Utilities Kingston
Report to Environment, Infrastructure & Transportation Policies Committee
Report Number EITP-25-006

To:	**Chair and Members of the Environment, Infrastructure & Transportation Policies Committee**
From:	**David Fell, President & CEO, Utilities Kingston**
Resource Staff:	**Heather Roberts, Director, Water and Wastewater**
Date of Meeting:	**December 10, 2024**
Subject:	**Recommendation to Not Proceed with Kingston Regional Biosolids & Biogas Facility**

Council Strategic Plan Alignment:

Theme: 2. Lead Environmental Stewardship and Climate Action

Goal: 2.1 Reduce carbon footprint of City operations.

Goal: 2.2 Support climate action and sustainability for residents, businesses and partners.

Executive Summary:

Utilities Kingston (UK) manages, operates and maintains the City of Kingston's (City) wastewater treatment plants (WWTPs). The Ravensview and Cataraqui Bay WWTPs both have anaerobic digesters to process and treat the solid stream in wastewater to remove organic materials. This process produces biosolids and biogas. The biosolids are stabilized to meet the Ministry of Agriculture, Food and Agribusiness and Ministry of Rural Affairs Non-Agriculture Source Materials (NASM) standards, and are land applied for beneficial use. Biogas (methane and carbon dioxide gases produced by anaerobic digestion) is used to produce electricity for on-site use or in the boiler systems for heating. Excess biogas is flared.

In 2012, Utilities Kingston (UK) completed a preliminary and detailed design for the Cataraqui Bay WWTP following the completion of an Environmental Assessment to increase the average daily flow of the plant to accommodate growth. Following a value engineering workshop in 2014, the addition of a digester and the expansion of the digester control building was deferred because there was sufficient processing capacity to 2029.

From 2014 – 2016 Utilities Kingston completed research to examine the feasibility of optimizing biogas production as part of future planning for upgrades to the solids treatment process at the Cataraqui Bay WWTP. A holistic approach was taken to consider both plants and a wide range of options were examined to understand technologies available to increase biogas production and manage biosolids. An increase to biogas production was identified as a benefit in reducing GHG emissions which, at the time, may have qualified for funding through Ontario's Cap and Trade program.

In 2017 a consultant was hired to complete a Master Plan for Enhanced Biosolids Management and Biogas Utilization (Master Plan) to review long-term approaches and alternatives for biosolids and biogas at the City's WWTPs.

In October 2019, an information report on the Master Plan was provided to the Environment, Infrastructure & Transportation Policies (EITP) Committee (Refer to Report, EITP-19-011).

In 2020, the Master Plan was complete and a recommendation and preferred solution to "develop an integrated biosolids and source separated organics processing facility at a greenfield development site". The opportune site for consideration would be located within the property boundary of Knox Farm. Knox Farm is a city-owned property centrally located north of Highway 401 with access from Perth Road and close proximity to UK's main natural gas delivery pipeline into the City. The option of incorporating organic waste processing (organics from the City's Green Bin program) to produce a biogas was considered beneficial due to the potential reductions in corporate and community greenhouse gas emissions if biogas is produced and used locally as a replacement for petroleum natural gas or other fossil fuels.

The project aligned with the City of Kingston's Council Strategic Priorities (2019-2022) (Refer to Council Report 22-259 for end of Council term updates) to Demonstrate Leadership on Climate Action, as increasing the production and capture of biogases to produce renewable natural gas (RNG) has the potential to reduce greenhouse gas emissions. Specifically, Theme 1, Demonstrate Leadership on Climate Action included an objective to support attraction of renewable energy from waste. The intent of pursuing the preferred alternative was to investigate the feasibility of harnessing the biogas from the treatment of solids at the WWTPs, from the City's green bin organics program, and potentially from other organic wastes derived from residential and Institutional, Commercial and Industrial (IC&I) sectors. In addition, the project

aligned with the City of Kingston's Climate Leadership Action Plan, dated December 2021, specifically, Objective 6, Produce renewable natural gas locally from waste sources and encourage adoption of other low carbon fuels. As a committed partner to the City, Utilities Kingston identified continuing to investigate the feasibility of an integrated Biosolids and Source Separated Organics (SSO) processing facility in the UK 2021-2025 Strategic Plan with a specific initiative to complete the balance of the Municipal Class Environmental Assessment that considers the preferred solution from the 2020 Master Plan, finalize investigations and seek approvals.

In 2021, EITP approved a recommendation (Refer to Report, EITP-21-019) for UK to further investigate "the proposed use of the Knox Farm property for the development of an integrated biosolids and source separated organics facility." The recommendation cited the consent was "limited for the purpose of advancing Phase 3 "Alternative Design Concepts for the Preferred Solution" of the Municipal Class Environmental Assessment and other potential sub-investigations that may be necessary to determine feasibility, prior to a future decision of Council to use the site for this purpose."

In 2022, UK retained Dillon Consulting Limited (Dillon) to complete a Municipal Class Environmental Assessment (EA) to review the environmental, technical and financial feasibility of constructing the biosolids and biogas facility at the Knox Farm property. A notice of project commencement was issued in September 2023. Part of this work included invitations in 2023 and 2024 to public information sessions where visitors were able to view informational boards (2023 boards and 2024 boards) to learn about the project and ask questions of project representatives. Additionally, stakeholder and Indigenous community consultations, and updates to the Environment, Infrastructure & Transportation Policies (EITP) Committee were undertaken in 2023 (Refer to Report, EITP-23-002) and 2024 (Refer to Report, EITP-24-010).

In August 2024, Utilities Kingston issued a Notice of Completion of a Schedule 'C' Municipal Class EA and posted the Environmental Study Report (ESR) to the project's webpage. Interested persons and organizations were invited to review the ESR and provide written comments. The study process, recommendations and comments received during the mandated 30-day review period are documented in the Final ESR. A copy of the ESR is attached to this report as Exhibit A.

The ESR compared two design concepts that considered the natural, physical, socio-economic and cultural environments, along with financial and technical factors. Design Concept 1, which focused on maximizing resource recovery (i.e., production/capture of biogas and nutrient-rich biosolid) was recommended as the preferred alternative design concept (Preferred Concept). The Preferred Concept best aligns with technical performance factors, along with UK and the City's overall objectives to:

- have sufficient capacity to accommodate growth and process future wastewater sludge and green bin organics.
- produce a high-quality treated residual biosolid product for beneficial reuse.
- reduce the City's overall carbon footprint by processing and harnessing biogas from waste feedstocks managed by UK/City. This would be achieved by converting the biogas to a renewable natural gas (RNG) for injection into an existing natural gas pipeline, reducing petroleum natural gas.

As part of the EA, various technical studies were completed, and the evaluation methodology used a comprehensive set of criteria that considered potential impacts to the **natural** (vegetation, habitat, wildlife, species at risk), **physical** (water, air, noise, climate change), **socio-economic** (land-use and government policies), and **cultural** (Indigenous communities, heritage, archaeological) environments, along with proposed mitigation and monitoring measures deemed necessary to limit potential impacts. The ESR reported that there could be temporary localized nuisance from noise, dust and traffic during construction. However, overall, in adherence with the implementation of the recommended mitigation measures, no net effects were identified. The ESR also anticipated a net reduction in greenhouse gas emissions with the implementation of the Preferred Concept (also referred to as Design Concept 1) because of the production of renewable natural gas and its substitution for petroleum natural gas within the UK gas distribution system. However, the monetary investment required to generate the expected greenhouse gas reductions from the generation of renewable natural gas production is relatively high in comparison to other methods of GHG reduction available.

Based on the results of the ESR, the development of a Biosolids and Biogas facility at the Knox Farm property is considered to be technically viable; however, the high capital and operating costs raise concerns, reaffirming the need to investigate the economic feasibility of the project. Further details are provided in the Options/Discussion section of this report.

To complement the EA, in 2024, UK retained Ernst & Young LLP ("EY") to complete an economic evaluation and develop a business case for a Biosolids and Biogas facility at the Knox Farm property.

In October 2024, Utilities Kingston received the Biosolids and Biogas Facility Business Case (Business Case) that provided detailed findings and outcomes of a project delivery options analysis, market sounding, qualitative risk assessment and financial viability analysis. The Business Case projected a $5.1-to-$7.2-million-dollar annual net operating loss and identified risks associated with limited interest from external parties to partner on the project and uncertainty in the project's ability to secure additional organic waste feedstocks needed to increase biogas production. For the business to break even annually, $5.1 to $7.2 million dollars funded from property taxes or sewer rates (or a combination thereof) would be required.

Therefore, the project is **not** considered to be financially viable. Further details are provided in the Options/Discussion and Financial sections of this report.

UK recently developed a corporate Risk Appetite Statement as part of its Enterprise Risk Management program. Risk Appetite is “the amount and type of risk that an organization is prepared to pursue, retain or take”. Utilities Kingston’s Risk Appetite Statement describes its principles for making decisions that may impact one or more of its strategic outcomes including safety and the environment, infrastructure and asset integrity/reliability, people and culture, reputation and community relationship, growth, financial responsibility, customer experience and climate action. Relevant to considering the development of the Biosolids and Biogas Facility, UK does “accept that we must have a high appetite for uncertainty with respect to the manner of achievement of our climate action goals”. However, we’ve also identified that “organic growth initiatives, through the delivery of new, related services to current customers, will be pursued with a cautious approach within our internal capacity, to ensure predictable outcomes and realization of benefits … we will operate with a high degree of confidence in our ability to support growth…”. Further, we “will take justified financial risks within the bounds of our cashflow requirements and reasonable prudence”.

Based on the results of the EA, Business Case and reflecting on acceptable risk, Utilities Kingston regards the potential project as technically feasible but financially imprudent and an unreasonably high-cost option for achieving GHG reductions through biogas production. Therefore, UK is not recommending that investigations or the development of a Biosolids and Biogas facility at the Knox Farm property proceed further.

Recommendation:

That the Environment, Infrastructure & Transportation Policies Committee recommend to Council:

> **That** Council direct Utilities Kingston to not proceed with the development of a Regional Biosolids and Biogas Facility at the Knox Farm property.

Authorizing Signatures:

ORIGINAL SIGNED BY PRESIDENT & CEO, UTILITIES KINGSTON

David Fell, President & CEO,
Utilities Kingston

ORIGINAL SIGNED BY CHIEF ADMINISTRATIVE OFFICER

Lanie Hurdle, Chief
Administrative Officer

Consultation with the following Members of the Corporate Management Team:

Paige Agnew, Commissioner, Growth & Development Services	☑
Jennifer Campbell, Commissioner, Community Services	Not required
Neil Carbone, Commissioner, Corporate Services	Not required
Brad Joyce, Commissioner, Infrastructure, Transportation & Emergency Services	Not required
Desirée Kennedy, Chief Financial Officer & City Treasurer	☑

Options/Discussion:

Purpose

The purpose of this report is to provide information on the results of a Municipal Class Environmental Assessment (EA) and associated Business Case for a proposed Regional Biosolids and Biogas Facility at the City owned Knox Farm property and, based on the preceding, to provide a recommendation to not proceed with further development of the proposed project.

Context

Utilities Kingston (UK) manages, operates and maintains the City's wastewater treatment plants (WWTPs). WWTP locations, descriptions, processes and approvals are available in annual wastewater reports brought to City Council annually and posted on UK's website.

The main processes used at the Ravensview and Cataraqui Bay WWTPs, to clean wastewater prior to discharge back to the environment are:

- Screening and grit removal to take out untreatable materials;
- Settling of organic solid materials;
- Biological treatment to remove dissolved carbon and nutrients;
- Disinfection to remove pathogens; and
- Biosolids and biogas management.

Biosolids Management refers to the processing and handling of the settled organic solid material and material from the biological treatment processes. At both WWTPs, these materials are currently stabilized in anaerobic digesters to reduce odour, pathogens and mass. Anaerobic digestion (AD) is a biochemical process where microorganisms convert organic compounds into methane and carbon dioxide. The end products of the AD process are methane and carbon dioxide gases and a nutrient and carbon rich solid soil amendment that meets the Ministry of Agriculture, Food and Agribusiness and Ministry of Rural Affairs Non-Agriculture Source Materials (NASM) standards, and are land applied for beneficial use. The methane produced by the process is a potent greenhouse gas (GHG) which is either used to produce electricity for on-site use or in the boiler systems for heating or flared to reduce its GHG potential.

The City of Kingston provides a source separated organics (SSO) "Green Bin" program to all residential properties in the city to divert food wastes and other acceptable organic material from landfill. The Green Bin materials are processed at a contracted processing facility located on Joyceville Road. The Green Bin organics are processed using an aerobic process that produces an A or AA compost.

Alternative methodologies for the management of WWTP solids and Green Bin materials, and the capture and utilization of biogas are available. Specifically, there are technologies capable of upgrading biogas into renewable natural gas. Renewable natural gas (RNG) can be used as a substitute for petroleum natural gas. Using RNG in place of petroleum natural gas can assist communities in reducing their net GHG emissions and contribute to the use of a local clean fuel.

Background

In 2012, Utilities Kingston (UK) completed preliminary and detailed designs for the Cataraqui Bay WWTP following the completion of an Environmental Assessment to increase the average daily flow of the plant to accommodate for expected growth. Following a value engineering workshop in 2014, the recommended addition of a digester and the expansion of the digester control building was deferred because there was sufficient processing capacity to 2029.

Through 2014 – 2016 UK completed research to examine the feasibility of optimizing biogas production as part of future planning for upgrades to the solids treatment process at the Cataraqui Bay WWTP. A holistic approach was taken to consider both plants and a wide range of options were examined to understand technologies available to increase biogas production and manage biosolids. An increase to biogas production was identified as a benefit in reducing operational GHG emissions which, at the time, may have qualified for funding through Ontario's Cap and Trade program.

In 2017 a consultant was hired to complete a Biosolids Management and Biogas Utilization Master Plan (Master Plan). The Master Plan developed the following Problem/Opportunity statement, identified and assessed alternative solutions to address the defined Problem/Opportunity, and developed a preferred solution.

"UK is presently positioned to address both the enhancement of the management of the biosolids generated at the Cataraqui Bay and Ravensview WWTPs, and to consider the introduction of the co-digestion of these solids streams with waste organics both collected by the City and generated by the IC&I sector. This opportunity has arisen, in part, from the developments in Ontario regarding:

- The consideration of wastes as resources within the context of a circular economy;
- The increased interest in the province for the more effective management of waste organics with the objective of eliminating the landfilling of these materials; and
- The identification of opportunities for the generation and utilization of RNG thereby reducing the City's carbon footprint."

For the purposes of the Master Plan, the undertaking was described as:

"The enhancement of the production of biogas through enhancements to the biosolids processing trains at the City's two WWTPs and including the possible co-digestion of the biosolids and waste organics both collected by the City as SSO and generated by facilities in the IC&I sector."

From 2017 – 2020 work to complete the Master Plan continued.

- In 2018, with the City's permission and funding (Refer to Council Report 18-048), the scope was expanded to consider the co-digestion of WWTP solids and Green Bin organics, along with potential organics generated by the institutional, commercial and industrial (IC&I) sector. The rationale to expand the scope was based on Ontario's commitment to build a circular economy that views 'waste' as a valuable resource with an objective to eliminate landfilling of food wastes, along with the opportunity to enhance the generation of biogases if food wastes are co-digested with WWTP solids.
- In 2019, Utilities Kingston provided an information report to the Environment, Infrastructure & Transportation Policies (EITP) Committee, titled, Kingston Biosolids and Biogas Master Plan, Report Number EITP-19-011. This report provided an update on the work, highlighted the alignment with the City's declaration of a Climate Emergency, Council's Strategic Priorities, and identified several options as well as details on a preliminary preferred option. In addition, the report identified an upcoming Public Open House to share information on the project.
- Also in 2019, the newly elected City Council had set forth Council Strategic Priorities for their term (2019-2022). Specifically, Theme 1, Demonstrate Leadership on Climate Action included an objective to support attraction of renewable energy from waste. This aligned with the project, as the intent of the Master Plan was to determine a preferred solution to manage biosolids and enhance the utilization of biogas, plus an expanded scope to consider co-digestion of the WWTP solids with Green Bin organics.
- In January 2020, UK hosted a public information session. Notice of the information session was advertised on UK's website and social media streams. The session included a presentation of the options and preferred solution. Members of the public were invited to provide feedback.

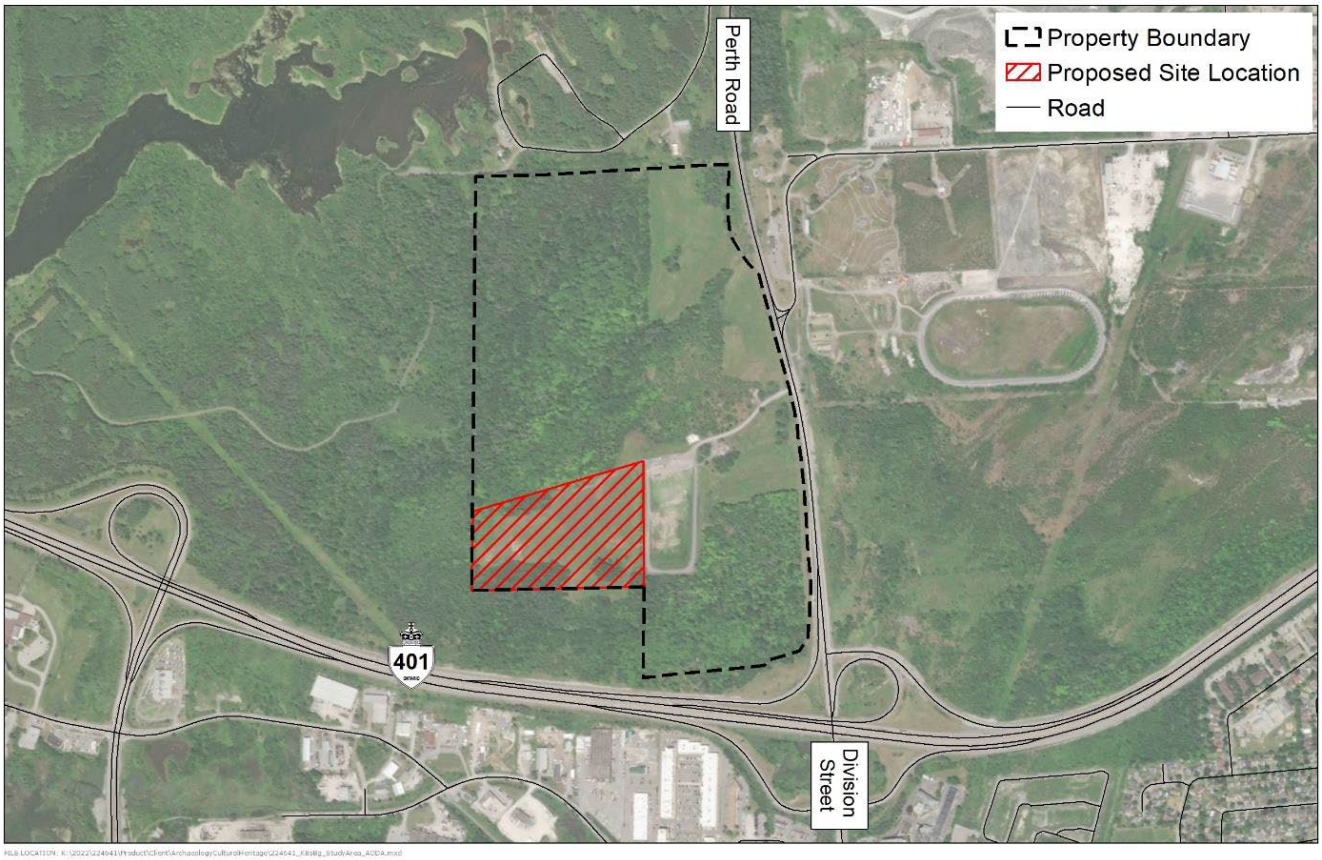
The Master Plan for Enhanced Biosolids Management and Biogas Utilization was completed in July 2020 identifying a recommendation and preferred solution to "develop an integrated biosolids and source separated organics processing facility at a greenfield development site. The opportunity site for consideration would be located within the property boundary of Knox Farm." The option of incorporating organic waste processing to produce a biogas was considered beneficial due to the potential reductions in greenhouse gas emissions if biogas is produced, upgraded to renewable natural gas (RNG) and used as a replacement for petroleum natural gas or other fossil fuels.

On August 25, 2020, Notice of Completion of the Master Plan was issued. Members of the public were invited to review the documents and provide comments back by September 24, 2020. No comments were received.

In 2021, EITP approved a recommendation (Refer to Report, EITP-21-019) for UK to further investigate "the proposed use of the Knox Farm property for the development of an integrated biosolids and source separated organics facility." The recommendation cited the consent was "limited for the purpose of advancing Phase 3 "Alternative Design Concepts for the Preferred Solution" of the Municipal Class Environmental Assessment and other potential sub-investigations that may be necessary to determine feasibility, prior to a future decision of Council to use the site for this purpose."

In 2022, UK retained Dillon Consulting Limited (Dillon) to conduct a Schedule C Municipal Class Environmental Assessment (EA) that builds on the 2020 Master Plan and progresses to complete Phase 3 and Phase 4 of the EA process to examine the potential for developing a regional integrated biosolids and source separated organics (SSO) processing facility at a City-owned property, referred to as the Knox Farm property. The facility would aim to process organic wastes from the City's wastewater treatment plants (WWTPs) and the Green Bin organics program operated by the City, as well as other potentially suitable streams of waste from local or regional sources to produce renewable natural gas from biogases and other beneficial solid resources.

Knox Farm is a municipally owned property centrally located off of Perth Road, northwest of the Highway 401 and Division Street interchange in the City, and adjacent to Little Cataraqui Creek Conservation Area. The Knox Farm property covers nearly 75 hectares, of which 9.3 hectares is a former sediment dewatering facility that previously held an Environmental Compliance Approval (ECA) but is now decommissioned. A portion of the property is currently in use as a municipal snow management facility with plans to continue as such. The Knox Farm property is in close proximity to the main natural gas delivery pipeline into the City that runs on Perth Road and as such, presented an opportunity for easy introduction of any produced renewable natural gas into the existing gas distribution system. The figure below shows the overall Knox Farm property boundary and the boundary of the portion of the site that was considered for the potential development of a biosolids and biogas facility (Proposed Site Location).



From summer to December 2022, Dillon undertook a reconfirmation exercise of Phases 1 and 2 as well as the Knox Farm Suitability Report prior to advancing Phases 3 and 4 of the EA process. The reconfirmation exercise confirmed the Problem/Opportunity statement, original Phase 2 alternative solutions and considered the opportunity of using the Knox Farm property as the potential site to host the development of a biosolids and biogas facility. During the suitability assessment multiple technical disciplines conducted assessments to understand the existing conditions of the Proposed Site Location to determine if the site would be suitable for the proposed facility. Relevant City departments and outside agencies were consulted for technical input into the various site suitability studies. The assessments did not identify any major barriers to the development of the proposed biosolids and biogas facility at the Knox Farm property.

In February 2023, UK staff provided an informational update report to EITP, “Information Update on the Kingston Regional Biosolids and Biogas Facility Municipal Class Environmental Assessment” (Refer to Report Number EITP-23-002), and in March 2023 UK advertised and

hosted a Public Information Session and presented a number of visual information boards to attendees who were encouraged to ask questions and provide feedback to the project team.

A notice of project commencement was issued in September 2023.

In February 2024, UK staff provided an informational update report to EITP, "Update on the Municipal Class Environmental Assessment for the Kingston Regional Biosolids and Biogas" (Refer to Report Number EITP-24-010), and in March 2024, UK advertised and hosted a Public Information Session and presented a number of visual information boards to the attendees to provide background information and details on the preferred alternative design concepts.

Also, in late 2023 and early 2024, focused information sessions and discussions took place with the Ministry of the Environment, Conservation and Parks (MECP), Cataraqui Region Conservation Authority (CRCA), Alderville First Nations and the Ministry of Transportation. The purpose of these sessions was to provide an overview of the project, share preliminary technical results and details on the alternative design concepts, and facilitate discussion.

In August 2024, Utilities Kingston issued a Notice of Completion of a Schedule 'C' Municipal Class Environmental Assessment and posted the Environmental Study Report (ESR). Interested persons were invited to review the ESR and provide written comments. The study process, recommendations and comments received during the 30-day review period are documented in the Final ESR. Discussion on the EA is provided below. A copy of the ESR is attached to this report as Exhibit A.

To complement the EA, in 2024, UK retained Ernst & Young LLP ("EY") to complete an economic evaluation and develop a business case for a biosolids and biogas facility at the Knox Farm property.

In October 2024, UK received the Biosolids and Biogas Facility Business Case (Business Case) that provided findings and outcomes of a project delivery options analysis, market sounding, qualitative risk assessment and financial viability analysis. Discussion on the Business Case is provided in the Options/Discussion section of this report.

Analysis

Municipal Class Environmental Assessment

The Municipal Class Environmental Assessment (EA) process is a regulated requirement for municipal projects that provides for a systematic evaluation of alternatives in terms of their advantages and disadvantages to determine potential environmental effects of a project/development and identify where mitigation of effects is needed. Criteria are chosen

based on conformance to Class EA requirements and their ability to identify positive and negative impacts of each alternative and distinguish the advantages and disadvantages between them. Notice of project commencement, completion and a 30-day public review period are required. The results of the EA, including information, feedback and comments collected during public consultation are compiled into an Environmental Study Report (ESR).

This work is referenced as the MCEA, EA and/or ESR throughout this report.

In 2022, UK retained Dillon to complete a Schedule C Municipal Class EA to review the environmental, technical and financial feasibility of constructing the biosolids and biogas facility at the Knox Farm property. Dillon's project work plan consisted of the following steps:

- Step 1: Review the 2020 Master Plan for Enhanced Biosolids Management and Biogas Utilization and complete a suitability assessment of the Knox Farm property prior to formally initiating the EA.
- Step 2: Proceed with public consultation and potential vendor engagement as it relates to the facility and considerations identified for the Knox Farm property.
- Step 3: Formally initiate the EA process to develop and evaluate alternative design concepts for the facility and assess the relative social, environmental and financial implications of each in relation to the project objectives. Complete final ESR.

Step 1

Dillon completed a high-level review of the 2020 Master Plan, and initiated consultation with potential organic waste feedstock suppliers in the regional IC&I sectors to gauge interest from the community. The following was noted:

- The problem and opportunity statement developed in the 2020 Master Plan describing the project's rationale and purpose was reconfirmed.
- A survey was circulated to nearly forty organizations including nearby municipalities, institutions, food and beverage companies and local breweries to gauge interest and potential availability of alternative organic waste feedstocks for the proposed facility. This would help refine the design to be used as the basis for the Class EA.
- Wet anaerobic digestion (AD) of biosolids and organics wastes was reconfirmed as an appropriate treatment technology to carry forward in the review of alternative design concepts.

- The preferred alternative to develop a dedicated facility to manage WWTP solids, the City's residential SSOs and other organic feedstocks was reconfirmed as the only alternative capable of meeting all the project objectives. It is noted that other alternatives from the 2020 Master Plan considered upgrades at one of the existing WWTP sites with or without SSOs and/or other feedstocks. The primary reason for discounting other alternatives was the lack of space at existing WWTP sites to expand facilities for the acceptance and processing of the biosolids, SSOs and other organic feedstocks needed to maximize biogas production.

The following considerations were highlighted by Dillon as it relates to further investigating the feasibility of the Preferred Solution at the Knox Farm property:

- "Operation with SSO volumes at present levels generated from the City's own Green Bin program may be better suited to a variant of Alternative 4 (i.e., upgrades at the Cataraqui Bay WWTP site), with SSO pre-processing located at an offsite facility" but agreed that "siting proposed in Alternative 4 does not align with the project objective of developing a site with the capacity to accept organic waste from a variety of Kingston and regional stakeholders."
- The success of the preferred alternative relies on UK's ability "to secure substantial, reliable supplies of SSO and other organic feedstock streams from local industrial and commercial establishments and neighbouring municipalities."
- "UK should anticipate competition for SSO and organic feedstock material from private sector processors, who can aggregate supplies from many diverse generators to manage risk and offer lower tipping fees. This presents a risk that the overall tonnages processed at the facility, and the tipping fees received, may be lower than anticipated or required to sustain facility operations."
- The acceptance of woody or brush materials in the City's green bin program can be problematic to wet AD systems if received in excess. As such, they would either need to be removed as residue during pre-processing (ultimately being sent to landfill or other end uses), or not permitted to be accepted into the City's Green Bins.
- The design basis for the facility will need to be re-developed as Dillon has identified opportunities to refine the approach used during the 2020 Master Plan (e.g., percentage of solids hauled from WWTPs to facility, feedstock quantity projections and planning horizon, existing sludge generation rates).
- Cost estimating during the Class EA may deviate from that considered during the 2020 Master Plan based on various comments/observations offered by Dillon.

Dillon also completed a combination of desktop and field assessments of the Knox Farm property to assess its suitability for housing a facility of this nature. The review included the following major components:

- Proposed site location description, including a review of the City's Official Plan land uses on and around the property;
- Baseline air quality assessment;
- Stage 1 Archaeology assessment of the entire property;
- Preliminary hydrogeology assessment of the proposed site location, including boreholes to bedrock, the development of shallow aquifer wells to assess groundwater quality and activity (to assess contamination and construction dewatering requirements) as well as a desktop review of nearby deep aquifer well records for potable water use;
- Natural environment study, including desktop observations of the entire property and a field assessment of the proposed site location;
- Baseline noise assessment;
- Preliminary site servicing assessment;
- Stormwater management assessment including desktop observations of the entire property and a field assessment of the proposed site location; and a
- Preliminary traffic assessment along Perth Road and at major nearby intersections, including updated traffic counts.

Consultation of the various components was undertaken with relevant city departments and outside agencies as part of the site suitability assessment.

Overall, Dillon indicated that "no major barriers were identified for Knox Farm as a potential location for the proposed facility".

Step 2

A public information session to inform the public of the results of the Knox Farm Suitability Assessment took place in March 2023. The Knox Farm Suitability Assessment report is available on the project website in four parts (part 1, part 2, part 3 and part 4). Refer to these display boards for information on what was presented to the public.

Utilities Kingston released a Request for Information (RFI) entitled *Request for Information (UK 23-17) for Prospective Vendors for the Kingston Regional Biosolids and Biogas Facility*. The

intent of the RFI was to solicit information from qualified anaerobic digestion vendors and seek feedback on the ability to develop the proposed Preferred Solution on the Knox Farm property.

Vendor submissions were summarized and compared to understand available technology that reflects the existing marketplace. Information gathered from these submissions were used to assist with the development of the alternative design concepts.

Step 3

A notice of project commencement was issued in September 2023.

Step 3 of Dillon's work was to complete Phases 3 and 4 of the EA process and involved the development and evaluation of two alternative design concepts and identification of a preferred design concept.

Two alternative design concepts were developed, both located at the Knox Farm property within the Proposed Site Location. A multidisciplinary assessment of each alternative was undertaken to determine the potential effects of the proposed facility and methods to mitigate its impact on the environment. The two design concepts were assessed based on evaluation criteria and compared to each other to determine the preferred option.

The alternative design concepts were developed with consideration of the following overall Project goals:

- Sufficient capacity to process future wastewater sludge loadings and City Green Bin organic waste;
- Production of a treated residual product for beneficial reuse (agricultural); and
- Reduction in the City's overall carbon footprint through the production of biogas and conversion to renewable natural gas (RNG).

The Project goals were derived from common goals, priorities, and initiatives identified in City and UK local planning documents, particularly the Utilities Kingston Strategic Plan, City of Kingston Strategic Plan, and City of Kingston Climate Leadership Plan.

The technical performance features were derived from materials obtained through the vendor engagement process (Step 2) and were used as the main distinguishing factors between the

concepts. Key technical process features which may differ between alternatives were first identified to guide the development of alternative design concepts. These features included:

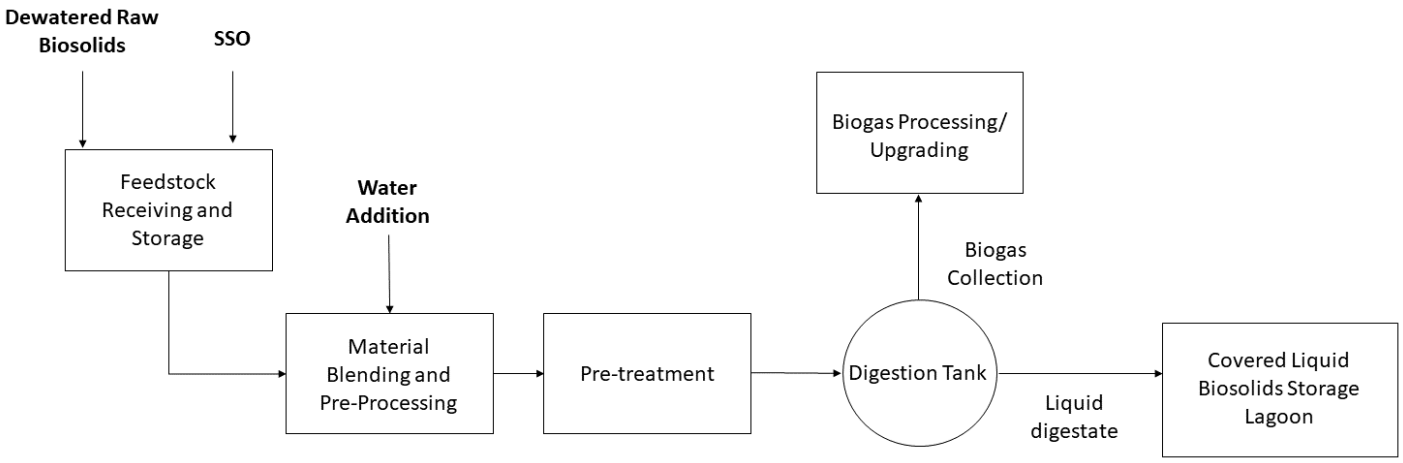
1. Type of feedstock preparation required.
2. Presence or absence of pre-conditioning steps (i.e., such as thermal hydrolysis) prior to digestion.
3. Core digestion process type.
4. Biogas treatment and utilization.
5. Form of biosolids product (i.e., liquid, semi-solid, dry powder, pellets).

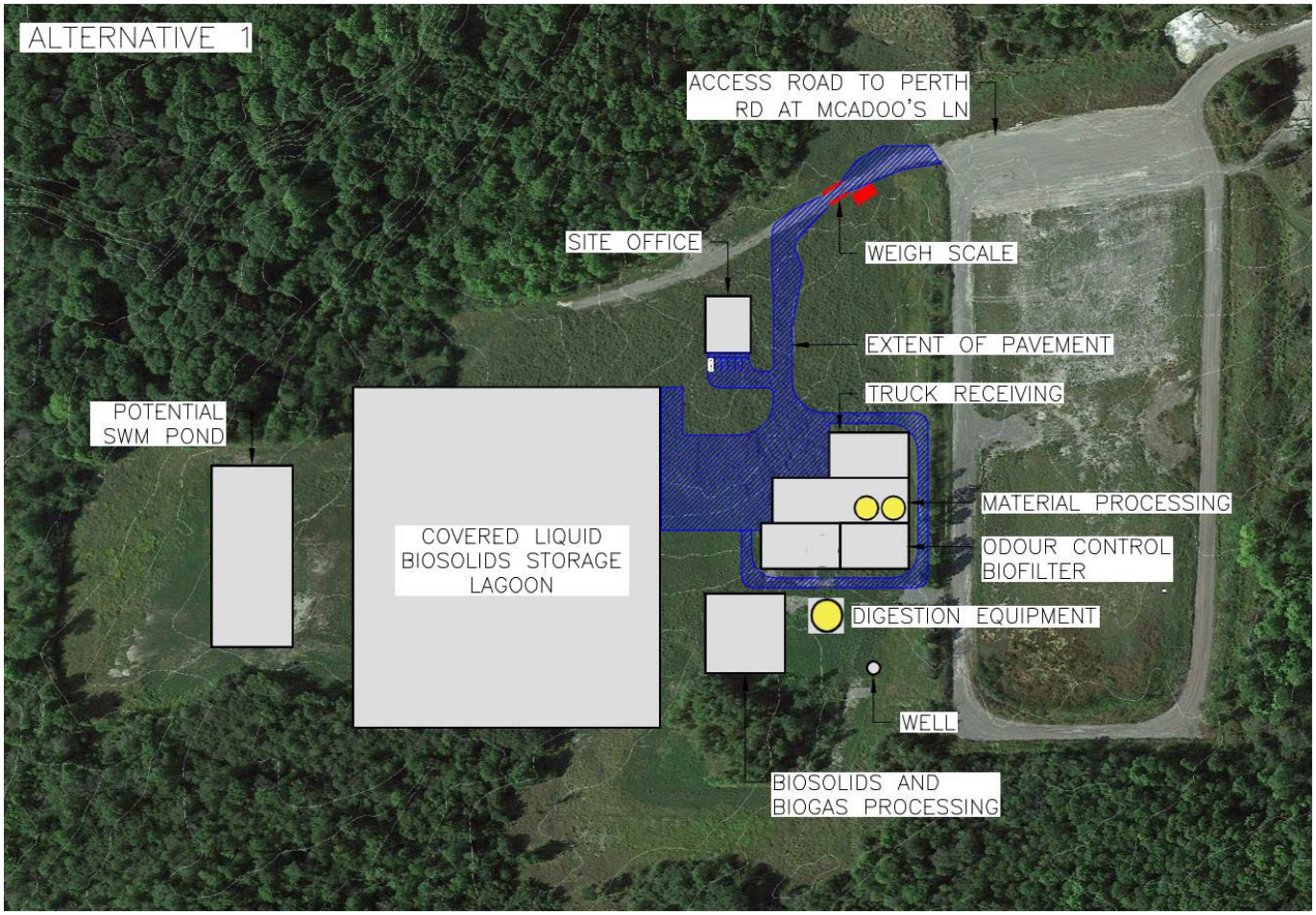
Based on the above features it was determined that features 2 and 5 were meaningful differentiating factors that could be evaluated and compared.

