatt hours per megalitre) is lower than the national average as published by the (NWWBI, 2013) for Canadian WRRCs (873 kilowatt hours per megalitre).

Natural gas is mainly used to fuel boilers to heat the digesters and buildings throughout the plant during colder months, though a small amount is used to supplement biogas fuel for cogeneration. Approximately 4,700 megawatt hours (16,920 GJ) per year of natural gas was used between 2017 and 2019.

5.6.2 Greenhouse Gas Emissions

Net GHG emissions from the Guelph WRRC were calculated based on electricity and natural gas consumption, considering offsetting from the production of electricity and heat by the cogeneration system production, and the GHG credits generated by land application of biosolids. Based on data from 2017 to 2019, the net GHG emissions were estimated to be 1,524 tonnes of carbon dioxide equivalent per year.

5.7 Current Effluent Quality Requirements

The effluent discharged from the Guelph WRRC must meet quality targets to maintain and protect the quality and characteristics of the Speed River. Meeting these targets is regulated by the Guelph WRRC Environmental Compliance Approval (ECA) document issued by the Ontario Ministry of the Environment, Conservation, and Parks (MECP).

The effluent concentration objectives and criteria, and loading limits, in ECA No. 8835-9QJKSD (MECP, 2014) for $cBOD_5$, TSS, TP, total ammonia nitrogen, total chlorine residual, pH and *E. Coli* are presented in Table 5-3.

Table 5-3. Guelph WRRC Existing Effluent Criteria

Effluent Parameter	Concentration Objective	Average Concentration Limit	Average Waste Loading Limit
BOD_5 – April 1 to October 31	19.8 mg/L	22 mg/L	1,408 kg/d
$cBOD_5$ – November 1 to March 31	6.7 mg/L	7.4 mg/L	473.6 kg/d
TSS	7.0 mg/L	10 mg/L	640 kg/d
TP – April 1 to October 31	0.34 mg/L	0.38 mg/L	24.5 kg/d
TP – November 1 to March 31	0.63 mg/L	0.7 mg/L	44.8 kg/d
Total ammonia nitrogen – November 1 to March 31	3.0 mg/L	3.4 mg/L	217.6 kg/d
Total Residual Chlorine	Non detectable	0.02 mg/L	-
pH	-	6.0 to 9.5	-

Note:

BOD_5 = 5-day Biochemical Oxygen Demand.

5.8 Physical Condition of Guelph Water Resource Recovery Centre Process Assets

Information on the physical condition and remaining useful life of treatment process is used to assess future needs to maintain reliability for the planning horizon. Asset condition information was presented in a Wastewater Facilities Inventory and Condition Assessment (GM BluePlan, 2019), and supplemented by input from plant staff.

Process assets are generally in good condition, with some exceptions due to equipment and structures reaching their end-of-life. Appendix A-1 presents a summary of process assets conditions at the Guelph WRRC. Asset reliability will be preserved with routine maintenance and capital investment to keep state-of-good-repair.

6. Future Conditions

6.1 Population and Flow Projections

Population projections were provided by the City's Planning Services division and align with those identified in the Growth Plan. The Growth Plan reflects the most recent provincial Places to Grow growth targets, which project population growth to the Class EA's planning horizon of 2051. (Ministry of Municipal Affairs and Housing, 2020)

The main driver for the population projections used in this Class EA is the Provincial Places to Grow growth targets (Ministry of Municipal Affairs and Housing, 2020). Population projections for the City of Guelph are presented in Table 6-1. While the growth rate is not constant, these projections represent an average growth rate of 1.43 percent per year from 2019 to 2051.

Table 6-1. City of Guelph Population Projections

Year	Projected Population
2019	141,963
2021	147,802
2026	162,401
2031	177,000
2036	184,000
2041	191,000
2051	208,000

These population projections do not account for the seasonal student population at the University of Guelph and the projected population in the Town of Rockwood, which are both in the service area. However, the flows from these communities are captured in the per capita flow assessment, as discussed in the following paragraphs.

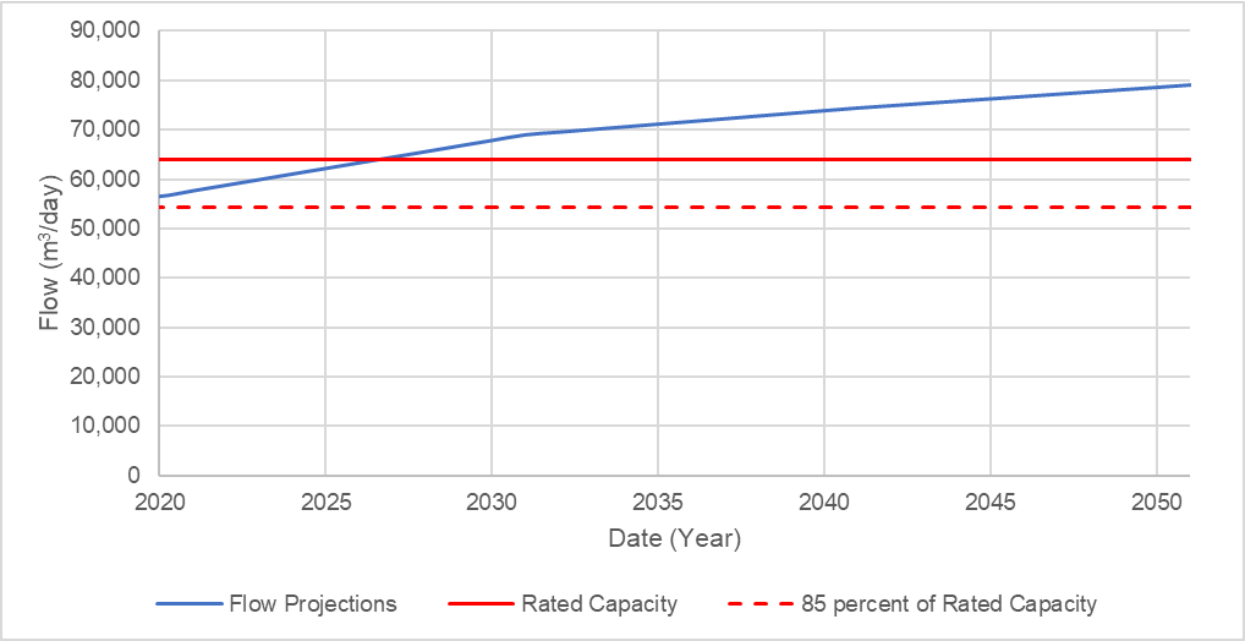
Population statistics from the City and historical average daily flows to the Guelph WRRC from 2010 to 2019 were analyzed to determine an average per capita flow rate of 390 litres per person per day. This value was used with population projections to forecast future flows.

The 390 litres per person per day flow is at the higher end of the typical range of 225 to 450 litres per person per day (MOE, 2008), because it includes the flows generated by the University of Guelph student population and the population in Rockwood (not included in the population numbers). It is important to note that future flows calculated using this per person flow rate and population projections in Table 6-1 represent flow projections based on the populations at University of Guelph and Rockwood growing at the same rate as the City.

Rockwood currently has a flow cap of 1.7 ML/d through a memorandum of understanding with the City and recorded an average daily flow of 1.2 ML/d from 2017 to 2019. For Rockwood to reach its flow cap, flows would have to increase by 1.39 percent per year on average until 2051. This is less than the projected City growth rate of 1.43 percent per year from 2019 to 2051. Therefore, the calculated per capita flow rate is conservative. Population information for the University of Guelph is not available.

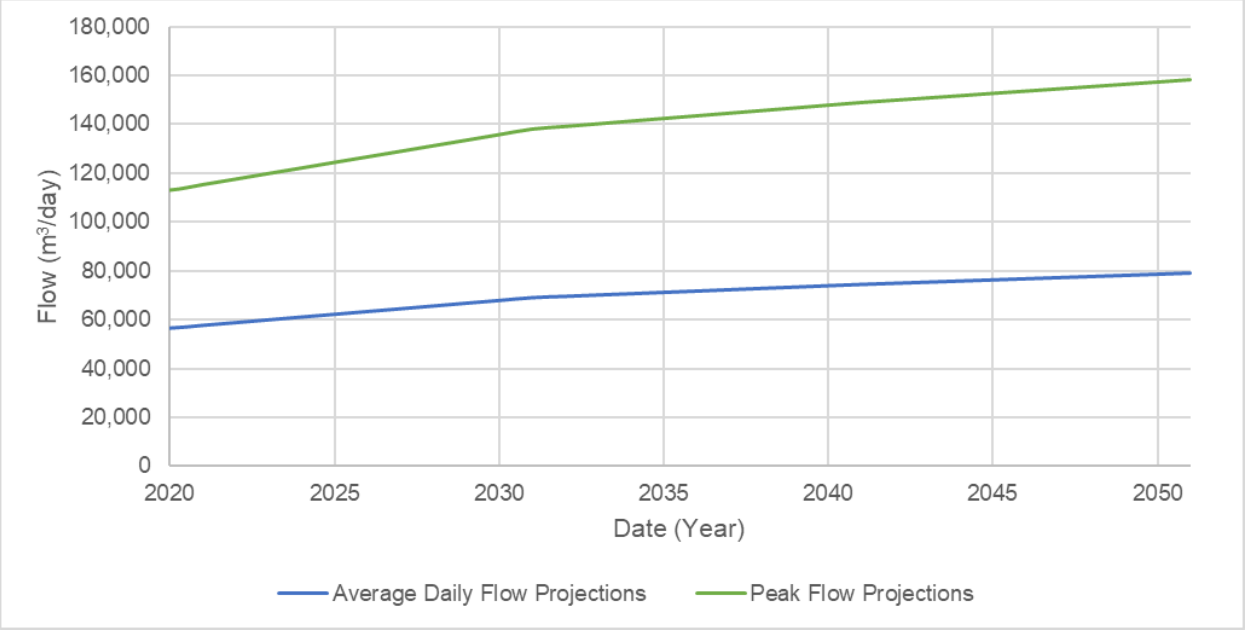
Wastewater flow projections to 2051 are presented in Figure 6-1, based on the population projections presented in Table 6-1 and the per person flow rate of 390 litres per person per day. Based on these projections, the WRRC will reach its current rated capacity in 2027, with a projected flow of 79.2 ML/d by 2051. The Guelph WRRC is currently operating above 85 percent of its ECA rated capacity. This utilization is a trigger to begin investigating a plant capacity expansion through a Schedule C Class EA study.

Figure 6-1. Guelph WRRC Flow Projections to 2051



Peak flows were projected using a peak factor of 2.0 (Figure 6-2), as identified in Section 5.3. This peak factor represents a 99.8 percentile flow event at the Guelph WRRC based on the analysis of flows from 2016 to 2018. A peak flow of 158.3 ML/d is projected in 2051.

Figure 6-2. Guelph WRRC Peak Flow Projections to 2051



6.2 Projected Sludge and Biosolids Generation

A summary of predicted sludge and biosolids generation rates is presented in Table 6-2. The projected average day dewatered biosolids cake generation is 13 dry tonnes per day in 2051. Detailed information for these projections is presented in Appendix A-1.

Table 6-2. Projected Guelph WRRC Sludge Generation

Parameter	2051 Projected Flow (79.2 ML/d) – Average Day Loading	2051 Projected Flow (79.2 ML/d) – Maximum Month Loading
Primary Sludge, kg/d	17,630	22,030
Secondary Sludge, kg/d	6,110	8,690
Thickened waste activated sludge, kg/d	5,200	7,380
Combined Sludge to Digestion, kg/d	22,820	29,410
Digested Biosolids, kg/d	14,150	18,200
Dewatered Cake, dry kg/d	13,020	16,750

6.3 Effluent Objectives and Criteria

The assimilative capacity study (introduced in Section 5.3) was completed to assess the existing conditions in the Speed River and to recommend future effluent criteria and objectives that will maintain or improve the health of the Speed River while Guelph WRRC flows increase within the planning period (i.e., to 79.2 ML/d) (Hutchinson Environmental Sciences Ltd., 2022).

The study recommends more stringent effluent criteria for the Guelph WRRC under future flow conditions. The effluent criteria recommended in the assimilative capacity study are presented in Table 6-3. The proposed reductions in effluent limits will result in a net improvement in Speed River water quality, even at higher future flows, compared to the current approved ECA limits (Hutchinson Environmental Sciences Ltd., 2022).