Focusing on technical distinctions between features 2 (pre-conditioning) and 5 (final biosolids product), at a high level, the following two design concepts were selected:

1. Alternative Design Concept 1: Focus on maximizing resource recovery. Concept 1 was based on prioritizing the generation of RNG for revenue and GHG benefit and biosolids residuals with an emphasis on retaining nutrient value for beneficial reuse in agriculture. Features of this alternative may require additional utility use for feedstock pre-treatment to improve and maximize biogas generation, compared to simpler alternatives without pre-conditioning. Unique and key features of Concept 1:
    a. Greatest potential to reduce community GHG emissions;
    b. Incorporation of pre-treatment of feedstock to maximize biogas generation.
    c. Production of a liquid biosolids end-product, which minimizes wastewater treatment demands and retains maximum nutrients for beneficial reuse.
    d. When considering only full truck round trips, 27 trucks would access the site daily, including 17 inbound containing sludge and 10 outbound containing liquid biosolids.
    e. Estimated capital cost of $71.1 million dollars.
    f. Estimated net annual operating cost of $2.16 million dollars.

Design Concept #1

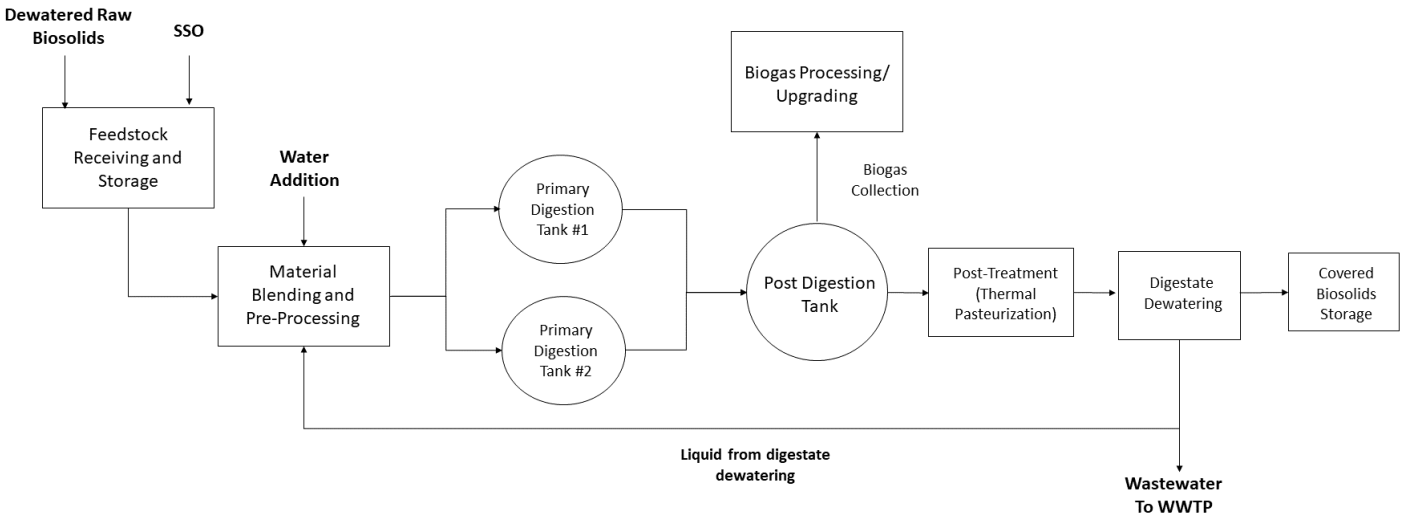


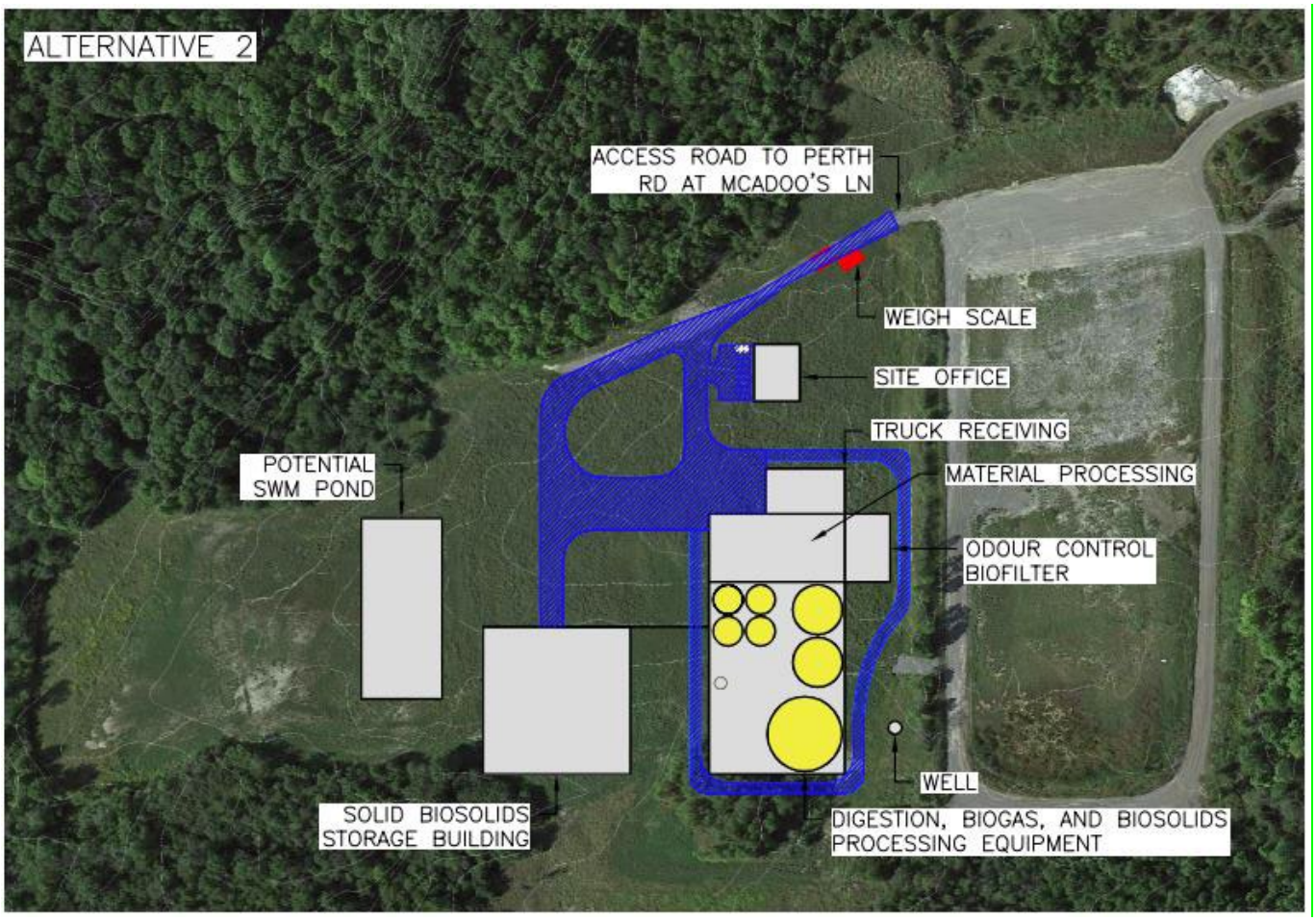


2. Alternative Design Concept 2: Focus on minimizing utility demands and residuals volume. Concept 2 was based on prioritizing simplicity of operation, reduced utility usage (i.e., no energy requirements to pre-treat) and the production of a lower volume biosolids product requiring less storage space and fewer trucks to transport to end-use. Unique and key features of Concept 2:
    a. No feedstock pre-treatment, which minimizes energy requirements.
    b. Dewatered biosolids end-product, minimizes onsite storage and trucking. This alternative would generate centrate liquids (liquids created when residuals are centrifuged) that cannot be treated on-site and would have to be trucked to a WWTP for treatment. Some centrate may be reused onsite for blending with incoming feedstock.

c. When considering only full truck round trips, 28 trucks would access the site daily, including 18 inbound containing sludge and 10 outbound containing process wastewater.
d. Estimated capital cost of $84.9 million dollars.
e. Estimate net annual operating cost of $1.35 million dollars.

Design Concept #2





Key similarities between Concepts 1 and 2:

- Both have similar potential impacts to groundwater and surface water, in terms of the potential risk of spills from digestion tanks and/or biosolids storage that could result in contamination. These potential impacts can be mitigated through conventional design and operational considerations.
- Both are anticipated to meet applicable noise limits to prevent impacts to neighbours.
- Both have minimal potential for negative impacts to archaeological and cultural heritage resources.
- Both concepts are consistent with provincial and local policies, and both would likely require land-use planning approvals.

- Both concepts include anaerobic digestion of wastewater biosolids and SSO wastes which is a proven technology with a long design life and well-established vendors to supply.
- Both concepts assume the generation and collection of biogas for upgrading and beneficial reuse as RNG.
- Both concepts require building ventilation and odour control. Odour mitigation strategies that are expected to be effective in mitigating odour impacts to nearby properties are available.
- Both concepts require trucking of feedstock to the facility and trucking to remove and beneficially reuse residual materials.

Key differences between Concepts 1 and 2:

- Due primarily to storage of liquid biosolid feedstock, Concept 1 has a larger footprint and larger scope of civil works that will result in higher requirements for tree and vegetation removal and corresponding loss of terrestrial habitat.
- Concept 1 is expected to be a more energy intensive operation due to the feedstock pre-conditioning requirement with corresponding impact on operating costs and emissions.
- Concept 1 is expected to yield a significantly higher biogas production resulting in higher potential revenues and a larger net reduction in GHGs downstream through substitution of RNG for petroleum natural gas or other fossil fuels.
- Concept 1 includes a concentrated liquid biosolids residual that is expected to retain a higher nutrient value and be a more favourable product for agricultural applications.
- Concept 2 is expected to have comparatively higher odour generation potential from the storage of biosolids in a solid form, compared to liquid biosolids in concept 1 that would be contained within a covered lagoon.

Details further describing the features of the design concepts, along with advantages and disadvantages are available in Section 5 of the ESR.

To expand on the financial analysis of the two Design Concepts, Dillon hired Watson Associates as part of the EA to complete an overall lifecycle cost estimate for each concept for the years 2030 through 2060 that included capital and operating costs, biogas revenues and an annual allowance for future capital replacement. The net present value of each concept was calculated and presented in 2024 dollars by applying a discount rate of 5 per cent. When a biogas revenue

equal to the present UK rate for natural gas was assumed, the net present value lifecycle of the two Design Concepts was generally comparable, with the overall lifecycle for Design Concept 2 being approximately 4.3 per cent less than Design Concept 1. However, when a higher revenue rate was used (more in line with actual/expected revenue for RNG), the net present value lifecycle cost decreased for both concepts, ultimately resulting in Design Concept 1 having a 1.5 per cent lower net present value than Design Concept 2. The complete analysis is provided in Appendix D in the ESR.

As stated above, the purpose of the evaluation process was to identify the potential impacts and advantages of the Design Concepts to determine which Design Concept should be carried forward. A detailed evaluation matrix with scoring, applying the six criteria categories with associated criteria is provided in Appendix E of the ESR.

The table below provides a summary of the evaluation of the Design Concepts 1 and 2:

Evaluation Criteria	Design Concept 1	Design Concept 2
Natural Environment, such as, potential impacts to vegetation/trees, terrestrial habitat and wildlife, fisheries/aquatic habitat and wildlife and species at risk (SAR).	Somewhat Preferred	More Preferred
Physical Environment, such as, potential impacts to groundwater, surface water, area drainage, climate change (i.e., greenhouse gas emissions), noise, vibration, air quality and odour.	Somewhat Preferred	Somewhat Preferred
Socio-economic Environment, such as, land-use, consistency and conformance with local, provincial, and federal policies, including provincial policy statement, City Official Plan, Kingston Climate Leadership Plan, Ontario Resource	Somewhat Preferred	Somewhat Preferred

Evaluation Criteria	Design Concept 1	Design Concept 2
Recovery and Circular Economy Act and nuisance to community.		
Cultural Environment, such as, potential impacts to heritage and archaeological resources and indigenous communities and resources.	Most Preferred	Most Preferred
Financial Factors, such as, capital, operating and maintenance costs, lifecycle costs and revenue.	Somewhat Preferred	Somewhat Preferred
Technical Factors, such as, construction, process and maintenance complexities, biogas production, expandability, servicing, wastewater treatment, residual volume and nutrient content, proven technology, including design life.	More Preferred	Somewhat Preferred

In general, if the concept had lower negative impacts/higher benefits it was deemed most/more preferred or preferred. If it had moderate impacts and benefits it was considered somewhat preferred.

Most of the evaluation criteria, except for Natural Environment and Technical factors resulted in equal scoring. With all criteria considered, the final evaluation of both concepts was comparable. Therefore, a recommended alternative was identified by considering UK and the City's overall Project goals. Based on the overall evaluation process, including the Project goals, Dillon recommended Design Concept 1 as the preferred alternative design based on the following factors:

- Greater contribution towards achieving UK and the City's climate action leadership goals.
- It was not expected to generate wastewater requiring treatment at a WWTP.
- Higher amount of biogas generated.

- Increased revenue from the sale of RNG.
- More attractive liquid biosolid product for beneficial reuse as agricultural fertilizer.

In-keeping with the EA process, as the preferred alternative, a further in-depth evaluation of Design Concept 1 was undertaken. Additional stormwater, noise, air, traffic and GHG assessments were carried out to refine the concept which assessed the potential impacts and identified mitigation measures.

A vision for the project was to consider regionalization; serving the broader community and accepting WWTP solids, SSO and other organic wastes beyond the quantities currently managed by UK and the City. This would potentially allow for increased RNG production and therefore higher GHG reductions. Although there was interest from organizations, a conservative approach using only tonnages of wastes that the UK or the City manages today were used in the evaluation.

A noise assessment was completed to determine the potential noise impacts associated with the proposed facility at nearby sensitive receptors under a predictable worst-case operating scenario. This was to determine compliance with the applicable MECP publication NPC-300 Environmental Noise Guideline – Stationary and Transportation Sources – Approval and Planning, 2013. Sensitive receptors included residences, hotels/motels, campgrounds, schools, libraries, daycares, hospitals, clinics, nursing and retirement homes, churches and places of worship. Representative Point of Receptions (PORs) within 1km of the proposed facility were selected and assessed. The findings of the noise assessment indicated that when operating under a predictable worst-case scenario, the proposed facility's noise sources are anticipated to comply with the applicable criteria.

An air assessment was completed to determine the potential for air quality impacts associated with the proposed facility. Nitrogen oxides, carbon monoxide, sulphur dioxide, particulate matter, hydrogen sulphide and odour were expected to have the highest potential for impacts and were selected as the indicator compounds. The predicted impact of emissions was calculated using the air dispersion model AERMOD version 22112, and were compared against the criteria for air quality in Ontario established in Ontario Regulation 419/05 Air Contaminant Benchmark and in Ontario's Ambient Air Quality Criteria (AAQC) which is commonly used in environmental assessments across the province. The assessment included a combination of background air quality for the region and the contribution of the expected air emissions from the facility on the atmospheric environment. The predicted impacts were determined at discrete receptors, such as homes, hotels, walking trails, etc. The air quality assessment demonstrated that the proposed facility could be designed to meet relevant air quality criteria and could operate under the relevant Ontario Regulation 419/05.

A traffic assessment was completed following the MTO Traffic Impact Assessment guidelines. Three future horizon years were assessed; 2030 corresponding to when the proposed facility would first begin operation, 2035 corresponding to 5-years after the start of operations and 2040 corresponding to 10-years after the start of operations. The assessment recommended minor modifications to turning lanes and signal improvements.

A GHG assessment was completed for the existing conditions (continuing to manage wastes status quo) compared to expected conditions under Design Concept 1. The GHG assessment compared the total emissions estimate for the new facility against the emissions profile of the existing wastewater treatment and SSO processing operations and included the impact of renewable natural gas production and its substitution for petroleum natural gas. With anticipated feedstock quantities and RNG production estimates for 2030 and 2060 the net annual reductions in GHG emission from Alternative Design Concept 1 were 2,697 and 3,797 tonnes eCO2 respectively, For comparison, the annual reduction in GHG emissions expected from the replacement of one diesel transit bus with one electric bus is roughly 120 tonnes. The results of the GHG assessment showed that a modest reduction in GHG emissions could be expected from the Alternative Design Concept 1 and that increases in feedstock and RNG production quantities would create increased GHG reductions.

Full evaluation details for Design Concept 1, including a table identifying potential impacts with mitigation measures are provided in Section 7 of the ESR.

Public Consultation

A comprehensive public and stakeholder consultation program was undertaken as part of the Class EA project. A public information session was hosted by UK and Dillon in March 2023 to inform the public of the results and findings from the Knox Farm Suitability Report and to seek feedback before the EA was formally initiated. A second public information session was hosted by UK and Dillon in March 2024 to provide the public with information on the alternative design concepts and present a preliminary preferred alternative. Feedback received by the public included the following:

- Concerns about the cost to tax and utility rate payers
- Interest in understanding potential provincial and federal funding
- Concerns about odours, air quality and contamination
- Concerns about processes and requesting clarification on the difference between managing/processing the wastes versus landfilling
- Interest in reason for the project
- Interest in making sure other people know about the project
- Interest in organic waste feedstocks and collaboration with other communities

- Concerns about agricultural land application of residual biosolids
- GHG emissions and questions about required trucking
- Concern about the location of the facility being adjacent to Little Cataraqui Conservation Area
- Questions about blending RNG and natural gas together in the same pipeline
- Questions about whether or not anaerobic digestion is a proven and used technology in Ontario

Additional targeted consultation activities took place that included the following:

- Maintenance of a project contact list to provide notifications to interested parties
- A Notice of Project & Opportunity for Consultation was circulated to the 15 Indigenous Communities in November 2022, and the project team continued to send notices about the information sessions
- Dedicated consultations with Huron-Wendat First Nation and Alderville First Nation
- Dedicated meeting with the City's Transportation Services Department
- Dedicated meeting with the Ministry of the Environment, Conservation and Parks
- Dedicated meeting with Cataraqui Region Conservation Authority
- Dedicated meeting with Ministry of Transportation

A 30-day public review period commenced on August 13, 2024, at the time of issuing the Notice of Completion.

Full details on the outcomes and feedback received, including results from public surveys are available in Section 6 of the ESR and Appendix F of the ESR available in various parts on the project website.

In response to the number of comments received, on October 15, 2024 UK posted a Comment Response Table on the project website.

Business Case

A Business Case explores the economic feasibility of a project.

To complement and follow up on estimated capital and operating costs of the project identified within the EA, in 2024, UK retained Ernst & Young LLP ("EY") to complete an economic evaluation and develop a business case for a biosolids and biogas facility at the Knox Farm property. The Business Case explored the economic feasibility of the preferred alternative, Design Concept 1, with the capability to receive, combine and process WWTP solids and Green

Bin materials to generate a renewable natural gas and liquid biosolid residual. The assessment considered non-traditional ownership and operating models between industry and municipalities.

The Business Case summarized the background definition of the project and provided details and outcomes of a project delivery options analysis, market sounding, qualitative risk assessment and financial viability analysis for Design Concept 1. The results from key components of the Business Case are included in the sections below.

Project Delivery Options Analysis Summary

The objective of the project delivery options analysis was to assess and evaluate various potential ownership, operating and procurement/delivery options for the project. Exhibit B includes details and illustrations for the various procurement/delivery options. The following options were reviewed and assessed with regards to alignment with the priorities and needs for the successfully delivery of the project:

- Design-Bid-Build (DBB)
- Construction Management (CM)
- Construction Management At-Risk (CM-AR)
- Integrated Project Delivery (IPD)/Alliance
- Design-Build (DB)
- Progressive Design-Build (P-DB)
- Progressive Design-Build-Finance (R-DBF)
- Design-Build-Finance (DBF)
- Progressive Design-Build-Finance-Maintain (P-DBFM)
- Design-Build-Finance-Maintain (DBFM)
- Progressive Design-Build-Finance-Operate-Maintain (P-DBFOM)
- Design-Build-Finance-Operate-Maintain (DBFOM)
- Design-Build-Operate-Maintain (DBOM)
- Private Delivery (PD)

For reference, the City's and UK's usual and traditional project delivery model is Design-Bid-Build.

Using a multi-criteria analysis and collaborative workshop approach, a shorter list of delivery options was developed along with weighted evaluation criteria that were based on the City's and UK's strategic objectives for the project. The following table identifies project delivery options, evaluation criteria and the weighting for each (3 being the most important), along with the scores assigned.

Evaluation Criteria	Weighting	Design-Bid-Build	Construction Management	Construction Management At-Risk	Integrated Project Delivery	Design-Build	Design-Build-Finance-Maintain	Design-Build-Finance-Operate-Maintain
Internal Capacity to Deliver	1	4	2	2	3	2	2	2
Minimize administrative complexity before contract award	2	4	4	3	2	4	2	2
Minimize administrative complexity post award	2	4	4	4	4	5	2	5
Schedule certainty	2	2	3	3	4	4	5	5
Construction cost certainty	3	3	3	3	3	4	5	5
Maximize procurement competition	1	5	5	5	3	5	2	3
Optimal post-construction / operational performance	3	4	4	4	4	4	4	4
Optimal allocation of market risks	3	1	1	1	2	1	1	5
Asset quality and longevity	1	4	4	4	4	4	5	5

Evaluation Criteria	Weighting	Design-Bid-Build	Construction Management	Construction Management At-Risk	Integrated Project Delivery	Design-Build	Design-Build-Finance-Maintain	Design-Build-Finance-Operate-Maintain
Minimize time to completion	2	3	3	3	2	4	4	5
Total Weighted Score		**34**	**33**	**32**	**31**	**37**	**32**	**41**

Description of the Scoring:

1- Minimally meets requirements of the Project
2- Meets some of the requirements of the Project
3- Adequately meets the requirements of the Project
4- Provides a good solution for the Project
5- Provides a highly efficient and effective delivery solution for the Project

The Design-Bid-Build, Design-Build and Design-Build-Finance-Operate-Maintain options were shortlisted as the highest scoring options with highest degree of alignment with the City's and UK's project objectives and priorities.

Market Sounding Summary

EY conducted a market sounding to gauge the market's level of interest, capability and capacity for delivering Design Concept 1. The market sounding included:

- Providing pertinent information related to Concept 1 to the market.
- Gaining insight from market vendors on the viability and scale of the project.
- Understanding the markets willingness to accept transferred risks and best practices to maximize risk transfer.
- Assessing the capability and appetite of the market to carry out the project under different project delivery and procurement options.
- Obtaining feedback to assist with the development of an efficient and effective procurement option.
- Discussing commercial expectations related to biogas revenues and feedstock procurement.

Participants in the market sounding included constructors, developers, technology suppliers, operators, investors, owners, and a combination thereof.

The table below provides the key themes and findings from the market sounding:

Key Theme	**Summary of Findings**
Delivery model options	Participants cited minimal interest in traditional Design-Bid-Build or Design-Build delivery models at this time. Participants indicated they would be interested in some collaboration for the design and costing of the facility, however, they indicated that City/UK would need to move quickly to implement any collaborative models to meet the 2030 operating target. Participants indicated limited appetite to take on the financial portion of the Design-Build-Finance-Operate-Maintain model. As such, it was suggested that the **shortlisted option could be amended to Design-Build-Operate-Maintain**, for which there was noted interest from a few parties.

Key Theme	Summary of Findings
	Participants indicated that for the size and scale of the facility, the expected private sector financing is too expensive compared to expected returns, i.e., the project capital cost and capacity is too small to make private sector financing an attractive opportunity. Participants noted interest in the Design-Build-Operate-Maintain model, suggesting that it is beneficial to have the operator at the table for design discussions, to ensure the development of an effective facility. There was **no stated interest in a private delivery model**. Two (2) participants had experience in this type of model but indicated that for the proposed feedstock volumes for this Project, that it would be a high risk and high-cost investment (i.e., capital value and facility capacity were too small to be considered an attractive opportunity).
Project scope and technical details	**Design:** Participants noted that there would need to be some allowance for flexibility and innovation in design and layout of the facility (i.e., less prescriptive design). **Construction:** Participants indicated that under progressive models, they could seek to procure equipment earlier to eliminate supply chain restrictions. **Operations & Maintenance:** Poor feedstock 'recipes/mixtures' could lead to increased cleanouts and maintenance costs; maintenance costs can be significant depending on quality of feedstock. Private firms do not have the same leverage as the City to enforce green bin programs with residents to ensure consistent SSO quality, as such the risk related to feedstock volume and quality would need to be retained by the City/UK.

Key Theme	Summary of Findings
Project risks and other considerations	**City/UK Retained Risks:** Most participants indicated that they expect guarantees, or a "design-basis" related to feedstock volume, composition, quality and price (tipping fees). As a result, the risk related to feedstock quality/quantity would need to be retained by the City/UK. In discussing additional potential sources of feedstock, some participants indicated that if there were a process output quality requirement, they would expect that the City/UK would be involved in retaining contracts with additional sources of feedstock. The response to the commercial risks related to biogas outputs was mixed. Some participants indicated that they would not seek to be involved on commercial activities related to biogas (but would take on risk for biosolids outputs). Other participants suggested that there could be opportunities for sharing profit from biogas sale, if the commercial risks could be shared. Another participant indicated that they would only take on commercial risk if they could retain all profits and benefits. Participants indicated that site conditions (i.e., geotechnical, contaminated soil, subsurface soil) investigations would be required, and that the City/UK could potentially retain this risk. Regulatory risk was cited as a major risk that will have an impact on a desired contract length. Participants noted that there are several expected changes to legislation and regulations that are outside of the private sector's control. Environmental assessment, permitting, Indigenous & public consultations should be completed prior to design. Participants noted that permitting delays can result in major delays to the overall Project timeline. As such, they would expect that the City/UK would retain this risk and begin the process early.

Key Theme	**Summary of Findings**
	Ideally, the required permits and approvals would be in place in time for construction to begin.
Market capacity and interest	Almost all participants considered this Project to be an attractive opportunity, pending decision on delivery model and other Project factors, including risk allocation.

Risk Assessment Summary

A key principle behind the use of an alternative project delivery and procurement approach is the ability for the public sector to transfer risk that it would typically accept under a traditional project delivery and procurement model. The risk assessment was undertaken to identify and comparatively assess the risk inherent project delivery and procurement options, including allocation of risk.

The approach taken was to identify and define key project development and delivery risks, estimate the likelihood of each risk materializing and the impact if it does occur and assign the risk to the party best positioned to manage it, depending on the project delivery and procurement option being considered. As part the process, the following risk themes and sub-risks were assessed to the shorter-list of project delivery/procurement options:

1. Policy and Strategic Risks
    a. **Legislative/Regulatory Changes** – risk that the project does not align with current and future legislative requirements or changes
2. Design and Tender Risks
    a. **Delays in contract award** – risk of delays in contract award, including procurement and negotiations, resulting in additional costs and schedule impacts.
    b. **Challenges in Site Approvals and Permitting** – risk of overall schedule delays or additional costs related to time required for site approvals and permitting.
    c. **Scope changes initiated by Project Owner during design** – risk that scope of work for the project is changed by the owner during the design phase, resulting in additional costs and schedule delays.
    d. **Failure to Design in Accordance with the City's/UK's Requirements** – risk of a failure to translate the needs of the City into the design, resulting in additional costs, arising from any modifications required to bring the design back in line with City requirements.
    e. **Tendering Competition** – risk that sufficient qualified contractors are not available to respond resulting in a smaller than expected number of bidders, which could result in higher bid prices or reduced asset quality.
3. Construction Risks
    a. **Scope Changes initiated by Project Owner During Construction** – risk that the scope of work is changed during the construction period.
    b. **Lack of Resource Availability (Labour, Materials, Equipment)** – risk that required resources, materials, and/or equipment are not available, resulting in delay and increased costs.
    c. **Schedule Delays** – risk that construction schedule is not maintained/achieved, resulting in delays.

d. **Capital Cost Overruns** – risk that the project experiences cost overruns during the construction phase.
e. **Equipment/Technology Selection Changes** – risk that equipment or technology procured/purchased is not suitable for the required use during operations.
f. **Quality Management** – risk that the quality does not meet expectations and therefore does not achieve the quality standard prescribed.
g. **Construction Contractor/Subtrade Bankruptcy** – risk that the construction contractor declares bankruptcy or defaults, and subsequent replacement is required. This could result in project delays and additional costs.

4. Operational Risks
    a. **Operating Cost Overruns** – risk that actual operating costs are higher than anticipated due to incorrect budget estimates and assumptions, resulting in increased actual contractor operating and maintenance costs.
    b. **Changes in Feedstock Volume/Quality** - risk of unplanned/off-schedule changes in volume and/or composition of feedstock, resulting in inoperability or technical issues (i.e., seasonality, competition from other facilities).
    c. **Failure to meet operating performance standards / targets** – risk that the facility does not perform as required.
    d. **Haulage and Transportation (Feedstock)** – risk that issues with haulage or transportation of feedstock materials to the facility results in delays or penalties.
    e. **Haulage and Transportation (Outputs and Residuals)** – risk that issues with haulage or transportation of outputs and residual materials from the facility results in delays or penalties.
    f. **Failure to Meet Process Output/Recovery Requirements** – risk that quality of process/facility outputs and recoverable materials do not meet specifications (i.e., volume or quality) resulting in loss of revenue or additional processing fees.
5. Maintenance Risks
    a. **Deferred Maintenance / Lifecycle Activities** - -risk that general/routine maintenance and capital maintenance are not performed when appropriate to maintain safety of the asset and to sustain capital value of the asset.
    b. **Asset Obsolescence** – risk that buildings, facility and equipment may become obsolete during the contract, leading to costs of replacement.
    c. **Operations Contractor/Subtrade Bankruptcy** – risk that the operations/maintenance service provider (contractor) declares bankruptcy or defaults, and subsequent replacement is required. This could result in project delays, operational shutdowns and additional costs.

The DEE, DB, P-DB, DBFOM, DBOM, P-DOM and Private Delivery models were considered as part of the risk assessment. It was assumed that under the public sector models, such as DBB,

DB and P-DB, City/UK would be responsible for all scope related to operations and maintenance of the facility.

The risk assessment identified that the private delivery and DMFOM models would allow for the highest degree of risk transfer to the private sector. However, as identified above in the key findings for the market sounding, market vendors participants suggested that they were not interested in financing a project of the size and scale of Design Concept 1. As such, these options may not be viable. In addition, participants noted that they were not interested in taking on the risk related to incoming feedstock quality or quantities. As a result, the risk assessment summary noted that the scope of operations would need to be negotiated with potential private sector partners.

Financial Viability Summary

The purpose of the financial viability analysis was to determine the feasibility of the project, through assessment of the project's ability to generate sufficient revenue to pay for its capital and operating costs (i.e., full cost recovery).

For this business case, the financial viability model was structured to reflect the traditional relationship between the City as the asset owner and UK as the asset operator. As per discussion with UK and the City, it was assumed that the City would fully own and fund the project through City-issued debt and equity investment using available reserves. For the purposes of the financial viability assessment, it was assumed that operating activities (including maintenance and lifecycle replacement) would be undertaken by UK.

The financial viability of the project was assessed under three (3) recovery scenarios:

> **Scenario 1: Full cost recovery (Base Case)** – Under this scenario, it was assumed the net operating deficit (i.e., total operating costs minus offset revenues) were covered by the City and directly passed to users.
>
> **Scenario 2: No return on investment** – Under this scenario, it was assumed that the City would not earn a return on its capital contribution to the project, while the capital invested would be recovered from end users.
>
> **Scenario 3: No reserve and no return recovery** – Under this scenario, it was assumed that a portion of the costs related to the investment made by the City would not be passed to end users, and that the City would not capture a return on the City's investment.

Scenario 1 was considered the preferred scenario and for the purposes of this report is discussed in further detail.

A cash-flow based financial model was developed to estimate the capital and operating funding that would be required for the project, including:

- **Capital funding requirement**: The funding needed to pay for capital expenditures, which include all construction-related costs.
- **Operating funding requirement**: The amount required to pay for the operations and maintenance ("O&M") costs, financing expenses, and the required return on equity. The operating funding requirements are offset by the revenue generated from sales of by products (i.e., RNG and biosolids).

The structure of the financial model developed for calculation of the required funding from the City is presented in the table below.

	Funding Requirement	**City Funding Source(s)**
Capital	Capital Cost	Reserve funding (equity) Debt
Operating	(+) O&M Costs (+) Interest Expense (+) Capital Recovery (+) Equity Return (-) Sale of biogas (-) Sale of biosolids (-) Transfer from tipping fee	Wastewater rates (for wastewater biosolids) Tax base (for organic solid waste)

The list below summarizes the general inputs and assumptions applied in developing the model:

- 30-year operating period
- Construction start date of January 1, 2025
- 5-year construction duration
- Cost base date of June 1, 2024
- 4% construction escalation
- 2% operation escalation
- 3.5% discount rate
- Capex Schedule
    - Year 1, 12%
    - Year 2, 22%
    - Year 3, 22%
    - Year 4, 22%
    - Year 5, 22%

- Project revenue was escalated by volume growth of feedstocks received, proportional to projected population growth.

The capital funding required represented the City-provided cash required to fund the capital expenditures for the project. Capital cost estimates were derived from the financial assessments within the EA and included:

- Direct Costs of $53 million related to equipment, structural/architectural, siteworks, electrical, instrumentation and controls, mechanical/HVAC, and other cost allowances
- Indirect Costs of $29 million related to construction allowances (bonding, mobilization and trial operation), contingency and engineering fees.

The estimated $82 million in total capital expenditures were assumed to be fully funded by the City and UK through a combination of reserve funds and long-term debt. The capital funding structures were assumed to be, $30 million from UK's reserve fund (sewer rates), $10 million from City's reserve fund (property taxes) and $42 million long-term financing.

It should be noted that the difference between the $71.1 million in total capital expenditures in the EA and the $82 million in the Business Case is because EY used a Construction Escalation Cost of 4%, under the assumption that the $71.1 million was the value on June 30, 2024.

The operating cash requirement included all estimated operating expenses incurred during the 30-year operating period and included the following:

- Operating and Maintenance Costs of $147 million based on utility and chemical costs, biogas upgrading and processing, labour and maintenance fees. The O&M costs were

separated into fixed and variable costs. The fixed costs were escalated by a long-term inflation rate, with variable costs escalated by the long-term inflation rate and forecasts growth volumes. This also included the potential net annual increase of $200,000 in operating costs to existing WWTP operations to reflect required modifications such as discontinuing anaerobic digestion and biosolids cake hauling and adding transportation of material to the Knox Farm property.

- Interest Expense of $43 million for financing fees calculated based on the long-term financing borrowed for capital expenditures. A 5% per annum all-in interest rate was used for the 30-year financing. It was also assumed that the principal recovery of the long-term financing will be paid equally throughout the loan period.

Project revenue was represented by the proceeds and returns from the sale of RNG and biosolids generated and feedstock tipping fees during the 30-year operating period.

For revenues from biogas, three potential revenue rate options were assessed, an optimistic, likely and conservative. Commodity rates were not escalated. Based on the 30-year operating period, the sale of products from the facility is summarized below:

Revenue Category	**Value ($ million)**	**Description**
Biogas Revenue (Conservative Revenue Option)	$11	Unit rate of $0.1663/m3 which is the current commodity price that UK charges for natural gas. Considered most conservative option for revenue potential.
Biogas Revenue (Likely Revenue Option)	$24	Unit rate of $0.37/m3 was assumed for the potential median market value for gas prices. Considered likely option for revenue potential.
Biogas Revenue (Optimistic Revenue Option)	$73	Unit rate of $1.14/m3 was provided for the highest potential revenue (based on market sounding participant feedback). Considered the optimistic option for revenue potential.
Biosolids (No Impact)	N/A	Conservative assumption for the purpose of this business case.
Biosolids (Optimistic Revenue Option)	$10	Unit rate of $9.36/m3 for solids concentration of 11% based on feedback from

		market sounding participants.

A tipping fee for the SSO from the City's Green Bin program was assumed to be charged by the facility. The total tipping fees were calculated based on an estimated annual tipping fee of $494,000 escalated by the SSO volume growth over the 30-year operating period.

The revenue is not enough to cover the expenses, and a contribution equal to the operating shortfall is required. The financial viability analysis assumed this contribution, equal to the annual operating shortfall would be provided by the City. This contribution is representative of the potential funding gap for the project. It is assumed that the gap/shortfall would be funded using wastewater utility rates and or allocation from property taxes. More details are provided next with the Scenario 1 details.

Given the purpose of the financial viability analysis to determine the projects' ability to generate sufficient revenue to pay for its capital and operating costs, Scenario 1 (Full Cost Recovery, conservative revenue option) was selected as the most appropriate scenario. The remainder of the results described below are for Scenario 1.