Table 6-3. Recommended Effluent Criteria for the Guelph WRRC at Average Daily Flow of 69 to 83 ML/d (Hutchinson Environmental Sciences Ltd. 2022)

Parameter	Period	Objective	Compliance Limit
TP	January 1 to December 31	0.2	0.3
TSS	January 1 to December 31	3	5
$cBOD_5$	January 1 to December 31	3	5
total ammonia nitrogen	June 1 to September 30	0.75	1
	October 1 to May 30	2	3

These effluent targets were an important consideration during the alternative identification and evaluation tasks identified in Sections 8 and 9. The findings of the assimilative capacity informed the study recommendations presented in Section 11 and the mitigation measures presented in Section 12.4.

6.4 Process Capacity

This section presents a summary of the Guelph WRRC process capacity assessment. Details of the capacity assessments are presented in Appendix A-1.

The Guelph WRRC has an existing rated capacity of 64 ML/d. Based on population projections provided by the City of Guelph, it is estimated that the average daily flow to the WRRC in 2051 will be 79.2 ML/d.

Firm capacity refers to a process' capacity with its largest unit out of service. For example, there are currently two grit tanks at the Guelph WRRC to provide grit removal. Firm grit removal capacity refers to the capacity of one grit tank, with the other grit tank out of service.

Treatment processes are typically designed to provide firm capacity, as this allows for the plant to provide the required treatment capacity while taking a component of a process out of service for maintenance or rehabilitation.

The following processes are projected to have adequate capacity within the planning period:

- Influent Pumping
- Primary Treatment, provided that the secondary treatment capacity of the existing plants can be increased.
- Sidestream Treatment
- Dewatering (rehabilitation/replacement will be required within the planning period due to facility condition).

The following processes are projected to have inadequate capacity within the planning period:

- Screening
- Grit Removal
- Secondary Treatment
- Tertiary Filtration
- Disinfection
- Waste Activated Sludge Thickening
- Anaerobic Digestion
- Biogas Utilization (Cogeneration)

6.5 Summary of Challenges and Opportunities

The following processes are projected to provide sufficient capacity and have remaining life (with regular maintenance and renewal investments) within the planning period:

- Influent Pumping
- Primary Treatment, provided that the secondary treatment capacity of the existing plants can be increased.
- Sidestream Treatment

The following processes are projected to require capacity upgrades or rehabilitation/replacement due to condition within the planning period:

- Screening
- Grit Removal
- Secondary Treatment
- Tertiary Filtration
- Disinfection
- Waste Activated Sludge Thickening
- Anaerobic Digestion
- Dewatering
- Biogas Utilization (Cogeneration)

Identified opportunities for this Class EA include:

- Explore wastewater treatment and solids handling alternative technologies that provide the required capacity and increase operational reliability and efficiency.
- Protect water quality in the Speed River by increasing plant resiliency and reliability to avoid overflows and by-passes.
- Minimize GHG emissions as an important part of alternative evaluation.
- Increase the energy efficiency and resource recovery at the Guelph WRRC.

7. Problem and Opportunity Statement

The goal of the Wastewater Treatment and Biosolids Management Master Plan Class EA is to plan for the future of the wastewater and biosolids management to provide capacity for growth, in a manner that is sustainable and protects surface water and the environment.

This Class EA provides a long-term plan that guides how the City will continue to meet the demands of its growing community over the next 30 years. The decisions are driven by goals for:

- Infrastructure reliability
- Legislation
- Sustainability
- Climate change mitigation
- City's goal to use 100 percent renewable energy sources by 2050
- Minimizing impacts to the Speed River
- Meeting priorities set out through the City's Strategic Plan

The City of Guelph is committed to managing the population growth and provide the necessary wastewater treatment capacity to accommodate the City's growth in a proactive and environmentally conscientious manner. The City's philosophy is to manage wastewater and biosolids as valuable resources. This Class EA has confirmed that the Guelph WRRC will require expansion and has identified several process components nearing the anticipated end of useful life within the planning period. This presents challenges and opportunities for the City as follows:

- Additional treatment capacity is needed in the near term
- The assimilative capacity study has identified more stringent effluent requirements which presents the opportunity for performance improvements
- Process equipment nearing the expected end of service life requires capital expenditure for renewal to allow the plant to continue providing reliable wastewater treatment and biosolids management

When addressing these challenges, there are also opportunities to reduce energy usage and increase resource recovery when processes are replaced or upgraded, which is in line with the City's sustainability policy.

8. Wastewater Treatment Process Alternatives Development and Evaluation

This section presents the alternatives development and evaluation for wastewater treatment based on the deficiencies, issues, and opportunities for each unit process. Further details of the evaluation and concept development for each sub-section are presented in Appendix A-2.

8.1 Screening

The process capacity assessment (presented in Section 6.4) identified that the existing screening system does not have sufficient firm capacity (i.e., with one screen out of service) to treat the projected flows in 2051. It is forecasted that the firm capacity of the screens will be exceeded in 2039. As the existing screening system must remain in service during construction, an expansion of the existing headworks facility to provide additional screening capacity is identified as the only feasible solution.

The screening technology selection will depend on the preferred solution for downstream treatment processes, as different technologies have different screening requirements. Rather than select technologies at this stage, alternative technologies will be considered further at the design stage for compatibility with the preferred downstream treatment processes.

For this Class EA study, the recommended concept is based on a headworks facility expansion, with an estimated capital cost of $14,100,000.

8.2 Grit Removal

The process capacity assessment (presented in Section 6.4) identified that the existing grit removal system does not have sufficient firm capacity (i.e., with one grit tank out of service) to treat current flows. Many mechanical components of the existing grit tanks are nearing the end of their expected service life, with replacement required. As the existing grit removal system must remain in service during construction, construction of a new grit removal process is recommended.

The Headworks Building was expanded in the early 2000s, during the construction of Plant 4. At that time, provisions were included to construct two more aerated grit tanks north of the existing tanks. Therefore, rather than evaluate alternative technologies, an expansion with aerated grit tanks (base case) is recommended.

The aerated grit tank expansion design concept is based on constructing two more grit tanks. This would provide sufficient grit removal capacity to the year 2051 and would also provide capacity to enable both the existing grit tanks to be taken out of service for major rehabilitation. The capital cost for two new grit tanks and rehabilitation of the existing grit tanks is estimated to be $5,900,000.

8.3 Primary and Secondary Treatment

8.3.1 Overview

The process capacity assessment (summarized in Section 6.4) identified that the Guelph WRRC has adequate primary treatment capacity for the projected flows in 2051. The primary clarifiers for Plants 1 to 4 have more capacity than their associated downstream secondary treatment trains. However, there is no ability to transfer flows between plants following primary treatment. This means that the capacity of each plant is limited by its secondary treatment capacity.

It was also identified that there is not enough secondary capacity for ammonia removal (via nitrification) to treat the projected flows in 2051 with the existing configuration. Capacity is projected to be exceeded

by 2027. As Plants 1, 2 and 3 were not designed to provide full nitrification, the nitrification capacity of these plants is limited to 44 ML/d by the capacity of the downstream RBCs. Plant 4 was designed to provide full nitrification with a capacity of 22 ML/d.

Alternatives for primary treatment, secondary treatment trains (Plants 1 to 4), and tertiary nitrification were evaluated together in consideration of process interdependencies. The following sub-sections present the alternatives development and evaluation for primary treatment and secondary treatment.

8.3.2 Short-listed Alternatives for Primary and Secondary Treatment

Long-lists of primary and secondary treatment alternatives were developed to address deficiencies to identify a short-list of potential technologies that may be implemented at the Guelph WRRC to provide capacity and/or improve performance reliability, sustainability, and resiliency. Technologies were reviewed with respect to their key features, potential benefits, and challenges and the feasibility of implementation at the Guelph WRRC.

The long lists of alternatives for primary treatment and secondary treatment (presented in Appendix A-2) were subject to preliminary screening based on the must-meet criteria presented in Section 4. The alternatives that passed the preliminary screening were moved forward for detailed evaluation.

Alternatives that passed the initial screening process were further investigated for their potential to retrofit into the existing primary and secondary treatment processes to enhance capacity or performance, as well as for use in a new treatment train (i.e., Plant 5) to increase capacity. The preliminary screening results are presented in Table 8-1. The future base case for secondary treatment was adjusted from CAS to “CAS with biological nitrification and denitrification” because the current best practice is to build a new treatment train with the capability to denitrify (i.e., with an anoxic zone in the aeration tanks).

Table 8-1. Preliminary Screening Results for Primary Treatment and Secondary Treatment Alternatives

Unit Process	Shortlisted for Detailed Evaluation – Retrofit Existing Process to Enhance Capacity or Performance	Shortlisted for Detailed Evaluation – Construct a New Treatment Train to Provide Additional Capacity
Primary Treatment	▪ CEPT	▪ Conventional Primary Treatment (Base Case) ▪ CEPT ▪ Ballasted Flocculation ▪ A-Stage Primary Treatment
Secondary Treatment	▪ Biological Nitrification and Denitrification ▪ Enhanced Biological Phosphorous Removal ▪ Integrated Fixed Film Activated Sludge ▪ Membrane Bioreactor ▪ Granulation by Physical Selection ▪ In-situ Bioaugmentation ▪ Membrane Aerated Biofilm Reactor	▪ Biological Nitrification and Denitrification (Future Base Case) ▪ Enhanced Biological Phosphorous Removal ▪ Integrated Fixed Film Activated Sludge ▪ Moving Bed Biofilm Reactor ▪ Biological Aerated Filter ▪ Membrane Bioreactor ▪ Granulation by Physical Selection ▪ In-situ Bioaugmentation ▪ Membrane Aerated Biofilm Reactor

8.3.3 Development and Screening of Integrated Alternative Solutions for Primary Treatment and Secondary Treatment

Integrated alternative solutions that considered Plants 1, 2, 3 and 4 were developed based on the following concepts:

- Providing additional capacity by constructing a new primary and secondary treatment train (Plant 5) or retrofitting the existing plants to achieve process capacity intensification
- Refurbishing or expanding the RBCs to provide additional nitrification capacity for Plants 1-3 versus removal of the RBCs and operating Plants 1-3 for full nitrification (with reduced capacity). Under current operating conditions, the capacity of Plants 1-4 is 66 ML/d.

The following integrated alternative solutions for wastewater treatment were developed for further evaluation:

- **Base Case Alternative Solution:** Construct a new Plant 5 and maintain the RBCs
- **Integrated Alternative Solution 1:** Construct a new Plant 5 and remove the RBCs
- **Integrated Alternative Solution 2:** Retrofit the existing plants and expand the RBCs
- **Integrated Alternative Solution 3:** Retrofit the existing plants and remove the RBCs

The four integrated alternatives were evaluated following the process described in Section 4 to identify the alternative solution that provides the greatest benefit.

The results indicated that Integrated Alternative Solutions 1 and 3 provide more benefit than provided by the Base Case Alternative Solution and Integrated Alternative Solution 2 (both of which include maintaining the RBCs). The Base Case Solution and Integrated Alternative Solution 2 scored lower due to the O&M complexities related to maintaining or expanding the RBCs. In general, this screening identified that removing the RBCs and operating all existing plants as nitrifying CAS is preferred to maintaining or expanding the RBCs.

Therefore, Alternative Solutions 1 and 3 were carried forward for detailed evaluation.

8.3.4 Detailed Evaluation for Primary Treatment and Secondary Treatment

8.3.4.1 Technology Evaluation – Integrated Alternative Solution 1

Integrated Alternative Solution 1 is to construct a new Plant 5, remove the RBCs and to operate the existing plants as nitrifying CAS. Table 8-2 shows the capacities for operating Plants 1-3 for partial and full nitrification; operating Plants 1-3 for full nitrification reduces their capacity. As a result, the secondary treatment capacity deficiency would be 14.8 ML/d based on the projected flow of 79.2 ML/d in 2051.