Scenario 1 assumed that the project is a typical City-owned asset where the City fully owns and funds the project using City issued debt and potential equity investment using available reserves. It was further assumed that operating activities would be undertaken by UK, with operating expenses offset by potential revenues generated from the sale of RNG and liquid biosolids. The net operating deficit (i.e., total operating costs minus offset revenues) were assumed to be covered by the City. The following table describes the required revenue over a 35-year period (5-year construction period plus 30-year operating period), and identifies the outlook using the different revenue options:

Required Revenue	**Optimistic Revenue Option ($ million)**	**Likely Revenue Option ($ million)**	**Conservative Revenue Option ($ million)**	**Comment**
O&M costs	$138	$138	$138	$138 million of O&M over the 30-year term

Required Revenue	Optimistic Revenue Option ($ million)	Likely Revenue Option ($ million)	Conservative Revenue Option ($ million)	Comment
Modified operation in other facilities	$9	$9	$9	Net increase of $9 million in costs resulting from modified operations at existing WWTPs
Interest expense	$43	$43	$43	Cost of borrowing at 5% per annum for the 30-year term
Capital recovery	$82	$82	$82	Recover $42 million in debt principal and $40 of reserve contribution that were used to fund the upfront capital cost The difference between the $71.1 million in total capital expenditures in the EA and the $82 million in the Business Case is because EY used a Construction Escalation Cost of 4%, under the assumption that the $71.1 million was the value on June 30, 2024.
Return on investment	$21	$21	$21	Return on the City's investment at 3.5% per annum
Gross cost	$293	$293	$293	Total project cost over the 35-year period

Required Revenue	**Optimistic Revenue Option ($ million)**	**Likely Revenue Option ($ million**	**Conservative Revenue Option ($ million)**	**Comment**
Revenue	($114)	($54)	($41)	Over the 30-year operating period RNG sales of $73 million for optimistic option RNG sales of $24 million for likely case option RNG sales of $11 million for conservative option Only optimistic option has $10 million for liquid biosolids sales Tipping fee of $31 million
Total net loss	$180	$240	$253	Total net loss over the 35-year period to be recovered from rates or property taxes
Average annual net operating loss	$5.1	$6.8	$7.2	Total revenue from rates or property taxes required annually to cover the shortfall

Although only Scenario 1 is shown in this report, it should be noted that, all the Scenarios identified an annual net operating loss, with the lowest being $3.4 million for Scenario 3 (No returns/recoveries, optimistic revenue).

A net present value (NPV) analysis was undertaken and considered the cash flows of the project. NPV is a financial metric used to assess the long-term financial viability of a project. The NPV represents the difference between the present value of the project cash inflows and outflows during construction and operating phases of the project. A positive NPV typically

indicates that the projected earnings (discounted to their present value) exceed the anticipated costs, indicating that the project is financially viable and should generate value. Conversely, a negative NPV indicates that the project's costs outweigh the revenue when discounted to their present value.

The NPV analysis presented in the table below for Scenario 1 (Full Cost Recovery) shows a negative NPV for the project. As illustrated below, the project has a negative NPV of $136 million assuming the worst-case, conservative revenue option.

Net Present Value Scenario 1, Full Cost Recovery

Costs & Revenue ($ million)	**Optimistic Revenue Option**	**Likely Revenue Option**	**Conservative Revenue Option**
Cash flows during 5-year construction period			
Construction costs	($74)	($74)	($74)
Debt issuance	$39	$39	$39
Contribution from sewer rates	$26	$26	$26
Reserve funding	$8	$8	$8
Costs during 30-year operating period			
O&M costs	($67)	($67)	($67)
Additional cost impact to existing WWTP operations	($5)	($5)	($5)
Interest expense	($29)	($29)	($29)
Debt principal payment	($22)	($22)	($22)

Costs & Revenue ($ million)	Optimistic Revenue Option	Likely Revenue Option	Conservative Revenue Option
Reserve Recovery/Return on Investment			
Investment recovery (sewer rates and taxes)	($21)	($21)	($21)
Return on investment	($13)	($13)	($13)
Revenues over 30 years			
Sale of products and tipping fees	$57	$27	$20
Net Cash Flow over 35-year period	**($100)**	**($130)**	**($136)**

A discount rate for the Project NPV was assumed at 3.5% based on the City's required rate of return on invested capital.

It should be noted that the cash flow requirement for the project decreased under Scenarios 2 and 3 (not shown) as the return on investment and investment recovery requirements diminished and removed. However, there was still a negative NPV for these Scenarios.

Business Case Conclusions

The Business Case provided an economic evaluation for the development of the preferred design alternative (Design Concept 1) as per the EA, based on the findings and outcomes of the project delivery and procurement options analysis, market sounding, risk assessment and financial viability analysis.

The Business Case determined that the DBFOM delivery model had the highest degree of alignment with the City and UK's objectives. The DB model was also highly aligned with project objectives. However, based on participants responses during the market sounding process, specifically noting a limited appetite to take on the financial portion of a DBFOM model, the preferred project delivery and procurement model was amended to DBOM. The risk assessment also aligned with the market sounding findings, to select an option that transfers design, construction, operations and maintenance risk to the private sector. Therefore, the DBOM model was recommended as the optimal delivery model for Design Concept 1.

Based on the financial viability analysis, it was determined that the project is not financially viable and has a negative NPV. Under Scenario 1, Full Cost Recovery with the conservative revenue option there is a net operating loss of $7.2 million dollars per year.

Conclusion and Recommendation Not to Proceed

In alignment with strategic plans and priorities for UK and the City, UK undertook a Municipal Class EA, resulting in a final ESR and Business Case to investigate and determine the feasibility of developing a Biosolids & Biogas facility at the Knox Farm property.

The results of the ESR concluded the project is technically feasible for development at the Knox Farm property with no major impacts to the natural, physical, socio-economic and cultural environments identified if appropriate considerations and mitigation strategies are employed and subject to obtaining required approvals. The ESR did show a reduction in GHG over continuing with the status quo management of biosolids and biogas at Cataraqui Bay WWTP. However, the monetary investment and project risk required to develop a Biosolids and Biogas facility at the Knox Farm property to achieve the estimated GHG reductions are significantly and unreasonably higher than other methods of GHG reduction available to UK and the City. Unreasonable, meaning the expense is far too high for the benefit being achieved relative to other options for GHG reduction that may be available. Therefore, based on the estimated financial requirements and cost-benefit related to GHG reduction, the project is **not** considered feasible.

The results of the Business Case reported a total gross cost of $293 million dollars over a 35-year period and identified a negative NPV. Factoring in revenue over the operating period, there is a total net loss of $253 million dollars when considering the worst-case scenario (i.e., Scenario 1, Full Cost Recovery, Conservative Revenue Option) which translated to a projected $7.2-million-dollar annual net operating loss. For the business to break even annually, $5.1 to $7.2 million dollars (depending on revenues) funded from property taxes or sewer rates would be required. The project is **not** considered to be financially viable. In addition, the other analyses performed as part of the Business Case revealed limited interest and appetite for risk transfer

from external parties, especially related to quality and quantity of feedstock (i.e., WWTP sludges and other organic materials).

In consideration of the results, UK also reflected upon its corporate Risk Appetite Statement and Enterprise Risk Management program. Risk Appetite is “the amount and type of risk that an organization is prepared to pursue, retain or take”. UK’s Risk Appetite Statement describes its principles for making decisions that may impact one or more of its strategic outcomes including safety and the environment, infrastructure and asset integrity/reliability, people and culture, reputation and community relationship, growth, financial responsibility, customer experience and climate action. Relevant to considering the development of the Biosolids and Biogas Facility, UK does “accept that we must have a high appetite for uncertainty with respect to the manner of achievement of our climate action goals”. However, we’ve also identified that “organic growth initiatives, through the delivery of new, related services to current customers, will be pursued with a cautious approach within our internal capacity, to ensure predictable outcomes and realization of benefits … we will operate with a high degree of confidence in our ability to support growth…”. Further, we “will take justified financial risks within the bounds of our cashflow requirements and reasonable prudence”.

Based on the results of the EA, Business Case and reflecting on acceptable risk, Utilities Kingston regards the potential project as technically feasible but financially imprudent and a very high-cost option for achieving GHG reductions through biogas production. Therefore, UK is not recommending that investigations or the development of a Biosolids and Biogas facility at the Knox Farm property proceed further.

Alternative & Next Steps

As referenced earlier in the Background section of this report, following a value engineering workshop in 2014, the recommended addition of a digester and the expansion of the digester control building (for solids treatment) was deferred because there was sufficient processing capacity to 2029.

If the recommendation to not proceed any further with investigating a Biosolids and Biogas facility at the Knox Farm property is approved, UK will proceed with planning for an expansion/upgrade to the solids treatment process at the Cataraqui Bay Wastewater Treatment Plant. Based on an updated cost estimate, the capital cost ranges from $13.3-to $17.3-million-dollars, with an estimated average net annual operating cost of $500,000.

This option is significantly less than the upfront capital cost of $82 million dollars and an average of $4.9 million in operating costs required to proceed with developing Design Concept 1 at the Knox Farm property. It is important to note that continuing with status quo methods to manage biosolids and biogas will not reduce GHG emissions from operations. However, as noted in this

report, the monetary investment required to develop a Biosolids and Biogas facility at the Knox Farm property to achieve reduced GHG emissions is imprudent, simply meaning the expense is far too high for the benefit being achieved relative to other options for GHG reduction that may be available.

The capital and operating expenses associated with the work required to continue managing biosolids and biogas at Cataraqui Bay will be included in future capital and operating budgets, as per usual practice.

In consideration of the Project goals of the 2020 Master Plan and 2024 EA, during the planning, design and engineering phases, UK will consider opportunities for GHG emission reduction by utilizing biogas produced at the WWTP and implementing technologies available on the market to maximize use for site operations or localized upgrading/storage or distribution to an end-user, if available.

It should also be noted that UK is undertaking a CALP that explores and investigates carbon neutral operations by 2040, with associated costs.

Existing Policy/By-Law

Not applicable.

Notice Provisions

As per the Municipal Class Environmental Assessment requirements, Notice of Commencement and Notice of Completion were issued on September 19, 2023 and August 13, 2024, respectively. The Notice of Completion identified the commencement of a 30-day public review period and identified how persons of the public could provide feedback. In addition, notification for public information sessions were issued on March 14, 2023 and March 12, 2024, respectively.

Financial Considerations

Financial considerations associated with developing a Biosolids and Biogas facility at the Knox Farm property are included in the Business Case details in the Options/Discussion section above. In summary, the total capital cost required to construct Alternative Design Concept 1 is estimated at $82 million dollars, with an average annual operating cost of $4.9 million dollars. Considering expenses, recoveries and revenues, the Business Case identified a negative NPV and a total net loss of $253 million dollars over a 35-year period when considering the worst-case scenario (i.e., Scenario 1, Full Cost Recovery, Conservative Revenue Option) which translated to a projected $7.2-million-dollar annual net operating loss. For the business to break

even, a contribution of $5.1 to $7.2 million dollars funded from property taxes or sewer rates would be required annually, depending on the actual revenue received from RNG sales, tipping fees, liquid biosolids sales and user rates.

If the development of a Biosolids and Biogas facility at the Knox Farm property is not pursued further, upgrades to the Cataraqui Bay WWTP will be required. The capital and operating costs associated with increasing the solid treatment process capacity at Cataraqui Bay WWTP will be included in future capital and operating budget requests, as per the usual practice. Expanding and upgrading the solids treatment process at Cataraqui Bay WWTP is estimated to be between $13.3-to $17.3-million-dollars, with an estimated average net annual operating cost of $500,000. This indicates that the incremental capital cost associated with constructing the Knox Farm Biosolids and Biogas project to achieve potential annual GHG reductions of between 2,700 and 3,800 tonnes eCO2 would be in the order of $68 million which represents a capital abatement cost of between approximately $18 to $25 thousand per annual tonne of GHG reduction which is significantly costlier than other methods of GHG reduction available to UK and the City.

The Knox Farm Biosolids and Biogas project is **not** considered to be financially viable, given the annual operating shortfall projected and the required funding needed annually, sourced from rates or property taxes. Furthermore, the monetary investment required to generate the expected GHG reductions from the generation of renewable natural gas production would be relatively large in comparison to other methods of GHG reduction available.

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Other City of Kingston Staff Consulted:

Lauren Scanlan, Project Advisor – Risk & Research, Utilities Kingston Engineering, Utilities Kingston

Paul MacLatchy, Environment Director, Business, Real Estate & Environment

Exhibits Attached:

Exhibit A – Regional Biosolids and Biogas Facility, Environmental Study Report, October 2024

Exhibit B – Project Delivery and Procurement Options List

DILLON CONSULTING

Utilities Kingston

Regional Biosolids & Biogas Facility

Environmental Study Report

October 2024 - 22-4641

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Acronyms and Abbreviations

AD	Anaerobic Digestion
ANSI	Area of Natural and Scientific Interest
ARA	Archaeological Research Associates Ltd.
CFIA	Canadian Food Inspection Agency
CHAR	Cultural Heritage Assessment Report
City	City of Kingston
cm	centimeter
CMA	Census Metropolitan Area
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CRCA	Cataraqui Region Conservation Authority
Dillon	Dillon Consulting Limited
ECA	Environmental Compliance Approval
ECCC	Environment and Climate Change Canada
EDR	Emergency Detour Route
EIA	Environmental Impact Assessment
ELC	Ecological Land Classification
EPA	*Environmental Protection Act*
ESA	*Endangered Species Act*
ESR	Environmental Study Report
GHG	Greenhouse Gas
HCM	Highway Capacity Manual

HVA	Highly Vulnerable Aquifer
IESO	Independent Electricity System Operator
IC&I Sector	Industrial, Commercial, & Institutional Sector
KCLP	Kingston Climate Leadership Plan
km	kilometer
LOS	Level of Service
masl	metres above sea level
mbgs	metres below ground surface
MCEA	Municipal Class Environmental Assessment
MECP	Ministry of Environment Conservation and Parks
MES	Municipal Energy Study
mm	millimeter
MMAH	Ministry of Municipal Affairs and Housing
MNRF	Ministry of Natural Resources and Forestry
MOE	Ministry of Energy
MTO	Ministry of Transportation
NASM	Non-Agricultural Source Material
NHIC	Natural Heritage Information Centre
NHRM	Natural Heritage Resource Manual
OMAFRA	Ontario Ministry of Agricultural, Food and Rural Affairs
OWES	Ontario Wetland Evaluation System
OWRA	*Ontario Water Resources Act*
PIC	Public Information Centre

PPS	Provincial Policy Statement
PSW	Provincially Significant Wetlands
RNG	Renewable Natural Gas
SAR	Species at Risk
SARA	*Species at Risk Act*
SCC	Species of Conservation Concern
SGRA	Significant Groundwater Recharge Area
SPA	Source Protection Area
SPP	Source Protection Plan
SSO	Source Separated Organics
SWH	Significant Wildlife Habitat
TRB	Transportation Research Board
TS	Total Solids
UK	Utilities Kingston
WWTP	Wastewater Treatment Plant

Executive Summary

Utilities Kingston (UK) and the City of Kingston (City) are taking steps to reduce the overall Greenhouse Gas (GHG) emissions footprint of their operations and the community. One potential approach to reducing net GHG emissions being investigated by UK is through the production of renewable biogas from the anaerobic digestion of organic waste streams that are available locally.

Dillon Consulting Limited (Dillon) has been retained by UK to conduct a Schedule C Municipal Class Environmental Assessment (MCEA) to examine the potential for developing a regional integrated biosolids and source separated organics (SSO) processing Facility (Facility) at a City-owned property (Knox Farm). The Facility will aim to process organic wastes from the City's wastewater treatment plants, the "Green Bin" program, and potentially other suitable material streams from local or regional sources to produce renewable natural gas (biogas) and other beneficial resources. The scope of work covered under the MCEA will henceforth be referred to as the 'Project'.

The Project builds on the Master Plan for Enhanced Biosolids Management and Biogas Utilization project completed in 2020 and the Knox Farm Suitability Report completed in April 2023. The MCEA is developed over four phases as follows:

- Phase 1: Problem/Opportunity Statement;
- Phase 2: Alternative Solutions;
- Phase 3: Alternative Design Concepts; and
- Phase 4: Environmental Study Report.

The following describes the work undertaken under the four phases.

Phase 1: Problem/Opportunity Statement and Phase 2: Alternative Solutions

Utilities Kingston (UK) completed a Master Plan for Enhanced Biosolids Management and Biogas Utilization in 2020 to review its long-term approach for biosolids management at local wastewater treatment plants. The Master Plan noted a potential deficiency in seasonal biosolids storage capacity and identified future limitations to biosolids processing capacity, particularly at the Cataraqui Bay WWTP. The following Problem/Opportunity statement was identified in the Master Plan

"UK is presently positioned to address both the enhancement of the management of the biosolids generated at the Cataraqui Bay and Ravensview WWTPs, and to consider the introduction of the co-digestion of these solids streams with waste organics both collected by the City and generated by the IC&I sector. This opportunity has arisen, in part, from the developments in Ontario regarding:

- The consideration of wastes as resources within the context of a circular economy;
- The increased interest in the province for the more effective management of waste organics with the objective of eliminating the landfilling of these materials; and,
- The identification of opportunities for the generation and utilization of RNG thereby reducing the City's carbon footprint."

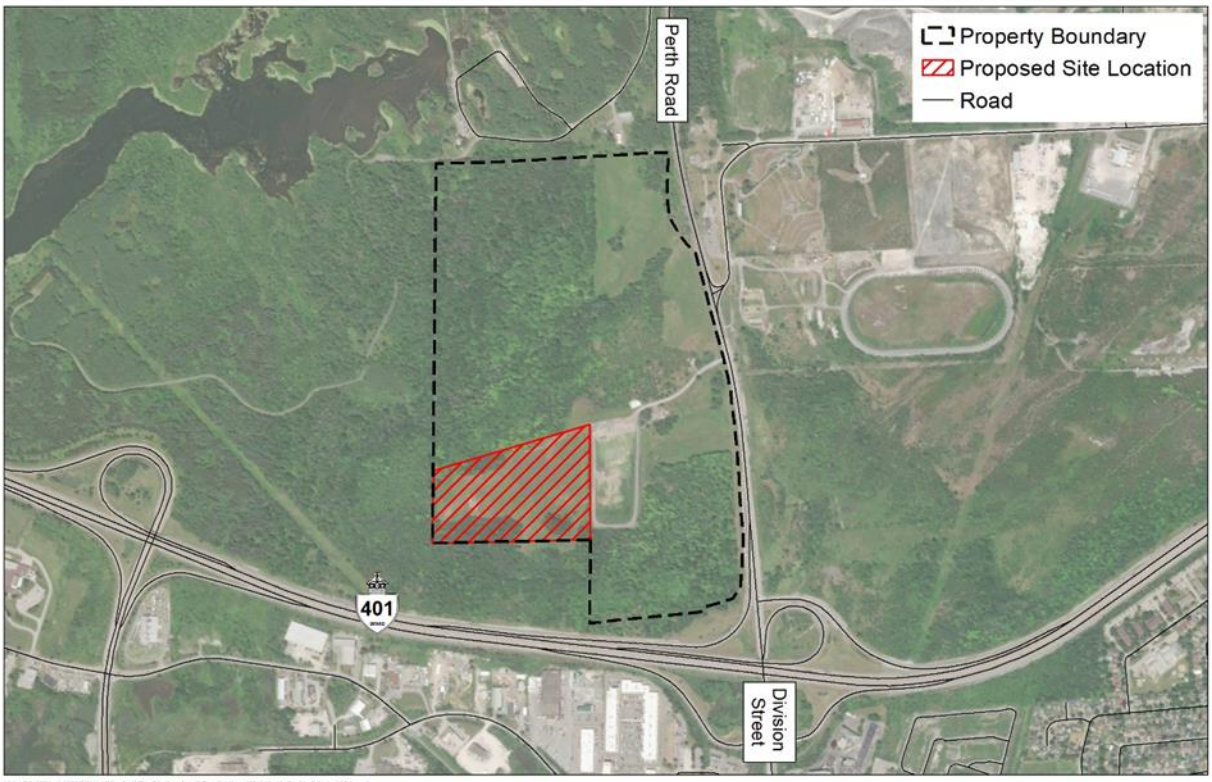
The preferred solution from the Master Plan exercise was to develop an integrated, offsite, anaerobic digestion (AD) Facility that manages biosolids and source separated organics (SSO) from both UK WWTPs to produce usable biogas.

Dillon was retained to assess the suitability of the Knox Farm property for the proposed Facility and if deemed suitable, proceed with Phase 3 and 4 of the MCEA process building on the completed Master Plan.

Between Summer 2022 and Spring 2023 Dillon undertook a reconfirmation exercise of Phases 1 and 2 as well as the Knox Farm Suitability Report. The reconfirmation exercise confirmed the original Problem/Opportunity statement, reviewed the original Phase 2 alternative solutions, and considered the opportunity of using an existing City-owned site, Knox Farm, for the potential development of a regional biosolids and biogas Facility.

Knox Farm is a municipally-owned property located off of Perth Road, northwest of the Highway 401 and Division Street interchange in the City. The site is north of Highway 401, with frontage to the west side of Perth Road and south of Little Cataraqui Creek Conservation Area and the Cataraqui Region Conservation Authority (CRCA). Knox Farm covers nearly 75 hectares (ha) of land, of which approximately 9.3 ha is a former sediment dewatering facility that previously held an Environmental Compliance Approval (ECA) and is now decommissioned. The figure below shows the overall Knox Farm property boundary and the boundary of the Proposed Site Location (i.e.,

approximate location of the proposed Facility). A portion of the property immediately east of the Proposed Site Location is currently in use as a municipal snow management facility with plans to continue as such.



Multiple technical disciplines conducted assessments to understand the existing conditions of the Proposed Site Location and if the site is suitable for the proposed Facility. The assessments did not identify any major barriers to development of the proposed Facility at Knox Farm.

The surrounding land uses to the south of Knox Farm and Highway 401 include General Industrial, Business Park Industrial, Arterial Commercial, Regional Commercial and Residential land uses. Four hotels are located along the southern perimeter of Highway 401 approximately 0.5 to 0.9 km from the southeast boundary of the Proposed Site Location. Residential dwellings are located approximately 1 km from the southeast boundary of the Proposed Site Location. The land use to the north of the Knox Farm boundary is comprised of Rural, Open Space, and Environmental Protection Areas (EPA). The Little Cataraqui Creek Conservation Area (CA) trails are located in the EPA to the

northwest of the boundary of the Proposed Site Location, with one trail (Reservoir Trail) present within the Knox Farm Property Boundary.

The roadways within the Study Area include Perth Road/County Road 10, Division Street, Highway 401, and McAdoo's Lane. There are no weight restrictions or seasonal load limits on McAdoo's Lane or Perth Road. There are no existing sidewalks, dedicated bicycle facilities or transit stops within the Study Area. The City's 2018 Active Transportation Master Plan does not identify future active transportation facilities in the Study Area.

Several confirmed and potential sensitive natural heritage features were identified as occurring within the Knox Farm Property Boundary such as the Cataraqui Clay Creek Ridges Earth Science Area of Natural and Scientific Interest (ANSI), significant woodlands, a watercourse and unevaluated wetlands as well as potential species at risk (SAR) habitat and candidate Significant Wildlife Habitat (SWH). However, the presence of these features was not significant within the boundaries of the Proposed Site Location. According to the Source Protection Atlas by the MECP, the Knox Farm Property is located within the Cataraqui Source Protection area (SPA) and is identified to be within a Significant Groundwater Recharge Area and a Highly Vulnerable Area; of which the majority of the Cataraqui SPA is identified. No distinguishable drainage features were identified within the Proposed Site Location through the review of available background information or field reconnaissance observations. Surface runoff over the Proposed Site Location appears to travel overland from the higher elevations near the municipal snow management facility towards the western and southern property boundaries.

Knox Farm is located outside of the City's urban boundary and as such there is no existing municipal sanitary, piped storm sewers or watermain infrastructure. Other methods will be required to provide these services for any proposed Facility. Perth Road is in the vicinity of the site and contains gas, aerial electrical, road-side ditching and telecommunication infrastructure within the right-of-way and as such, servicing for these utilities is not expected to be an issue.

A review of the three years of ambient air quality monitoring data from the Kingston Station indicated that the ambient (background) concentrations of indicator compounds for air quality are below all applicable criteria maximums. The results of the Background

Noise Assessment confirmed that the ambient (background) noise environment in the area is best characterized as having qualities of a Class 1 area where the background noise is dominated by human activity. Elevated background noise levels due to surrounding roadways were identified at some receptor locations, particularly the hotels on the south side of Highway 401.

A Stage 1 Archaeological Assessment (PIF # P007-1420-2022) determined that the Study Area comprised a mixture of areas of archaeological potential and areas of no archaeological potential and recommended that all areas of archaeological potential that could be impacted by the Project be subject to a Stage 2 archaeology assessment. The Stage 2 Archaeological Assessment (PIF# P007-1543-2023) did not result in the identification of any archaeological materials and recommended that no further assessment be required within the study area. Additionally, a Cultural Heritage Assessment Report (CHAR) concluded that no cultural heritage resources were identified within the assessed area.

Phase 3: Alternative Design Concepts

Two alternative design concepts were developed. These considered Project priorities including meeting future biosolids (wastewater sludge) and source separated organics (Green Bin material) processing needs, developing a high quality beneficial treated biosolids product, generating biogas for beneficial reuse, while reducing overall GHG emissions from wastewater treatment operations. Each alternative was assumed to be located at the Knox Farm site. The following describes the two concepts:

- **Alternative Design Concept #1 – Focus on maximizing resource recovery:** This alternative maximizes the generation of energy as renewable natural gas (RNG) and biosolids residuals with an emphasis on retaining nutrient value for beneficial reuse in agriculture. Features of this alternative may require additional utility use for required sludge and biosolids processing (such as feedstock pre-treatment to improve biogas recovery) relative to simpler processing alternatives.
- **Alternative Design Concept #2 – Focus on minimizing utility demands and residuals volume:** This alternative prioritizes simplicity of operation, reduced utility usage (no feedstock pre-treatment) and the production of a lower-volume biosolids product requiring less volume to store and fewer trucks to transport to end-use.

An evaluation methodology and criteria were developed to compare the two design concepts that considered the natural, physical, socio-economic and cultural environments and financial and technical factors. The resulting evaluation yielded comparable results between the two design concepts, across all evaluation criteria categories. However, Alternative 1 was best aligned with technical performance factors. Alternative 1 was also better aligned with UK and the City's overall Project goals:

- Sufficient capacity to process future wastewater sludge loadings and City Green Bin organic waste;
- Production of a treated residual product for beneficial reuse (agricultural); and
- Reduction in the City's overall carbon footprint through the production of biogas and conversion to renewable natural gas (RNG).

Design Concept #1 is being recommended as the Preferred Alternative Design Concept based on the following factors when compared to Design Concept #2:

- Greater net beneficial contribution towards achieving UK's and the City's climate change leadership goals;
- Absence of wastewater generation requiring transportation back to, and treatment at City wastewater treatment plants;
- Higher amount of biogas generated;
- Increased revenue potential from RNG production which is assumed to be distributed into the Utilities Kingston natural gas pipeline; and
- More attractive end-use biosolids product (i.e., liquid product).

Public and Stakeholder Consultation

A comprehensive public and stakeholder consultation program was undertaken for the Project. The first round of consultation activities, including a Public Drop-In Session, was conducted in March 2023 to inform the public of the results of the Master Plan reconfirmation exercise and Knox Farm Suitability Report, and to seek feedback on the suitability of Knox Farm for the proposed Facility. The feedback received as part of this first round of consultation was used to contribute to understanding the suitability of developing the proposed Facility at the Knox Farm location.

In Fall 2023, the Notice of Commencement for the MCEA process was issued. A Public Information Centre was held in March 2024 to provide the public with the opportunity

to be informed and provide feedback regarding the findings of Phase 3 (Alternative Design Concepts) of the MCEA process.

Consultation with Indigenous communities and regulatory agencies took place throughout the process.

Phase 4: Environmental Study Report

This Environmental Study Report (ESR) documents the planning and design process leading to the selection of the Preferred Design Concept for the Facility and was submitted for public review from August 13 until September 11, 2024. Utilities Kingston is currently undertaking a separate business case analysis of the proposed Facility. It is anticipated that a decision on whether the Project should proceed could be made by the end of 2024. If the Project is recommended to proceed, Phase 5: Project Implementation will be initiated in 2025 with an anticipated timeline for the Facility to obtain additional approvals and be constructed over approximately 5 years and be operational in 2030.

1.0 Introduction

1.1 Purpose of the Project and the Environmental Study Report

Utilities Kingston (UK) and the City of Kingston (City) are taking steps to reduce the overall Greenhouse Gas (GHG) emissions footprint of their operations and the community. One approach to reducing net GHG emissions being investigated by UK is through the production of renewable biogas from the anaerobic digestion of organic waste streams that are available locally and potentially regionally.

Dillon Consulting Limited (Dillon) has been retained by UK to conduct a Schedule C Municipal Class Environmental Assessment (MCEA) to develop a regional integrated biosolids and Source Separated Organics (SSO) processing Facility at a City-owned property, Knox Farm (**Figure 1-1**). The Facility will aim to process organic wastes from the City's wastewater treatment plants, the "Green Bin" program, and potentially other suitable organic material streams from local or regional sources to produce renewable natural gas (RNG) and other beneficial resources.

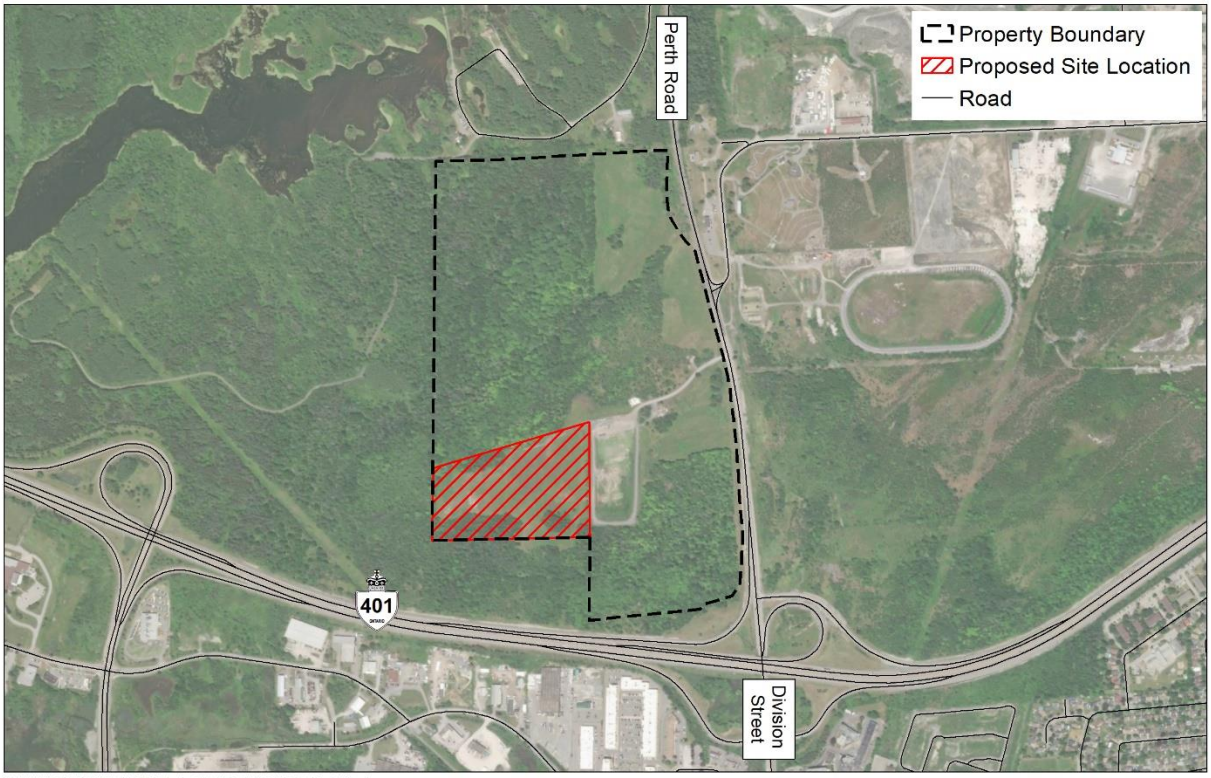
The MCEA (henceforth referred to as the 'Project') builds on the Master Plan for Enhanced Biosolids Management and Biogas Utilization project completed in 2020 The purpose of the Master Planning exercise was to address the need to increase capacity to handle sludge generated by wastewater operations at the Cataraqui Bay WWTP and review a long-term approach to biosolids management at all three existing WWTPs. The preferred alternative identified in the Master Plan was to evaluate Knox Farm as a potential site for a regional organics processing facility. As part of the recommendation, the Knox Farm Suitability Report was completed in April 2023 to determine whether the property is suitable for the proposed Facility. The Master Plan followed Approach 1 of the MCEA process and included Phases 1 and Phase 2. To complete the MCEA process as a Schedule C project, this environmental assessment is intended to fulfil Phase 3 (Alternative Design Concepts) and Phase 4 (Environmental Study Report).

This Environmental Study Report (ESR) documents the planning and design process leading to the selection of the Preferred Design Concept for the Facility.

1.2 Study Area

The Study Area is defined by the Knox Farm property boundary. Knox Farm is a municipally-owned property located off of Perth Road, northwest of the Highway 401 and Division Street interchange in the City (**Figure 1-1**). The site is north of Highway 401, with frontage to the west side of Perth Road and south of Little Cataraqui Creek Conservation Area and the Cataraqui Region Conservation Authority (CRCA). Knox Farm covers nearly 75 hectares (ha) of land, of which approximately 9.3 ha is a former sediment dewatering Facility that previously held an Environmental Compliance Approval (ECA) and is now decommissioned. A portion of the property to the east of the Proposed Site Location is currently in use as a municipal snow management Facility and is planned to continue as such. Knox Farm is located outside of the City's Urban Boundary.

Figure 1-1: Project Study Area



1.3 Municipal Class Environmental Assessment Process

Municipal infrastructure projects must meet the requirements of the Ontario *Environmental Assessment Act*. The Municipal Engineers Association's newly amended Municipal Class EA (MCEA) came into force and effect in February 2024. The MCEA applies to a group or "class" of municipal projects which occur frequently and have relatively minor and predictable impacts. These projects are approved under the *EA Act*, as long as they are planned, designed and constructed according to the requirements of the MCEA.

The requirements of the MCEA for a proposed undertaking depend on the type of the proposed work, its complexity, and the significance of its potential environmental impacts. Four categories of projects are identified in the 2024 amended MCEA:

Exempt projects generally include various maintenance, operation, rehabilitation, and other small projects that are limited in scale and have minimal adverse environmental effects. Previously these projects were classified as Schedule A or A$^+$.

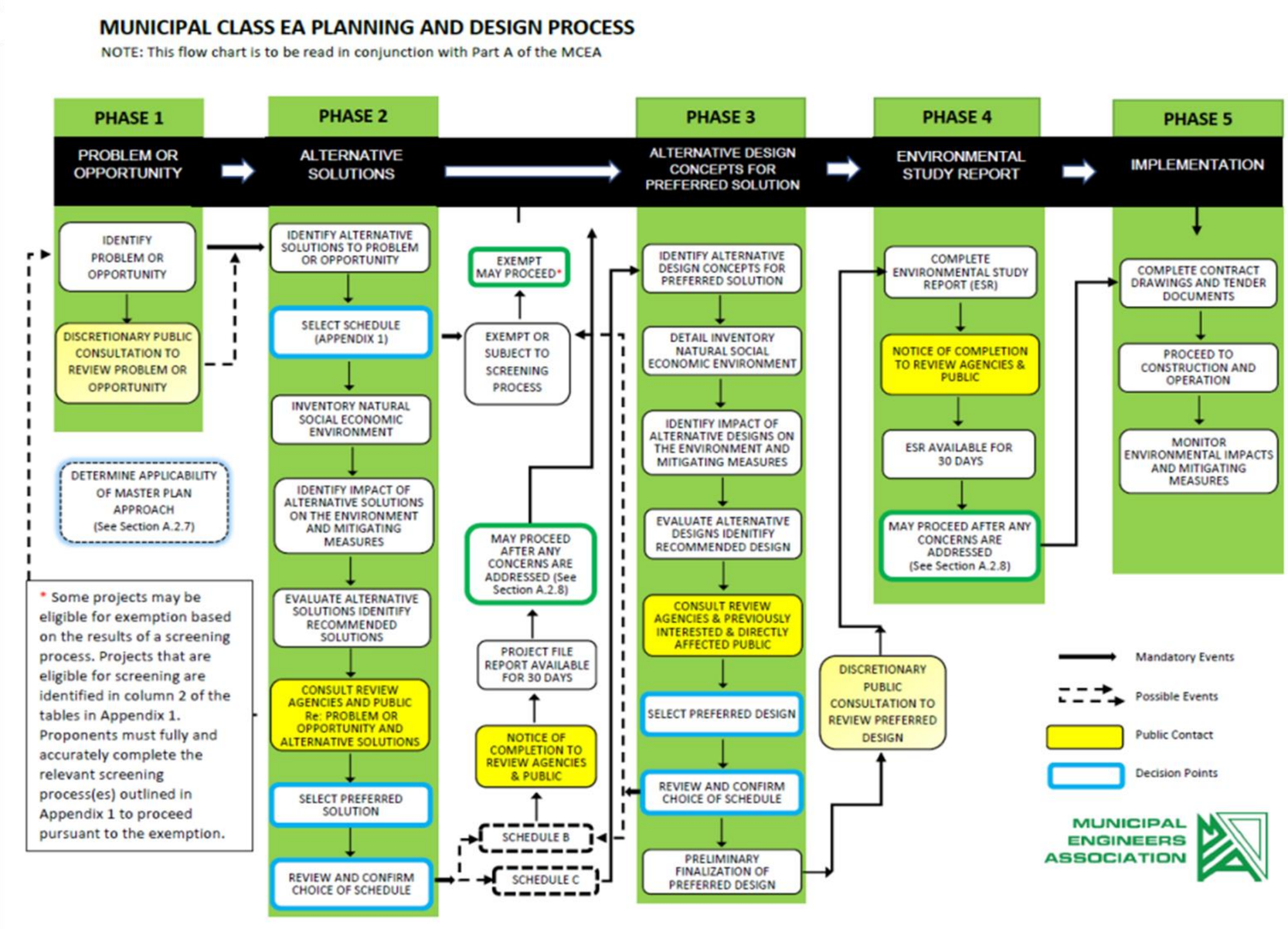
Projects Eligible for Screening to Exempt may be eligible for exemption based on the results of a screening process submitted to the local Ministry of Environment, Conservation and Parks (MECP) Regional Environmental Planner. If the process concludes that the project is not exempt, it must follow the applicable Schedule B or C process.

Schedule B projects generally include improvements and minor expansions to existing facilities and have the potential for some adverse environmental impacts. A Schedule B project must follow Phases 1 and 2 of the MCEA process and requires environmental screening to avoid or minimize adverse impacts. Public and agency consultation is also required. The screening process is documented in a Project File.

Schedule C projects generally include the construction of new facilities or major expansions to existing facilities and have the potential for significant environmental impacts. A Schedule C project must follow all five phases of the MCEA process and requires the completion of an Environmental Study Report. Extensive public and agency consultation is required for a Schedule C project.

This Project falls within a Schedule 'C' undertaking as outlined in the Municipal Class Environmental Assessment. **Figure 1-2** presents a graphic prepared by the Municipal Engineers Association outlining the overall MCEA process stages and key components.

Figure 1-2: Municipal Class EA Planning and Design Process (MCEA, 2024)



2.0 Planning Context

The following subsections provide an overview of federal, provincial, and local policies that may influence the Project in terms of potential funding opportunities and alignment with other plans and strategies.

2.1 Federal Planning Context

2.1.1 Canada's Strengthened Climate Plan (2020)

Canada's Strengthened Climate Plan builds on the Pan-Canadian Framework on Clean Growth and Climate Change (2016) and contains 64 federal policies, programs and investments focused on building a healthier economy and environment.

Canada's Strengthened Climate Plan proposes to explore opportunities to support waste and biosolids management infrastructure, such as composting, anaerobic digestion and landfill methane collection and use (ECCC, 2020).

The Plan also commits to investing $1.5 billion in a Low-carbon and Zero-emissions Fuels Fund to increase the production and use of low-carbon fuels (e.g., hydrogen, biocrude, renewable natural gas and diesel, cellulosic ethanol) (ECCC, 2020).

2.1.2 Canada's 2030 Emissions Reduction Plan (2022)

Canada's 2030 Emissions Reduction Plan builds on the actions identified in Canada's Strengthened Climate Plan (2020) and the Pan-Canadian Framework on Clean Growth and Climate Change (2016) to provide a roadmap for how Canada will meet its enhanced Paris Agreement target to reduce emissions by 40-45% from 2005 levels by 2030 (ECCC, 2022).

Canada's emissions reduction plan for 2030 and pathway to 2050 identifies economy-wide strategies as well as strategies targeted to the following eight sectors:

1. Buildings;
2. Electricity;
3. Heavy Industry;

4. Oil and Gas;
5. Transportation;
6. Agriculture;
7. Waste; and
8. Nature-Based Solutions.

The road map identifies the need for actions to reduce waste generation and increase diversion of biodegradable waste to achieve longer-term emission reductions. The Plan commits to exploring opportunities to advance a circular economy and acknowledges that supporting provincial, territorial, Indigenous, and municipal governments to develop infrastructure, such as landfill gas recovery systems, anaerobic digesters, composting facilities, thermochemical processing, and waste diversion strategies will help facilitate progress towards a low-carbon future (ECCC, 2022).

2.2 Provincial Planning Context

2.2.1 Provincial Policy Statement

The Provincial Policy Statement (PPS; Ministry of Municipal Affairs and Housing (MMAH), 2020), provides overall policy directions on matters of provincial interest related to land use and development in Ontario and applies to the City. The PPS requires planning authorities to plan for, protect and preserve natural resources, public health and safety, employment areas, and the quality of the built environment for current and future uses.

Section 1.2 of the PPS relates to coordination and includes policies related to land use compatibility:

> Major facilities and sensitive land uses shall be planned and developed to avoid, or if avoidance is not possible, minimize and mitigate any potential adverse effects from odour, noise and other contaminants, minimize risk to public health and safety, and to ensure the long-term operational and economic viability of major facilities in accordance with provincial guidelines, standards and procedures (MMAH, 2020).

Section 1.6 of the PPS (Infrastructure and Public Service Facilities) includes the policies related to the proposed Facility.

The proposed Facility is, at a minimum, intended to accept organic waste material from two sources that Utilities Kingston (biosolids) and the City (Green Bin wastes) manage and to process these materials to generate a renewable energy source (i.e., biogas). There is a potential that additional sources of organic material could be processed at the Facility to increase renewable natural gas production and provide increased opportunity for diversion of organic wastes from landfill. The proposed Facility falls under several sections of the PPS, most importantly, Section 1.6, including Section 1.6.6 (Sewage, Water and Stormwater), Section 1.6.10 (Waste Management), and Section 1.6.11 (Energy Supply).

Section 1.6.6 of the PPS (Sewage, Water and Stormwater), includes the following relevant policies:

Planning for sewage and water services shall:

- Ensure that these systems are provided in a manner that:
  - Can be sustained by the water resources upon which such services rely;
  - Prepares for the impacts of a changing climate;
  - Is feasible and financially viable over their lifecycle; and
  - Protects human health and safety, and the natural environment.
- Promote water conservation and water use efficiency;
- Integrate servicing and land use considerations at all stages of the planning process; and
- Be in accordance with the servicing hierarchy outlined through policies 1.6.6.2, 1.6.6.3, 1.6.6.4 and 1.6.6.5. For clarity, where municipal sewage services and municipal water services are not available, planned or feasible, planning authorities have the ability to consider the use of the servicing options set out through policies 1.6.6.3, 1.6.6.4, and 1.6.6.5 provided that the specified conditions are met (MMAH, 2020).

Section 1.6.10 of the PPS (Waste Management), includes the following relevant policies:

> Waste management systems need to be provided that are of an appropriate size and type to accommodate present and future requirements, and facilitate, encourage and promote reduction, reuse and recycling objectives; and,
>
> Waste management systems shall be located and designed in accordance with provincial legislation and standards (MMAH, 2020).

Section 1.6.11 of the PPS (Energy Supply), includes the following relevant policies:

> Planning authorities should provide opportunities for the development of energy supply including electricity generation facilities and transmission and distribution systems, district energy, and renewable energy systems and alternative energy systems, to accommodate current and projected needs (MMAH, 2020).

Another relevant section of the PPS is Section 1.7.1 (Long-Term Economic Prosperity), which includes the following relevant policy:

> Long-term economic prosperity should be supported by...(j) promoting energy conservation and providing opportunities for increased energy supply…(MMAH, 2020).

The PPS sets forth a vision for Ontario's land use planning system by managing and directing land use to achieve efficient development and land use patterns, wise use and management of resources, and protecting public health and safety. In relation to the natural environment, Policy 2.1, Natural Heritage, and Policy 2.2, Water, provides for the protection and management of natural heritage and water resources, which include the following:

- Significant wetlands;
- Significant coastal wetlands;
- Significant woodlands;
- Significant valleylands;
- Significant wildlife habitat;
- Significant areas of natural and scientific interest (ANSIs);
- Fish habitat;
- Sensitive surface water features; and
- Sensitive ground water features.

The PPS defines "significant" to mean:

- In regard to wetlands, coastal wetlands and areas of natural and scientific interest, an area identified as provincially significant by the Ontario Ministry of Natural Resources using evaluation procedures established by the Province, as amended from time to time;
- In regard to woodlands, an area which is ecologically important in terms of features such as species composition, age of trees and stand history; functionally important due to its contribution to the broader landscape because of its location, size or due to the amount of forest cover in the planning area; or economically important due to site quality, species composition, or past management history. These are to be identified using criteria established by the Ontario Ministry of Natural Resources; and
- In regard to other features and areas in policy in 2.1, ecologically important in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or natural heritage system.

The PPS defines "sensitive" to mean:

- In regard to surface water features and ground water features, means areas that are particularly susceptible to impacts from activities or events, including, but not limited to, water withdrawals, and additions of pollutants.

Potential significance of natural heritage features may be evaluated based on size, age, presence of rare or sensitive species, species diversity, and linkage functions, taking into consideration factors such as adjacent land use and degree of disturbance. Criteria for determining significance follow guidance outlined in the Natural Heritage Reference Manual (MNRF, 2010) and the Significant Wildlife Habitat Technical Guide Ecoregion 6E Criterion Schedules (MNRF, 2015), where applicable.

2.2.2 Powering Ontario's Growth: Ontario's Plan for a Clean Energy Future (2030-2050), 2022

The Powering Ontario's Growth Plan is an action plan to support increasing demand for electricity from 2030-2050. The Plan builds upon the Independent Electricity System Operator (IESO) *Pathways to Decarbonization Report* released in December 2022 which

recommended "no-regret" actions that could be taken to develop needed electricity resources. This included:

- Accelerating current efforts to acquire new non-emitting electricity supply, including the implementation of recent conservation and demand management directives.
- Investing in emerging technologies like low-carbon fuels. Further work is needed to determine if they can replace at scale some of the flexibility that natural gas currently provides the system (Ministry of Energy [MOE], 2023).

The Powering Ontario's Growth Plan advances these recommendations and includes an action to start planning for Ontario's next competitive electricity procurement that will focus on capacity to meet peak electricity demand, including non-emitting energy technologies such as wind, solar, hydroelectric, and biogas (MOE, 2023).

2.2.3 Endangered Species Act, 2007

In June 2008, the *Endangered Species Act, 2007* (ESA) came into effect in Ontario. The purpose of the ESA is to identify SAR based on the best available scientific information; to protect SAR and their habitats, to promote the recovery of SAR; and to promote stewardship activities to assist in the protection and recovery of SAR in Ontario. There are three applicable regulations under the ESA; Ontario Regulation 230/08 (the SARO List); Ontario Regulation 242/08 (General); and, Ontario Regulation 830/21 (Exemptions – Bobolink, Eastern Meadowlark and Butternut). These regulations serve to identify which species and habitat receive protection and provide direction on the current implementation of the ESA by the MECP.

2.2.4 Resource Recovery and Circular Economy Act, 2016

In 2016, the Resource Recovery and Circular Economy Act (RRCEA) was passed by the Legislative Assembly of Ontario. The RRCEA authorizes the transition of the financial and operational responsibility for waste diversion programs in Ontario from municipalities to product and packaging producers.

Section 2 of the RRCEA describes the aims of the Act:

- Protect the natural environment and human health;
- Foster the continued growth and development of the circular economy;

- Minimize greenhouse gas emissions resulting from resource recovery activities and waste reduction activities;
- Minimize the generation of waste, including waste from products and packaging;
- Minimize the need for waste disposal;
- Minimize the environmental impacts that result from resource recovery activities and waste reduction activities, including from waste disposal;
- Provide efficient, effective, convenient and reliable services related to waste reduction and resource recovery, including waste management services;
- Increase the reuse and recycling of waste across all sectors of the economy;
- Increase opportunities and markets for recovered resources;
- Promote public education and awareness with respect to resource recovery and waste reduction; and,
- Promote co-operation and co-ordination among the various person and entities involved in resource recovery activities and waste reduction activities.

2.2.5 Ontario's Food and Organic Waste Policy Statement, 2018

The Food and Organic Waste Policy Statement supports the provincial vision of a circular economy and is an important tool to help move towards the province's visionary goals of zero waste and zero greenhouse gas emissions from the waste sector.

The Policy Statement focuses on waste reduction and resource recovery through preventing and reducing food waste, effectively and efficiently collecting and processing food and organic waste and reintegrating recovered resources back into the economy.

The Policy Statement provides policy direction to further the provincial interest related to waste reduction, and resource recovery of food and organic waste: 'waste reduction and resource recovery of food and organic waste' will help improve environmental outcomes, reduce greenhouse gas emissions and recover valuable nutrients, thus fostering a 'circular economy'.

The policies that make up the Policy Statement are intended to further the aims of the provincial interest set out in Section 2 of the *Resource Recovery and Circular Economy Act, 2016*, as described in **Section 2.2.4.**

2.3 Local Planning Context

2.3.1 Utilities Kingston Strategic Plan (2021-2025)

The Strategic Plan outlines the goals and initiatives for Utilities Kingston from 2021 to 2025, and its key drivers were shaped by internal and external forces, including increasing concerns for climate change. The Strategic Plan notes that UK supports the strategic goals of the City and Kingston Hydro Corporation. Some of the relevant goals of the Strategic Plan include:

- Managing assets for sustainability;
- Managing assets for climate action;
- Development of a Utilities Kingston Climate Action Leadership Plan; and
- Investigating an integrated biosolids and source-separated organics processing facility (Utilities Kingston, 2021).

2.3.2 City of Kingston Strategic Plan (2023-2026)

The City's Strategic Plan 2023-2026 (Strategic Plan) outlines five central priorities for the community, including leading environmental stewardship and climate action. The Strategic Plan provides an outline of the objectives in relation to leading environmental stewardship and climate action, including reducing the carbon footprint of City operations and exploring different opportunities in the City to transition to alternative fuel sources (City of Kingston, 2021a).

The proposed Facility is anticipated to be consistent with the objectives of the Strategic Plan (specifically under the "Lead Environmental Stewardship and Climate Action" priority) as the Facility will aim to produce renewable natural gas (biogas) and other beneficial resources that work to reduce community GHG emissions.

2.3.3 Municipal Energy Study (2018)

The Municipal Energy Study (MES) examined current and future energy use scenarios for the City using the Ontario Ministry of Energy's Community Energy Planning framework. The MES examined the emerging trends in energy and identified six strategic energy objectives, including:

1. **Alignment** – Improve Kingston's alignment with Provincial energy and climate strategy and policies;
2. **Planning** – Continue to integrate desired energy outcomes into local urban planning;
3. **Efficiency** – Reduce the energy and carbon footprint of new and existing buildings;
4. **Generation and Distribution** – Localize more of our energy production and distribution;
5. **Transportation** – Reduce the energy cost and carbon footprint of transportation; and,
6. **Energy Knowledge and Community Capacity** – Increase energy literacy and leverage community capacity (City of Kingston, 2018).

Input from the public and energy stakeholders was used to consider future energy scenarios and helped to identify options for action areas for each of the energy objectives. The MES also identified emerging trends in energy storage technologies, and identified or reinforced energy affordability through potential biogas production.

It is noted that the MES supports implementation of the Kingston Climate Action Plan (2014), which has since been superseded by the City Climate Leadership Plan (2021).

2.3.4 City of Kingston Climate Leadership Plan (2021)

The Kingston Climate Leadership Plan (KCLP) is an integrated corporate and community-based plan completed in 2021. The KCLP outlines several objectives and actions to achieve the City's target of carbon neutrality by 2040 (City of Kingston, 2021). The Plan's vision is:

"Kingston is an innovative carbon neutral city that continues to work collaboratively with community partners to achieve climate leadership.

Kingston is a healthy and resilient community and is able to mitigate the risks and benefit from the opportunities presented by a changing climate.

Kingston has a thriving low-carbon economy that is compatible with being a sustainable community with a high quality of life" (City of Kingston, 2021).

The KCLP has five key theme areas, including:

- Buildings and Energy Production
- Waste
- Transportation
- Food and Forestry
- Climate Change Adaptation and Resilience

The Project is anticipated to be consistent with the objectives and actions of the KCLP including:

"Objective 1: Accelerate local production of renewable and low carbon energy and energy storage.

Objective 6: Produce renewable natural gas locally from waste sources and encourage adoption of other low carbon fuels.

> "Action 6.1: Develop infrastructure to locally produce renewable natural gas (RNG) as outlined in the City's Biogas Master Plan. Identify a local partner interested in purchasing RNG to retain environmental benefits within Kingston.
>
> Action 6.2: Increase diversion of organic waste through expansion of the City's Green Bin program.
>
> Action 6.5: Encourage the industrial sector to accelerate its switch to renewable energy for process loads through purchase of renewable natural gas or use of green hydrogen."

2.3.5 City of Kingston Official Plan (2010; 2022 Consolidation)

The City Official Plan (2010) is intended to guide development in the City until 2036 and provides the framework for the City's zoning bylaw. The Official Plan was consolidated on December 2, 2022, and includes all approvals and modifications made to the Official Plan after it came into effect, up to and including November 30, 2022 (City of Kingston, 2023b).

Existing land uses (as of June 2024) and land use designations are described below to include the Proposed Site Location and surrounding lands within approximately 1 km of the Proposed Site Location. Land use designations were identified through Schedule 3-B

of the Official Plan. The Official Plan and its associated schedules were accessed June 2024.[1]

2.3.5.1 Knox Farm – Proposed Site Location

The Proposed Site Location is in the south-western section of the Knox Farm Property Boundary (**Figure 1-1**) and was part of the former sediment dewatering areas for the City's Cataraqui River Dredged Material Storage and Dewatering Facility. The Proposed Site Location is currently vacant and the land immediately east of the Proposed Site Location currently serves as a snow management facility managed by the City.

As identified in Schedule 3-B of the Official Plan, the Proposed Site Location consists of Open Space, Rural Lands, and Environmental Protection Areas (EPA) (**Figure 2-1**).

Section 3.1.1 of the Official Plan notes that municipal infrastructure may be permitted in all land use designations, provided they can be made compatible with surrounding land uses and subject to the *Environmental Protection Act* and the MECP regulations (City of Kingston, 2010).

Open Space

The majority of the Proposed Site Location consists of Open Space. Under Section 3.8.3 of the Official Plan, the proposed use for the site is not specifically listed as a permitted use in Section 3.8.3; however, given it is identified as a generally permitted use under Section 3.1.1, the use is permitted within the Open Space designation.

Rural Lands

A small section of the eastern extent of the Proposed Site Location falls within the Rural Lands designation. As noted under Section 3.12 of the Official Plan, Rural Lands on Schedule 3 reflect areas outside of the Urban Boundary which generally have Classes 5, 6, and 7 soils and are less suitable to sustain viable agriculture and "existing non-farm development that may limit the future intensive farm activity" (City of Kingston, 2010). Based on the permitted uses identified under Section 3.12.2, the proposed Facility is not

[1] Land use designations and any applicable Official Plan Amendments and Zoning Bylaw Amendments are to be confirmed using original planning documents and amendments at the time of the Site Plan application.

permitted; however, Section 3.12.2 indicates that limited non-farm growth is permitted in the Rural Lands if it does not limit or interfere with agricultural-related uses, agricultural use, on-farm diversified uses or a broader range of rural uses, and if it meets the environmental objectives of the Official Plan (City of Kingston, 2010). As noted above, municipal infrastructure may be permitted in all land use designations subject to the policies under Section 3.1.1.

Environmental Protection Areas (EPA)

Based on Schedule 7-B of the Kingston Official Plan a small west section (approximately 15 m in width) of the Proposed Site Location is designated as EPA which coincides with the boundaries of Cataraqui Clay Creek Ridges Earth Science Area of Natural and Scientific Interest (ANSI) and also encompasses Provincially Significant Wetlands which occur further to the west. Under Section 3.10.2 (Permitted Uses), the proposed Facility is not permitted within the EPA; however, Section 3.10.3 notes that new public or private works or utilities may be permitted where such facilities are not feasible outside of the EPA (City of Kingston, 2010).

Schedule 7-B and Schedule 8-B, identifies Natural Heritage Area 'A' and Natural Heritage Area 'B' features and areas, respectively. As noted above, ANSI (i.e., Natural Heritage 'A' feature) is located adjacent and partially within the Proposed Site Location. The Proposed Site Location is also surrounded by significant woodland (i.e., Natural Heritage 'B' feature), on three sides, and a small section of the significant woodland is located within the Proposed Site Location along the western boundary. Based on Section 6.1.1, development will be directed away from natural heritage areas and features (City of Kingston, 2010).

Currently, the proposed Facility is located adjacent to the EPA, ANSI and significant woodland (i.e., Natural Heritage 'A' and 'B' features); however, Section 6.1.8 of the Official Plan notes development and site alteration are not permitted adjacent to Natural Heritage 'A' or 'B' features, unless:

"…it has been demonstrated that there will be no negative impacts on the natural heritage features and areas or on their ecological functions. In the review of any development or site alteration, an environmental impact assessment will be required as follows, unless otherwise directed by the City in consultation with the Cataraqui Region Conservation Authority:

…d. within 120 metres of significant woodlands

…g. within 50 metres of areas of natural and scientific interest – earth science"

(City of Kingston, 2010).

Section 6.1.10 of the Official Plan also notes that some of the natural heritage system feature boundaries are approximate and, where considered inaccurate, will require an environmental impact assessment (EIA) to confirm the limits of the features and their associated ecological functions. The City will consult with the appropriate authorities regarding potential boundary adjustments. As noted under Section 6.1.10 of the Official Plan:

"Minor adjustments to the boundaries of natural heritage system features, being Natural Heritage 'A' Features and Areas and Natural Heritage 'B' Features and Areas, may be permitted without an amendment to [the Official] Plan. As outlined in Section 3.10.6, the identification of new Natural Heritage 'A' Features and Areas, listed in Section 6.1.2 of [the Official] Plan, will require an amendment to [the Official] Plan to ensure these features fall within an Environmental Protection Area designation. A zoning by-law amendment may be required to implement the objectives of the Official Plan amendment as they relate to boundary adjustments" (City of Kingston, 2010).

It is noted that in accordance with Section 6.1.8 of the Official Plan an EIA is required. To satisfy this requirement the contents and requirements of an EIA have been incorporated into this ESR.

Energy Conservation and Production

The policies under Section 6.2 (Energy Conservation and Production) of the Official Plan are supportive of the KCLP (2021) and the MES. This section references renewable energy systems, and its general policies promote the design and orientation of development that:

- Explores opportunities for renewable energy systems on a site-specific or district-wide basis; and,
- Enhances the feasibility of district energy (City of Kingston, 2010).

It is anticipated that the proposed Facility will be consistent with the goal of Section 6.2, by contributing to a renewable energy system through the development of a renewable energy source (i.e., biogas).

Section 6.2.14.1 of the Official Plan notes that:

"A proposed electricity generation facility may be required to demonstrate, through appropriate supporting studies, that emissions from dust, noise, contaminants, odour, water, wastewater, stormwater drainage, or solid waste disposal will not have any adverse effects on sensitive uses. Where applicable, a completed Environmental Compliance Approval for emissions will be required prior to the municipality's consideration of the implementing zoning by-law" (City of Kingston, 2010).

Section 5.0 of this ESR provides an overview of the studies completed for the proposed Facility and **Section 7.3** provides an overview of potential impacts and mitigation measures.

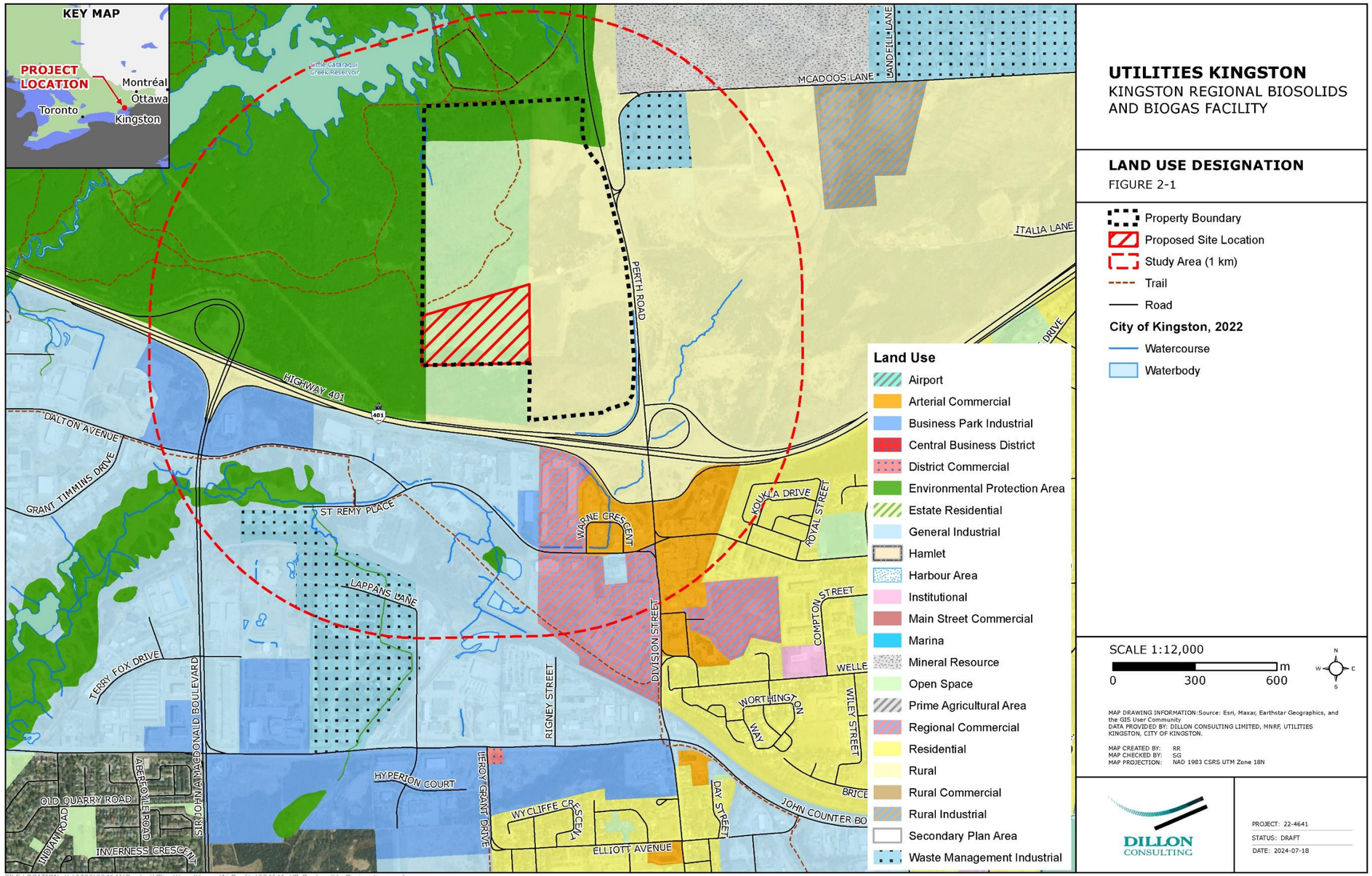
Land Use Compatibility Principles – Distance Separation

Under Section 2.7.5 of the Official Plan, it is noted that distance separation will likely be the recommended form of mitigation, particularly between electricity generation facilities and residential or other sensitive uses (City of Kingston, 2010). Sensitive uses as defined in the Official Plan:

"Buildings, amenity areas, or outdoor spaces where routine or normal activities occurring at reasonably expected times would experience one or more adverse effects from contaminant discharges generated by a nearby major facility. Sensitive uses may be a part of the natural or built environment. Examples may include, but are not limited to residences, day care centres, public parkland and educational and health facilities" (City of Kingston, 2010).

An overview of adjacent land uses is provided under **Section 2.3.5.2** of this ESR.

Figure 2-1: Proposed Site Location Land Use Designations



2.3.5.2 Adjacent Land Uses Within 1 km

A description of existing land uses and designations within approximately 1 km of the Proposed Site Location are included below. **Figure 2-1** illustrates the land use designations adjacent to the Proposed Site Location.

North of Proposed Site Location

Land use designations north of the Proposed Site Location includes Open Space, EPA, and Rural Lands. The majority of the land consists of vacant land, wooded area and Little Cataraqui Creek Conservation Area trails. The area north of the Proposed Site Location also includes the Little Cataraqui Creek Conservation Area, and several Natural Heritage features, including ANSI, Provincially Significant Wetland (PSW), significant woodlands, watercourses, linkages, and valleylands. A Cataraqui Region Conservation Authority operated trail is located on City-owned land within approximately 1 km of the Proposed Site Location. Two residential properties are located off of the Little Cataraqui Creek Conservation Area Trails roadway approximately 700 m northeast of the Proposed Site Location (**Figure 2-2**).

A waterbody (Little Cataraqui Creek Reservoir) is located approximately 1 km to the northwest; and a Trans-Northern Pipeline is located approximately 2.9 km north/northwest of the Knox Farm Property Boundary and carries refined liquid petroleum products (Canada Energy Regulator, 2022).

East of Proposed Site Location

Land use designations east of the Proposed Site Location include Waste Management Industrial, Mineral Resource and Rural. The majority of lands appear to be undeveloped or vacant, with some commercial and industrial businesses located along McAdoo's Lane (e.g., crushed stone supplier, used car dealer, concrete contractor, waste management service, trucking company/accessory store). Two residential properties are located off McAdoo's Lane in close proximity to active quarry and industrial operations, approximately 690 m northeast of the Proposed Site Location (**Figure 2-2**).

West of Proposed Site Location

Land use designations west of the Proposed Site Location includes EPA, Business Park Industrial, and Rural Lands. The majority of the land is wooded area and contains the

Little Cataraqui Creek Conservation Area trails. Several industrial and commercial businesses are located southwest of the Proposed Site Location, immediately south of Highway 401.

South of Proposed Site Location

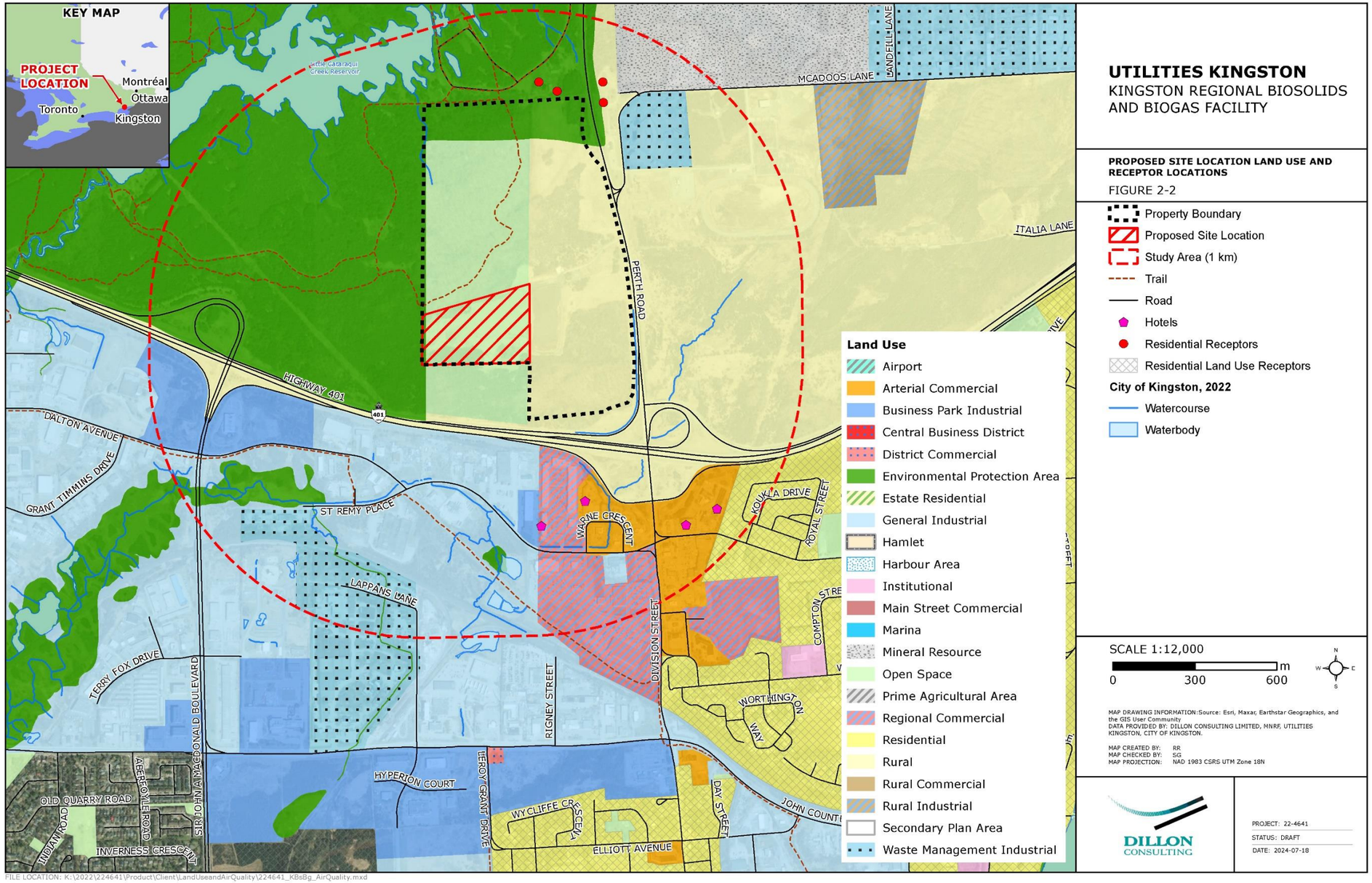
The Proposed Site Location is separated from several land use designations by Highway 401, which is located immediately south. As noted under Section 2.0, the Proposed Site Location is outside of the Urban Boundary, and within the rural area of the municipality based on Schedule 2 of the Official Plan. Land use designations south of the Proposed Site Location includes Rural, EPA, Arterial Commercial, Regional Commercial, General Industrial, Business Park Industrial, Residential, Waste Management Industrial, and Institutional. Retail centres (e.g., restaurants and fast food establishments, clothing outlets, grocery stores, movie theatre, gas station) and several industrial parks (e.g., automobile services, contractors/construction services) are located south of the Proposed Site Location.

Sensitive receptors (**Figure 2-2**) are predominately located south of the Proposed Site Location and include:

- Residential properties (Approximately 20 residential properties in high, medium and low density formats); and,
- Hotels (Four).

Residential properties located off of Division Street are approximately 1 km southeast of the Proposed Site Location. The majority of residential properties are apartments and townhouses (City of Kingston, 2023b). Approximately eight townhomes are located along Conacher Drive. The lot behind these townhomes currently have Development Applications identified for the construction of several other townhouses with multiple units (City of Kingston, 2023b). Four hotels are located south of Highway 401 and are approximately 0.5 km to 0.9 km from the Proposed Site Location.

Figure 2-2: Proposed Site Location Land Use and Receptor Locations



2.3.6 Kingston Zoning Bylaw Number 2022-62

The Kingston Zoning Bylaw 2022-62 was enacted on April 26, 2022, and regulates "the use of lands and the size and location of buildings for almost all properties in the City (all properties except those identified as "Not Subject to this By-law")" (City of Kingston, n.d.). The land within the Property Boundary includes EPA Zone and General Rural Area Zone (**Figure 2-3**).

Environmental Protection Area Zone

The majority of the Proposed Site Location is currently located within the EPA Zone, which, according to Section 19 of the Zoning Bylaw indicates that "no use, building or any part of a private sewage system is permitted in the EPA Zone" and identifies the excepted uses, including "new public or private works or utilities such as pipelines, roads, bridges or parking areas, where such facilities are not feasible outside of the Environmental Protection Area" (City of Kingston, n.d.). Section 4.9.1 (Uses Permitted in all Zones) restricts the development of the identified uses (including municipal infrastructure, electricity generation facilities and public utility installations required by any public authority or private utility) from the EPA Zone (City of Kingston, n.d.). Accordingly, if the proposed Facility is located within the EPA Zone, a Zoning Bylaw amendment is required in order to permit the proposed Facility.