Table 8-2. Guelph WRRC Secondary Treatment Capacity with Partial and Full Nitrification

Plant	Secondary Treatment Capacity – Partial Nitrification, ML/d	Secondary Treatment Capacity – Full Nitrification, ML/d
Plant 1	23.5	18.5
Plant 2	13	10.9
Plant 3	17	13
Plant 4	22 [a]	22
Total	**88.5**	**64.4**

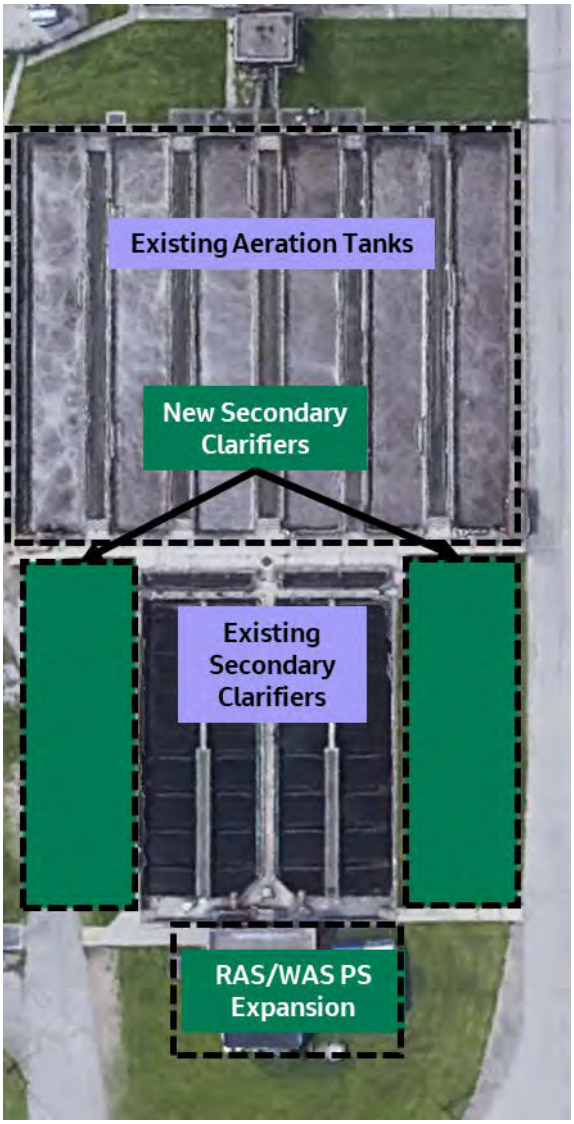
Notes:

[a] Plant 4 is currently operated for full nitrification

Expanding Plant 2 secondary clarifiers was investigated before completing the technology evaluation because the capacity of this plant is limited by secondary clarifiers and there is available space on either side of the existing clarifiers for two more secondary clarifiers next those existing. Constructing two new secondary clarifiers (the same size as the existing clarifiers) could increase Plant 2 treatment capacity from 10.9 ML/d to 19.0 ML/d. This would increase Guelph WRRC secondary treatment capacity from 64.4 ML/d to 72.5 ML/d with full nitrification in Plants 1 to 4, reducing the capacity deficit from 14.8 ML/d to 6.7 ML/d in 2051. This approach would also defers the need for further secondary treatment expansion to 2038.

Figure 8-1 presents a preliminary layout for the Plant 2 secondary clarifier expansion. A new Plant 2 return activated sludge/waste activated sludge pumping station is required for these upgrades.

Figure 8-1. Preliminary Layout of Plant 2 Secondary Clarifier Expansion



As a result of this evaluation, a Plant 2 secondary clarifier expansion was included as a common item for the technology evaluation and concept development for Integrated Alternative Solution 1. Concepts for the new Plant 5 were developed to address the 6.7 ML/d deficit. There is an opportunity with a new Plant 5 to provide operational flexibility by providing redundant capacity. Therefore, concepts for a new Plant 5 were developed with a capacity of 17.7 ML/d, which provides a total secondary treatment capacity

of 79.2 ML/d with the largest treatment train out of service (i.e., half of Plant 4). This would provide the required treatment capacity while the City takes a treatment train out of service for maintenance.

For this alternative, a new Plant 5 is not required until 2038. Several technologies were reviewed, but for the purpose of this Class EA, CAS was carried forward, as it represents a conservative footprint and cost. A technology evaluation is recommended closer to the time that design is expected to start, which will consider the state of technologies at that time, taking into account any advances in secondary treatment technologies. For the purposes of this Class EA and based on a preliminary evaluation completed in Appendix A-2, CAS with biological nitrification and denitrification is carried forward for the new Plant 5 in Integrated Alternative Solution 1.

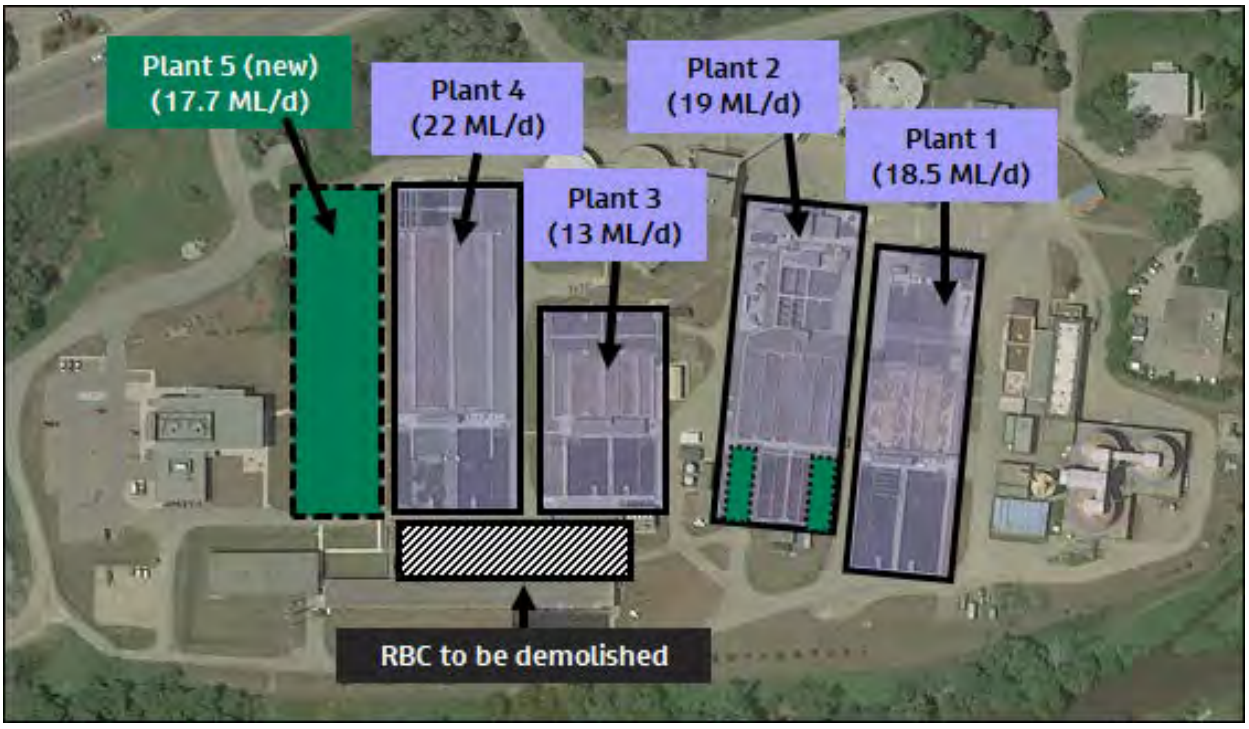
The design concept for Integrated Alternative Solution 1 and associated capital costs are summarized in Table 8-3.

Table 8-3. Design Concept for Integrated Alternative Solution 1

Component	Capital Cost Estimate
Two new secondary clarifiers in Plant 2 Remove the RBCs and operate all plants as nitrifying CAS	$12,200,000
New Plant 5 (based on with conventional primary treatment and CAS with biological nitrification and denitrification)	$34,700,000
Total	**$46,900,000**

Figure 8-2 presents the concept for Integrated Alternative Solution 1.

Figure 8-2. Preliminary Layout of Integrated Alternative Solution 1



8.3.4.2 Technology Evaluation – Integrated Alternative Solution 3

Integrated Alternative Solution 3 is to retrofit one or more of the existing plants to achieve process capacity intensification, remove the RBCs and to operate the existing plants as nitrifying CAS. Like Integrated Alternative Solution 1, a Plant 2 secondary clarifier expansion is included as a common item in

concept development. This would increase the secondary treatment capacity to 72.5 ML/d, delaying the need for process intensification until 2038. Therefore, the secondary treatment capacity of the existing plants must be increased by 6.7 ML/d.

Like Integrated Alternative 1, process intensification is not required until 2038. Several technologies were reviewed, but for the purpose of this Class EA, process intensification via waste activated sludge hydrocyclones and a membrane aerated biofilm reactor (MABR) retrofit in Plant 1 were carried forward, as these are promising technologies that have demonstrated the ability to increase secondary treatment capacity within existing plants. However, due to the emerging nature of these technologies, it is recommend that pilot testing be completed to confirm each process' ability to achieve process intensification.

The preferred design concept for Integrated Alternative Solution 3 and associated capital costs are summarized in Table 8-4.

Table 8-4. Summary of Preferred Design Concept for Integrated Alternative Solution 3

Component	Capital Cost Estimate
Two new secondary clarifiers in Plant 2 Remove the RBCs and operate all plants as nitrifying CAS	$12,200,000
Install waste activated sludge hydrocyclones in all plants and retrofit Plant 1 with MABR	$13,400,000
Total	$25,600,000

8.3.4.3 Detailed Evaluation for Integrated Alternative Solutions

Overall, the two integrated liquid treatment alternative solutions received similar non-economic scores and neither alternative was eliminated from consideration at that stage. Then, the total scores for each alternative were compared. The total score for Integrated Alternative Solution 3 (retrofit the existing plants and remove the RBCs) was higher due to the lower associated costs. However, pilot testing for waste activated sludge hydrocyclones and MABR is recommended to demonstrate their effectiveness in increasing treatment capacity.

Regardless of the preferred alternative solution, upgrading Plant 2 to install two new secondary clarifiers is the common recommendation. This can increase the plant total nitrification capacity to 72.5 ML/d, deferring the need for additional secondary treatment capacity to 2038.

This evaluation demonstrates that cost is the main differentiator between constructing a new Plant 5 (Integrated Alternative Solution 1) and retrofitting the existing plants (Integrated Alternative Solution 3). The costs for different technologies are expected to change overtime and therefore, it is recommended that the future Plant 5 treatment technologies be selected in a future Master Plan update. It is a best practice to update master plans on a 5 to 8 year cycle. A Master Plan update is expected to be completed before the second stage of upgrades is needed. To be conservative, the budgetary estimate for a new Plant 5 will be carried forward in this Class EA for capital expenditure planning purposes. There is the potential to defer a new Plant 5 if process intensification can be achieved through waste activated sludge hydrocyclones and MABR.

A phased implementation strategy is recommended, as follows:

- Construct two new secondary clarifiers in Plant 2 by 2027. The RBCs can be demolished following Plant 2 upgrades.
- Complete pilot testing for waste activated sludge hydrocyclones and MABR on one train of Plant 1 to demonstrate effectiveness by 2035.
- If the pilot testing is successful, implement full-scale waste activated sludge hydrocyclones for existing plants and/or Plant 1 MABR retrofit by 2038.

- If the pilot testing demonstrates that retrofitting existing plants cannot reliably provide the additional capacity, construct a new Plant 5 by 2038. The technology selection for new Plant 5 should be re-evaluated based on the latest development at that time.

It is noted that both upgrades have the potential to reduce effluent nitrate concentrations at the plant. This strategy and its associated timing should be revisited as part of the next Master Plan update.

8.4 Tertiary Filtration

The process capacity assessment (summarized in Section 6.4) identified that the tertiary filters do not have sufficient firm capacity under current flows (i.e., with the largest filter out of service). Therefore, an expansion is required in the near term. The filters in the East-West building are at the end of their useful life and require replacement. Retrofitting alternative technologies into existing filter buildings to increase capacity is not feasible because the existing filters must remain in service during construction.

A filter expansion to provide additional capacity is feasible, followed by refurbishing the East-West filter building. Alternative solutions were developed based on different technologies that could be implemented within a new tertiary filter building.

The following sub-sections present the alternatives development and evaluation for tertiary filtration.

8.4.1 Long-List of Alternatives and Screening for Tertiary Filtration

The following technologies were considered for a tertiary filtration expansion:

- Sand Filtration (Base Case)
- Disk Filtration
- Membrane Filtration

8.4.2 Alternative Screening for Tertiary Filtration

Each of the alternatives in the long-list was subject to preliminary screening based on the must-meet criteria presented in Section 4 to eliminate those not feasible for at Guelph WRRC. Each alternative met the required criteria and was moved forward for detailed evaluation.

8.4.3 Detailed Evaluation for Tertiary Filtration

The three shortlisted tertiary filtration alternatives (in addition to the do-nothing baseline alternative) were subject to the first stage of detailed evaluation, where each received a non-economic “benefit score” based the social/cultural environment, natural environment, and technical feasibility criteria described in Section 4.

This evaluation resulted in sand filtration and disk filtration moving forward to the detailed evaluation, which included development of detailed concepts and costs so that than economic score could be assigned. The do-nothing alternative was eliminated because it does not provide the capacity required within the planning period. Membrane filtration was eliminated because it does not provide benefits over the other alternatives, and the capital cost for membrane filtration is the highest of the alternatives.

The design concept developed for sand filtration and disk filtration and associated capital costs are summarized in Table 8-5.

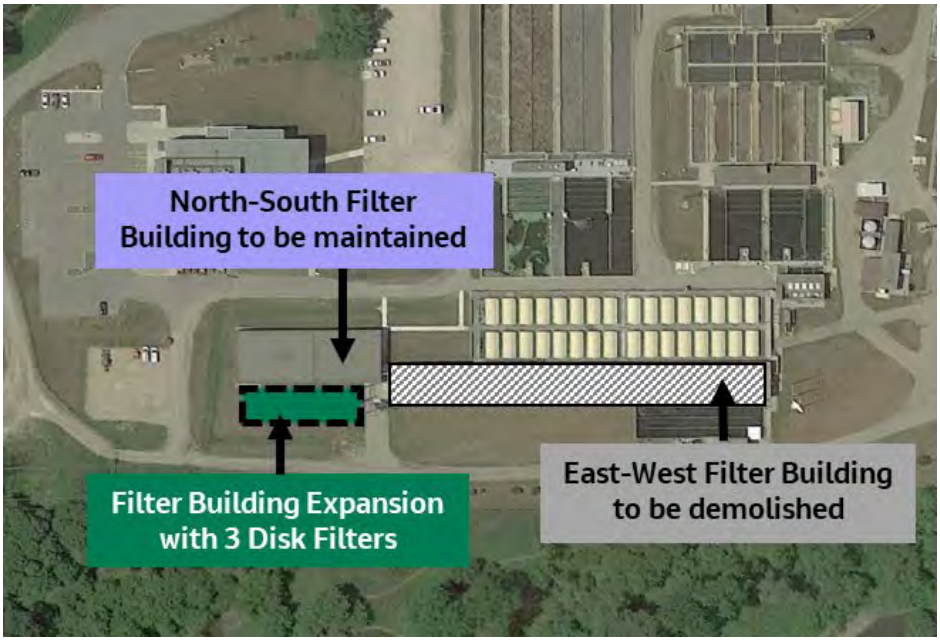
Table 8-5. Alternative Design Concepts for Tertiary Filtration

Alternative	Description	Capital Cost
Sand Filter Expansion	Construct a new filter building with two sand filters Maintain the North-South filter building Refurbish the East-West filter building	$53,800,000
Disk Filter Expansion	Construct a new filter building with two disk filters and provisions for a third Maintain the North-South filter building Demolish the East-West filter building	$33,300,000

An expansion with disk filters was selected as the preferred solution based on the detailed evaluation. Overall, both alternatives scored very similarly for non-economic criteria. When cost is included, disk filtration had a higher overall score because its cost is significantly lower than the cost for a sand filtration expansion.

Figure 8-3 presents a preliminary concept for the preferred solution for tertiary filtration.

Figure 8-3. Preliminary Concept for Disk Filter Expansion



8.5 Disinfection

The process capacity assessment (summarized in Section 6.4) identified that the existing chlorine contact tank (CCT) does not provide sufficient disinfection capacity. Dosing chlorine at the inlet of the tertiary filters is currently used to provide additional contact time. The CCT is also nearing the end of its useful service life. The existing CCT needs to remain in operation during construction, therefore, the feasible approach is to construct a new disinfection facility to replace the existing facility. Alternative solutions were developed based on different technologies that could be implemented within a new disinfection facility.

8.5.1 Long-List of Alternatives for Disinfection

The following alternatives were considered for a new disinfection facility:

- Chlorination/Dechlorination (Base Case)
- UV Disinfection
- Peracetic Acid
- Hybrid Disinfection (combination of UV disinfection and peracetic acid)

8.5.2 Alternative Screening for Disinfection

To eliminate alternatives that cannot feasibly be implemented at the Guelph WRRC, each of the alternatives in the long-list was subject to preliminary screening based on the must-meet criteria presented in Section 4. The following alternatives met the must meet criteria and were moved forward for detailed evaluation:

- Chlorination/Dechlorination (Base Case)
- UV Disinfection

8.5.3 Detailed Evaluation for Disinfection

The two shortlisted disinfection alternatives (in addition to the do-nothing baseline alternative) were subjected to the first stage of detailed evaluation. Each received a non-economic "benefit score" using the social/cultural environment, natural environment, and technical feasibility criteria described in Section 4.

Based on the non-economic evaluation, chlorination/dichlorination and UV disinfection were moved forward to Stage 2 of the detailed evaluation process, which entails concept development and costing to develop an economic score. The do-nothing alternative was eliminated because it does not provide the capacity required within the planning period.

The design concepts developed for chlorination/dechlorination and UV disinfection and their associated capital costs are summarized in Table 8-6.

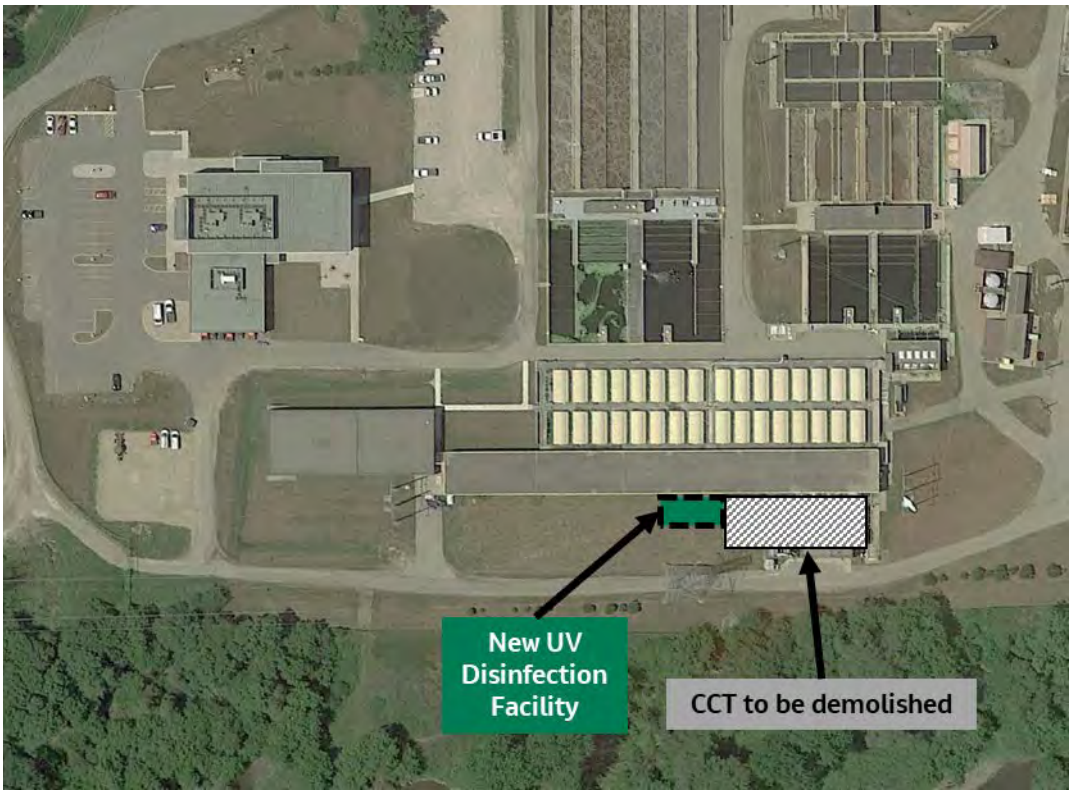
Table 8-6. Alternative Design Concepts for Disinfection

Alternative	Description	Capital Cost
Chlorination/Dechlorination	Construct two new CCTs Demolish the existing CCT	$9,400,000
UV Disinfection	Construct a new UV facility with two channels Demolish the existing CCT	$13,700,000

A new UV facility was selected as the preferred solution, with key factors being the greater protection to the Speed River it offers due to elimination of chemical use for disinfection (in particular, potentially reducing chloride concentrations), and elimination of the potential for disinfection byproduct formation. Disinfection byproducts are not currently regulated in treated effluent discharges but are a contaminant of concern. While the CCT expansion offers a slightly higher benefit to cost ratio, the O&M cost for chlorination/dechlorination is dependent on the chemical dosages. Considering the historical range of chemical dosages applied at the Guelph WRRC, the overall cost effectiveness (represented by the benefit to cost ratio) for the two disinfection alternatives is considered comparable. Therefore, UV disinfection was selected as the preferred alternative. While UV disinfection typically has a higher energy consumption than chlorination/dechlorination, UV equipment energy efficiency has increased significantly in recent years. Implementing UV disinfection also eliminates the need for chemical production and transportation to the Guelph WRRC, both of which have indirect GHG emissions, making UV disinfection the more sustainable alternative.

Figure 8-4 presents a preliminary concept for the preferred solution for disinfection.

Figure 8-4. Preliminary Concept for a new UV Facility



8.6 Summary of Preferred Solution for Wastewater Treatment

The preferred solution for wastewater treatment is summarized as follows for each unit process:

- Screening: screening process and headworks building expansion.
- Grit Removal: grit removal process expansion and rehabilitation, address hydraulic bottlenecks.
- Primary Treatment, Secondary Treatment and Tertiary Nitrification: construct 2 new secondary clarifiers in Plant 2, remove the RBCs and operate all plants as nitrifying CAS, construct a new Plant 5.
- Tertiary Filtration: construct a new disk filter facility, decommission the East-West Filter Building.
- Disinfection: construct a new UV disinfection facility, decommission the CCT.

Table 8-7 presents a summary of costs, drivers, and timing for the preferred solution for wastewater treatment at the Guelph WRRC.

Table 8-7. Preferred Solution for Wastewater Treatment

Unit Process	Preferred Solution	Year Required	Drivers	Capital Cost, $ million in 2021
Screening	Screening process and headworks building expansion	By 2038	Capacity	$14.1
Grit Removal	Grit removal process expansion and rehabilitation Hydraulic improvements	By 2027	Capacity Condition	$6.0
Primary Treatment, Secondary Treatment and Tertiary Nitrification	Construct 2 new secondary clarifiers in Plant 2 Removal of RBCs and operate all plants as nitrifying CAS	By 2027	Capacity	$12.2
Primary Treatment, Secondary Treatment and Tertiary Nitrification	Construct a new Plant 5	By 2038	Capacity	$34.7
Tertiary Filtration	Construct a new disk filter facility Demolish the East-West filter building	By 2027	Capacity Condition	$33.3
Disinfection	Construct a new UV disinfection facility Demolish the CCT	By 2027	Capacity Condition	$14.4

9. Biosolids Processing and Management Alternatives Development and Evaluation

This section presents the alternatives development and evaluation for biosolids management based on the deficiencies, issues and opportunities for each unit process presented in Section 6. Further details of the evaluation and concept development for each sub-section are presented in Appendix A-2.

9.1 Waste Activated Sludge Thickening

The waste activated sludge thickening process at the Guelph WRRC does not have redundancy. Therefore, the feasible solution is to upgrade the waste activated sludge thickening system to provide redundancy. There is insufficient space available in the existing facility to install another rotating drum thickener, so a new facility is required. This will be considered in the concept development and cost estimates presented in the following sub-sections.

9.2 Sludge Stabilization

This section presents an overview of the alternatives development and evaluation for sludge stabilization. Details are presented in Appendix A-2.

The process capacity assessment (summarized in Section 6.4) identified that there will not be enough total anaerobic digestion capacity by 2045 (at a plant flow of greater than 76.1 ML/d). With one digester out of service, there is currently not enough firm capacity (flow greater than 57.1 ML/d). These findings are based on the current operational practices for sludge treatment, which includes maintaining upstream waste activated sludge thickening.

A long-list of technologies was developed and screened against the 'must-meet' criteria presented in Section 4 to develop a short list of alternatives feasible for implementation at the Guelph WRRC. All are based on maintaining anaerobic digestion as the primary stabilization method but include enhancements to provide capacity (without digester expansion) and/or optimize the digestion process.

9.2.1 Short-listed Alternatives for Sludge Stabilization

The following alternatives, all based on maintaining anaerobic digestion for stabilization, met the must-meet criteria and were moved forward for integrated alternative solution development and detailed evaluation:

- Waste Activated Sludge Thickening (Base Case) with Anaerobic Digester Expansion
- Waste Activated Sludge and Primary Sludge Thickening (digester expansion not required)
- Thermal Hydrolysis Pretreatment (THP) (digester expansion not required)
- Recuperative Sludge Thickening (digester expansion not required)

Therefore, four sludge treatment and stabilization schemes were developed and are summarized in Table 9-1. These integrated alternatives were evaluated against the do-nothing baseline alternative.