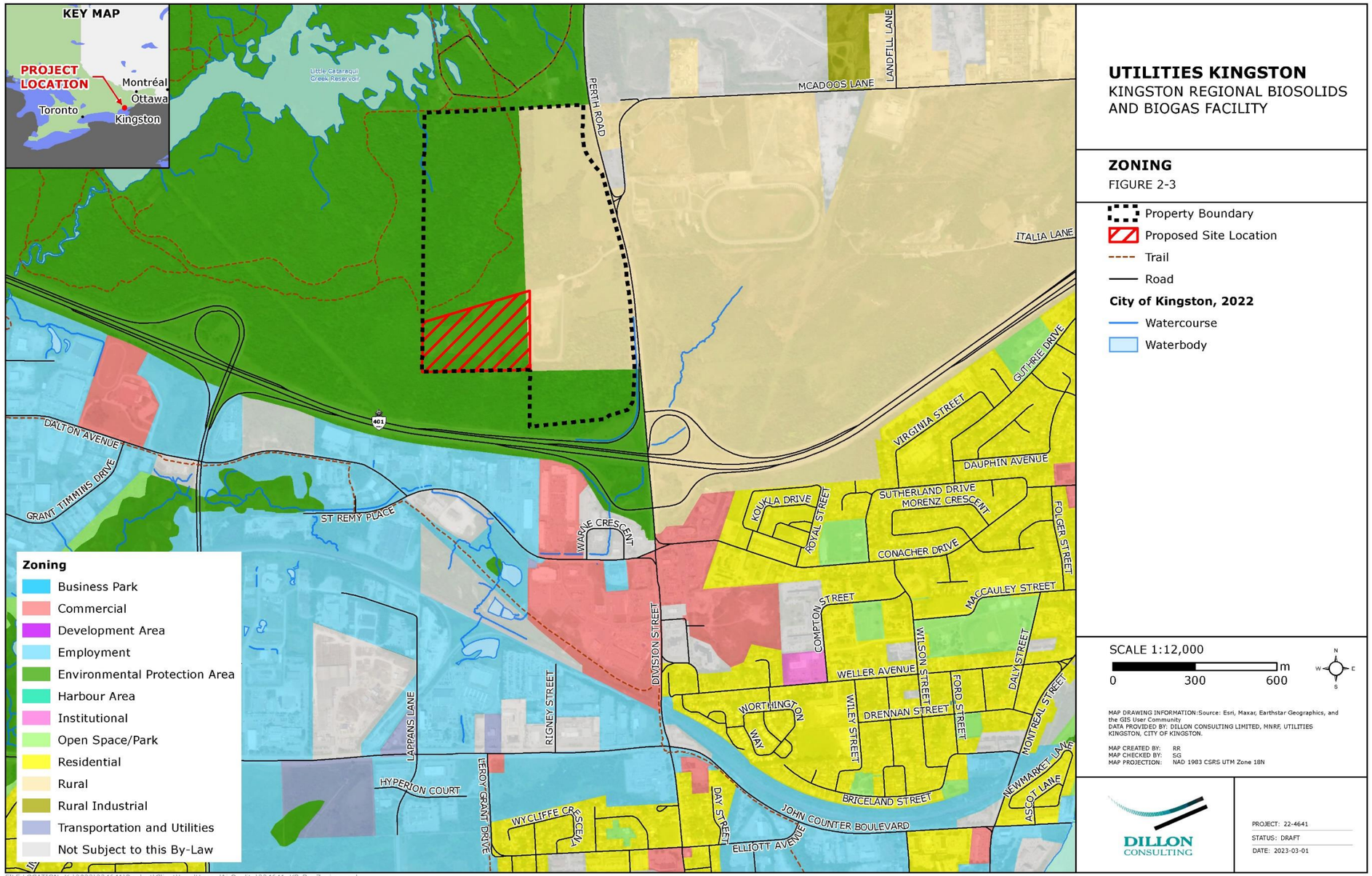
It is understood from the City's planning department that the area designated as Open Space in the Official Plan (which spans the majority of the Proposed Site Location; refer to **Figure 2-1**) was incorrectly zoned as an EPA Zone. It is further understood that the City's planning department is currently undergoing a Zoning Bylaw Amendment to change the incorrectly zoned area from EPA to either "General Open Space" or "General Rural Area" in the Proposed Site Location area.

If the Zoning Bylaw Amendment changes the EPA to General Open Space, the proposed Facility is not listed as a permitted use under Section 18 of the Zoning Bylaw; however, the proposed Facility may be permitted in the General Open Space Zone based on Section 4.9.1 (Uses Permitted in all Zones) of the Zoning Bylaw (City of Kingston, n.d.). Refer to the General Rural Area below for permitted uses.

General Rural Area Zone

The snow management facility (adjacent to the Proposed Site Location) is within a General Rural Area Zone, and as mentioned above, a small section of the eastern portion of the Proposed Site Location also appears to fall within this zone. The proposed Facility is not identified under the permitted uses listed in Table 8.1.2 of the Zoning Bylaw; however, based on Section 4.9.1 (Uses Permitted in all Zones) of the Zoning Bylaw, the proposed Facility may be permitted in the General Rural Area Zone (City of Kingston, n.d.).

Figure 2-3: Zoning



3.0 MCEA Phases 1 and 2 Summary

Utilities Kingston (UK) undertook a Master Plan for Enhanced Biosolids Management and Biogas Utilization that was completed in 2020 by Tetra Tech Canada Inc. (Tetra Tech) to review its long-term approach for biosolids management at local wastewater treatment plants. The Master Plan developed a Problem/Opportunity statement, identified and assessed alternative solutions to address the defined Problem/Opportunity, and developed a preferred solution. The preferred solution was to develop an integrated AD Facility that manages biosolids and SSO at Knox Farm.

Dillon was retained to assess the suitability of the Knox Farm property for the proposed Facility and if deemed suitable, proceed with a MCEA that builds on the completed Master Plan and progresses to complete Phase 3 and Phase 4 of the MCEA process.

Between Summer 2022 and Spring 2023 Dillon undertook a reconfirmation exercise of Phases 1 and 2 as well as the Knox Farm Suitability Report prior to advancing Phases 3 and 4 of the MCEA process.

3.1 Phase 1: Problem/Opportunity

The MCEA document states that municipalities generally undertake projects in response to certain identified problems or deficiencies. The document goes on to state that, on the other hand, there may be opportunities that need to be addressed.

In 2020, UK completed the Master Plan for Enhanced Biosolids Management and Biogas Utilization (Master Plan). The purpose was to review the long-term approach to biosolids management at local WWTPs, address the need to increase capacity to treat sludge produced at the Cataraqui Bay WWTP, and consider co-digestion of biosolids with SSO (or Green Bin materials) collected by the City and generated by the industrial, commercial and institutional (IC&I) sector as a future management approach.

The Master Plan identified the following opportunity that UK would address:

> UK is presently positioned to address both the enhancement of the management of the biosolids generated at the Cataraqui Bay and Ravensview WWTPs, and to consider the introduction of the co-digestion of these solids streams with waste

organics both collected by the City and generated by the IC&I sector. This opportunity has arisen, in part, from the developments in Ontario regarding:

- The consideration of wastes as resources within the context of a circular economy;
- The increased interest in the province for the more effective management of waste organics with the objective of eliminating the landfilling of these materials; and,
- The identification of opportunities for the generation and utilization of RNG thereby reducing the City's carbon footprint.

For the purposes of the Master Plan, the undertaking was described as:

"The enhancement of the production of biogas through enhancements to the biosolids processing trains at the City's two WWTPs and including the possible co-digestion of the biosolids and waste organics both collected by the City as SSO and generated by facilities in the IC&I sector."

The Problem/Opportunity statement from the original Master Plan was reconfirmed during the Project, alongside the opportunity of locating the Facility on an existing City-owned site, Knox Farm. The proposed Facility would process City-managed organic wastes and potentially accept organic waste from other sources in and around the City including local businesses, institutions and neighbouring municipalities. The opportunity to achieve a net reduction in GHGs produced through wastewater treatment and biosolids processing through enhanced biogas production was also a key driver identified at this stage.

3.2 Phase 2: Alternative Solutions

The Master Plan for Enhanced Biosolids Management and Biogas Utilization identified the following five Alternative Solutions:

- Alternative 1 – Do Nothing;
- Alternative 2 – Optimize Infrastructure at Cataraqui Bay WWTP;
- Alternative 3 – Optimize Infrastructure at Ravensview WWTP;
- Alternative 4 – Incorporate SSO at Cataraqui Bay WWTP; and
- **Alternative 5 – Integrate Processing of Biosolids and SSO at Knox Farm (Preferred Alternative).**

Each alternative (with the exception of the Alternative 1 "Do Nothing") is summarized briefly below.

Alternative 2 – Optimize Infrastructure at Cataraqui Bay WWTP

Alternative 2 is focussed on biosolids process optimization at the Cataraqui Bay facility. Under Alternative 2, the existing mesophilic digestion process at Cataraqui Bay would be upgraded to include a thermophilic digestion stage. Mesophilic digestion is the most common type of digestion and requires temperatures between 35°C and 39°C Thermophilic digestion requires heating to between 50°C and 57°C, and provides an opportunity for greater volatile solids destruction, reducing digestate volume and increasing biogas production. A subset of Alternative 2 was created (referred to as Alternative 2B) which considered the addition of a biological hydrolysis pre-treatment step ahead of digestion, in place of a new thermophilic digestion system. Biological hydrolysis incorporating a thermal-based process, breaks down organic compounds in feedstock (particularly plant-based constituents such as cellulose and lignin that normally resist digestion) making them more available to subsequent anaerobic biological digestion and enhancing overall biogas production.

In both Alternative 2A and Alternative 2B, biological sludge produced at the Ravensview WWTP facility would be dewatered at-source and transported to the Cataraqui Bay WWTP for blending and processing.

Alternative 3 – Optimize Infrastructure at Ravensview WWTP

Alternative 3 would include the construction of a biological hydrolysis facility to complement existing digesters at the Ravensview WWTP, in a similar processing configuration to Alternative 2B. Biological sludge produced by the Cataraqui Bay WWTP would be dewatered and transported to the Ravensview WWTP for blending and processing. It is assumed that the biosolids generated by this process would be dewatered into a cake form and stored on-site prior to offsite management.

Alternative 4 – Incorporate SSO at Cataraqui Bay WWTP

Alternative 4 is similar to Alternative 2, with the addition of a SSO feedstock derived from the City's residential Green Bin program, and the potential to accept further outside SSO inputs at a later date. In addition to an SSO receiving and processing facility, Alternative 4 assumes the construction of a new biological hydrolysis conditioning step

ahead of the digestion step. Digested biosolids would be dewatered and stored onsite prior to removal for end use. The Master Plan report notes a lack of space for constructing the required new infrastructure and accommodating new expansion as the primary factor in discounting Alternative 4. It is agreed that the siting proposed in Alternative 4 does not align with the Project objective of developing a site with the capacity to accept organic waste from a variety of Kingston and regional stakeholders.

Alternative 5 - Integrate Processing of Biosolids and SSO at Knox Farm

Alternative 5 proposes the same biosolids management process as Alternative 4 but located at a dedicated facility constructed at Knox Farm north of the City. It was put forward as the preferred alternative for more detailed consideration. The Knox Farm Facility would receive dewatered biosolids from both Cataraqui Bay WWTP and Ravensview WWTP as well as Green Bin SSO collected by the City. The SSO would be pre-processed on-site for size reduction and physical contaminant removal to create a clean feedstock to co-digest with the wastewater sludge. It was intended that the Facility would have the potential to accept and process other organic feedstocks at a later date, however the exact quantity and characteristics of other potential feedstocks are unknown at this time.

Alternative 5 was identified as the preferred alternative as it addressed both the need to increase capacity to manage sludge produced by the Cataraqui Bay WWTP and provincial motivation for more effective management of organic waste. Further, this presented an opportunity for the City to reduce their overall carbon footprint through the production of RNG. Dillon reconfirmed the alternative presented in the 2020 Master Plan and provided additional considerations regarding Alternative 5, including future expansion capabilities, updated cost estimates, and consideration of additional resources.

Although Alternative 5 was identified as the preferred approach, a technical review of the suitability of Knox Farm for the proposed Facility was not completed as part of the 2020 master plan. Therefore, a series of desktop technical studies were conducted to determine whether Knox Farm would be a suitable location for the proposed Facility. Findings of the studies were documented in the Knox Farm Suitability Report (Dillon, 2023) and are summarized in **Section 4.0**, which concluded that there were no major barriers to Facility development identified at the site.

4.0 Existing Conditions

As part of the Knox Farm Suitability Report, technical assessments were completed to understand existing conditions with respect to the proposed site. This section covers the environmental conditions potentially affected by the preferred alternative solution and the alternative design concepts developed for the Project.

4.1 Natural Environment

Baseline information on the natural environment within the Knox Farm property was collected through a combination of desktop background review and field investigation of the Proposed Site Location.

The desktop review consisted of a review of mapping, aerial imagery and relevant background information to screen the potential for natural heritage features, species at risk (SAR), SAR habitat and any other sensitive natural environment features within the immediate vicinity of the property.

To verify desktop findings and search for additional natural heritage or sensitive natural environment features that may occur within and adjacent to the Proposed Site Location, Dillon undertook natural environmental field investigations in 2022 and 2023.

Based on the results of the background review and 2022 and 2023 field investigations the majority of the Proposed Site Location was found to contain areas of low natural environmental value based on the disturbed meadow which dominates the centre of the Proposed Site Location and is known as the former site of the Cataraqui River Dredged Material Storage and Dewatering Facility.

Several confirmed and potential sensitive natural heritage features were identified as occurring within the property such as the Cataraqui Clay Creek Ridges Earth Science Area of Natural and Scientific Interest (ANSI), significant woodlands, a watercourse and unevaluated wetlands as well as potential SAR habitat and candidate SWH. However, the presence of these features was limited within the Proposed Site Location. The results of the desktop review and 2022 and 2023 field program is summarized in the subsections below.

4.1.1 Aquatic Environment

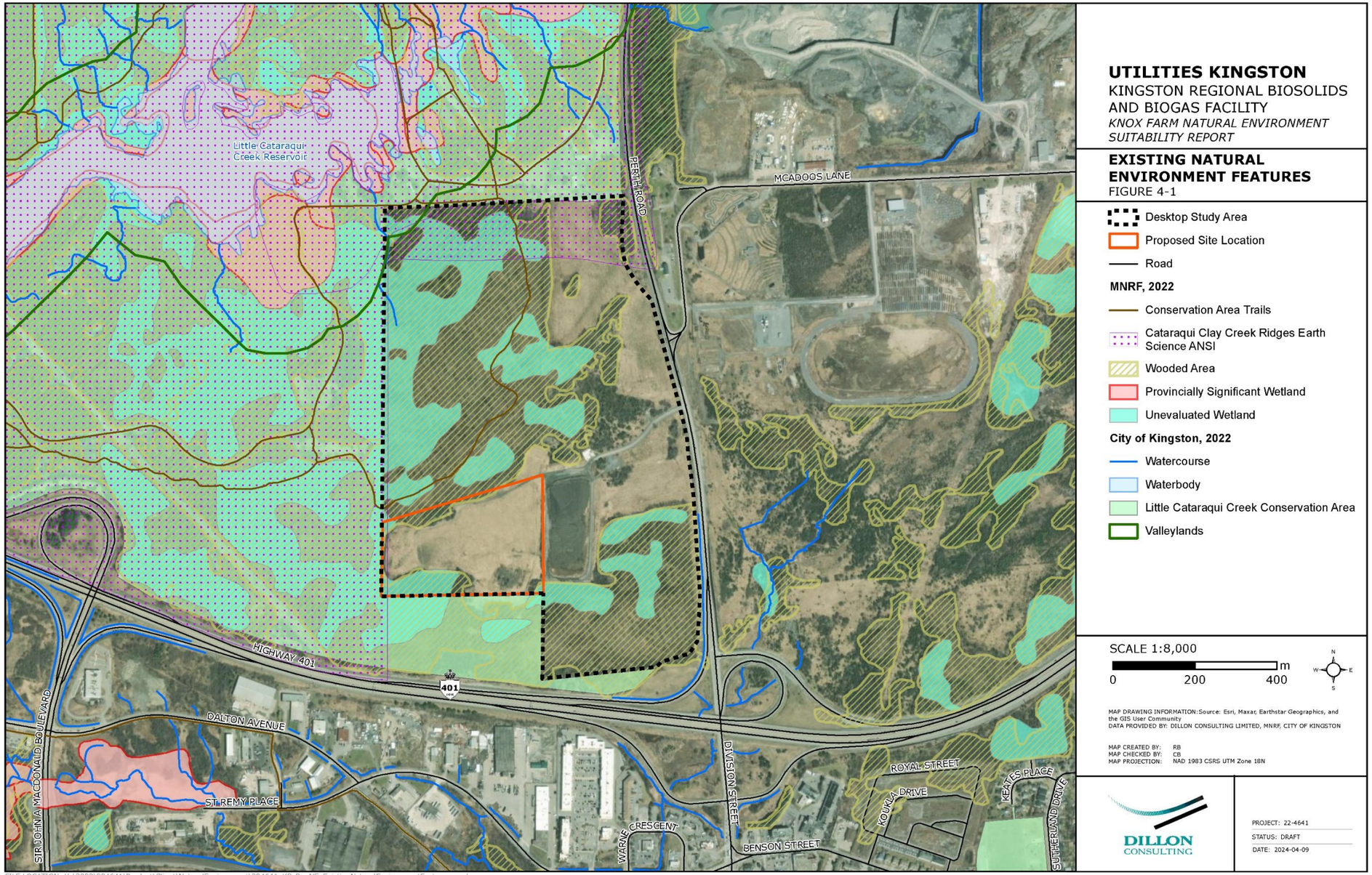
4.1.1.1 Watershed Summary

The Knox Farm property lies within the Cataraqui Region Conservation Authority (CRCA) watershed coverage area. The CRCA Watershed jurisdictions covers an area of approximately 3,800 km^2 and generally includes 11 subwatersheds across 11 municipalities. The two main rivers, the Cataraqui and the Gananoque, flow in southerly directions through the central part of the region to Kingston and Gananoque, respectively (CRCA, 2008). The western and eastern sections are drained by several smaller streams. The Knox Farm property is more specifically located within the Collins Creek subwatershed.

4.1.1.1 Fish Habitat

A review of MNRF and City Official Plan mapping reveals that one mapped watercourse with a north to south orientation occurs within the northwest portion of the Knox Farm property as shown on **Figure 4-1**. This watercourse flows approximately 500 m north until discharging into the Little Cataraqui Creek Reservoir.

Figure 4-1: Existing Natural Environment Features



Based on a review of the Fisheries and Oceans Canada (DFO) Aquatic Online Mapping Tool, and the MNRF Natural Heritage Information Centre (NHIC), there are no records of aquatic SAR, and no critical or resident SAR habitat was identified within a 1 km radius of the Proposed Site Location. Based on a review of Land Information Ontario (LIO) Aquatic Resource Area (ARA) database (2018) one fish survey inventory was completed within the eastern branch of the Little Cataraqui Creek Reservoir in 2004 and the following common fish species are known to occur in association with the Little Cataraqui Creek Reservoir: Banded Killifish (*Fundulus diaphanus*), Central Mudminnow (*Umbra limi*), Common Shiner (*Luxilus cornutus*), Creek Chub (*Semotilus atromaculatus*), and Pumpkinseed (*Lepomis gibbosus*). Based on the potential connectivity of Little Cataraqui Creek Reservoir and the mapped watercourse within the northwest portion of the Knox Farm property the common fish species listed above have the potential to occur.

The potential for aquatic fish habitat was investigated as part of the 2022 field program. Based on the results of the field investigations no surface water features or aquatic habitat was observed within or adjacent to the Proposed Site Location.

4.1.2 Terrestrial Environment

4.1.2.1 Areas of Natural and Scientific Interest

ANSIs are designated by the MNRF based on the presence of unique natural landscapes or existing features that meet specific criteria as having life or earth science values related to protection, scientific study or education. A review of the MNRF LIO geographic database indicates that the Cataraqui Clay Creek Ridges Earth Science Regionally Significant ANSI occurs within and adjacent to the west and north boundaries of the Knox Farm property.

The location of Cataraqui Clay Creek Ridges Earth Science Regionally Significant ANSI is shown on **Figure 4-1**.

4.1.2.2 Valleylands

Section 1 of the City Official Plan also identifies significant valleylands, which are identified as those identified by the Central Cataraqui Region Natural Heritage Study (2006) or through criteria established by MNRF. Schedule 8-B of the City Official Plan

identified one significant valleyland associated with Little Cataraqui Creek to be located within the northwest corner of the Knox Farm property outside of and approximately 625 m from the northern boundary of the Proposed Site Location.

The location of the identified significant valleyland is shown on **Figure 4-1.**

4.1.2.3 Wetlands

Wetlands within the Knox Farm property and the City are considered southern wetlands based on their location south of the northern limit of Ecoregions 5E, 6E, and 7E as shown on Figure 1 of the PPS, 2014. Provincially Significant Wetlands (PSW) are wetland areas that receive special protection by the province based on calculated value as determined by the scientifically based Ontario Wetland Evaluation System (OWES) (MNRF, 2022). During the desktop review several unevaluated wetlands were identified within the Knox Farm property and one PSW (Little Cataraqui Creek Complex) occurs approximately 40 m northwest of the Knox Farm property boundary.

Wetlands within and adjacent to the Knox Farm property identified during desktop review are shown on **Figure 4-1**. However, based on the results of Ecological Land Classification (ELC) conducted in 2022 outlined in **Section 4.1.2.4** below, no wetlands were identified within the Proposed Site Location.

4.1.2.4 Ecological Land Classification (ELC)

ELC was conducted by two Dillon biologists on September 26, 2022. In total, 10 ELC communities were identified within the Knox Farm property, eight of which are considered natural and two which are considered cultural that include:

Natural

- FOD – Deciduous Forest;
- FODM6-2 – Fresh-Moist Sugar Maple-Black Maple Deciduous Forest;
- THD – Deciduous Thicket;
- THDM2-5 – Buckthorn Deciduous Shrub Thicket;
- FODM8-3 – Moist Cottonwood Deciduous Forest;
- ME – Meadow;
- MEGM3-8 – Reed Canary Grass Graminoid Meadow;
- SWD – Deciduous Swamp;

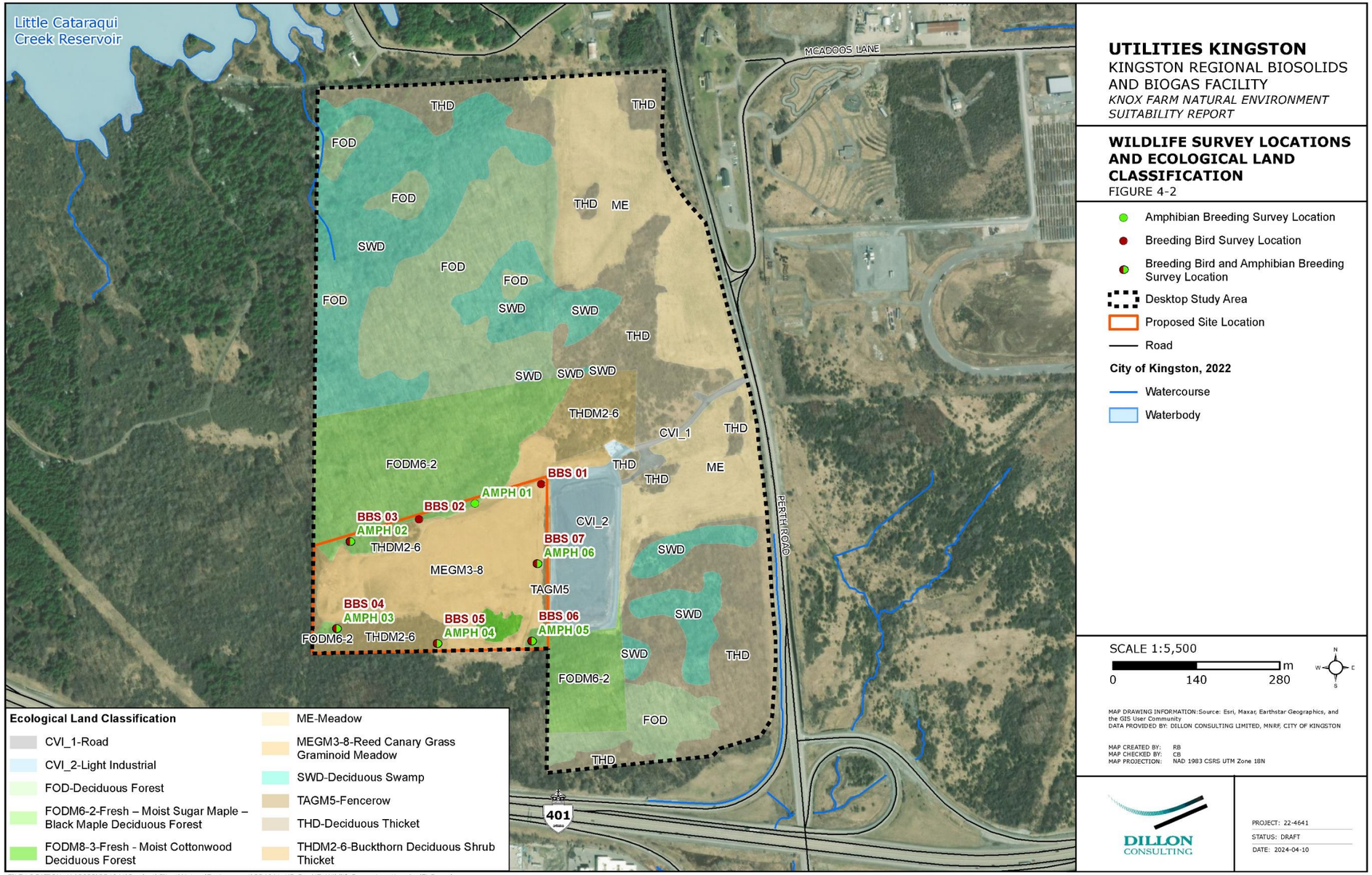
Cultural

- TAGM5 – Fencerow; and
- CVI_2 – Disposal and Recycle.

Approximately half of the communities within the Knox Farm property are wooded, including forest, swamp and thicket while the other half was identified as meadow. The Proposed Site Location is primarily meadow with woodland and thicket along the boundary. None of the ELC communities observed are considered rare in Ontario.

The ELC communities are shown on **Figure 4-2.** ELC survey methodology and detailed descriptions of ELC communities are further documented in Section 2.4 of the Knox Farm Suitability Report (**Appendix A**).

Figure 4-2: Wildlife Survey Locations and Ecological Land Classification



FILE LOCATION: K:\2022\224641\Product\Client\NaturalEnvironment\224641_KBsBg_NE_WildlifeSurveyLocationsAndELC.mxd

4.1.2.5 Botanical Survey

A total of 63 vascular botanical species were documented within the Proposed Site Location during the September 2022 field investigations. Of the 63 species, approximately 60% are listed as native species considered to be common (S4) to very common (S5) in the Province of Ontario and approximately 40% are listed as non-native species; therefore, a status ranking is not applicable as the species is not a suitable target for conservation activities (SE or SNA rank). One plant was only identified to the genus level (Willow [*Salix sp.*]) and could not be identified to the species level; therefore, no status ranking is assigned. None of the botanical species observed are designated as SAR under the Ontario *Endangered Species Act, 2007* (ESA) or the Federal *Species at Risk Act, 2002* (SARA).

A full list of the botanical species observed within the Proposed Site Location and survey methodology is documented in the Knox Farm Suitability Report (**Appendix A**).

4.1.2.6 Woodlands

Section 1 of the City Official Plan identifies significant woodlands as those woodlands identified by the Central Cataraqui Region Natural Heritage Study (2006) or identified using criteria established by the MNRF using evaluation procedures established by the Province. A review of Schedule 8-B of the City Official Plan reveals that significant woodlands occur within the Knox Farm property. The extent of significant woodlands identified within the Knox Farm property by the City was generally consistent with woodlands shown in **Figure 4-1** from MNRF data. In general significant woodlands occur throughout the Knox Farm property, however, only small portions of small woodlands were observed within the Proposed Site Location.

Woodlands identified within the Knox Farm property as a result of the ELC are shown in **Figure 4-2** and have been assumed significant as they overlap with significant woodland as per Schedule 8-B of the City Official Plan. Many portions of woodlands within the Proposed Site Location identified by MNRF and Schedule 8-B of the City Official Plan to be woodland during desktop review were actually identified as deciduous thicket based on the site investigation in 2022 during ELC and have been excluded from consideration as significant woodland.

Potential impacts to woodlands are discussed in **Section 7.3**.

4.1.2.7 Amphibian Breeding Surveys

Amphibian monitoring followed the Marsh Monitoring Program protocol (Bird Studies Canada, 2009). In accordance with the protocol, three different surveys were conducted between April 1 and June 30, 2023 with at least two weeks between each survey. Surveys were completed between one-half hour after sunset and midnight, during the evenings of April 20, May 23, and June 26. A minimum night temperature of 8 ^{o}C, 13 ^{o}C, and 20 ^{o}C was recorded for each of the three surveys, respectively.

The calling activity of individuals estimated to be within 100 m of the observation point was documented. All individuals beyond 100 m were recorded as outside the count circle. Calling activity was then ranked using one of the three abundance code categories:

- Code 1: Calls not simultaneous, number of individuals can be accurately counted.
- Code 2: Some calls simultaneous, number of individuals can be reliably estimated; and
- Code 3: Calls continuous and overlapping, number of individuals cannot be estimated.

Three amphibian breeding surveys were conducted at six (6) point count stations (AMPH 1 - AMPH 6). Point count stations were chosen to survey calling amphibians within the Project Location based on proximity to suitable habitat (**Figure 4-2**).

In total, three amphibian species, Gray Treefrog (*Hyla versicolor*), Spring Peeper (*Pseudacris crucifer*) and Western Chorus Frog (Great Lakes/ St. Lawrence – Canadian Shield Population (*Pseudacris triseriata* pop. 1) were recorded within and adjacent to the Proposed Site Location during the amphibian breeding surveys conducted on April 20, May 23 and June 26, 2023.

Gray Treefrog is considered very common (Srank of S5) in Ontario. The highest level of species activity recorded was approximately five individual Gray Treefrog with a call code of 1 at point count station AMPH 3 within or adjacent to the Black Maple Deciduous Forest (FODM6-2). Additional isolated Gray Treefrog calling activity was recorded in other locations associated with different point count stations mainly located within or adjacent to the FODM6-2 communities.

Spring Peeper is considered very common (Srank of S5) in Ontario. The highest level of species activity recorded was approximately two Spring Peepers at point count station AMPH 1 with a call code of 1. All other Spring Peeper activity within the Study Area included isolated individual calling with a call code of 1. All activity recorded was within or adjacent to the FODM6-2 communities.

Western Chorus Frog (Great Lakes/ St. Lawrence – Canadian Shield Population (*Pseudacris triseriata* pop. 1)) is considered rare to uncommon (Srank of S3) in Ontario and is listed as Threatened under SARA. The species was detected at two point count stations (AMPH 1 and AMPH 6) with calls originating east of the Proposed Site Location. The highest level of species activity recorded was approximately seven individuals with a call code of 2 at AMPH 6 with call originating east of and adjacent to the Fencerow (TAGM5) and within the Disposal and Recycle cultural community (CVI_2).

Potential for SWH habitat for breeding amphibians within and adjacent to the Proposed Site Location is further discussed in **Section 4.1.2.10**.

4.1.2.8 Breeding Bird Surveys

Two diurnal breeding bird surveys took place in June and July of 2023 and were conducted within the Study Area following the methods outlined in the Ontario Breeding Bird Atlas Guide for Participants (Ontario Breeding Bird Atlas, 2001).

Specifically, surveys consisted of point counts generally conducted between dawn and five hours after sunrise to establish quantitative estimates of bird abundance in suitable habitat types within the Study Area. During the surveys evidence of breeding behaviour was recorded which generally includes, but is not limited to, males singing, nest building, egg incubation, territorial defence, carrying food, and feeding their young.

To supplement the surveys, area searches of the habitat were completed using binoculars to observe species presence and breeding activity between point counts. Area searches involved noting all individual bird species and their corresponding breeding evidence while traversing the habitat on foot.

Two breeding bird surveys were conducted at seven (7) point count stations (BBS1 – BB7) on June 9 and July 5, 2023; the location of the seven count stations (BBS1-BB7) is shown on **Figure 4-2**. A total of 23 bird species were observed during the 2023 breeding bird surveys (**Table 4-1**). All species observed are considered common and secure (Srank

of S4) to very common (Srank of S5) in Ontario based on the Provincial conservation rankings assigned by the NHIC. One species, Wood Thrush (*Hylocichla mustelina*) is considered special concern and threatened under the ESA and SARA, respectively.

Table 4-1: 2023 Breeding Bird Survey Results

Table notes:

2 Federal Species at Risk Act, 2002

3 Ontario Endangered Species Act, 2007

4 S-Rank is an indicator of commonness in the Province of Ontario. A scale between 1 and 5, with 5 being very common and 1 being the least common. These provincial ranks may further be modified; ? - A question mark following the rank indicates that there is some uncertainty with the classification due to insufficient information; S2S3 - Indicates that an element is rare, but insufficient information exists to accurately assign a single rank; N = non-breeding population; B = breeding population; --- denotes no information or not applicable.

Scientific Name	Common Name	SARA[2]	ESA[3]	Srank[4]
Agelaius phoeniceus	Red-winged Blackbird	---	---	S4
Buteo jamaicensis	Red-tailed Hawk	---	---	S5
Cardinalis cardinalis	Northern Cardinal	---	---	S5
Carduelis tristis	American Goldfinch	---	---	S5B
Corvus brachyrhynchos	American Crow	---	---	S5B
Corvus corax	Common Raven	---	---	S5
Cyanocitta cristata	Blue Jay	---	---	S5
Dumetella carolinensis	Gray Catbird	---	---	S4B
Geothlypis trichas	Common Yellowthroat	---	---	S5B
Hylocichla mustelina	Wood Thrush	THR	SC	S4B
Melospiza melodia	Song Sparrow	---	---	S5B
Myiarchus crinitus	Great Crested Flycatcher	---	---	S4B
Passerina cyanea	Indigo Bunting	---	---	S4B
Pheucticus ludovicianus	Rose-breasted Grosbeak	---	---	S4B
Pipilo erythrophthalmus	Eastern Towhee	---	---	S4B
Piranga olivacea	Scarlet Tanager	---	---	S4B

Scientific Name	Common Name	SARA[2]	ESA[3]	Srank[4]
Poecile atricapillus	Black-capped Chickadee	---	---	S5
Quiscalus quiscula	Common Grackle	---	---	S5B
Setophaga petechia	Yellow Warbler	---	---	S5B
Sitta carolinensis	White-breasted Nuthatch	---	---	S5
Spizella pusilla	Field Sparrow	---	---	S4B
Turdus migratorius	American Robin	---	---	S5B
Vireo olivaceus	Red-eyed Vireo	---	---	S5B

Potential SWH and SAR habitat for breeding birds to occur within and adjacent to the Proposed Site Location as a result of the survey data collected is further discussed in **Section 4.1.2.10** and **Section 4.1.2.11**, respectively.

4.1.2.9 Incidental Wildlife Observations

Three species were observed incidentally in addition to those wildlife surveys completed during the 2023 field investigations including White-tailed Deer (*Odocoileus virginianus*) and Killdeer (*Charadrius vociferus*) which are considered widespread and common in Ontario (Srank of S5) and Eastern Wood-Pewee (*Contopus virens*) which is listed as special concern under the ESA and considered common in Ontario (Srank of S4).

4.1.2.10 Significant Wildlife Habitat

The Significant Wildlife Habitat Technical Guide (MNRF, 2000) defines Species of Conservation Concern (SCC) as globally, nationally, provincially, regionally, or locally rare (Srank of S1, S2 or S3) as well as species listed as Endangered or Threatened federally; but does not include provincial SAR (species listed as Threatened or Endangered under the ESA).

Based on the results of the background review, a total of 11 SCC were identified as having the potential to occur within the general vicinity of the Knox Farm property and have been considered in determining the potential for SWH. The 11 identified SCC are further documented in the Knox Farm Suitability Report (**Appendix A**). The 11 SCC identified helped to inform of the potential for Significant Wildlife Habitat (SWH) as defined in the Ecoregion 6E Criterion Schedules (MNRF, 2015) within and adjacent to the Proposed Site Location. Criteria for determining the significance of wildlife habitat follow the guidelines outlined in the NHRM (MNRF, 2010) and the Significant Wildlife

Habitat Technical Guide Ecoregion 6E Criterion Schedules (MNRF 2015), where applicable.

The potential for SWH within the Proposed Site Location was further investigated through field surveys, general wildlife habitat assessments and incidental observations during the field programs in 2022 and 2023. Potential SWH was investigated using the results of general wildlife habitat assessments and two species-specific surveys (amphibian breeding surveys and breeding bird surveys). Through the ELC and botanical survey results, species-specific surveys, and the general wildlife assessments the potential for various types of SWH were screened against the criteria for Eco-region 6E.

Based on the results of the 2022 and 2023 field programs and in accordance with the Eco-Region 6E Criterion Schedules (MNRF, 2015), it was determined that the following SWH are present:

- Confirmed SWH for Special Concern and Rare Wildlife Species Habitat (Eastern Wood-Pewee) – Woodlands within and adjacent to the Proposed Site Location due to the incidental observation of Eastern Wood-Pewee calling during the 2023 field program.
- Confirmed SWH for Special Concern and Rare Wildlife Species Habitat (Wood Thrush) –Larger woodland within the northern and southeast extents of the Proposed Site Location (Fresh – Moist Sugar Maple – Black Maple Deciduous Forest [FODM6-2]) due species calling during the 2023 breeding bird surveys.
- Candidate SWH for Bat Maternity Colonies – Larger woodlands within the northern and southeast extents of the Proposed Site Location (Fresh – Moist Sugar Maple – Black Maple Deciduous Forest [FODM6-2]) have the potential to contain snags and trees that could support roosting habitat for SAR bats.

Potential impacts to SWH and general wildlife habitat are discussed in **Section 7.3**.

4.1.2.11 Species at Risk

Sixteen species at risk (SAR) were identified through background review with the potential to occur within the vicinity of the Knox Farm property. These 16 SAR are documented in the Knox Farm Suitability Report (**Appendix A**). Of the 16 SAR identified, and considering their range distributions, known occurrences, the vegetation communities and habitat features observed in the Proposed Site Location and ELC

communities identified throughout the Knox Farm property, the following species have been brought forth for further consideration:

- Black Ash;
- Butternut;
- Blanding's Turtle;
- Bobolink;
- Eastern Meadowlark; and,
- SAR bats.

Although not observed within the Proposed Site Location, Black Ash and Butternut have the potential to occur throughout the Knox Farm property.

Both Eastern Meadowlark and Bobolink require large grassland habitat to complete their life processes. This may include (but is not limited to): hayfields, pastures, and old or abandoned fields. Bobolink are highly area sensitive and require areas of habitat that are much larger than Eastern Meadowlark which is a less area-sensitive species. Based on the 2022 field investigations and desktop review, Knox Farm may contain suitable habitat associated with meadow communities. However, based on size requirements for Bobolink (≥ 10 ha) the habitat would only be considered suitable for Eastern Meadowlark. Meadows along Perth Road may provide suitable breeding habitat for Eastern Meadowlark; however, meadow community within the Proposed Site Location was observed as disturbed and has been considered to have a low probability of providing suitable habitat for Eastern Meadowlark. Furthermore, Eastern Meadowlark was not observed during the 2023 breeding bird surveys.