Table 9-1. Integrated Alternatives for Stabilization

Alternative Solution	Sludge Treatment	Sludge Stabilization
Base Case Solution	Waste activated sludge thickening	Digester expansion
Alternative Solution 1 – Primary Sludge Thickening	Waste activated sludge thickening Primary sludge thickening	Maintain existing digesters
Alternative Solution 2 – Recuperative Sludge Thickening	Waste activated sludge thickening Recuperative sludge thickening	Maintain existing digesters Modify existing digesters to provide high-intensity mixing
Alternative Solution 3 – Thermal Hydrolysis Pretreatment	Pre-dewatering of waste activated sludge and primary sludge THP	Maintain existing digesters

The integrated alternatives were compared based on their projected biogas production, biosolids generation and required digester volume, as presented in Table 9-2.

Table 9-2. Impacts of Integrated Alternative Solutions for Stabilization

Parameter	Base Case Alternative Digester Expansion	Alternative Solution 1 Primary Sludge Thickening	Alternative Solution 2 Recuperative Sludge Thickening	Alternative Solution 3 THP
Number of Primary Digesters Required	6	4	4	3
Digester Expansion Required	Yes	No	No	No
Projected Biogas Generation (Maximum Month), in cubic metres per day	11,650	11,980	11,910	14,480
Projected Biosolids Generation (Maximum Month), dry tonnes per day	15	15	15	12

9.2.2 Detailed Evaluation for Sludge Stabilization

The four integrated alternative solutions for stabilization (in addition to the do-nothing baseline alternative) were subjected to the first stage of detailed evaluation, where each received a non-economic "benefit score" based the social/cultural environment, natural environment, and technical feasibility evaluation criteria described in Section 4.

Based on the non-economic evaluation, the following integrated alternatives were moved forward for Stage 2 of the detailed evaluation process for detailed concept development and costing:

- Base Case Solution – Digester Expansion
- Alternative Solution 1 – Primary Sludge Thickening
- Alternative Solution 3- THP

The do-nothing alternative was eliminated because it does not provide sufficient capacity within the planning period. Alternative Solution 2 – Recuperative Sludge Thickening was eliminated because it is a similar concept to Alternative Solution 3 – Primary Sludge Thickening but provides less benefit.

The design concepts developed for digester expansion, primary sludge thickening and THP and their associated capital costs are summarized in Table 9-3.

Table 9-3. Design Concepts for Sludge Stabilization Alternatives

Alternative	Description	Capital Cost
Base Case Alternative Digester Expansion	Construct two new primary digesters Construct a new waste activated sludge thickening facility	$49,000,000
Alternative Solution 1 Primary Sludge Thickening	Construct a new primary sludge and waste activated sludge thickening facility	$23,300,000
Alternative Solution 3 THP	Construct a new pre-dewatering facility Construct a new THP facility	$47,800,000

Alternative Solution 1 – Primary Sludge Thickening was selected as the preferred solution for sludge treatment and stabilization. Primary sludge thickening scored the highest, as it represents the most efficient use of site (smallest footprint for new buildings), the highest biogas energy recovery potential (due to lower digester heating demand), and the lowest costs.

9.3 Biosolids Dewatering

This section presents an overview of the alternatives development and evaluation for biosolids dewatering. Details are presented in Appendix A-2.

In Section 6.4, it was identified that various components of the existing dewatering facility are in poor condition, and there is a lack of redundancy in the dewatering conveyance system. The facility and dewatering equipment (belt filter presses) are reaching the end of service life. A previous condition assessment advised against retrofitting the existing facility with new equipment (GM BluePlan, 2019). Therefore, the feasible solution for dewatering is to construct a new dewatering facility.

The new dewatering facility would be sized based on the estimated biosolids production in 2051 resulting from the preferred solution for sludge treatment and stabilization (implementing primary sludge thickening).

The following sub-sections present the alternatives development and evaluation for dewatering.

9.3.1 Short-listed Alternatives for Dewatering

To eliminate alternatives that are not feasible within a new dewatering facility at the Guelph WRRC, four technology alternatives in the long-list (presented in Appendix A-2) were subject to preliminary screening based on the must-meet criteria presented in Section 4. The following alternatives met the required criteria:

- Belt Filter Press (Base Case)
- Centrifuge

Generally, selection of dewatering technology is usually determined at the design stage. As a conservative approach, the concept development and costing was based on centrifuges in a new dewatering building, because the capital cost for centrifuge dewatering is higher than belt filter presses (due to the higher equipment cost, and additional building cost associated with structural support for vibration control).

9.3.2 Detailed Evaluation for Dewatering

A new dewatering facility with centrifuges and the do-nothing alternative were subjected to the first stage of detailed evaluation, where each received a non-economic "benefit score" based the social/cultural environment, natural environment and technical feasibility criteria described in Section 4. The do-nothing alternative was eliminated because it would not provide sufficient dewatering capacity within the planning period. Therefore, a new dewatering facility with centrifuges was selected as the preferred solution. The capital cost for the new dewatering facility is estimated to be $16,100,000.

9.4 Biogas Utilization

The existing cogeneration system (500 kW) at the Guelph WRRC does not have sufficient capacity to receive all biogas produced in the anaerobic digesters based on the future biogas production to 2051. Therefore, additional cogeneration or alternative biogas utilization capacity is required.

At the time of writing this report, the City had initiated the design of a cogeneration system expansion to provide the required capacity in 2051. Therefore, an evaluation of alternative biogas utilization strategies is not required.

The annual average biogas production is expected to be 7,900 cubic metres per day in 2051. As part of the sludge stabilization alternatives evaluation, an investigation was completed to determine the optimal biogas usage, i.e., how much biogas should be sent to the cogeneration process and how much should be sent to the boilers to supplement natural gas usage. It was found that directing 100 percent of biogas to the cogeneration process is the optimal biogas utilization strategy. Under this scenario, a cogeneration capacity of 700 kW will be required, which is consistent with the design basis for the expansion project, to produce enough heat to satisfy the digester heating demand, with excess heat available to supplement building heating.

Detailed concept development and costing is not included for this process, as a preliminary design was completed in a separate project.

9.5 Biosolids Management

This section presents an overview of the alternatives development and evaluation for biosolids management. Details are presented in Appendix A-2.

Biosolids cake generated at Guelph WRRC undergo enhanced treatment using the Lystek process, which results in a fertilizer product is applied on agricultural land. The existing on-site Lystek process does not have sufficient capacity to process all dewatered cake produced at the plant. Currently, a portion of the dewatered cake is hauled to Lystek's facility in Dundalk for processing prior to beneficial reuse via land application. The City currently has a management contract with Lystek to manage biosolids through 2028. Therefore, biosolids management alternatives were considered for implementation in 2028.

9.5.1 Short-listed Biosolids Management Alternatives

A long-list of alternatives was considered for biosolids management following expiration of the current contract. Each alternative in the long-list was subject to a preliminary screening based on the must-meet criteria presented in Section 4 to eliminate alternatives that are not feasible for implementation at the Guelph WRRC.

The following alternatives met the required criteria and were subject to detailed evaluation:

- Enhanced Treatment with Beneficial Reuse
- Incineration and Ash Management
- Biosolids Composting
- Contracted Management of Biosolids (as-is, with no further processing).

9.5.2 Detailed Evaluation for Biosolids Management

The four shortlisted biosolids management alternatives (in addition to the do-nothing baseline alternative) were subjected to the first stage of detailed evaluation, where each received a non-economic "benefit score" based the social/cultural environment, natural environment, and technical feasibility criteria described in Section 4.

This evaluation resulted in enhanced treatment with beneficial reuse, biosolids composting and contracted haulage of biosolids moving forward to Stage 2 of the detailed evaluation process. Stage 2 of the detailed evaluation includes developing detailed concepts and costs to develop an economic score for each alternative. The do-nothing alternative (status quo) was eliminated, as it would not provide a biosolids management strategy for the Guelph WRRC beyond 2028. Incineration was eliminated due to its low social/cultural environment score.

The design concepts developed for the biosolids management alternatives and their associated capital costs, O&M costs and lifecycle costs are summarized in Table 9-4. The O&M costs and lifecycle costs are presented for this set of alternatives because some alternatives require no capital expenditure and would only incur O&M related costs.

While enhanced treatment could be provide off-site, a capital cost was carried that would allow the City to implement its own enhanced treatment process on-site based on locating the process in the old composting building. The concept for contracted haulage was developed based on hauling costs incurred by other municipalities in Southwestern Ontario and a worst-case scenario of there being no land available for biosolids application, with all biosolids hauled for mine reclamation (i.e., the longest hauling distance).

Table 9-4. Alternative Design Concepts and Costs for Biosolids Management

Alternative	Description	Capital Cost	25-year Net Present Value O&M Costs	25-year Lifecycle Costs
Enhanced Treatment with Beneficial Reuse	Rehabilitate the Compost Building Construct a new Enhanced Treatment Process within the Compost Building	$28,400,000	$14,300,000	$42,700,000
Biosolids Composting	Construct a new Biosolids Composting Facility	$32,100,000	$11,800,000	$43,900,000
Contracted Haulage of Biosolids	All biosolids hauled for mine reclamation (worst-case scenario)	--	$33,600,000	$33,600,000

Enhanced treatment with beneficial reuse was selected as the preferred solution for biosolids management following expiration of the City's current contract in 2028. This solution provides a significant GHG emission reduction for the Guelph WRRC, and there is a well-established market for the products from enhanced biosolids treatment in Ontario. It is noted that enhanced treatment could be provided by contract rather than on-site, however, a capital cost for on-site treatment was carried forward. While biosolids composting has a similar capital cost to enhanced treatment with beneficial reuse, it requires the largest footprint and would require the City to establish a new marketing program for managing compost products. While presented as having the lowest lifecycle cost, contracted haulage of biosolids has the highest cost risk to the City, as it is entirely contractor dependent; the costs could deviate substantially from those presented for this Class EA depending on market conditions.

In general, it is recommended that an additional biosolids management evaluation be completed prior to expiration of the current Lystek contract to confirm the future strategy based on market conditions at the time.

9.6 Summary of Preferred Solution for Biosolids Processing and Management

The preferred solution for biosolids processing and management is summarized as follows for each unit process:

- Sludge Stabilization: New Primary Sludge and Waste Activated Sludge Thickening Facility
- Dewatering: New Dewatering Facility
- Biogas Utilization: Expand the Cogeneration System (design currently underway)
- Biosolids Management: Enhanced Treatment with Beneficial Reuse

Table 9-5 presents a summary of the costs, drivers and timing for the preferred solution for biosolids processing and management at the Guelph WRRC.

Table 9-5. Preferred Solution for Biosolids Management

Unit Process	Preferred Solution	Year Required	Drivers	Capital Cost, $ million in 2021
Sludge Treatment/ Stabilization	New Primary Sludge and Waste Activated Sludge Thickening Facility	By 2027	Capacity	$23.3
Dewatering	New Dewatering Facility	By 2027	Condition	$16.1
Biosolids Management	Enhanced Treatment with Beneficial Reuse[a]	2028	Contract Duration	$28.4

Notes:

[a] Enhanced treatment with beneficial reuse could be on-site of off-site through a long-term contract. A capital cost for on-site treatment has been carried forward for this Class EA.

10. Public, Agency, and First Nations Consultation and Engagement

Engagement is a key component of the Municipal Class EA process. Exceeding the minimum consultation requirements of the Class EA process was key objective of the engagement completed for this study. The engagement approach was informed by the City's Guiding Principles for Community Engagement, which include:

- **Inclusive:** The City encourages participation by those who will be affected by a decision. The City builds relationships with stakeholders by using a range of tools to engage varied audiences.
- **Early Involvement:** The City involves the community as early as possible in the engagement process, so stakeholders have time to learn about the project and actively participate.
- **Access to Decision Making:** The City designs processes that will give participants the opportunity to influence decisions.
- **Coordinated Approach:** The City coordinates community engagement activities to effectively use community and City resources.
- **Transparent and Accountable:** The City designs engagement processes so that stakeholders understand their role, the level of engagement and the outcome of the process.
- **Open and Timely Communication:** The City provides information that is timely, accurate, objective, easily understood, accessible, and balanced.
- **Mutual Trust and Respect:** The City engages the community in an equitable and respectful way that fosters understanding between diverse views, values, and interests.
- **Evaluation and Continuous Improvement:** The City evaluates engagement activities and uses findings to maintain effective engagement processes.

10.1 First Nations Engagement

Meaningful engagement with First Nations, Indigenous, and Métis communities and the City's Treaty Rights Holders was an important component of this study. The Community Engagement and Communications Plan developed for this study was updated on an ongoing basis throughout the project to incorporate the project team's understanding of First Nations, Indigenous, and Métis community concerns and priorities.

The City's Treaty Partners include:

- Six Nations of the Grand River First Nation
- Mississauga's of the New Credit First Nation
- Haudenosaunee Confederacy Chiefs Council
- Métis Nation of Ontario

The City's project team led engagement and communications activities with the City's Treaty Partners. As the City is undertaking other master planning activities concurrently, City communications team focused on coordinating communications with Treaty Rights Holders regarding the on-going master plans. Appendix C – First Nations Engagement contains the detailed outcomes of relevant engagement activities with the City's Treaty Partners.

10.2 Public Engagement Activities

The study approach to public engagement was early and often with three to four week for the community to provide feedback. The public was invited to provide general project feedback at anytime and provided contact information for the project team on the project webpage. This section summarizes the engagement activities undertaken during the study.

Engagement activities included:

- Project Notices
- Community Liaison Group (three meetings)
- Public Open Houses (three open houses)

An opportunity for participants to provide feedback was a key objective each engagement activity.

10.2.1 Project Notices

Project notices were used to raise awareness of the project and inform the community of an opportunity to provide input. Notices were posted on the project's engagement webpage, emailed to the project mailing list and agency contact list, mailed to those on the mailing list without email addresses, and published in two consecutive publications of the local newspaper (Guelph Mercury).

Notices for this study are provided in Appendix B. Notices were distributed and published for the following points throughout the project:

- Notice of Commencement
- Notices of Open Houses
- Notice of Study Completion

Notices provided a clear overview of the project rationale and objectives, description of the process, advise the community where to find project updates, an invitation to participate, and provide contact information for the study project team.

Table 10-1. Study Notices

Communication Method	Study Commencement	Open House 1	Open House 2	Open House 3	Study Completion
Project Webpage	August 17, 2020	October 28, 2020	May 12, 2021	March 15, 2022	TBD
City Website	August 17, 2020	October 28, 2020	May 12, 2021	March 15, 2022	TBD
Project Mailing List	August 17, 2020	November 2, 2020	May 12, 2021	March 15, 2022	TBD
Social Media	Various	Various	Various	Various	Various
Internal Staff and Council	August 17, 2020	October 28, 2020	May 12, 2021	March 15, 2022	TBD
Traditional Media	Various	Various	Various	Various	Various

10.2.2 Community Liaison Group

A community liaison group (CLG) was formed at the beginning of the study. The CLG members were selected to represent key stakeholder groups within the community, including the business community, special interest groups, agencies such as the GRCA and MECP, adjacent municipalities, and members of the public.

Terms of reference for the CLG members role on the project were developed and included in the invitations. The Terms of Reference can be found in the Community Engagement Plan in Appendix B.

Three meetings were held with the CLG throughout the project. Meetings were held prior to each Open House and included a presentation to inform the members on the study's progress and key findings. Meetings were conducted virtually in MS Teams and used interactive features for participants to provide feedback throughout the meeting. When CLG members were unable to attend a scheduled meeting, a separate opportunity to review the materials and speak with the project team was provided. The following summarizes the CLG meetings:

- **CLG Meeting 1:** Was held on October 18, 2020, before the first Open House. The purpose of this meeting was to introduce the project background, and decision-making approach to the CLG members. CLG members were provided with opportunities to provide feedback throughout the meeting.
- **CLG Meeting 2:** Was held on April 27, 2021, before the second Open House. The purpose of this meeting was to present the identified alternatives and present the preliminary preferred solutions to the CLG members.
- **CLG Meeting 3:** Was held on January 19, 2022, before the third Open House. The purpose of this meeting was to notify the CLG that the project team had decided to complete the assignment as a Schedule C Class EA (rather than a Schedule B) and to present the Implementation Plan developed in accordance with the Class EA process. CLG members were invited to provide feedback and ask questions throughout the meeting.

Detailed summaries of the CLG meetings, including presentation materials, are available in Appendix B.

10.2.3 Public Open Houses

The purpose of public open houses was to provide an opportunity to provide an update on the study progress to the community and to provide feedback to the project team. The feedback received through the open houses helped to inform the project teams understanding of the community priorities related to wastewater treatment and biosolids management, thereby helping to inform how the City will treat wastewater and manage biosolids in the future.

Three public open houses were held for this study. Public open houses were held virtually through the project engagement webpage due to the COVID-19 pandemic. Open house materials were maintained for 3 to 4 weeks and requested participants respond to an optional survey to collect feedback.

Detailed summaries of the process and outcomes from each open house are included in Appendix B.

10.2.3.1 Public Open House 1

Public Open House 1 (POH1) was conducted during phase 1 of the Municipal Class EA process. The objective of this open house was to introduce the study, existing condition, and future needs and to provide the opportunity for the community to provide feedback.

Logistics for open house 1:

- **Where:** Online through the project engagement webpage
- **When:** October 28, 2020 to December 10, 2020

The POH was hosted online in an interactive format, allowing visitors to navigate a virtual room that displayed the POH presentation materials in a manner similar to an in person open house format. The panels were also available for download or viewing through the project engagement webpage. After viewing the presentation materials participants were invited to respond to a survey. A summary of the POH including display materials, and survey responses are provided in Appendix B. As illustrated Figure 10-1, POH1 received 173 unique visitors, 27 of whom completed surveys, and 16 provided additional comments to the project team.

The project team drafted responses to the questions and comments received from the community. These questions and responses were posted to the Frequently Asked Questions portion of the project webpage on the City's Have Your Say platform. The team's responses are documented in the POH1 summary report in Appendix B.

Figure 10-1. Public Open House 1 Summary

10.2.3.2 Public Open House 2

Public Open House 2 (POH2) was conducted during phase 2 of the Municipal Class EA process. The objective of this open house was to present the identified alternatives, evaluation process, and present the preliminary preferred alternatives and to provide the opportunity for the community to provide feedback.

Logistics for open house 2:

- **Where:** Online through the project engagement webpage
- **When:** May 12, 2021 to June 22, 2021

The POH was hosted online in an interactive format, allowing visitors to navigate a virtual room that displayed the POH presentation materials in a manner similar to an in person open house format. The panels were also available for download or viewing through the project engagement webpage. After viewing the presentation materials participants were invited to respond to a survey. A summary of the POH including display materials, and survey responses are provided in Appendix B. As illustrated in Figure 10-2, POH2 received 177 unique visitors, 18 of whom completed surveys, and 16 provided additional comments to the project team.

The project team drafted responses to the questions and comments received from the community. These questions and responses were posted to the Frequently Asked Questions portion of the project webpage on the City's Have Your Say platform. The team's responses are documented in the POH2 summary report in Appendix B.

Figure 10-2. Public Open House 2 Summary

10.2.3.3 Public Open House 3

Public Open House 3 (POH3) was conducted during phase 3 of the Municipal Class EA process. The objective of this open house was to present the identified alternatives, evaluation process, and present the preliminary preferred alternatives and to provide the opportunity for the community to provide feedback.

Logistics for open house 3:

- **Where:** Online through the project engagement webpage
- **When:** March 14, 2022 to April 4, 2022

The POH was hosted online in an interactive format, allowing visitors to navigate a virtual room that displayed the POH presentation materials in a manner similar to an in person open house format. The panels were also available for download or viewing through the project engagement webpage. After viewing the presentation materials participants were invited to respond to a survey. A summary of the POH including display materials, and survey responses are provided in Appendix B. As illustrated in Figure 10-3, POH3 received 33 unique visitors, none of whom completed surveys, and no additional comments to the project team.

The project team drafted responses to the questions and comments received from the community. These questions and responses were posted to the Frequently Asked Questions portion of the project webpage on the City's Have Your Say platform. The team's responses are documented in the POH3 summary report in Appendix B.

Figure 10-3. Public Open House 3 Summary

10.2.4 Engagement Webpage

A webpage for the project was published on the City's engagement site, "Have Your Say", with the Notice of Commencement (click here for the City of Guelph's Wastewater Treatment and Biosolids Management Master Plan webpage). The purpose of the web page was to raise awareness of the purpose and objectives of the ongoing study, share project updates, and provide access to engagement opportunities. The webpage includes:

- Notices and general project updates
- Engagement opportunities
- Background information on the City's current Wastewater Treatment operations
- Link to subscribe for project updates
- Project contact information

From the project launch in Spring 2020 to publication of this ESR the project webpage has received 1,000 page views, 855 representing unique visitors.

10.2.5 Social Media

The City of Guelph's Facebook (facebook.com/cityofguelph) and Twitter (twitter.com/cityofguelph) accounts were used to complement the projects webpage and reach a wider audience. Social media posts were developed to promote points of engagement throughout the project. These posts provided links to the project webpage and open house content and surveys.

Open Houses were also promoted on social media by interested groups including Our Energy Guelph.

10.2.6 Traditional Media

The notices of commencement and each open house were published in two consecutive publications of the Guelph Mercury Tribune and digital advertisements were placed with the Guelph Mercury, GuelphToday, and Weather Network.

10.3 How the Preferred Solution Incorporates Engagement Feedback

The engagement conducted throughout the study resulted in the team receiving valuable feedback at key stages in the study. In summary, the team identified common themes in the feedback received across the engagement activities:

1. **Wastewater is a resource.** Feedback received through engagement activities consistently emphasized the view that wastewater is a resource containing nutrient and organic material that could be used beneficially on agricultural land. This is consistent with the City's Smart Cities Initiative to support a circular food economy. The organics in wastewater can also be digested and energy can be recovered from the resulting biogas. These reflect the innovations previously implemented at the Guelph WRRC. The feedback confirmed this as a priority informing the City's approach to municipal planning.

2. **Energy Efficiency.** Feedback received through the engagement activities emphasized that energy efficiency at the WRRC should be a priority for the City. The feedback received included concerns around GHG emissions, but also related to opportunities for energy efficiency throughout the facility.

3. **Protecting the Speed River.** The Speed River is an important natural feature of the City, supporting aquatic and natural habitats.

The feedback received through the engagement process impacted the decision-making on this study can be summarized as follows:

1. **Evaluation Framework:** Feedback received early in the project related to the community's values including resource recovery and energy efficiency were incorporated into the detailed evaluation framework documented in Section 4.3 of this ESR. The criteria related to GHGs, beneficial reuse of biosolids (compatibility with agricultural practices), and energy requirements were also shaped by feedback received through engagement activities. In addition, the feedback received through the engagement activities provided important context for the project team during the scoring and evaluation of alternatives project phase.

2. **Confirmation of the short-listed alternatives and preferred solutions:** Engagement activities prioritized, presented, and sought feedback on the decision-making process throughout the study. The feedback received during these activities confirmed the decision-making process reflected the community's priorities and values. The study team received feedback supporting the identified preferred solutions and indicated that the community priorities identified through earlier engagement activities were reflected in the recommendations.

3. **Assimilative Capacity of the Speed River:** Feedback through engagement activities indicated that protection of the Speed River was a priority. At the time of the study commencement the City was undertaking an assimilative capacity study of the Speed River as a separate study. Based on the feedback received and the timing of the future needs for treatment capacity identified through the technical work, the decision to complete this project as a Schedule C Class EA (rather than a Schedule B Class EA). This change in approach included incorporating the findings of the Assimilative Capacity study directly in this study. Treatment technologies identified considered the findings of the assimilative capacity by continuing to exceed the effluent objectives identified through the assimilative capacity study.

4. **Chloride Concentrations in the Speed River:** Feedback through engagement activities with the CLG and public, highlighted concerns related to chloride concentrations in the Speed River. Water softener salt is a primary source of chlorides in treated effluent and the most effective mitigation strategy is through upstream management of chlorides. Expansion of the City's influent and effluent monitoring program to include chlorides is included in the Class EA recommendations. This will enable the City to monitor chloride concentrations discharged to the Speed River.

11. Recommendations

11.1 Recommended Solutions

A summary of the recommended solutions for wastewater treatment and biosolids management in the City of Guelph for the planning period to 2051 is presented in Table 11-1.

A Stage 2 Archaeological Assessment will be required for some areas of the WRRC site ahead of commencing detailed design for select recommended solutions identified in Table 11-1 (Stage 1 Archaeological Assessment Guelph WRRC, 2022).Refer to the Stage 1 Archaeological Assessment Report located in Appendix A-4.