Based on the field investigation, Blanding's Turtle nesting and overwintering habitat was not observed within the Proposed Site Location; however, this species was considered as potentially occurring within the Knox Farm property based on nearby potential aquatic habitat associated with Little Cataraqui Creek PSW complex located approximately 40 m northwest of the property as this species is known to travel considerable distances from their habitat of origin during nesting and overwintering migrations (MECP, 2019).

Bats utilize mature trees and snags with peeling bark, cracks, crevices, cavities and dense leaf clusters as well as human made structures for maternity roosting (MECP, 2022). With the exception to the Cottonwood Deciduous Forest (FODM8-3) which was

observed to not contain suitable SAR bat habitat, the woodland communities (i.e., forest and swamp) throughout the Knox Farm property have the potential to contain snags and trees that could support roosting habitat for SAR bats.

If additional areas of impact are anticipated outside of the Proposed Site Location, further studies such as additional ELC and breeding bird surveys are recommended to confirm the presence or absence of potential SAR and SAR habitat within the Knox Farm property.

Potential impacts to SAR and SAR habitat are discussed in **Section 7.3**.

4.2 Road Network and Traffic

4.2.1 Existing Road Network

The following describes the roadways within the Study Area.

Perth Road/County Road 10 runs from Highway 401 in the south to the Village of Westport in the north. The majority of the roadway is a two-lane rural cross section; however, a four lane rural cross section is provided from Division Street to approximately 200 m north of the north ramp terminal. To the south of Highway 401, the roadway continues as Division Street. The elevation changes by approximately 27 m from the Highway 401 north ramp terminal to McAdoo's Lane. The posted speed limit is 60 km/h within the Study Area. Perth Road is a designated emergency detour route (EDR) when Highway 401 is closed between Sydenham Road and Montreal Street/Battersea Road.

Division Street is a four-lane arterial road that becomes Perth Road north of Highway 401. It terminates in the south at Union Street, in downtown Kingston. The posted speed limit is 50 km/h within the Study Area.

Highway 401 is a six-lane freeway under the jurisdiction of the Ministry of Transportation of Ontario (MTO). The posted speed limit is 100 km/h within the Study Area.

McAdoo's Lane is a two-lane local road that begins at Perth Road and terminates at Battersea Road (County Road 11). It is a designated EDR when Highway 401 is closed between Division Street/Perth Road and Montreal Street/Battersea Road. The posted

speed limit is 60 km/h from Perth Road to 500 m east of Perth Road, where it increases to 70 km/h.

By-law 2003-229 confirms that there are no weight restrictions or seasonal load limits on McAdoo's Lane or Perth Road.

There are no existing sidewalks, dedicated bicycle facilities or transit stops within the Study Area. The City's 2018 Active Transportation Master Plan does not identify future active transportation facilities in the Study Area.

4.2.2 Existing Traffic Volumes

Weekday AM and PM peak hour intersection turning movement counts were undertaken at the Study Area intersections on September 20 & 22, 2022. On September 20, the AM peak hour occurred between 7:30 AM and 8:30 AM and the PM peak hour occurred between 4:15 PM and 5:15 PM.

At the intersection of McAdoo's Lane and Perth Road, the 2022 traffic volume data was compared to historical traffic volumes from 2018; the 2022 traffic volumes appear generally in line with expectations and represent some traffic growth in the corridor.

4.2.3 Existing Pedestrian and Cycling Activity

Traffic counts undertaken in the fall of 2022 indicated that there were no pedestrians observed. Two cyclists were counted travelling north/south on Division Street/Perth Road through the study area, which includes the Perth Road at Highway 401 Ramp terminals and the Perth Road at McAdoo's Lane intersection.

4.2.4 Existing Intersection Operations

The Study Area intersections are operating at acceptable levels and there is sufficient capacity in the existing road network to accommodate additional traffic. In the AM peak hour, the eastbound right turn at the Division Street and Highway 401 South Ramp Terminal operates close to capacity with the volume to capacity (v/c) ratio being 0.96, with moderate delay and a Level of Service (LOS) E. In the PM peak hour, the eastbound right turn movement operates with a good LOS B and is deemed critical by the MTO with a v/c ratio of 0.76. The MTO prefers that ramp terminal intersections operate at a v/c ratio below 0.75 and as such, mitigation measures may be required.

4.3 Hydrogeological Assessment

The hydrogeological assessment included a review of background hydrogeology records and borehole drilling, monitoring well installation, groundwater sample collection and hydrogeological testing. The results of the assessment are documented in Section 2.3 of the Knox Farm Suitability Report (**Appendix A**).

4.3.1 Physiography

The Knox Farm property is located within the physiographic region known as the Napanee Plain, characterized by the flat to undulating plain of limestone of the Gull River and Bobcaygeon Formations. The Napanee Plain is known to be relatively thin as the most recent glaciation had stripped most of the overburden in the region, with exception in stream valleys and depressions (Putnam, 1984).

According to the Source Protection Atlas by the MECP, the Knox Farm property is located within the Cataraqui Source Protection Area (SPA) and is identified to be within a Significant Groundwater Recharge Area and a Highly Vulnerable Area; of which the majority of the Cataraqui SPA is identified.

Potential Karst Topography mapping noted in the City Official Plan (2010) indicated the Knox Farm property is on potential/inferred karst topography. Karst formations are formed when rock is dissolved by water, creating features that can act as underground drainage systems; creating a pathway for contaminants on the surface to reach groundwater. It is noted that Dillon completed a preliminary karst assessment in 2023 which is discussed in **Section 4.9**.

4.3.2 Geology

Bedrock Geology

The Knox Farm property is underlain by Upper Ordivician limestone (OGS, 2009). A previous geotechnical investigation by Inspec-Sol in 2004 and a Phase II Environmental Site Assessment by XCG in 2008 found bedrock to occur from 0 to 2.5 metres below ground surface (mbgs) at the Proposed Site Location; described as grey limestone.

Quaternary Geology and Surficial Geology

Mapping by OGS (2000) indicates that the Quaternary geology and surficial geology of the Knox Farm property consists of Pleistocene aged glaciomarine deposits composed of silt, clay, minor sand basin and quiet water deposits. Previous investigations by Inspec-Sol (2004) and XCG (2008) found the overburden overlying the bedrock to be up to 2.5 metres (m) thick, consisting of silty clay to clay soils.

Inspec-Sol's (2004) results of field percolation testing indicate that the stratified in-situ soils at the Proposed Site Location have a permeability range in the order of 10^{-2} to 10^{-6} cm/s. The permeability of the soil is anticipated to be greater in the horizontal direction, with lower permeability in the vertical direction.

Site Investigation

Three boreholes were drilled (P1, P2, P3) and bedrock was encountered at each borehole location at depths ranging between 2.0 to 3.1 mbgs or 103.0 to 104.8 metres above sea level (masl). A grain size sample was collected at borehole location P1 at approximately 1.2 metres within the overburden. The grain size analysis indicates that 93% of the particles are finer than 0.075 mm; characteristic of fine silty clay to clayey soils.

Details on borehole locations, drilling depths, and borehole logs are documented in the Knox Farm Suitability Report (**Appendix A**).

4.3.3 Local Hydrogeology

Based on the Proposed Site Location's geology, a simple hydrogeological system can be interpreted. Surficial geology mapping and the previous investigations completed by Inspec-Sol (2004) and XCG (2008) indicate deposits of silty clay to clay soils overlying limestone bedrock underlie the Proposed Site Location. Silt and clay deposits and limestone typically have hydraulic conductivity (k) in the order of 10^{-6} to 10^{-9} m/s (Freeze and Cherry, 1979).

Groundwater

A Risk Assessment previously completed by XCG (2010), identified that the Proposed Site Location's hydrogeological system is as follows; the shallow groundwater system is

present at the silty clay and shallow bedrock (limestone) interface, the shallow aquifer (limestone) is present within 1.2 m and 2.1 mbgs and a deep aquifer at depths greater than 3 m within the limestone. The groundwater flow direction of the shallow aquifer is to the west and southwest towards the Little Cataraqui Creek (1.2 kilometers west), while the groundwater flow direction of the deep aquifer is towards the north.

The Risk Assessment completed by XCG (2010) at the Proposed Site Location indicates the estimated seepage rate of the shallow aquifer to be 0.95 m/yr directed to the west-southwest. The seepage rate is based on a maximum hydraulic conductivity of 5.9×10^{-5}cm/s (or 5.9×10^{-7} m/s) calculated for the site and an average horizontal hydraulic gradient of 0.02 to 0.05.

There are 39 wells records within 500 metres of the Knox Farm property with depths ranging from 3 m to 54.2 m. All water supply wells were completed within limestone at bottom depths ranging between 18.3 m and 54.2 m. Recommended pumping rates noted on supply water well records range between 18.9 and 75.7 litres per minute (l.p.m). Note that the locations of the wells are based on the MECP water well record database, which often contains inaccurate location coordinates. Actual well locations and potential unregistered wells should be verified in the field as needed.

A full list of water wells from the MECP Water Well Record database within 500 metres of the Knox Farm property is documented in the Knox Farm Suitability Report (**Appendix A**).

Site Hydrogeological Investigations

Dillon completed a drilling program at the proposed site location in 2022. The drilling program included the advancement of three shallow boreholes and installation of three monitoring wells. These monitoring wells were installed to intersect the shallow groundwater aquifer system. Following the development of each monitoring well, hydrogeological and environmental investigations were completed and their results are discussed herein. In November 2023, the City advanced a 6-inch diameter well to a depth of 52 meters below grade to assess the potential for an on-site potable water supply. The well was installed at the southeast corner of the Proposed Site Location and yielded approximately 20L/min during a short duration pumping test.

Elevations and Flow Direction

Static water levels were measured on two occasions, prior to well development and groundwater sampling. Well development occurred on October 26, 2022, measured water levels ranged between 0.95 and 1.93 mbgs. Groundwater sampling occurred on November 7, 2022, groundwater levels ranged between 1.06 and 2.13 mbgs. Groundwater flow direction of the shallow aquifer system at the Proposed Site Location is interpreted to be to the west/northwest.

Hydraulic Conductivity Testing

Hydraulic conductivity testing was completed at each of the three monitoring wells on October 26, 2022.

Hydraulic conductivity values ranged between 1.3 $x10^{-8}$ and 2.2 $x10^{-7}$ m/s. The shallow aquifer system at the Proposed Site Location is interpreted to be the top of the limestone bedrock. Literature values indicate that the hydraulic conductivity limestone can range between 10^{-6} and 10^{-9} m/s (Freeze and Cherry, 1979).

Soil Percolation Testing

Soil percolation testing was completed on November 7, 2022, using a Guelph Permeameter. The change in water level within the Guelph Permeameter water reservoir could not be observed during the test due to the nature of the fine soils (silty clay to clay). It was determined that the use of a Guelph Permeameter is not suitable to measure the infiltration rate of the shallow soils at the Proposed Site Location due to the characteristics of the fine soils and the limited capabilities of the equipment in the fine soil type.

Inspec-Sol's (2004) results of field percolation testing indicate that the stratified in-situ soils at the Site have a permeability range in the order of 10^{-2} to 10^{-6} cm/s. The permeability of the soil is anticipated to be greater in the horizontal direction, with lower permeability in the vertical direction. Laboratory falling head permeability testing completed by Inspec-Sol of the same soil tested during the field percolation testing, indicates permeability values of 1.9 to 6.8 $x10^{-8}$ cm/s.

Based on the characteristics of the surficial soil and previous findings, the percolation time is likely greater than 50 min/cm.

Groundwater Sampling

Groundwater samples were collected from all three monitoring wells on November 7, 2022.

The groundwater analytical results were compared to MECP Table 6: Generic Site Condition Standards for Shallow Soils in a Potable Ground Water Condition (MECP Table 6). This is the same criteria used in the dredge dewatering facility closure plan completed by XCG in 2015 and used to compare groundwater quality then to now for consistency. All samples met the reference MECP Table 6 criteria which would be applicable for the proposed development.

4.4 Drainage and Stormwater Management Conditions

Drainage and stormwater management assessments involved a preliminary examination of existing topographic and hydrologic characteristics of Knox Farm.

4.4.1 Topography

Available contour mapping obtained from the City indicates that the Knox Farm property is located within an area of low to moderate topographic relief. The gradient of the property generally slopes from higher elevations within the eastern portion of the site to the west and north towards the Conservation Area lands. A small area within the southeast corner of the property is graded south towards Highway 401.

The existing topography within the proposed site location area generally slopes from higher elevations near the snow management facility (approximately 110 m) to the west and south where site elevations are in the range of approximately 101–102 m. The average slope between the northeast and southeast corners of the proposed site location is roughly 2%.

4.4.2 Drainage

There is very limited formal drainage infrastructure within the Knox Farm property. Surface runoff generally occurs in the form of overland (sheet) flow that follows the topographic gradient towards the west and north. During the field reconnaissance performed by Dillon, ditching was observed along the access road and at the perimeter of the snow management facility. Based on the available contour mapping, it is

understood that the ditches and associated culvert structures capture and convey runoff around the snow management facility towards the southern portion of the property.

Surface runoff from the majority of the Knox Farm property travels in a northwesterly direction towards the Little Cataraqui Creek Reservoir. The City's GIS mapping shows that a watercourse extends from the reservoir into the northwest corner of the property.

No distinguishable drainage features were identified within the Proposed Site Location through the review of available background information or field reconnaissance observations. Surface runoff appears to travel overland from the higher elevations near the snow management facility towards the western and southern site boundaries.

4.4.3 Storm Sewer Servicing

There is no existing storm sewer infrastructure (closed pipe system) in the vicinity of the site as it is located outside of the City's urban boundary. There is an existing roadside ditch along the west side of Perth Road which would be the closest stormwater discharge point for the site.

4.5 Site Servicing

Knox Farm is located outside of the City's urban boundary and as such there is no existing municipal sanitary or storm sewers or watermain infrastructure and other servicing methods for water and sanitary sewer will be required. Perth Road is in the vicinity of the site and contains gas, aerial electrical and telecommunication within the right-of-way and as such, servicing for these utilities is not expected to be an issue.

4.6 Socio-Economic Conditions

4.6.1 Population and Demographics

According to Statistics Canada, the City (Census subdivision) experienced a population increase of approximately 7.0% between 2016 (123,798) and 2021 (132,485) (Statistics Canada, 2017; Statistics Canada, 2023). The average age of the population in the City was 42.3 in 2016 and 42.7 in 2021.

Neighbourhoods within approximately 1 km of the Proposed Site Location include Markers Acres and Novelis (Alcan). Both neighbourhoods experienced a decrease in population of 0% to -2% between 2016 and 2021. The nearby neighbourhood of Cataraqui Westbrook/Cataraqui North experienced an increase in population of more than 20% between 2016 and 2021 (City of Kingston, 2022b).

4.6.2 Economic Activities, Employment and Labour Force

The City (Census subdivision) had a total labour force population aged 15 years and over of 110,400 individuals in 2021 (Statistics Canada, 2023). The City had a labour participation rate of 60.7% in 2021, which is lower than 2016 by 1.7%, and an unemployment rate of 13.2% in 2021, which is higher than 2016 by approximately 5.3% (Statistics Canada, 2017; Statistics Canada, 2023).

The Kingston Economic Development Corporation (the Corporation; n.d.(a)) identified several key industry sectors within the City, including:

- Clean Technology;
- Electric Vehicle and Battery Technology;
- Food Processing;
- Health Innovation;
- Material and Process Innovation;
- Research and Development;
- Sustainable Manufacturing; and,
- Warehousing and Distribution.

The Corporation notes that the City is pursuing sectors with a focus on long-term sustainability. The Corporation's 2022 Annual Report identified the two fastest growing sectors as Health Innovation and Sustainable Manufacturing (Kingston Economic Development Corporation, 2022).

Within 1 km of the Proposed Site Location, land use designations include Arterial Commercial, Business Park Industrial, General Industrial, Mineral Resource, Regional Commercial, Rural, Rural Commercial, and Waste Management Industrial. This includes several retail outlets, industrial parks, hotels, contractors (e.g., pools, concrete), manufacturers, automobile services, fabricators, and suppliers.

Clean Technology

The City was the first Ontario city to declare a climate emergency, and "the first Canadian city to adopt a protocol for sustainable energy procurement" (Kingston Economic Development Corporation, n.d.(b)). The City hosts several local and large multinational companies (e.g., Alcan, Kingston Process Metallurgy), as well as several innovation and commercialization hubs (e.g., Queen's Innovation Centre, Launch Lab). Due to the City's existing assets, several companies, including CAST Technologies and Cyclic Materials, have established in the area (Kingston Economic Development Corporation, n.d.(b)).

Based on the Corporation's mapping, the employment in the Clean/Chem Technology sector is higher around the Proposed Site Location, with approximately 399 total employment around the Novelis neighbourhood, and 174 total employment around the Elginburg/Silvers Corners/Shannon's Corners neighbourhood (Localintel Inc., 2022). The Sydenham neighbourhood had the highest total employment (approximately 350) in all the City (Localintel Inc., 2022).

Electric Vehicle and Battery Technology

The City is strategically located between the raw material supply chain and materials (e.g., graphite, nickel, lithium, cobalt), and Canada's automotive corridor. The City is approximately three hours away from major manufacturers such as Ford Motors, GM, and Fiat Chrysler, all of whom have committed to building Electric Vehicles (Evs) in Canada (Kingston Economic Development Corporation, n.d.(c)). Due to the City's sustainable outlook and research and development capabilities, several companies (e.g., Cyclic Materials), have commercialized their technologies (Kingston Economic Development Corporation, n.d.(c)).

Based on the Corporation's mapping, the employment in the EV and Battery Technology sector is the highest near the Proposed Site Location, with approximately 14 total employment around the Novelis neighbourhood (Localintel Inc., 2022). The Novelis neighbourhood had the highest total employment in the sector in all the City.

Food Processing

The City is strategically located within proximity to speciality machine shops, agriculture, and skilled labour. The City hosts several corporations involved in custom equipment manufacturing, food colour and food additives, food processing, research and development of biotechnology, breweries, and food and beverage distribution. The City also houses several specialty machine shops that can design and build full production lines for the agri-food industry (Kingston Economic Development Corporation, n.d. (d)).

Based on the Corporation's mapping, the employment in the Food Processing sector is the highest outside of the Proposed Site Location, with approximately 199 total employment around the Cataraqui North neighbourhood (Localintel Inc., 2022). Total employment immediately adjacent to the Proposed Site Location was unavailable.

Health Innovation

The City hosts world-renowned research institutions, and a "single cohesive and integrated healthcare network" (Kingston Economic Development Corporation, n.d. (e)). The healthcare and life sciences, and professional, scientific, and technical services has over 11,000 workers and are the fastest-growing employment sectors in the City. The two main hospital sites in Kingston includes Providence Care and Kingston Health Sciences Centre (KHSC). Providence Care provides specialized mental health care, geriatric services, rehabilitation, palliative care, complex continuing care, and long term care (Kingston Economic Development Corporation, n.d. (e)). KHSC includes a network of hospitals, research labs and health services that date back to the 1830s (Kingston Economic Development Corporation, 2022). KHSC services include research, complex, acute and speciality care, and teaching hospital (Kingston Economic Development Corporation, n.d. (e)).

Based on the Corporation's mapping, the employment in the Health Innovation sector is the highest outside of the Proposed Site Location, with approximately 2,667 total employment around the Queen's University neighbourhood (location of the Kingston General Hospital), approximately 2,654 total employment around the Sydenham neighbourhood (location of Hotel Dieu Hospital), and approximately 2,594 total employment around the Portsmouth neighbourhood (location of Providence Care Hospital). The Novelis neighbourhood had approximately 1,140 total employment (Localintel Inc., 2022).

Material and Process Innovation

The City has applied its strength in primary metals and chemicals to the local manufacturing marketplace, which has resulted in a more sustainable manufacturing ecosystem. The City hosts local innovations in a range of areas, including advanced polymer composites, graphene, green chemistry, and sustainable building materials. The City also had a long-standing history in the aluminum industry, with a sheet rolling plant built in 1939, and a high location quotient of 6.38 in this area, easily allowing it to supply other markets (Kingston Economic Development Corporation, n.d. (f)).

Based on the Corporation's mapping, the highest total employment in the Material and Process Innovation sector is outside of the Proposed Site Location around the Reddendale neighbourhood with approximately 2,020 total employment. The Novelis neighbourhood had approximately 364 total employment (Localintel Inc., 2022).

Research and Development

The City ranks number one in industrial and academic research and development, and hosts several accelerators and incubators, including Queen's University, Launch Lab, and Innovation Hub at St. Lawrence College. Areas of research include clean technology, health innovation, and military and veteran. Other initiatives include the environment and sustainability (e.g., Sustainable Kingston), physics, advanced computing and engineering, finance and economics, and diversity and democracy (Kingston Economic Development Corporation, n.d.(g).

Based on the Corporation's mapping, the highest total employment in the Research and Development sector is outside of the Proposed Site Location around the Sydenham neighbourhood with approximately 350 total employment. The Novelis neighbourhood had approximately 158 total employment (Localintel Inc., 2022).

Sustainable Manufacturing

The City has over 5,000 workers and 100 companies in the Sustainable Manufacturing sector, and is also recognized for its innovative and leading technology. The City hosts several multinational corporations (e.g., DuPont, INVISTA), as well as several Kingston-based companies. Due to the City's location between major cities in the United States and Canada (e.g., Ottawa, Montreal, Toronto), as well as its connectivity through

Highway 401 and the CN Rail, it supports outsourcing or inbound shipping service. Some of the manufacturing industries that are supported in the City include chemical products, rail production, graphene research, and resin and intermediates (Kingston Economic Development Corporation, n.d. (h)).

Based on the Corporation's mapping, the highest total employment in the Sustainable Manufacturing sector is outside of the Proposed Site Location around the Reddendale neighbourhood with approximately 2,020 total employment. The Novelis neighbourhood had approximately 789 total employment (Localintel Inc., 2022).

Warehousing and Distribution

As noted above, the City is centrally located near major cities in both Canada and the United States, and major transportation corridors (e.g., Highway 401, CN Rail, VIA Rail). The City hosts several national and international distribution, transportation and warehousing services (e.g., Vitran Express, Prologix, SCI Distribution) (Kingston Economic Development Corporation, n.d.(i).

Based on the Corporation's mapping, the highest total employment in the Warehousing and Distribution sector is outside of the Proposed Site Location, with approximately 290 total employment around the Cataraqui North neighbourhood. The Novelis neighbourhood had approximately 79 total employment (Localintel Inc., 2022).

4.6.3 Tourism and Recreation

The tourism and recreational features located within 1 km of the Proposed Site Location are outlined below.

4.6.3.1 Arts and Culture

A movie theatre is located south of Highway 401 on Dalton Avenue. No other arts or culture features are located within 1 km of the Proposed Site Location.

4.6.3.2 Parks and Open Spaces

The Little Cataraqui Creek Conservation Area (CA) is located within 1 km of the Proposed Site Location. The CA is located at 1641 Perth Road and includes several features such as pathways and trails (i.e., Little Cataraqui Creek CA Trails), outdoor skating rink, picnic areas, day camp, meeting rooms and rental facilities (City of Kingston, 2023d). The

looped trail network is approximately 14 km in length, and the Reservoir Trail is within 100 m of the northern boundary of the Proposed Site Location (CRCA, n.d.).

No other parks are located within 1 km of the Proposed Site Location.

4.6.3.3 Trails

As noted above, the Little Cataraqui Creek CA Trails are located within 1 km of the Proposed Site Location. The K&P Trail is also within 1 km of the Proposed Site Location and is located south of Highway 401 along Dalton Avenue. This section forms part of the urban K&P Trail which is approximately 7 km in length (City of Kingston, 2023e).

4.6.4 Community Facilities

Table 4-2 includes an overview of the community facilities located within 1 km of the Proposed Site Location. These features were identified using the Corporation's interactive mapping, the City's MyNeighbourhood and Google mapping/satellite imagery.

Table 4-2: Community Facilities Located within Approximately 1 km of the Proposed Site Location

Type of Community Facility	Within 1 km of Proposed Site Location (Yes/No)	Description
Recreation Facilities and Community Centres	No	-
Childcare Centre	Yes	La Garderie Croque Soleil (711 Dalton Avenue)
Place of Worship	Yes	Encounter Church (near 1201 Division Street)
School	No	-
Libraries	No	-
Emergency Services	No	-
Cemetery	No	-

It is noted that there are no bus stops located immediately adjacent to the Proposed Site Location; however, there are several bus stops along Dalton Road, Division Street, and Benson Street south of Highway 401 (City of Kingston, 2023c).

4.7 Air Quality and Odour

Background air quality was quantified through historic monitoring data proximate to the Study Area in addition to a review of on-site air monitoring data. The MECP and Environment and Climate Change Canada (ECCC) National Air Pollution Surveillance (NAPS) data from nearby stations was reviewed for each indicator compound. The closest monitoring station to the Study Area with a three-year data set was selected.

A summary of NAPS station IDs and the available data for each indicator compound is summarized in **Table 4-3** below. It is noted that data was not available for CO and SO_2 in closer proximity to the Study Area than the ECCC NAPS Ottawa station. As the area surrounding Ottawa contains higher population and more industry than Kingston the data obtained from the Ottawa station is anticipated to serve as a conservative surrogate for Kingston air quality considerations for CO and SO_2.

Table 4-3: Indicator Compound MECP and ECCC NAPS Station ID

Indicator Compound	Station ID	Data Range
TSP	N/A	N/A
PM10	N/A	N/A
PM2.5	ECCC NAPS – Kingston (60304)	2018-2020
Nitrogen Dioxide (NO2)	ECCC NAPS – Kingston (60304)	2018-2020
Hydrogen Sulphide (H2S)	N/A	N/A
Carbon Monoxide (CO)	ECCC NAPS – Ottawa (60104)	2018-2020
Sulphur Dioxide (SO2)	ECCC NAPS – Ottawa (60104)	2018-2020
Odour	N/A	N/A

The background concentrations for the indicator compounds from the MECP and ECCC NAPS stations were calculated for the respective averaging period of the data obtained for the monitoring stations.

Ambient monitoring data for hydrogen sulphide is not readily available for the study areas. ECCC documents an overall average concentration, measured in urban areas presumed to be away from major anthropogenic sources in Canada (ECCC, 2017), which was used as the background concentration for this assessment.

$PM_{2.5}$ is the only particulate species which is monitored by MECP or ECCC. To be consistent with using 3 years of background data where possible, the monitored MECP $PM_{2.5}$ data was adjusted to estimate TSP and PM_{10} background data.

The high-level summary of the background concentrations for each indicator is provided below. A detailed overview is documented in Section 2.1 of the Knox Farm Suitability Report (**Appendix A**).

Nitrogen Dioxide

A review of the three years of ambient monitoring data from the Kingston Station indicated that the ambient concentrations of nitrogen dioxide are below all applicable criteria.

Particulate Matter

A review of the three years of ambient monitoring data from the Kingston Station indicated that the ambient concentrations of each relevant particulate matter species are below all applicable criteria.

It is noted that the maximum values for $PM_{2.5}$ and PM_{10} represent a relatively high percentage when compared to Ontario's Ambient Air Quality Criteria (AAQC). However, the 90^{th} percentile and average concentration values for these contaminants are well below their respective criteria indicating concentrations approach but do not exceed the maximum on an infrequent basis.

Sulphur Dioxide

A review of the three years of ambient monitoring data from the Ottawa Station indicated that the ambient concentrations of sulphur dioxide are well below all applicable criteria.

Carbon Monoxide

A review of the three years of ambient monitoring data from the Ottawa Station indicated that the ambient concentrations of carbon monoxide are well below all applicable criteria.

Hydrogen Sulphide

As ambient monitoring data was unavailable for hydrogen sulphide, a review of the ECCC documents provided the background concentration for this assessment. The ambient concentration of hydrogen sulphide is well below the applicable criteria.

4.7.1 Sensitive Receptors

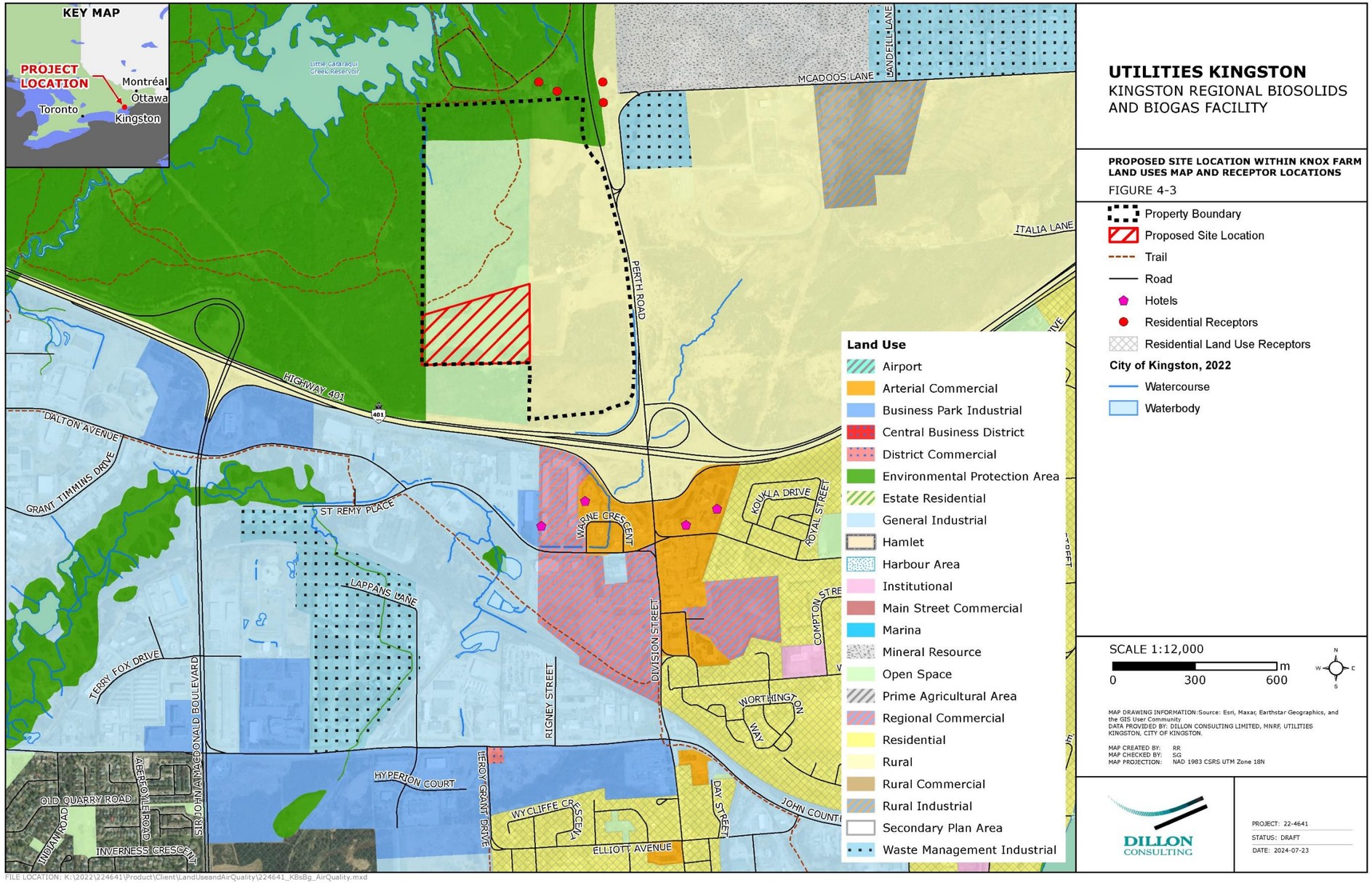
Potential air quality impacts have been determined through a qualitative assessment at sensitive receptors located within the Study Area. Environmental assessments generally consider sensitive receptors in locations where human activities may regularly occur. Typical land uses that are defined as sensitive receptors for evaluating potential air quality impacts include, but are not limited to: residences, schools, daycares, hospitals, and sports fields.

A review of the surrounding land uses to the south of Knox Farm and Highway 401 show General Industrial, Business Park Industrial, Arterial Commercial, Regional Commercial and Residential land uses. Located in the Arterial Commercial and Regional Commercial areas are four hotels located along the southern perimeter of Highway 401 approximately 250 m to 600 m from the southeast boundary of the proposed site location. Residential dwellings are located approximately 900 m from the southeast boundary of the Proposed Site Location. Additionally, two residential properties are located on Little Cataraqui Creek Conservation Area Trails Road approximately 700 m north-northeast of the Proposed Site Location, as well as two residential properties located on McAdoo's Lane approximately 690 m northeast of the Proposed Site Location. It is noted that there is a Little Cataraqui Creek Conservation Authority trail (Reservoir Trail) that currently runs through the northwestern part of the Property. The Reservoir Trail is considered a sensitive receptor for odour for the purposes of the air quality review. Recreational trails are not, however, considered a receptor under the noise assessment in accordance with NPC-300 noise guidelines given the transient nature of the trail users.

The land use to the north of the Knox Farm boundary is comprised of Rural, Open Space, and Environmental Protection Areas. The Little Cataraqui Creek Conservation Area (CA) trails are located in the Environmental Protection Area to the north and northwest of the boundary of the Proposed Site Location within the Knox Farm boundary is considered a sensitive receptor for the consideration of potential air quality impacts.

Land use and sensitive receptors are shown on **Figure 4-3**.

Figure 4-3: Land Use and Sensitive Receptor Locations



FILE LOCATION: K:\2022\224641\Product\Client\LandUseandAirQuality\224641_KBsBg_AirQuality.mxd

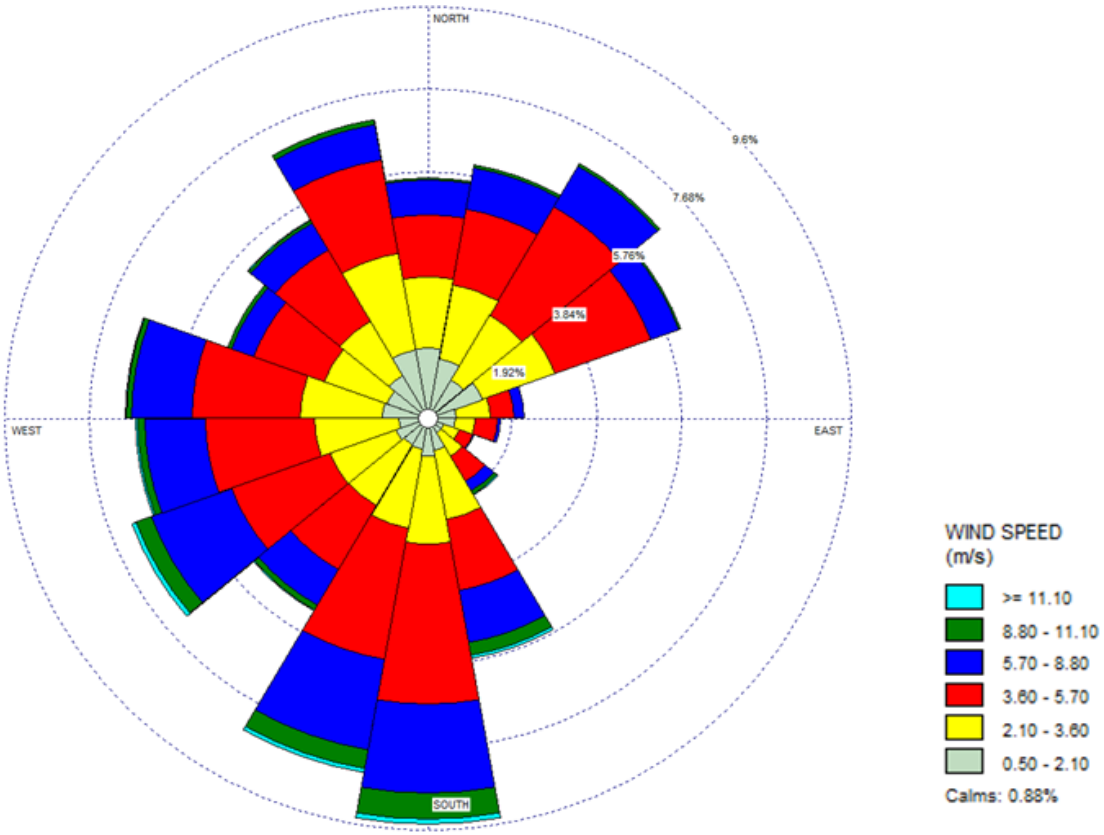
4.7.2 Wind Speed and Direction

Prevailing wind speed and direction play a critical role in the dispersion of contaminants through the atmosphere and the potential downwind impacts. The most recent annual wind speed and direction data was reviewed from the nearby Kingston Airport NAVCAN weather station.

The predominant wind direction is shown to be from the southwest with moderate westerly and northerly components.

A wind rose summarizing the 2021 hourly wind data is provided in **Figure 4-4**.

Figure 4-4: Kingston Airport 2021 Windrose



4.8 Noise

The feasibility of a proposed land use development was assessed using the MECP D-series Guidelines and the D-6 "Compatibility Between Industrial Facilities" guideline in particular. This guideline categorizes industrial facilities and specifies the potential influence area and the required separation distance from the Facility. The proposed Facility is best classified as a Class 2 Industry due to the assumed use of heavy trucks and primarily daytime operations. The industrial classification and the minimum separation distance are tabulated in **Table 4-4**.