11.2 General Recommendations

The following general recommendations have been identified throughout the Class EA through conversations with City staff and through feedback received through engagement activities:

- Complete a Wastewater Treatment and Biosolids Management Master Plan update every 5 to 8 years. This will allow the City to adjust its capital expenditure plan based on an increased or decreased growth rate and continue to provide reliable wastewater treatment and biosolids management.
- Opportunistically implement green energy technologies (i.e., solar energy and wind energy-related technologies) as new facilities are constructed.
- Continue to collaborate with the Water Services Department to identify any potential impacts to future flow projections due to water conservation measures. It is recommended that the City update its Water Efficiency Strategy to quantify any potential reductions in water usage, wastewater generation, and anticipate changes in wastewater concentration that may impact WRRC processes.
- Continue to collaborate with the Engineering Division to identify any potential impacts to future flow projections due to the implementation of inflow and infiltration reduction measures.
- Continue to explore and implement, where feasible, approaches to reuse treated effluent. It is expected that effluent reuse will be driven through water supply planning activities.

Table 11-1. Summary of Preferred Solution for Guelph Wastewater Treatment and Biosolids Management Master Plan Class EA

Unit Process	Preferred Solution	Year Required	Drivers	Supportive Studies	Capital Cost, $ million
Screening	Screening process and headworks building expansion	By 2038	Capacity	Schedule A	$14.1
Grit Removal	Grit removal process expansion and rehabilitation Hydraulic improvements	By 2027	Capacity Condition	Schedule C [a,b]	$6.0
Primary Treatment, Secondary Treatment and Tertiary Nitrification	Construct 2 new secondary clarifiers in Plant 2 Removal of RBCs and operate all plants as nitrifying CAS	By 2027	Capacity	Schedule C [a,b]	$12.2
Primary Treatment, Secondary Treatment and Tertiary Nitrification	Construct a new Plant 5	By 2038	Capacity	Schedule C	$34.7
Tertiary Filtration	Construct a new disk filter facility Demolish the East-West filter building	By 2027	Capacity Condition	Stage 2 Archaeological Assessment [c] Schedule C [a,b]	$33.3
Disinfection	Construct a new UV disinfection facility Demolish the CCT	By 2027	Capacity Condition	Stage 2 Archaeological Assessment [c] Schedule C [a,b]	$14.4
Sludge Treatment/Stabilization	New Primary Sludge and Waste Activated Sludge Thickening Facility	By 2027	Capacity	Schedule B [a,b]	$23.3
Dewatering	New Dewatering Facility	By 2027	Condition	Schedule B [a,b]	$16.1
Biosolids Management	Enhanced Treatment with Beneficial Reuse	2028	Contract Renewal	Schedule A	$28.4

Notes:

[a] EA requirements are satisfied by this Class EA.

[b] Project is required as part of an overall capacity expansion.

[c] Project will require a Stage 2 Archaeological Assessment to be completed ahead of detailed design.

12. Implementation Plan

This section presents the implementation plan for the recommendations from this Class EA in accordance with the MEA Municipal Class EA process for Schedule C Class EA's. Further details of the implementation plan are presented in Appendix A-3.

12.1 Recommended Implementation Plan

The treatment capacity at the Guelph WRRC will be expanded in two phases during the planning period, as follows:

- **Phase 1: Expansion from 64 ML/d to 72.5 ML/d by 2027**: By constructing two new secondary clarifiers in Plant 2 and operating all four plants as nitrifying CAS plants (and removing the RBCs), the total nitrification capacity will increase to 72.5 ML/d. This upgrade is required by 2027, which is the year that the existing rated capacity (64 ML/d) is projected to be exceeded. This rated capacity increase also requires a tertiary filter expansion, new UV disinfection system, new primary sludge/waste activated sludge thickening facility and dewatering upgrades.
- **Phase 2: Expansion from 72.5 ML/d to 79.2 ML/d by 2038**: To increase treatment capacity beyond 72.5 ML/d (projected to be exceeded in 2038), process intensification of existing plants (via waste activated sludge hydrocyclones and/or MABR retrofits) or construction of a new Plant 5 is required. The second phase expansion at Guelph WRRC will increase capacity from 72.5 ML/d to 79.2 ML/d, which is the average daily flow projected in 2051. At that time, new growth projections may dictate a larger expansion to provide capacity beyond 2051.

Table 12-1 presents the upgrades required in Phase 1 (needed to be in service by 2027), and Table 12-2 presents the upgrades required in Phase 2, or in service by 2038. As noted in Table 11-1 a Stage 2 Archaeological Assessment will be required for select areas of the WRRC site ahead of detailed design for some recommended phase 1 solutions.

It is noted that a Master Plan update with an extended planning horizon (i.e., beyond 2051) will be completed prior to the Phase 2 upgrades and as a result, the preliminary requirements identified through this Class EA may change. The cost for a new Plant 5 will be carried forward for budgetary purposes, although the timing for a new Plant 5 may be deferred if process intensification can be achieved within the existing plants, as discussed in Section 8.3.

In addition to the projects listed in the following tables, a new biosolids management contract and/or potential on-site enhanced biosolids treatment capacity expansion (capital cost estimate of $28,400,000) is required by 2028 when the existing contract expires.

Table 12-1. Guelph WRRC Phase 1 Expansion and Upgrade - Required by 2027

Project	Capital Cost, $ million
Rehabilitate and expand the grit removal system and address hydraulic bottlenecks	$6.0
Construct 2 new secondary clarifiers in Plant 2, remove RBCs and operate all plants as nitrifying CAS plants	$12.2
Expand tertiary treatment with new disk filter facility and decommission the East-West filter building	$33.3
Construct a new UV disinfection facility and demolition of existing chloring contact tank	$14.4
Construct a new dewatering facility with biosolids storage	$16.1
Construct a new primary sludge thickening and waste activated sludge thickening facility	$23.3
Total	$105.3

Table 12-2. Guelph WRRC Phase 2 Expansion and Upgrade - Required by 2038

Project	Capital Cost, $ million
Expand the screening system	$14.1
Construct a new Plant 5 [a]	$34.7
Total	**$47.8**

Notes:

[a] There is potential for capital expenditure to be delayed if process intensification can be achieved within the existing plants. Pilot testing to demonstrate the potential for process intensification is recommended prior to 2038

It is recommended that projects within the same general plant area be packaged into one contract. The suggested short-term contracts are as follows:

- **Contract 1:** Solids Upgrades (Dewatering, Sludge Thickening Facility)
- **Contract 2:** Grit Removal Upgrades and Address Hydraulic Bottleneck
- **Contract 3:** Primary/Secondary/Tertiary Upgrades (Plant 2 Secondary Clarifiers, Tertiary Filter Expansion and UV Facility)

The packaging of future upgrade contracts can be assessed in the future (biosolids management, screening upgrades and plant retrofit/new Plant 5).

It is recommended that the City update the cost estimates presented in this Class EA as each project is undertaken. The COVID-19 pandemic has resulted in significant escalation of capital project costs throughout Ontario due to supply chain issues and increasing material costs. It is unknown at this time if these issues will continue in the future and as such, it is expected that cost estimates will need to be revised.

12.2 Permits and Approvals

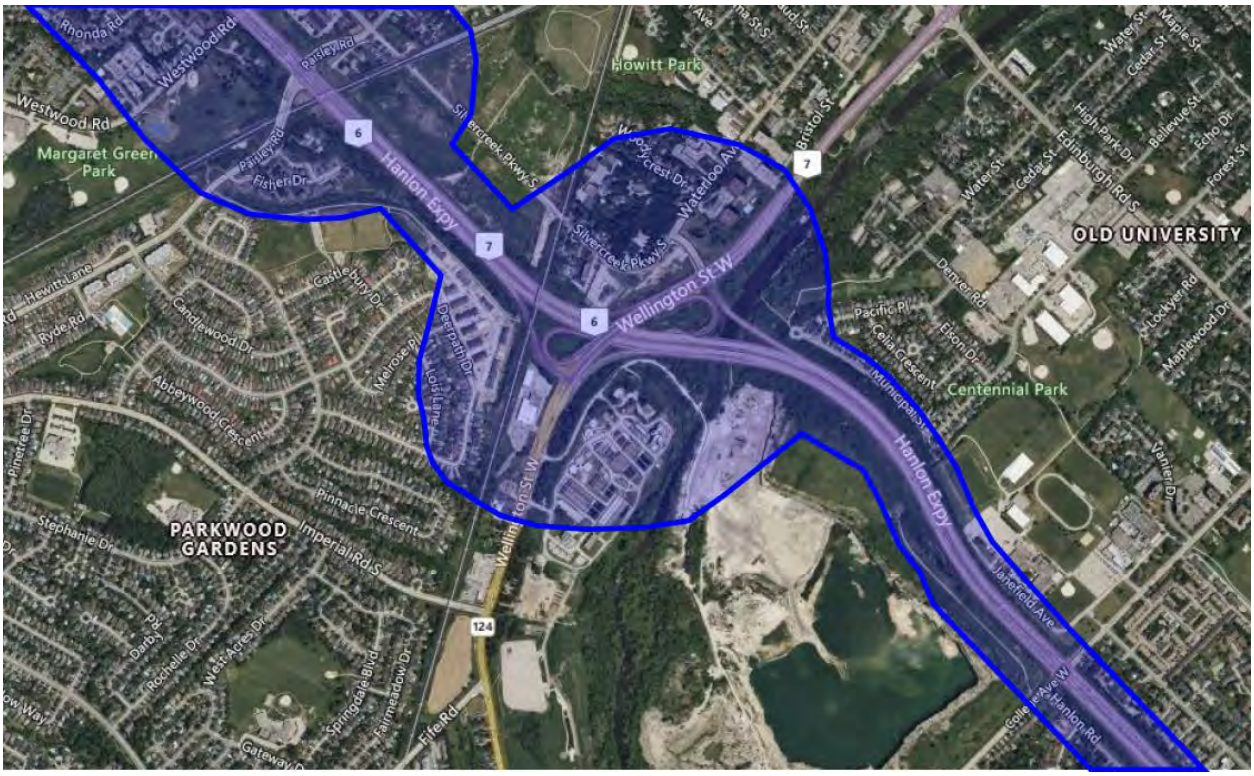
12.2.1 Natural Environment Permitting

Authorization or review by Fisheries and Oceans Canada (DFO) is likely not required given in-water works within the Speed River and work within the ordinary high-water mark are not required.

A permit under *O. Reg. 150/06, Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses* is required for construction or development within the GRCA regulated area (GRCA, 2022).

The Guelph WRRC is within the MTO controlled Area (shown in Figure 12-1) for impacts to highway systems. The MTO encourages pre-consultation and engagement and is responsible for providing comments under the Planning Act to help facilitate construction project within the corridor. Permit types include Building and Land Use, Entrance, Sign, and Encroachment. For proposed land development, construction or other activities within MTO Controlled Areas, the review process is managed by the Highway Corridor Management Office, including MTO Permit issuance and administration. The recommended solutions will no impact on sight lines along the Hanlon Parkway and associated interchange ramps.

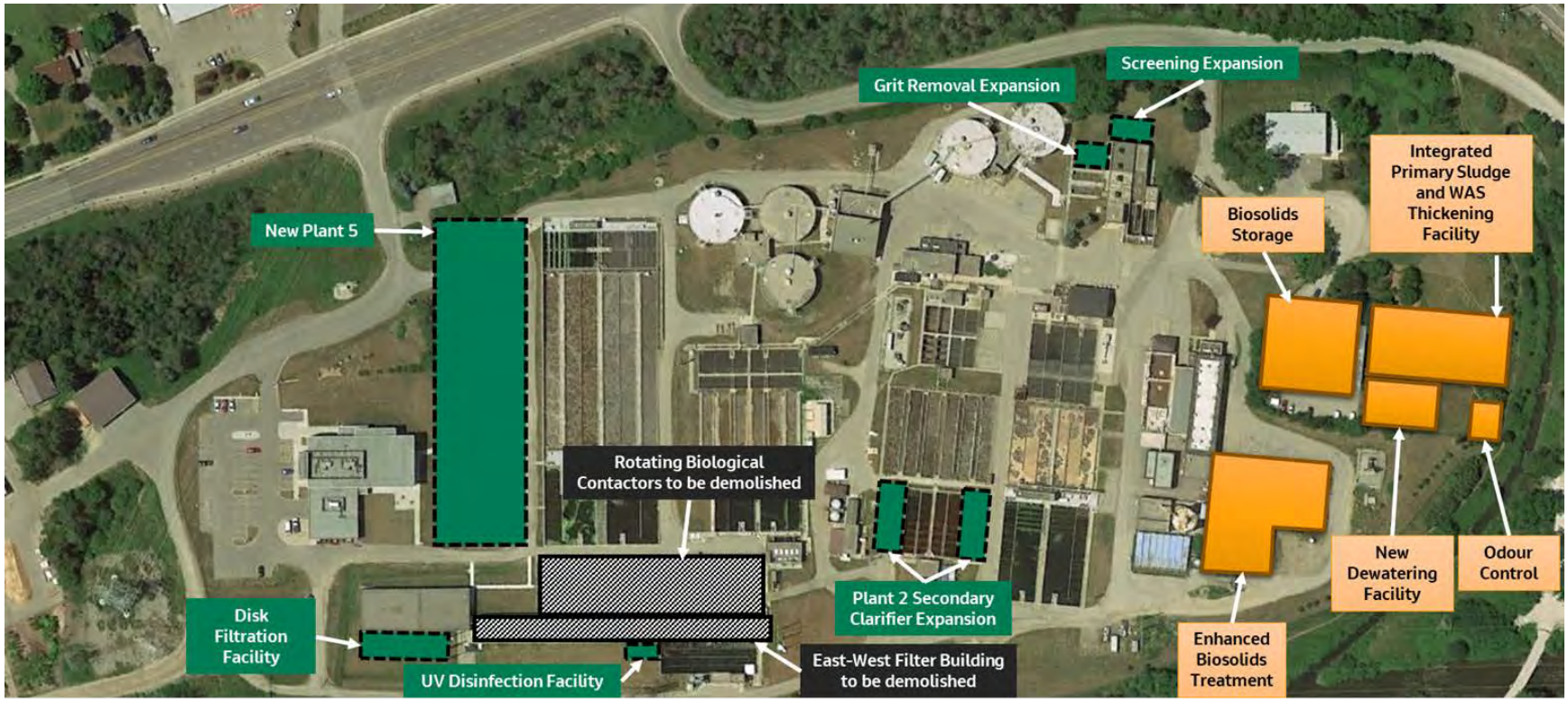
Figure 12-1. MTO Controlled Area



12.3 Future Site Plan

Figure 12-2 presents a preliminary concept for the Guelph WRRC site plan in 2051, based on treating a future average daily flow of 79.2 ML/d. Capacity needs and the associated footprint for the new Plant 5 are likely to change following the next Master Plan update.