Table 4-4: Industrial Categorization and Recommended Separation Distances

Category	Category Criterion	Minimum Separation Distance [m]	Area of Influence [m]
Class I	Small scale and self-contained plant with no outside storage; Daytime operations only.	20	70
Class II	Medium level plant with open process and outside storage permitted; frequent movement of products and/or heavy trucks movement mostly during the daytime; shift operation permitted.	70	300
Class III	Large production level; with open process and outside storage of raw and finished products; continuous movement of products and employees.	300	100

In addition to the compatibility D-6 guidelines, the MECP publication NPC-300 establishes sound level limits that are applied to stationary noise sources such as industrial facilities. The noise impact assessment descriptor is the One-Hour Equivalent Sound Level (Leq). As per NPC-300, the sound level limit at a point of reception is the higher of the applicable exclusion limit value, or the minimum background sound level. The ambient (background) noise environment in this area can be characterized as having qualities of a Class 1 area where the background noise is dominated by human activity. The exclusionary limits of class 1 area are presented in **Table 4-5**.

Table 4-5: Class 1 Area Exclusionary Limits

Area	Daytime (07:00 to 19:00)	Evening (19:00 to 23:00)	Nighttime (23:00 to 07:00)
Plane of Window [dBA]	50	50	45
Outdoor Point of Reception [dBA]	50	50	--

To confirm the Class 1 Area classification, the hourly sound levels from Perth Road were measured from September 15, 2022, to September 19, 2022. The measured data was supplemented with weather data from Environment Canada's Kingston A weather station.

The results of the Background Noise Assessment confirmed that the ambient (background) noise environment in the area is best characterized as having qualities of a Class 1 area where the background noise is dominated by human activity. Elevated background noise levels due to surrounding roadways were identified at some receptor locations, particularly the hotels on the south side of Highway 401. A detailed overview of the Background Noise Assessment, the monitoring location, and the measured data can be found in Section 2.5 of the Knox Farm Suitability Report (**Appendix A**).

The industrial operations assessed are compliant with NPC-300 if they are at or below either the exclusion limits or the ambient (background) noise levels as measured or calculated. As shown in **Section 7.2.1**, the findings of noise assessment indicate that when operating under a predictable worst-case scenario, the proposed Facility's noise sources are anticipated to result in noise levels that comply with the applicable criteria.

4.9 Source Water Protection

The Proposed Site Location falls within the Cataraqui Source Protection Area (SPA) and as identified in Schedule 11B of the Official Plan (**Figure 4-5**), is located in a Highly Vulnerable Aquifer (HVA) and Significant Groundwater Recharge Area (SGRA).

Section 5.A.5 of the Official Plan (under Source Water Protection), indicates that new developments that constitute a drinking water threat within an HVA and SGRA "may be required to incorporate measures to adequately mitigate and manage any risk to source

water" to the satisfaction of the City in consultation with the Cataraqui Source Protection Authority (City of Kingston, 2022a). Risk management measures would generally include strategies or works to minimize or mitigate water quality impacts to groundwater. The policies in the Official Plan are consistent with the intent of the policies included in the Cataraqui Source Protection Plan (SPP); however, the SPP must be referenced for clarification and policy detail.

The Study Area is located on an inferred karst formation of unstable bedrock (

Figure 4-6) and the SPP policies indicate that developments or certain activities (e.g., waste hauling, snow storage) occurring on surface karst topography formations should have a karst assessment performed to determine if any additional risk management measures are required (CRCA, 2015; CRCA, n.d.).

A Preliminary Karst Assessment was completed in November 2023. Based on the desktop background information review and field-based visual observations the likelihood of significant karst features at the Proposed Site Location is low; the majority of the Proposed Site Location is overlain by low permeability soils, which limits the karstification of the underlying limestone. Karstic features such as sinkholes, caves or disappearing streams were not observed during the field visit and where surface limestone bedrock was found, it was observed to be minimally weathered.

It is understood that the Facility is located outside of the City's urban boundary and therefore, the proposed Facility will be required to be serviced through an onsite domestic wastewater treatment system. In addition, the Facility may require an area for the temporary storage of biosolids product (liquid or dewatered product). The design of the domestic wastewater treatment system and area for the temporary storage of biosolids product should consider the Subject Site's hydrogeological conditions and allow for sufficient vertical separation to the underlying bedrock.

Figure 4-5: City of Kingston Official Plan Schedule 11-B Constraint Mapping - Source Water Protection

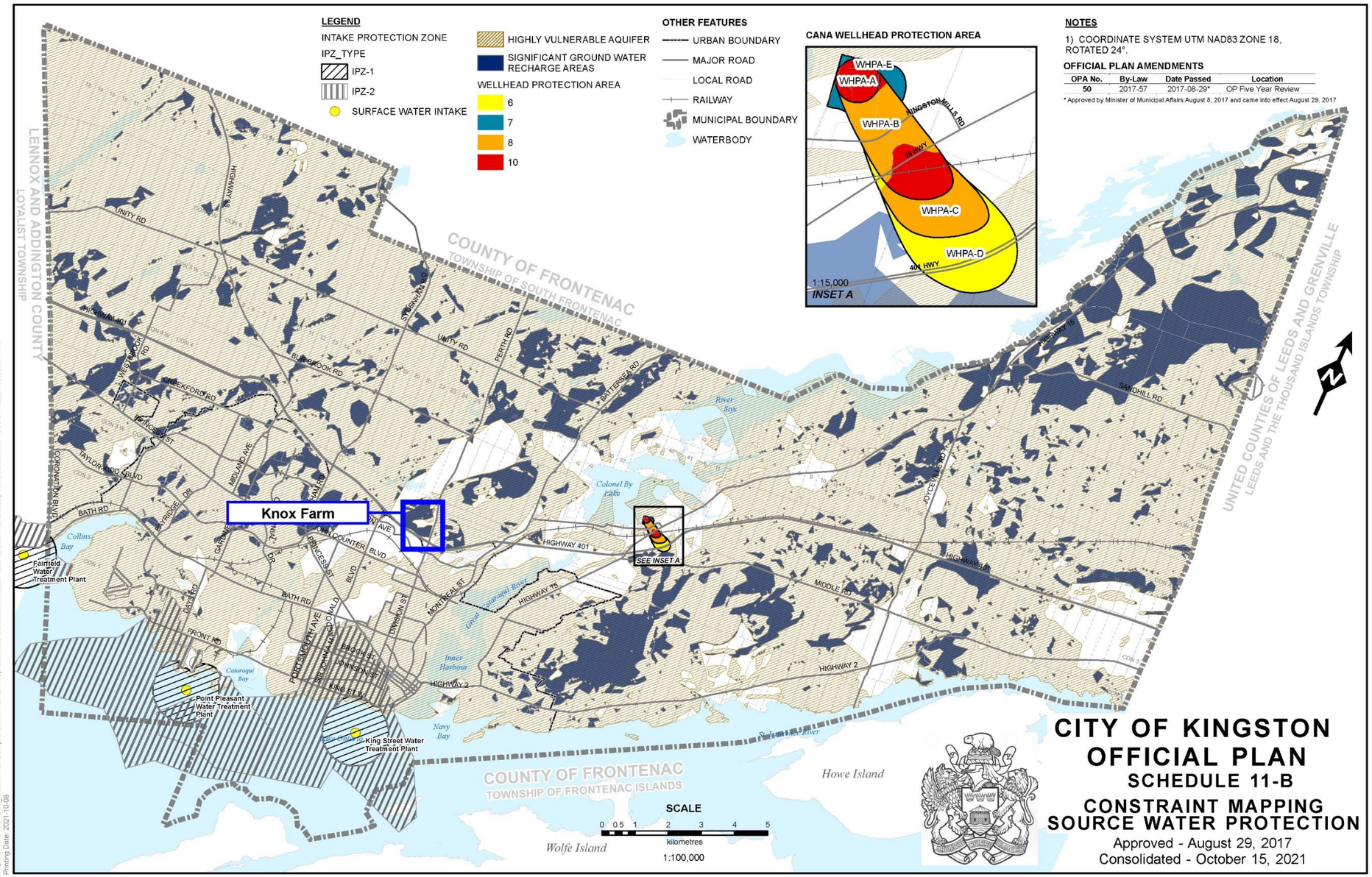
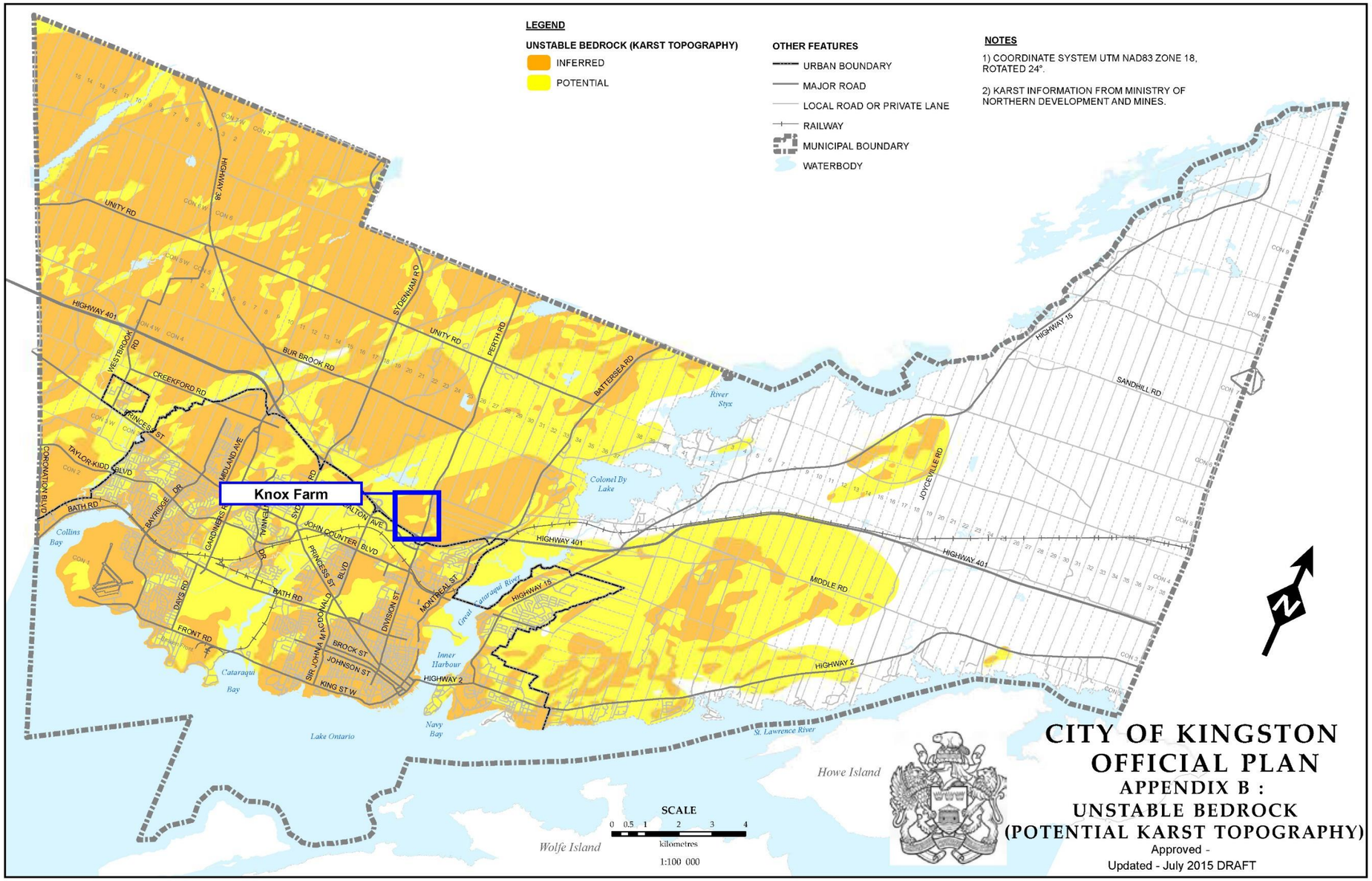


Figure 4-6: City of Kingston Official Plan Appendix B - Unstable Bedrock



Based on this preliminary karst assessment, it does not appear that there are significant karst features at the Proposed Site Location that would impact the proposed development of the Facility. If a significant karst feature such as a sinkhole, cave or deep fracture appear during construction, construction activities would need to be adapted in order to evaluate the risk (environmental, geotechnical, etc.) associated with the newly identified karst feature. Should karst features appear or become visible as a result natural processes, further studies could be required to improve the understanding of the identified karst.

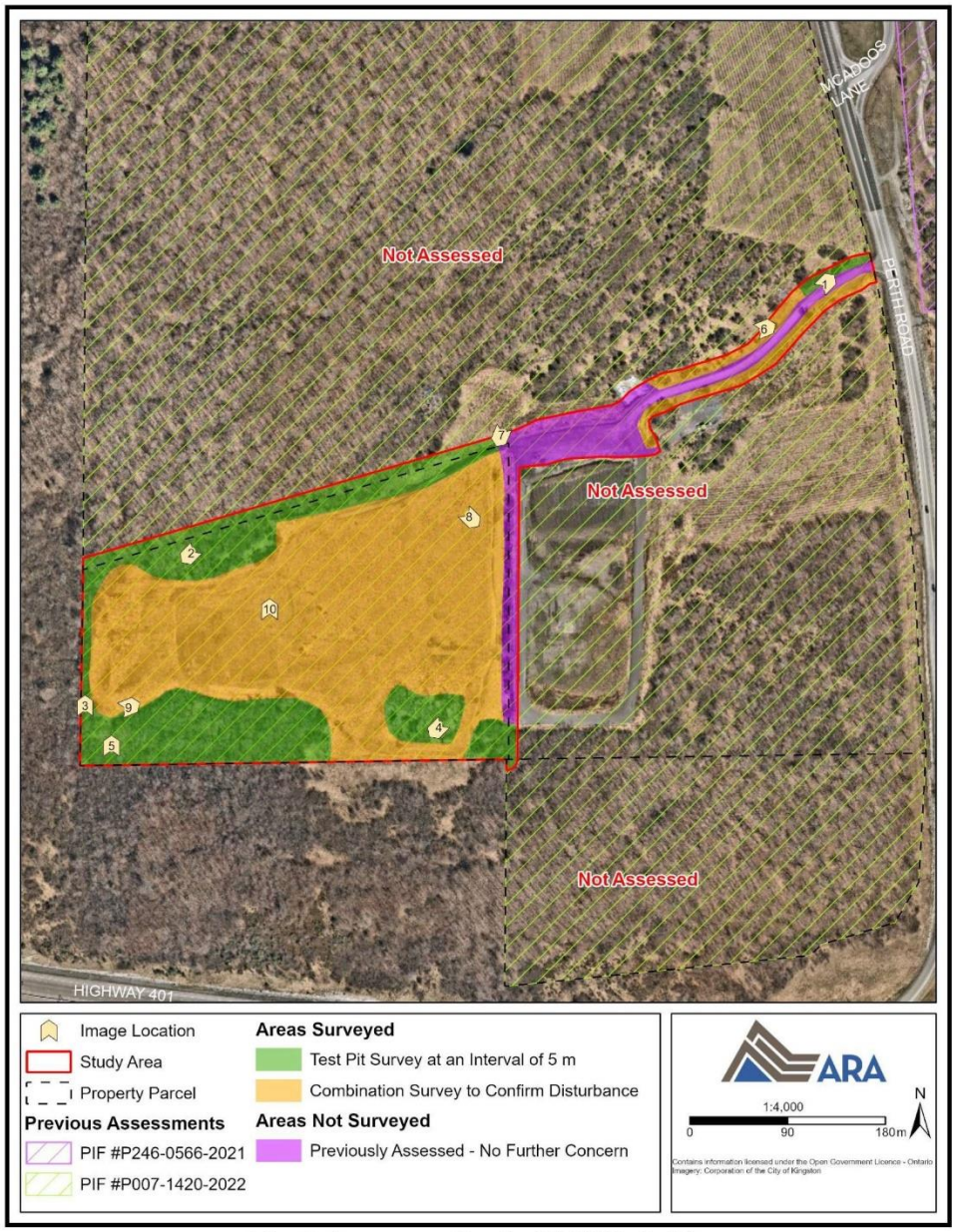
4.10 Archaeology

Archaeological Research Associates Ltd. (ARA) conducted a Stage 1 Archaeological Assessment (PIF# P007-1420-2022; **Appendix B-1**) in October 2022 of the entire Knox Farm property.

The Stage 1 assessment determined that the Study Area comprises a mixture of areas of archaeological potential and areas of no archaeological potential. It was 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 Standards and Guidelines for Consultant Archaeologists. Based on the assessment, the Proposed Site Location is within an area of archaeological potential.

The Stage 2 Archaeological Assessment (PIF# P007-1543-2023; **Appendix B-2**) conducted in November 2023 by ARA did not result in the identification of any archaeological materials and recommended that no further assessment be required within the study area, shown in **Figure 4-7**. The remainder of the Knox Farm property was not assessed and may require further assessment if development is contemplated in the future.

Figure 4-7: Assessment Results – Stage 2 Archaeological Assessment



Map 8: Assessment Results (Field Methods)
(Produced under licence using ArcGIS® software by Esri, © Esri)

4.11 Built Heritage Resources and Cultural Heritage Landscapes

A Cultural Heritage Assessment Report (CHAR) was completed by ARA (**Appendix C**). The purpose of the CHAR is to identify known and potential built heritage resources and cultural heritage landscapes, including properties recognized under the Ontario Heritage Act, those located adjacent to a Canadian Heritage River, National Historic Sites, properties with an Ontario Heritage Trust easement or plaques and any known cemeteries in the entire study area. Any properties that have been identified through other reports for projects within the Study Area are also examined in the CHAR.

After conducting historical research, consultation and field survey, no known or potential built heritage resources or cultural heritage landscapes were identified within the Study Area. To date, there are no concerns with respect to built heritage resources and cultural heritage landscapes related to the proposed Facility construction on the Knox Farm property.

5.0 Phase 3: Alternative Design Concepts

Phase 3 of the MCEA process involves developing and evaluating alternative design concepts and identifying a preferred design concept. Two alternative design concepts for the proposed Facility were developed, both located at Knox Farm within the Proposed Site Location. A multidisciplinary assessment of each alternative was undertaken to determine the potential effects of the Project and methods to mitigate its impact on the environment. The two design concepts were assessed based on evaluation criteria and compared to each other to determine the preferred option.

The alternative design concepts were developed with consideration of the following overall Project goals:

- Sufficient capacity to process future wastewater sludge loadings and City Green Bin organic waste;
- Production of a treated residual product for beneficial reuse (agricultural); and
- Reduction in the City's overall carbon footprint through the production of biogas and conversion to renewable natural gas (RNG).

The Project goals were derived from common goals, priorities, and initiatives identified in City and UK local planning documents, particularly the Utilities Kingston Strategic Plan (2021-2025), City of Kingston Strategic Plan (2023-2026), and City of Kingston Climate Leadership Plan (2021).

5.1 Current Organic Waste Management Processes

Source separated organics (SSO) generated from the City's Green Bin program and municipal biosolids from the City's wastewater treatment plants (WWTPs) were considered as the base feedstock for the proposed Facility. The following sections include a description of the Green Bin program and the City WWTPs. Historical waste quantities are provided and were used to develop the organic material volume projection model in **Section 5.2.1.**

5.1.1 City of Kingston Green Bin Program

The City introduced the Green Bin program in 2009 to divert residential SSO (organics) from the landfill. The City services approximately 57,835 households through a weekly

curbside collection program and delivers the majority of the SSO to a privately-owned transfer station in the west-end of the City, from there the private company transports the SSO to their processing facility located in the east-end of the City[2]. Accepted Green Bin materials include food waste, soiled paper, and limited amounts of yard waste. Historical quantities of organics collected through the City's Green Bin program were provided by UK and consolidated in **Table 5-1**.

Table 5-1: Historical SSO Tonnages (2019 – 2022)

Year	SSO Quantities (Metric Tonnes, MT)
2019	3,886
2020	3,979
2021	4,214
2022	3,912

Since 2010, the City has commissioned seasonal residential waste composition audits to assess their diversion performance. In Fall 2022, AET Group Inc. carried out a waste audit to identify the composition of waste collected from single family households, as well as to calculate generation rates and performance indicators to determine the effectiveness of the City's diversion programs. **Table 5-2** provides a summary of the per household generation rates for the types of organics found in the Green Bin and the waste (garbage) stream.

[2] 2021 Census of Population, Kingston, Ontario

Table 5-2: Fall 2022 Green Bin Stream Characterization

*Green Bin organics as a percentage of total acceptable organics

Estimation of Organics within Waste and Green Bin Streams	Organic Waste Generation (kg/hh/year)	Organic Waste Generation (% of total acceptable organics)
Total Acceptable Organics	**195.34**	
Acceptable Organics (Green Bin)	100.46	51.4
Acceptable Organics (Waste Stream)	94.88	48.6
Total Other	**36.87**	
Soiled Paper Products (Green Bin)	6.91	3.5
Yard Waste (Green Bin)	25.06	12.8
Grass Clippings (Green Bin)	0.00	0
Newspaper, Mixed Fine Paper (Green Bin)	1.03	0.5
Other/Residual Materials (Green Bin)	3.87	2
Total Green Bin Organics	**137.33**	**70.3***

Table 5-2 suggests that there is still almost 95 kg/household/year of organics (48.6% of the total) which could potentially be diverted from the garbage stream to the Green Bin stream which demonstrates there is potential to increase participation and capture rates in the Green Bin program.

5.1.2 Utilities Kingston Wastewater Treatment Plants

UK is responsible for providing water and wastewater treatment for the City, which has a service population of approximately 122,000. UK manages three WWTPs: Ravensview WWTP, Cataraqui Bay WWTP, and Cana WWTP. At each of the two largest WWTPs (i.e., Ravensview WWTP and Cataraqui Bay WWTP), the wastewater generally undergoes screening and grit removal to take out large and inorganic materials. Then, the wastewater is pumped to settling tanks for removal of heavy solids. The wastewater

undergoes biological treatment to remove organic compounds and dissolved carbon and nutrients, followed by disinfection for pathogen removal[3,4].

Undigested sludge from the liquid treatment trains is processed at the Ravensview and Cataraqui Bay WWTPs through anaerobic digestion and digestate dewatering. The treated biosolids are then stored temporarily onsite before being trucked to licensed agricultural fields for land application. Sludge from the Cana WWTP is currently transported to the Ravensview WWTP for processing.

Starting in 2016 to 2023, the Cataraqui Bay WWTP underwent major capital upgrades to increase the plant's rated treatment capacity, which was identified as a City priority in the 2010 Sewage Infrastructure Master Plan.

Monthly sludge volumes and their respective total solids (TS) concentrations as a percentage of total sludge volume were obtained from raw daily sludge data provided by UK from 2017-2023. The historical undigested sludge tonnages and annual average solids concentration for Cataraqui Bay WWTP are summarized in **Table 5-3**. Sludge volumes were available for the entire period, however, there was no solids quality data available for the thickened waste activated sludge (TWAS) stream. Years 2017 through 2021 represent operation prior to the completion of the recent facility upgrade. Only 2022 and 2023 was used as inputs for the undigested wastewater sludge loading in the organic material volume projection model (see **Section 5.2.1**). The 2023 data set represents the current operations at Cataraqui Bay, with all four primary clarifiers and new gravity thickeners online.

Table 5-3: Cataraqui Bay Undigested Sludge Volumes and Quality (2017-2023)

Year	Primary Raw Sludge (m^3)	Annual Average TS (%)	TWAS (m^3)	Annual Average TS (%)	Thickened Secondary Sludge (m^3)	Annual Average TS (%)
2017	13,538	4.0%	19,233	n.d.	-	-
2018	11,566	4,1%	19,776	n.d.	-	-
2019	10,436	4.2%	16,405	n.d.	-	-
2020	22,456	3.7%	1,517	n.d.	-	-

[3] Kingston Regional Biosolids and Biogas Facility
[4] Ravensview Wastewater Treatment Facility

Year	Primary Raw Sludge (m^3)	Annual Average TS (%)	TWAS (m^3)	Annual Average TS (%)	Thickened Secondary Sludge (m^3)	Annual Average TS (%)
2021	46,318	3.3%	-	-	-	-
2022	42,685	3.1%	-	-	2,168	5.4%
2023	34,945	3.1%	-	-	8,184	5.3%

Undigested sludge from the Ravensview WWTP is generated from the primary clarifiers only, representing primary settled raw sludge and co-thickened activated sludge from the BAF backwash water. Undigested sludge tonnages and annual average solids concentration for Ravensview WWTP are summarized in **Table 5-4** for 2022 - 2023.

Table 5-4: Ravensview WWTP Undigested Sludge Volume and Quality (2022-2023)

Year	Undigested Sludge Volume (m^3)	Annual Average TS (%)
2022	45,727	4.0%
2023	53,742	3.6%

*This data set contained multiple outliers which were adjusted by using the preceding data point to estimate the actual undigested sludge volume.

The data used to forecast future wastewater sludge quantities is summarized in **Table 5-5.**

It is assumed that undigested wastewater sludge would be trucked to the proposed Facility at Knox Farm for co-digestion with City Green Bin SSO. To minimize GHG emissions associated with trucking raw, undigested sludge, it was assumed that the undigested wastewater sludge would be dewatered to a minimum of 15% TS using existing centrifuge dewatering equipment. Sludge dewatering is expected to reduce the volume of makeup water required for processing at the proposed Knox Farm Facility and the volume of wastewater to be sent back to the treatment plants.

Table 5-5: Total Wastewater Sludge Loading (2022 - 2023)

Year	Existing Volume (m^3)	Existing Dry Tonnage (tonnes per year)	Thickened Wet Tonnage at 15% TS (tonnes per year)	Thickened Wet Tonnage at 15% TS (tonnes per day)
Cataraqui Bay WWTP				
2022	42,685 at 3.1% TS 2,168 at 5.4% TS	1,430	9,530	26
2023	34,945 at 3.1% TS 8,184 at 5.3% TS	1,537	10,244	28
Ravensview Bay WWTP				
2022	45,727 at 4.0% TS	1,801	12,008	33
2023	53,742 at 3.6% TS	1,945	12,964	36
Total				
2022	90,581	3,231	21,538 at 15% TS	59
2023	96,870	3,481	23,207 at 15% TS	64

5.2 Future Servicing Needs and Design Basis

As part of the development of the alternative design concepts for the proposed Facility, Dillon developed a design basis, which includes the potential organics loading at the 2030 initial operation year and 2060 ultimate operation year. The following section describes the methodology used to estimate the future quantities of organics (i.e., municipal sludges and Green Bin SSO) to be processed at the new Facility. This section includes the assumptions used to develop the design basis of the two alternative design concepts, which incorporates the historical SSO and undigested sludge tonnages as shown in **Table 5-1** and **Table 5-5.**

5.2.1 Organic Material Volume Projection Model

Three loading scenarios were developed to understand the potential ranges in organic waste to be managed at the proposed Facility. Although the Facility may ultimately have some success in securing undigested sludge from nearby municipalities, sludge quantities between the three scenarios are assumed to be sourced from the City's WWTPs for simplicity. For SSO, the scenarios considered tonnages available within the City's Green Bin program and other tonnages potentially available (e.g., SSO tonnages

from neighbouring municipalities and non-residential organics). The three scenarios are as follows:

- **Scenario 1** (Baseline) – The baseline tonnage projection scenario considers feedstock from only the City's SSO Green Bin program and the City's WWTPs. The projection assumes that the current performance will remain the same over the design and construction period, which includes a 57% participation rate in the Green Bin program and 51% diversion rate of acceptable organics into the Green Bin program, as per 2021 waste audit data[5]. A calibration factor was factored into the participation rate reported in the 2021 AET waste audit to reflect waste tonnage metrics of the entire Kingston CMA area, rather than just the households that were audited. The calibration factor was based on: (1) waste audit data reflecting the average actual annual tonnage of Green Bin materials collected from 2019 – 2022 (excluding 2021, as volumes were considered an anomaly), and (2) the household Green Bin audit data from 2022. The calculated calibration factor was approximately 94% of the originally estimated program participation of 60%, resulting in a corrected overall participation rate of 57%.
- **Scenario 2** (Most Likely) – This scenario is based upon the most likely tonnage projection, which assumes increased participation and diversion rates from the City residents. The participation rate was increased to 66% and the organic diversion rate was increased to 76% (i.e., a 50% improvement in the recovery of acceptable organics currently being disposed of in the residual waste stream by participating households). In summary, this would result in an approximately 60% increase in SSO tonnes from Scenario 1.
- **Scenario 3** (Assertive) – The assertive tonnage projection scenario describes a potential 12% increase of SSO collection through the servicing of the Kingston census metropolitan area (CMA), which includes the residents of Loyalist Township, as well as a 10% contribution of SSO tonnages generated from neighbouring CMAs (e.g., Brockville, and/or Belleville/Quinte). It is assumed that the program will have an 80% participation rate and a net SSO diversion rate of 90%, thereby representing an 80% improvement in the recovery of acceptable organics disposed of in the waste stream

[5] City of Kingston Residential Waste Composition Audit - Fall 2021 Waste Audit Summary Report – AET Group Inc.

by participating households relative to the base case. In summary, this would result in an approximately 200% increase in SSO tonnage from Scenario 1.

To estimate the future biosolids and SSO tonnages, population growth projections needed to be established over the design period.

In December 2023, City Council endorsed the adoption of the Medium Growth Scenario for the City from 2021 to 2051 in the revised Watson & Associates Economists Ltd. *City of Kingston Growth Forecast Update, Summary of Draft Findings Technical Memorandum* (Watson Report). The Council Report states that the Medium Growth Scenario was determined to be the most likely scenario for future population growth and will serve as the basis for multiple municipal studies and plans (e.g., the Transportation Master Plan, Water and Wastewater Master Plan, Official Plan, etc.).

Table 5-6 illustrates population and household growth on five year increments up to the year 2051. The average annual household growth rate over this period is projected at 1.3%.

Table 5-6: 5-Year Medium Growth Scenario Projections for City of Kingston

Year	Permanent Population	Permanent Housing (number of units)
2021	136,600	57,800
2026	148,000	63,000
2031	158,900	67,800
2036	169,900	72,600
2041	179,600	77,000
2046	188,800	80,900
2051	197,000	84,800

Annual growth rates were determined based on data in **Table 5-6**. Linear growth was assumed between projection years and corresponding percentage growth for each period, is shown in **Table 5-7.** The Watson report provided growth projections up to 2051. Since the ultimate design year for this Project is in 2060, the annual growth rate for the 2047 – 2051 period was extrapolated to 2060.

Table 5-7: Kingston Growth in Households Calibrated to Watson Report

Time Period	Household Growth Rates
2021 – 2026	1.74%
2027 – 2031	1.48%
2032 – 2036	1.38%
2037 – 2041	1.18%
2042 – 2046	0.99%
2047 – 2051	0.95%
2052 – 2060	0.95%
30-Year Annual Average (2021 – 2051)	**1.30%**

The following assumptions and modelling input factors were used to further refine the growth projections and the future tonnages:

- The 2021 Census Summary, *Population and Dwelling Counts, Kingston, Ontario – Census Metropolitan Area (CMA)*[6] reported that the City accounts for 82% of the Kingston CMA. This number was used to represent SSO diversion program access within the CMA, since all City residents have access to SSO services through the City;
- An additional 5,100 households were added to year-over-year projections to reflect the large populations in the City with access to SSO diversion programs but not captured in the census as part of City's population. Other temporary populations not captured by the 2021 Census were not considered in the SSO tonnage projections but represent a source of potential incremental volumes of organic material;
- Current characteristics of biosolids were assumed to apply in the future including:
  - Dewatering of sludge generated at UK WWTPs to 15%. Both WWTPs presently dewater digested sludge to a solids content of greater than 15%. A lower solids content was chosen to account for a possible reduction in the dewatering efficiency for un-digested sludge compared to the digested sludge presently processed. A reduced solids content also helps achieve a more neutral water balance at the Knox Farm Facility, where the majority of the water required for digestion is contained in the sludge rather than added as a separate dilution stream, and;

[6] *Population and Dwelling Counts, Kingston, Ontario – Census Metropolitan Area (CMA)*

- The Volatile Suspended Solids (VSS) content of undigested biosolids was assumed to be 70-85%, varying by source facility. VSS represents the fraction of organics which may be converted into biogas through digestion.

Anticipated feedstock loadings for each of the three scenarios are described in **Table 5-8** and **Table 5-9.** Three loading scenarios with identical sewage biosolids production and varying SSO quantities were developed to illustrate potential future variability in Facility tonnages, with Scenario 2 identified as the most likely SSO availability scenario.

Table 5-8: Organic Input Loadings – Initial Operation (2030 Design Year)

Scenario	SSO Quantity (TPY)	Raw Biosolids Quantity (WTPY)	Total Loading (TPY)
1. City Baseline Scenario	4,450	26,000	30,450
2. Most Likely SSO Availability Scenario	7,100	26,000	33,100
3. External Contribution + Assertive SSO Availability Scenario	13,500	26,000	39,500

Table 5-9: Organic Input Loadings – Ultimate Operation (2060 Design Year)

Scenario	SSO Quantity (TPY)	Raw Biosolids Quantity (wTPY)	Total Loading (TPY)
1. City Baseline Scenario	6,150	36,100	42,250
2. Most Likely SSO Availability Scenario	9,800	36,100	45,900
3. External Contribution + Assertive SSO Availability Scenario	18,650	36,100	54,750

Scenario 2 in the tables above was carried forward as the basis for Phase 3 evaluation.

5.3 Biogas End Use Considerations

A major driver for the proposed Facility is the generation of biogas for beneficial reuse. Biogas has two components that provide value: the net energy value of the gas and the net environmental attributes associated with the gas.

Biogas is a mixture of methane, carbon dioxide and small quantities of other gases produced when organic matter biodegrades in an oxygen-free environment. The precise composition of biogas depends on feedstock characteristics used and the production mechanism with methane content typically ranging from 45% to 75% by volume. The variability of methane content results in a range of lower heating values (or net calorific value) for biogas ranging between 16 megajoules per cubic metre (MJ/m^3) and 28 MJ/m^3.

Biogas is generally recognized as a key component of a sustainable energy portfolio, reducing greenhouse gas (GHG) emissions via two primary pathways. These include:

(1) The displacement of fossil fuel derived methane; and,
(2) The avoidance of methane emissions resulting from the prevention of fugitive methane emissions and the combustion of that methane in an energy generating application.

The quantity and value of GHG reductions resulting from pathway (1) would be proportional to the net energy generated by a biogas facility. The quantity and value of GHG reductions resulting from pathway (2) would be more complex and contingent on the regulatory context (i.e., baseline requirements for controlling methane emissions), the emission control performance of the biogas facility, and the methane destruction efficiency at the end use application. Collectively these considerations determine methane avoidance related GHG reductions relative to the regulatory baseline.

5.3.1 Potential Biogas End Uses

To realize economic value from the energy produced by a biogas facility, the gas must be relayed to an energy use application. Common energy use applications for biogas include:

(1) Direct use of biogas in an industrial application, such as fuel for industrial boilers;
(2) Electricity generation; and,

(3) Biogas upgrading and injection into natural gas pipeline as renewable natural gas (RNG), where biogas methane is co-mingled with fossil fuel methane and combusted by commercial and residential end users connected to the pipeline.

Although not an energy use application, a fourth option, (4) methane destruction via flaring, could be considered. Option (4) isolates the methane emission avoidance benefit, which, consequently, enables the evaluation of the incremental and standalone energy benefit of energy end uses (1) through (3).

The relative energy and environmental attribute values of different energy end use options depends on gas production and upgrading facility operational factors including:

- Quantity of biogas generated – different end use applications have different economies of scale;
- Quality of biogas generated – requirements may differ between end use applications;
- Methane content and impurity characteristics of biogas;
- Consistency of biogas generated – fluctuations in biogas quantity or quality can have varying impacts on the productivity and availability of different energy use applications;
- Project siting – the cost of environmental controls and supporting infrastructure associated with an end use application will be specific to the technological solution, with variability potentially being amplified as a result of site-specific conditions (e.g., distance to connect to utilities, proximity to sensitive receptors, etc.); and,
- Regulatory context – the economic or 'monetizable' value of carbon reductions relies on the federal and/or provincial regulatory contexts and emission thresholds in place over the duration of operations.

Based upon the site location, availability of supporting infrastructure (nearby City – owned and UK operated natural gas transmission main) and preliminary GHG analyses, production of RNG to pipeline has been identified as the preferred beneficial reuse for biogas developed at the proposed Facility at this stage of the Project.

The preliminary assumption of RNG as the preferred end-use was based on the ability to utilize RNG offsite, rather than through the onsite co-generation or flaring of biogas which occurs presently at the WWTPs. Both electricity generation and upgrading of biogas to RNG provide a potential avenue for offsite use. Utilities Kingston, as an

electricity and natural gas distributor to local customers is well suited to facilitate offsite use of energy derived from biogas produced at the Facility. In the case of the Knox Farm site, the presence of the nearby natural gas pipeline infrastructure (potentially avoiding transmission challenges and third-party energy sale agreements) makes RNG an attractive option for consideration. Upgrading requirements were reviewed at a high-level as part of the Project, and it is understood at this time that biogas generated from wastewater sludge and SSO would be suitable for upgrading into RNG.