Figure 12-2. Preliminary Concept for Future Site Plan in 2051



12.4 Potential Effects, Benefits, and Mitigation Measures

The recommendations from this Class EA are expected to provide a range of benefits related to serving the City's strategy for growth, reducing GHG emissions and protecting the Speed River. Potential effects from construction and operation of the preferred solution are identified in this section along with the appropriate mitigation measures and benefits that are expected to occur because of study recommendations.

12.4.1 Natural Environment

Construction and operation of the preferred solution are not anticipated to interact with the physical environment. A negligible increase in air emissions is expected from construction vehicles and equipment which will be short-term in duration (i.e., the construction schedule). An increase in air emissions during ongoing operation of the WRRC is not anticipated.

Potential effects from construction and operation of the preferred solution on water quality, terrestrial habitat and wetlands may occur. To protect the natural environment during construction and long-term operation, the following future studies are recommended and associated mitigation measures will be adopted:

- An Environmental Impact Study (EIS), species at risk assessment, and arborist surveys (if required) will be completed the detailed design stage, and measures will be identified and implemented to protect species at risk and associated habitat during construction activities.
- The project will be screened by MECP for species at risk occurrences to determine setback or restricted activity periods
- Vegetation removal, grading, and heavy equipment use will only occur within the project footprint where these areas have been previously demarcated and construction works is approved. Silt fencing will be erected, where appropriate.
- A site-specific Erosion and Sediment Control Plan will be developed by a qualified person and updated as required.
- Stockpiled material will be covered to prevent erosion and potential sedimentation into natural features. Staging access areas are planned to be located primarily within existing open and disturbed areas.
- Access and movement of vehicles and equipment will be controlled to limit the introduction and spread of invasive species. Vehicles and equipment will be inspected prior to entering and leaving the construction site to verify the equipment is clean and free of invasive species. Equipment will be inspected and used only if in good working order by the contractor.
- A designated and lined refuelling area with appropriate spill containment will be established a minimum of 30 m from any watercourse. A spill response team member (from the contractor's team) will be appointed as a point of contact in the case of an accident or spill to verify the proper and timely implementation of site response controls as required.
- Absorbent materials and equipment required to control and clean up spills of deleterious substances will be available onsite. Spills and leaks of deleterious substances will be immediately contained and cleaned up in accordance with regulatory requirements and reported immediately to the Ontario Spills Action Centre (SAC) at 1.800.268.6060, as well as the necessary site contacts (i.e., City project manager).
- If possible, tree and shrub removal, and vegetation clearing will be avoided from early April to late August, conforming to the general nesting period at the site, corresponding to the MBCA (Government of Canada, 2018).

Concerns regarding chloride concentrations in the Speed River were raised by members of the CLG and the community through engagement activities. It is recommended that the City expand its effluent monitoring program to include chloride concentration sampling.

12.4.1.1 Natural Environment Benefits

- Energy use will reduce due to selection of newer, more efficient technologies, and by maximizing energy recovery from biogas; both reducing GHG emissions.
- Resource (nutrient and organics) recovery from biosolids will be maximized by continuing beneficial re-use of biosolids as a fertilizer product on agricultural land.
- An assimilative capacity study was completed to recommend new treated effluent contaminant loading limits that will maintain the health of the Speed River with increased effluent flows. Treatment technologies were selected so that the Guelph WRRC effluent will continue to exceed the effluent objectives.

12.4.1.2 Plant Operations Benefits

- **Training:** Training and opportunities for continuing education for WRRC operators will be provided as recommended solutions are implemented, particularly where new processes are part of the recommended solutions.
- **Expertise:** The recommended solutions and continued operations of the WRRC require experienced operators with expertise in the processes to continue to provide environmental benefit through process controls that are proactive and reflect best practices. It is recommended that the City continue to update hiring practices to attract operators with the necessary expertise.

12.4.2 Social, Economic and Cultural Environment

Potential effects from construction and operation of the preferred solution on the social, economic and cultural environment are generally expected to be negligible and short-term in duration.

The following measures will be taken to mitigate potential impacts to the community from the recommendations, both during and following construction:

- **Community Health and Safety:** Development and construction activities may increase the type and volume of traffic on surrounding roadways (e.g., construction vehicles and equipment) or introduce additional hazards to the environment (e.g., material spill). Vehicles and equipment used during construction will follow traffic laws and multi-passenger vehicles will be used, when possible, to reduce traffic associated with construction activities.
- **Noise:** Construction noise will be temporary and short-term in nature. Construction activities will generally be carried out during the day where traffic and human activity along Wellington Street West (e.g., gas station, hardware store) are occurring. A negligible increase in noise at the existing Guelph WRRC is expected during ongoing operation of the plant. The technologies that were selected for upgrades are not expected to result in off-site noise impacts on the surrounding community.
- **Odour:** Existing odour control and treatment facilities will continue to operate, and a new odour control facility will be constructed to mitigate potential odours from the new solids handling processes. Odour is not expected to increase substantially during construction.
- **Infrastructure and Services:**
  - Traffic: In general, Guelph WRRC traffic has not been a notable issue due to the location of the facility entrance off a main road (Wellington Road) near Highway 6. During construction, a small increase in traffic to and from the Project footprint is anticipated to transport crews and equipment. No increase in traffic is expected during operations. Eliminating the need for disinfection chemicals by implementing an ultraviolet disinfection system is expected to reduce traffic in the future.

  - Utilities: Additional utilities may be needed to support the operation of the preferred solution. In the event existing utilities are disrupted during construction activities, it is expected that this will be short-term in duration, temporarily disturbing services. Ontario One-Call locates will be done prior to construction to reduce the potential for service disruptions.
  - Services: All waste materials from operation of the plant, such as screenings and grit, will be disposed of off-site in accordance with applicable legislation and guidelines. Construction and operation of the preferred solution is not anticipated to increase demand on local or regional services (e.g., emergency or health care services).

- **Viewshed:** Permanent infrastructure changes within the existing site may present a negligible change to the existing viewshed considering these changes will be made within the Guelph WRRC site adjacent to existing buildings and aboveground structures. MTO approval is required for upgrades that are visible from provincial roads (i.e., Highway 6).
- **Cultural Heritage:** Before a development project can proceed, an archaeological assessment of all lands that are part of the project is required where land has a known archaeological site or the potential to have archaeological sites (Ministry of Heritage, Sport, Tourism and Culture Industries, 2022). A Stage 1 Archaeological Assessment was completed for the study area by Archaeological Research Associates Ltd. (PIF #P007-1342-2022). The Stage 1 Archaeological Assessment Report identified some locations within the study area of archaeological potential a Stage 2 Archeological Assessment is recommended for these areas. Master Plan recommendations where a Stage 2 Archaeological Assessment is required are indicated in Table 11-1.

  Construction within a previously disturbed site reduces the potential to uncover archaeological resources during construction. However, ground disturbance (e.g., soil handling, grading) may uncover previously unidentified artifacts. Disturbing these resources in a controlled, scientific excavation is considered an acceptable, and in some cases, the only method to collect in situ information to add to the historic record. The removal of these resources is offset by the recovery of knowledge about the site when catalogued and preserved in compliance with provincial guidelines. In the event an artifact is encountered during construction, work should be suspended, and the Ministry of Tourism, Culture and Sport should be contacted. Construction and City personnel are not permitted to collect or disturb artifacts in accordance with the Ontario Heritage Act R.S.O. 1990 c 0.18.

  The Stage 1 Archaeological Assessment Report identifies the following recommendations and mitigation measures:

  - The Stage 1 assessment determined that the study area comprises a mixture of areas of archaeological potential, areas of no archaeological potential and previously assessed lands of no further concern. The potential modelling results are presented in Map 9–Map 10 in Appendix A-4 (Stage 1 Archaeological Assessment Guelph WRRC, 2022). It is recommended that all areas of archaeological potential that could be impacted by the project be subject to a Stage 2 property assessment in accordance with Section 2.1 of the 2011 S&Gs. The identified areas of no archaeological potential and previously assessed lands of no further concern do not require any additional assessment. (Stage 1 Archaeological Assessment Guelph WRRC, 2022)
  - The grassed areas shown in green (in Map 9 – Map 10 in Appendix A-4) in the southeast must be assessed using the test pit survey method. A survey interval of 5 metres will be required due to the proximity of the lands to the identified features of archaeological potential. Given the likelihood that the grassed areas shown in yellow were previously impacted, a combination of visual inspection and test pit survey should be utilized to confirm the extent of disturbance in accordance with Section 2.1.8 of the 2011 S&Gs. This will allow for the empirical evaluation of the integrity of the soils and the depth of any impacts. If disturbance cannot be confirmed, then a test pit survey interval of 5 m must be maintained. (Stage 1 Archaeological Assessment Guelph WRRC, 2022)
  - Each test pit must be excavated into at least the first 5 centimetres of subsoil, and the resultant pits must be examined for stratigraphy, potential features and/or evidence of fill. The soil from each test pit must be screened through mesh with an aperture of no greater than 6 millimetres and examined for archaeological materials. If archaeological materials are encountered, all positive test pits must

be documented, and intensification may be required. (Stage 1 Archaeological Assessment Guelph WRRC, 2022)

12.4.2.1 Social Benefits

- Operation of the Guelph WRRC ultimately contributes to community health and safety by wastewater treatment, which contributes to a high-quality effluent discharged to the Speed River.
- Capacity to service growth to 2051 will be provided, allowing the City to meet the growth objectives outlined in its Places to Grow document (Ministry of Municipal Affairs and Housing, 2020).
- Overall reliability will improve by replacing infrastructure that is at or nearing its end of life.

12.4.2.2 Economic Benefits

Use of existing infrastructure will be maximized to avoid expansion where possible and reduce capital cost.

12.4.2.3 Climate Change

The preferred solution will be designed and constructed in accordance with current applicable building standards and best available technology and operated according to best practices to protect infrastructure from future climate change risks.

It is anticipated that the implementation and operation of the preferred solution will provide for additional cogeneration capacity that will reduce greenhouse gas emissions. Construction equipment and vehicles will be maintained in good working order. Energy efficiency and greenhouse gas emissions were a major factor in alternative solution development and evaluation for preferred solution, with the purpose of reducing the plant's carbon footprint. Primary sludge thickening implementation is expected to provide significant benefits related to energy efficiency and greenhouse gas emissions by reducing digester heating requirements and increasing biogas production, which will increase the energy and heat production from the plant's cogeneration system.

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Appendix A
Technical Information

Appendix A-1
Technical Memorandum 2

Appendix A-2
Technical Memorandum 3

Appendix A-3
Technical Memorandum 4

Appendix A-4
Cultural Heritage & Archaeology

Appendix B
Community Engagement

Appendix C
First Nations Engagement

Appendix D
Communications

Appendix E
30-day Review Period