Future considerations to confirm the viability of RNG as the preferred biogas end use should include:

- Cost refinement: As part of this Class EA, capital and operating costs associated with upgrading biogas to RNG have been approximated from industry sources. During the detailed design phase, capital and operating costs should be refined, including additional consideration for:
  - the cost of energy upgrading/utilization equipment, facility permitting and approvals, supporting infrastructure, and operational monitoring and controls;
  - the cost of the Knox Farm site operations including both the fixed annual component for operations and the variable component based on the volume of gas processed or energy upgraded; and
  - the market value of RNG energy produced (e.g., $/GJ) and potential premium pricing. The present EA has conservatively assumed a cost recovery from RNG based on potential biogas production at regular natural gas rates.
- Performance Criteria: Additional details may be required to confirm biogas recovery potential related to the following:
  - Impact of feedstock quality on biogas composition (e.g., biogas generated from food waste has been reported to contain elevated levels of sulfuric compounds which can result in production of hydrogen sulfide and damage downstream equipment[7], presence of siloxane-containing compounds in municipal sludges can result in decreased biogas production[8]);

[7] Li, Alaimo, Kim, Kado, Peppers, Xue, Wan, Green, Zhang, Jenkins, Vogel, Wuertz, Young, and Kleeman (2019). Composition and Toxicity of Biogas Produced from Different Feedstocks in California. *Environmental Science & Technology,* 2019, 53 (19), 11569-11579, DOI: 10.1021/acs.est.9b03003

[8] Dewil, Raf, Appels, Lise, and Baeyens, Jan (2006). Energy use of biogas hampered by the presence of siloxanes. *Energy Conversion and Management*, 2006, 47(13-14), 1711-1722, DOI: 10.1016/j.enconman.2005.10.016

- Minimum thresholds for operations that would limit cost-effectiveness of RNG production (e.g., minimum % methane content or minimum gas flow rate); and,
- Any maximum thresholds for impurities that would limit energy upgrading (e.g., maximum % impurities). A more detailed review of equipment requirements for upgrading and gas quality generated from characterization of feedstock samples and biomethane potential studies would occur as the project design phases progress.

Initial estimates of Project financial parameters are provided in **Section 5.5.2.4** and **Section 5.5.3.4**. UK is currently undertaking a separate business case analysis which will supplement information herein.

5.4 Alternative Design Concept Development

Two alternative design concepts have been developed considering overall Project goals for the City and UK, as described in **Section 5.0**. Technical performance features, derived from vendor materials obtained through a Request for Information (RFI) process completed in Spring 2023 and Dillon's professional expertise, were identified to distinguish between the two concepts. A single site location (Knox Farm) is being considered, and several factors such as general layout, site access, as well as potential environmental impacts and mitigation are also similar for each option. As a result, siting, access and potential environmental impacts are unlikely to significantly distinguish different design concepts from one-another. Key technical process features which may differ between alternatives were identified to help guide the development of alternative design concepts. These features included:

1. Type of feedstock preparation required;
2. Presence or absence of pre-treatment steps prior to digestion;
3. Core digestion process type;
4. Biogas utilization, and generation; and,
5. Form of biosolids (i.e., digestate) product (e.g., liquid, semi-solid cake, dry powder or pellets).

Based on the above features, it was concluded that feature 1 (the physical preparation of feedstock to remove impurities, blend sludge and SSO and ensure appropriate consistency for processing) was likely to be similar for each technology and unlikely to

provide meaningful differentiation in a final evaluation process. It is also assumed that the incoming raw, undigested sludge will be dewatered onsite at WWTPs for all alternatives, as is the current practice for digested sludge. The dewatering process is expected to require minimal changes but there may be a need to modify existing dewatered cake storage bays to accommodate lower solids content sludge. Larger trucks may be required to transport sludge to Knox Farm than are presently used to remove dewatered, digested sludge for land application which may require modifying the existing loading bays, or installing equipment to load trucks outside.

Feature 2 (pre-treatment prior to digestion) was identified as a meaningful differentiator as it may influence process features, including:

- Capital and operating costs (associated with running this additional processing step);
- Maximum total solids content of feedstock to digestion (affecting raw water demand);
- Volatile Suspended Solids destruction through the digestion process (impacting overall processed biosolids generation); and,
- Specific biogas generation per tonne of feedstock, related to the biogas generation highlighted under feature 4 (pre-treatment is expected to lead to greater energy recovery).

Feature 3 (core digestion process) for potential design concepts is expected to be relatively similar between the proposed technology solutions under consideration and is not a meaningful differentiator.

Feature 4 (biogas utilization) is a key driver of overall project feasibility. While biogas utilization for all concepts will be assumed to be RNG, alternatives with the potential for greater biogas generation offer the potential for improved GHG reduction and cost recovery.

Feature 5 (form of biosolids biproduct) was also considered to be a meaningful differentiator influencing:

- Total volume of end biproduct requiring temporary storage onsite;
- Energy demands associated with post-processing stages such as dewatering or drying;

- Marketability of end biproduct (liquid product may be potentially more marketable and maximizes the recovery and beneficial reuse as a valuable crop nutrient);
- Production of excess high-strength wastewater (e.g., centrate produced through dewatering), which cannot be reused in the digestion process and requires offsite treatment; and,
- Cost and greenhouse gas impacts associated with trucking and utilization of final biproducts.

Design concepts were developed, focusing on distinctions between feature 2 (pre-conditioning) and feature 5 (form of biosolids biproduct) and are described below.

5.5 Overview of Design Concepts

Two alternative design concepts were developed by considering different potential approaches to feature 2 (pre-treatment of feedstock or no pre-treatment of feedstock) and feature 5 (a production liquid vs. solid biosolids product) described in **Section 5.4**.

Features that are common to both alternatives are discussed in **Section 5.5.1**. Further details regarding key process components, site layout development, and costing for each alternative are described in **Section 5.5.2** and **Section 5.5.3**.

Design Concept 1: Focus on maximizing resource recovery

This alternative prioritizes the generation of renewable natural gas (RNG) and biosolids residuals with an emphasis on retaining nutrient value for beneficial reuse in agriculture. Features of this alternative may require additional utility use for required sludge and biosolids processing, such as feedstock pre-treatment to improve biogas generation, relative to simpler alternatives.

Key features:

- Greatest potential to reduce community GHG emissions;
- Incorporation of pre-treatment of feedstock to maximize biogas generation. Feedstock pre-treatment may be performed after blending the feedstocks, or on the wastewater sludge stream alone based on performance requirements; and,
- Production of a liquid biosolids product (minimized wastewater treatment demands, maximum nutrient beneficial reuse).

Design Concept 2: Focus on minimizing utility demands and residuals volume

This alternative prioritizes simplicity of operation, reduced utility usage (i.e., no pre-treatment of feedstock) and the production of a lower volume biosolids product requiring less volume to store and fewer trucks to transport to end-use.

Key features:

- No feedstock pre-treatment (minimized energy inputs required for process); and,
- Dewatered biosolids, thereby minimizing residual volume requiring onsite storage. While some centrate will be reused for blending with incoming material, some of this liquid will be returned for treatment at a City WWTP.

Simplified block-flow diagrams depicting key components in each Alternative are shown in **Figure 5-1** and **Figure 5-2**.

Figure 5-1: Process Flow Diagram of Design Concept 1

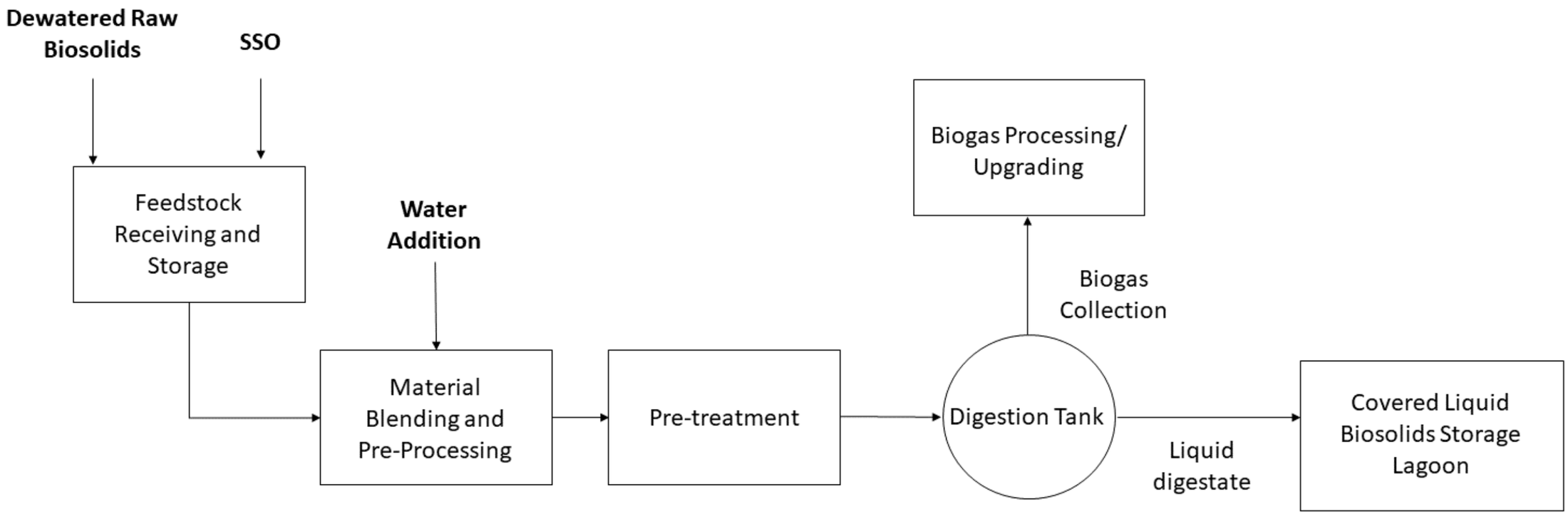
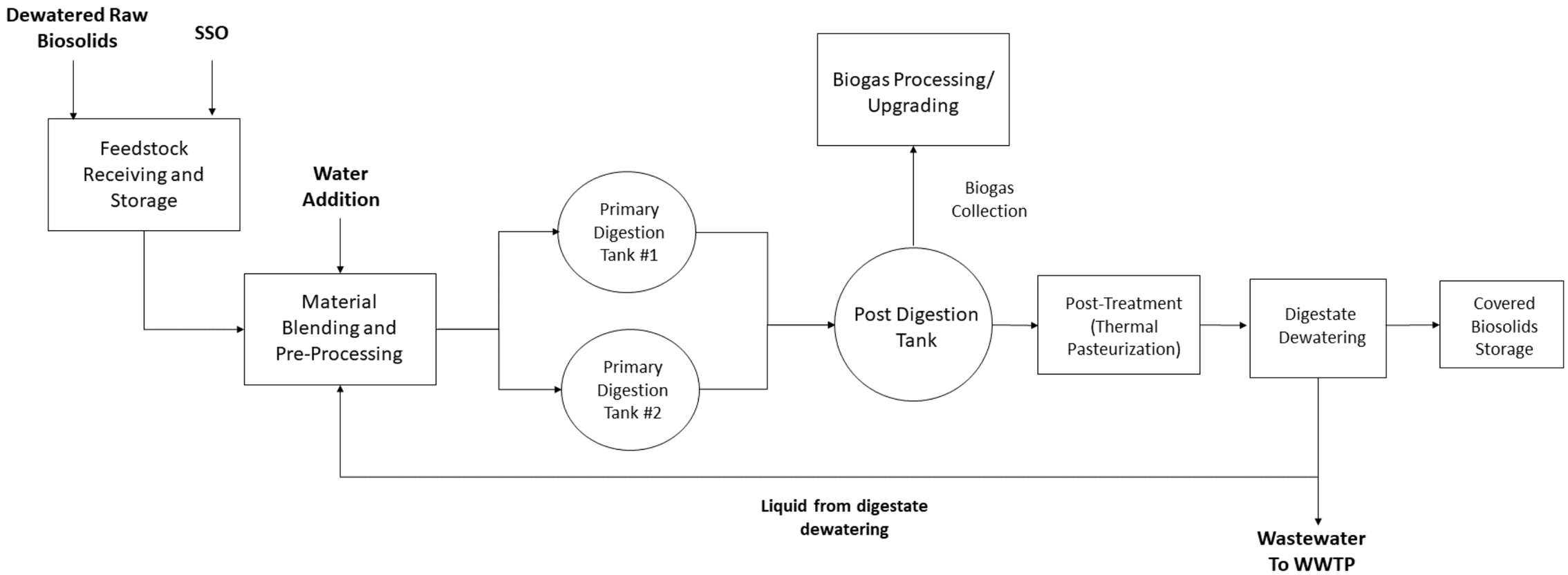


Figure 5-2: Process Flow Diagram of Design Concept 2



5.5.1 Common Features

Both alternative design concepts have been described as complete facilities, including several common elements aside from the distinct features which are of focus for the EA evaluation. We have described these common elements in the sections below, followed by descriptions of the unique components of each concept.

5.5.1.1 Receipt and Storage of Sludge and SSO

We have assumed that each design concept will include site access roadways, offices, scale house facilities for incoming and outgoing trucks, and an enclosed receiving building for accepting both SSO and dewatered wastewater sludge feedstock for the digestion process. A common tipping floor footprint, capable of accommodating up to four trucks at one time, has been assumed for each concept. Within the tipping floor footprint, dedicated collection bunkers or bins could be used depending on material consistency.

5.5.1.2 Physical Feedstock Preparation

Green Bin organics are assumed to contain varying levels of physical contamination consisting of inorganic materials (e.g., plastics, metals, glass, ceramics, etc.). As a result, the feedstock needs to be prepared prior to digestion to protect the subsequent treatment units and improve the quality of the final digestate. Typical technologies may include milling, extrusion, and hydro-pulping to homogenize the waste and remove large non-organic contaminants. This is followed by a polishing process, downstream of physical processing, to remove fine particles from the organics. Common processing equipment includes process units such as grinders, mincers, screw presses, paddle finishers, disc screen shredders, and/or hydro-cyclones.

Feedstock preparation requirements ahead of AD are similar for both design concepts and as such, a common feedstock preparation building footprint has been assumed. Selection and configuration of specific pre-processing units is likely to be determined by the AD technology vendor selected during detailed design.

5.5.1.3 Core Digestion Process

Both alternative design concepts include a common AD process consisting of circular tanks that are supplied with a liquified mixture of processed sludge and SSO. AD

technology uses microorganisms to break down organic waste in the absence of oxygen. This achieves a number of benefits, including:

- Reduction in the volume of organics;
- Production of a nutrient-rich fertilizer; and
- Production of biogas – a renewable energy source that can be used to replace petroleum natural gas.

AD is a complex process that can be influenced by a variety of operating and environmental parameters. The temperature of the digester is a consideration that influences the type of organisms present in the digester and the effectiveness of the digestion process at removing pathogens, as well as the amount of energy required for heating. Both concepts have assumed a similar operating temperature range, known as mesophilic digestion, with additional treatment to remove pathogens before or after digestion. Typically, AD occurs in a single reactor (known as single stage digestion), but recently there has been an increase in scientific literature that explores two-stage digestion. Two-stage digestion involves the physical separation of the acid-forming and gas production phase of AD into separate tanks. During the detailed design phase of the Project the number of digestion stages will be confirmed.

5.5.1.4 Biogas Treatment

Both concepts assume the generation and collection of biogas for beneficial reuse as RNG. Following generation in digesters, biogas requires cleaning and processing to achieve a quality suitable for injection into natural gas pipelines. A number of biogas constituents, including carbon dioxide, hydrogen sulphide, nitrogen, water and oxygen must be removed at this time.

Raw biogas quality, and the gas cleaning equipment required for this treatment step, is assumed to be similar between both considered alternatives.

5.5.1.5 Residuals and Storage

It is assumed that any selected technology would produce a digestate biproduct that will meet the requirements of the federal *Fertilizer Act* and regulations as administered by the Canadian Food Inspection Agency (CFIA). This implies that the product would not be subject to approval and end-use requirements for Non-Agricultural Source Materials (NASMs) set out in *O.Reg. 267/03* (General) under the *Nutrient Management Act*, as

administered by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). NASM-regulated products are subject to specific hauling, storage, and disposal requirements listed under the Ontario *Environmental Protection Act* (EPA) and must have a land application plan. A CFIA-regulated fertilizer product is considered a value-add in the current market, and there are fewer restrictions on use than NASM. CFIA-regulated fertilizers must meet maximum metals concentration limits, and the ability of processed digestate to meet these requirements is influenced by the quality of the raw feedstock. Based on information available at this time it is expected that sludge and SSO quality should allow a CFIA fertilizer product to be produced for both alternatives. Ongoing testing will be necessary to confirm sludge quality continues to meet current CFIA standards.

It is noted that vendors providing technology information through the RFI also described processes that would produce a CFIA fertilizer product, confirming that the biproduct will meet the requirements of the *Fertilizer Act.*

Final product storage for 240 days of production at normal processing capacity was assumed, following guidance in the Ontario *Design Guidelines for Sewage Works* and the Ontario Nutrient Management Act (*O.Reg. 267/03)*. For both alternatives the storage capacity is assumed to be in the form of dewatered solids stockpiles or liquid digestate, depending on the processing technology selected.

As discussed in **Section 5.5.2.2**, contaminants are anticipated to be found in the SSO stream that will be removed and stored separately in containers. When full, these inorganic material containers would be hauled for final disposal at a licensed facility.

5.5.2 Unique Features of Design Concept 1

Two specific key features have been identified for development of this design concept:

- The blended sludge and SSO feedstock is pre-treated prior to digestion to maximize and increase biogas generation; and,
- A liquid residual product is produced, minimizing the need to remove and treat liquid from the processed digestate, and as a result maintaining a greater fraction of nutrients in the residual product for beneficial reuse.

An overall site plan depicting this alternative is shown below in **Figure 5-3**. This layout shows a number of site features common to both design concepts in addition to process areas including:

- Site access roadway and onsite roads;
- Parking and vehicle turning areas;
- Truck weigh scale;
- Site office;
- Potential onsite well for potable use and/or non-potable process water; and,
- Stormwater management pond.

5.5.2.1 Traffic Considerations

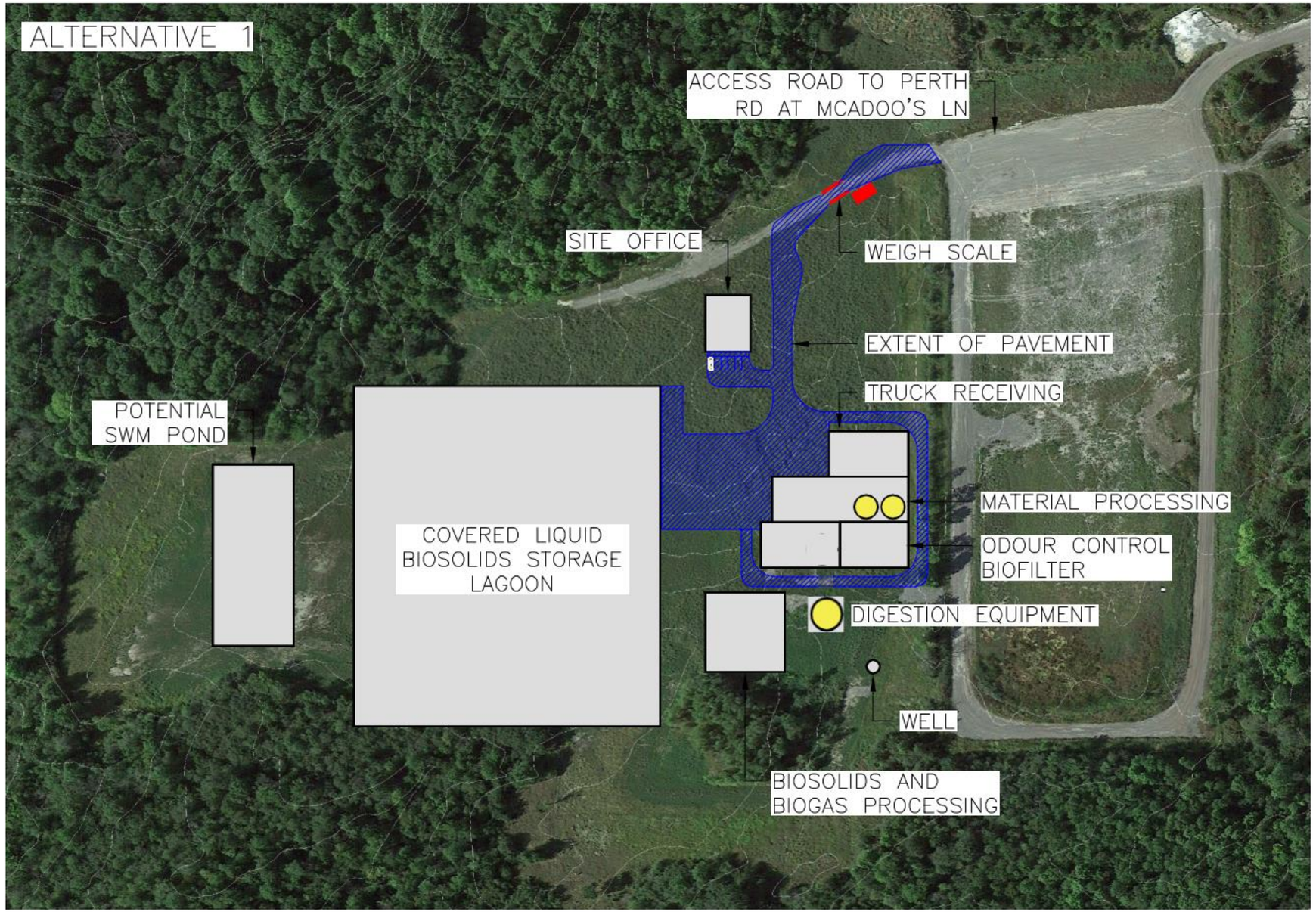
The truck traffic to/from the site for both Design Concepts differs slightly over the course of a full day. When considering only full truck round trips to and from the site, 27 trucks (17 inbound trucks containing sludge or SSO and 10 outbound trucks containing processed biosolids) will access the site daily for Design Concept 1.

Table 5-10 summarizes the number of site trips generated during the commuter peak hours for Design Concept 1. Design Concept 1 is estimated to generate 12 net vehicle trips (6 inbound, 6 outbound) during the AM peak commuter hour and 22 vehicle trips (11 inbound, 11 outbound) during the PM peak commuter hour in the summer season.

Table 5-10: Design Concept 1 - Site Generated Peak Hour Trips at Full Buildout

Type of Operation	AM peak hour			PM peak hour		
	Total trips	Trips in	Trips Out	Total trips	Trips in	Trips out
Sludge Trucks	0	-	-	2	1	1
Waste Collection Vehicles	0	-	-	8	4	4
Operations Staff	6	3	3	6	3	3
Finished product shipped to end user (summer season)	6	3	3	6	3	3
Snow Management (winter season)	4	2	2	0	-	-
Total (winter season)	**10**	**5**	**5**	**16**	**8**	**8**
Total (summer season)	**12**	**6**	**6**	**22**	**11**	**11**

Figure 5-3: Design Concept 1 Layout



5.5.2.2 Building Ventilation Requirements

Building ventilation and odour control is a major design consideration for large waste management facilities. Areas such as tipping floors and processing rooms may have mandatory minimum ventilation rates to satisfy health and safety or electrical code requirements, and the heating of fresh air and treating of odourous room air prior to release to the outdoor environment have significant Project cost and regulatory compliance implications.

To estimate the ventilation airflow (and odour treatment capacity) for this alternative, the footprint required for large features on the site was estimated. Some areas, particularly receiving and processing buildings, require continuous ventilation and air treatment to prevent offsite odour impacts. Building footprints and heights (where estimated) are shown in **Table 5-11** below. The ventilation requirement for buildings requiring odour treatment is also shown since total ventilation requirement directly impacts the cost of the odour control system.

Table 5-11: Design Concept 1 – Process Component Sizes and Ventilation Requirements

Table notes: *Based on an assumed six air changes per hour (ACH).

Process Component	Footprint (m^2)	Building Height (m)	Ventilation Requirement (m^3/hr)*
Weigh Scalehouse	50 m^2	N/A	N/A
Site Office	200 m^2	N/A	N/A
Truck Receiving	700 m^2	13 m	54,600
Material Processing	1,300 m^2	9 m	70,200
Pre-treatment Equipment	700 m^2	9 m	37,800
Odour Control Biofilter	600 m^2	9 m	N/A
Biosolids and Biogas Processing	1,225 m^2	9 m	N/A
Covered Liquid Biosolids Storage Lagoon	20,250 m^2	N/A	N/A
Total Ventilation Requirement (m^3/hr)			162,600

5.5.2.3 Process Components

This section describes the process components associated with Alternative Design Concept 1 as previously illustrated in **Figure 5-1**.

Pre-Treatment

Design Concept 1 includes a pre-treatment step. This step may involve a technology such as thermal hydrolysis, which consists of the application of high heat and pressure, and in some cases alkaline chemicals to wet organic waste streams to break down difficult to degrade compounds within the feedstock. Pre-treatment causes the cells within the organic material to rupture, which in turn enhances the biodegradability of the feedstock. This process also destroys pathogenic organisms, which must be removed to meet final biosolids quality requirements.

Advantages of pre-treatment include:

- Increased soluble organic matter and more easily pumpable sludge at high solids content percentages;
- Greater volatile solids destruction in the downstream digestion process, reducing final biosolids product volume;
- Higher biogas yield per tonne of feedstock digested; and,
- Faster degradation kinetics (more rapid digestion processing).

Some challenges associated with thermal hydrolysis as a pre-treatment include:

- Increased energy usage and/or chemical use to operate the pre-treatment process; and,
- Higher capital and operating costs.

Digestate Treatment and Storage

Design Concept 1 is expected to produce a concentrated, high-solids, liquid CFIA-registered fertilizer, which will be stored on site in a covered lagoon prior to transportation to end use.

Advantages to a liquid digestate product include:

- Retention of soluble nutrients in the liquid digestate;

- No need to transport liquid removed from residual product to an offsite wastewater treatment plant;
- Potentially more favourable product for agricultural applications due to simplified spreading requirements and reduced soil disturbance; and,
- Handling of product by pumping only, without additional mobile equipment such as front-end loaders.

Disadvantages to a liquid digestate product include:

- Increased final product transportation costs of liquid digestate due to increased volume compared to a dewatered (solid) residual product; and
- Large site area required to provide the necessary 240 days of storage onsite prior to use.

Table 5-12 illustrates anticipated digestate production volumes for Design Concept 1 in the 2030 initial operation year and the 2060 ultimate design year. Digestate volumes were calculated based on a preliminary mass balance.

Table 5-12: Design Concept 1 – Anticipated Loading and Digestate Production Volume for 2030 and 2060

Year	Feedstock Tonnage (Wet Tonnes)	Anticipated Digestate Volume (m^3 at 11% TS)
2030	33,100	**30,170**
2060	45,900	**41,870**

Biogas Production

Assuming the complete conversion of organics to methane, the maximum theoretical methane generation potential of an organic feedstock is 0.35 m^3 CH_4/kg Chemical Oxygen Demand (COD) at standard temperature and pressure (STP)[9]. COD is a measure of the oxygen demand required to break down a feedstock and is used to represent organic content. In the RFI submissions, vendors provided anticipated biogas production rates. The vendor-provided biogas production rates per wet tonne of feedstock were validated against currently observed raw biogas production rates at existing UK facilities and were compared to the theoretical maximum methane

[9] Wastewater Engineering Treatment & Resource Recovery, 5th ed., Metcalf and Eddy

generation potential of the feedstock to confirm the values were reasonable. Vendors may use their own design values for feedstock biodegradability, solids content, VS content and COD/VSS ratios. The following assumptions were made:

- Biogas Composition:
  - 64% methane (CH_4), 36% carbon dioxide (CO_2), calculated based on historical biogas data provided by UK.
- Sludge Characteristics:
  - Thickened sludge total solids concentration = 15% TS
  - VS/TS ratio = 70%, based on historical data
  - COD/VSS ratio = 1.74[10]
  - Average sludge biodegradability = 54%[11]
  - Biodegradability after pre-treatment = 65% (i.e., 21% increase over untreated sludge), based on vendor input.
- SSO Characteristics:
  - Total Solids concentration = 30% TS[12]
  - SSO VS/TS ratio = 90%[13]
  - COD/VSS ratio = 2.20[14]
  - Biodegradability = 40%[15]
  - Biodegradability after pre-treatment = 58% (i.e., 45% increase over untreated SSO), based on vendor input.

Biogas production rates per wet tonne of feedstock were calculated using the above assumptions. **Table 5-13** and **Table 5-14** show the estimated future feedstock quantity

[10] Ahnert, Schalk, Bruckner, Effenberger, Kuehn, and Krebs,Organic matter parameters in WWTP – a critical review and recommendations for application in activated sludge modeling. Water Science & Technology (2021) 84(9), 2093-2112. 10.2166/wst.2021.419

[11] The biodegradability of municipal sludges processed at Cataraqui Bay and Ravensview WWTPs was determined by dividing the 2022 and 2023 reported biogas volumes by the respective tonnages.

[12] Spencer, Robert, High Solids Anaerobic Digestion Of Source Separated Organics. BioCycle (2010), 51(8), 46. https://www.biocycle.net/high-solids-anaerobic-digestion-of-source-separated-organics/

[13] Li, Chenxi, Champagne, Pascale, Anderson, Bruce C., Evaluating and modeling biogas production from municipal fat, oil, and grease and synthetic kitchen waste in anaerobic co-digestions. Bioresource Technology (2011), 102 (20), 9471 – 9480. DOI: 10.1016/j.biortech.2011.07.103

[14] Fisgativa, Tremier, and Dabert,Characterizing the variability of food waste quality: A need for efficient valorisation through anaerobic digestion. Waste Management (2016) 50, 264-274. 10.1016/j.wasman.2016.01.041

[15] Calculated by using 130 Nm3/tonne food waste, as per 2017 City of London study.

and daily biogas production rate for Design Concept 1 for the 2030 and 2060 design years.

Table 5-13: Design Concept 1 – Anticipated Loading and Biogas Production (2030 Design Year)

Feedstock	Tonnage (Wet Tonnes)	Biogas Production Rate (m^3/wet tonne feedstock)	Biogas Production Rate (m^3/day)
Biosolids	26,000	70	5,000
SSO	7,100	188	3,650
Total	**33,100**		**8,650**

Table 5-14: Design Concept 1 – Anticipated Loading and Biogas Production (2060 Ultimate Operation)

Feedstock	Tonnage (Wet Tonnes)	Biogas Production Rate (m3/wet tonne feedstock)	Biogas Production Rate (m3/day)
Biosolids	36,100	70	6,950
SSO	9,800	188	5,050
Total	**45,900**		**12,000**

5.5.2.4 Cost Estimation

Estimated capital and operating and maintenance (O&M) costs were developed for each alternative.

Cost estimates considered the equipment cost, site construction requirements (including construction of a stormwater management pond), structural/architectural requirements, and costs for mechanical and electrical works. Costs were established through input from equipment vendors, standard unit pricing and Dillon's professional experience. Costs are shown in 2024 dollars.

The estimated direct capital costs for Design Option 1 are shown in **Table 5-15** and include markups such as:

- Equipment installation allowances; and,
- General contractor and subcontractor price markups.

Several indirect costs are also included:

- "Construction allowance" includes a number of other typical Project cost items such as the mobilization and demobilization of contractor equipment from the site, the cost of vendor performance bonds and the cost of startup and trial operation periods by the contractor and design teams;
- "Contingency – Estimating" reflects the uncertainty in pricing at this stage of the Project. We have reflected the uncertainty by adding percentage of the direct cost to provide a more conservative estimate at this stage; and,
- "Engineering design fees" – Estimated at 20% of capital cost but actual costs will vary depending on the detailed design selection process. Permitting costs are included under this line item.

It is assumed that the following items fall under the relevant item descriptions or contingency cost:

- Waste management operating costs (e.g., residuals are assumed to be hauled to a disposal facility);
- Process and domestic wastewater (assuming any process wastewater would be hauled offsite, with domestic wastewater accommodated by a small onsite septic system);
- Potable and process water (assumed to be trucked to site);
- Connections to natural gas main in Perth Road as source and injection points;
- Transformation/connection to aerial electric in Perth Road;
- Telecom connections; and
- A cost allowance is provided for potential retrofits at the WWTPs. This may potentially include modifications to the existing sludge loading bays to accommodate larger trucks transporting sludge to Knox Farm and loading equipment required for sludge at lower solids content.

Costs for property taxes are excluded.

Table 5-15: Design Concept 1 – Estimated Capital Cost

Item Description	Estimated Cost*
Direct Costs (i.e., equipment purchase and construction)	**$46,200,000**
Equipment	$19,600,000
Structural/Architectural	$10,500,000
Siteworks	$7,400,000
Electrical, Instrumentation, and Controls	$2,900,000
Mechanical/HVAC	$5,200,000
Existing WWTP Retrofit Cost Allowance	$600,000
Indirect Costs (i.e., construction allowance, contingency, and engineering)	**$24,900,000**
Construction allowance (bonding, mobilization, trial operation) – 4%	$1,900,000
Contingency – Estimating, 30%	$13,800,000
Engineering – 20%	$9,200,000
Total Cost	**$71,100,000**

*Note: This opinion of probable costs is based on an assumed scope of work only. Actual costs can only be established following detailed design and tendering. Costs do not include taxes, capital replacement, or regulatory approvals. Capital replacement cost is accounted for in net present value calculations presented in the alternative evaluation. A 30% contingency is recommended and included. Subtotals are rounded up to the nearest $100,000.

Estimated annual operating and maintenance costs for Design Concept 1 are provided in **Table 5-16**. Costs for utilities (i.e., electricity, natural gas, water service), chemicals, and labour were estimated with vendor input. Additional costs beyond the vendor RFI scope were estimated using standard unit pricing and Dillon's professional experience. Costs are shown in 2024 dollars.

Revenue from the sale of RNG was conservatively estimated using the anticipated daily biogas production value for 2060 (as calculated under **Biogas Production** in **Section 5.5.2.3**) and multiplying by the UK Natural Gas Block 1 Rate ($0.37/m^3 natural gas). Block 1 natural gas rates include the costs of transmission in addition to raw natural gas commodity price. Nevertheless, it was decided to select this value as a minimum RNG price understanding that at least some price premium over conventional natural gas

would be applied. It is noted that there is current precedent for RNG to be priced at a more substantial premium compared to current natural gas rates than assumed in our base case (e.g., RNG in British Columbia can be priced up to $30/GJ or $1.12/$m^3$ natural gas[16], Enbridge prices RNG at $24/GJ or $0.90/$m^3$). Should UK secure a contract where RNG is priced at $25/GJ ($0.90/m^3), a 74% net reduction in annual operating and maintenance costs could be observed. Actual RNG value depends on many factors including market pricing, offset credits and cost recovery requirements.

It is assumed that there would be no net revenue savings from the sale of the treated digestate since the value of processed biosolids is highly variable. Future changes in biosolids quality standards (e.g., changes to CFIA standards related to per and polyfluoroalkyl substances (PFAS)) have not been considered in this cost estimate.

Table 5-16: Design Concept 1 – Estimated 2060 Annual Operating and Maintenance Costs

*Note: This opinion of probable costs is based on an assumed scope of work only. Actual costs can only be established following detailed design and tendering. Costs do not include taxes or regulatory approvals. All values are rounded up to the nearest $1,000.
**Preventative Maintenance includes regular inspection and cleaning of equipment and buildings, including some work by external contractors.

***Variable costs and revenues are assumed to be dependent on the tonnage processed at the Facility. Fixed costs are associated with maintaining operations and are assumed to remain constant.

Item Description	Variable Cost?***	Estimated Cost*
Utility Costs	No	$1,300,000
Chemical Costs	Yes	$300,000
Biogas Upgrading and Processing	Yes	$590,000
Revenue from Sale of RNG	Yes	-$930,000
Labour	No	$500,000
Preventative Maintenance** (i.e., assumed to be 2% of equipment capital cost)	No	$400,000
Total Cost		**$2,160,000**

[16] Renewable Natural Gas Developments in Ontario: An Evolving Outlook, August 2017 - Canadian Biogas Association

Costs and revenues displayed above are associated with the proposed alternative only and do not consider the potential cost impacts at the existing WWTPs, existing SSO management, or the net financial impact of the proposed alternative as compared to what UK would be required to undertake if the proposed alternative is not implemented.

Costs above do not include the following:

- Trucking sludge from WWTPs to Knox Farm;
- Potential revenue from feedstock tipping fees;
- Facility vehicle(s);
- Equipment replacement;
- Contracted services except for preventative maintenance;
- Major building repairs (e.g., roof replacement); and,
- Site maintenance.

Trucking costs for final biosolids product are assumed to be equivalent to revenue from final product sale.

A lifecycle cost analysis, considering both capital costs, operating costs, and RNG revenues for each operating year between 2030 and 2060, was performed by Watson & Associates Economists Ltd (Watson). This analysis considered inflation and increases in processed tonnages throughout the Facility operating life. Lifecycle costs are discussed as part of the Design Concept Evaluation. The Watson report is provided in **Appendix D**.

5.5.3 Unique Features of Design Concept 2

Two specific key features have been highlighted in developing this design concept:

- This alternative does not include feedstock pre-treatment, thus minimizing the energy inputs required for the process and reducing the volume of biogas produced relative to Design Concept 1;
- The digestate will be dewatered via centrifuge to minimize the volume of residuals requiring onsite storage. Some of the centrifuged liquid (centrate) will be circulated back for blending with the incoming material providing additional hydration to the feedstock; however, a portion of this liquid must be returned to one of the City's wastewater treatment plants for treatment.

An overall site plan depicting this alternative is shown below in **Figure 5-4**. This layout shows a number of key site features common to both design concepts in addition to the process components identified above, including:

- Incoming site access roadway and onsite road, parking and vehicle turning areas;
- Truck weigh scale;
- Site office;
- Potential onsite well for potable use and/or non-potable process water; and,
- Stormwater management pond.

5.5.3.1 Traffic Considerations

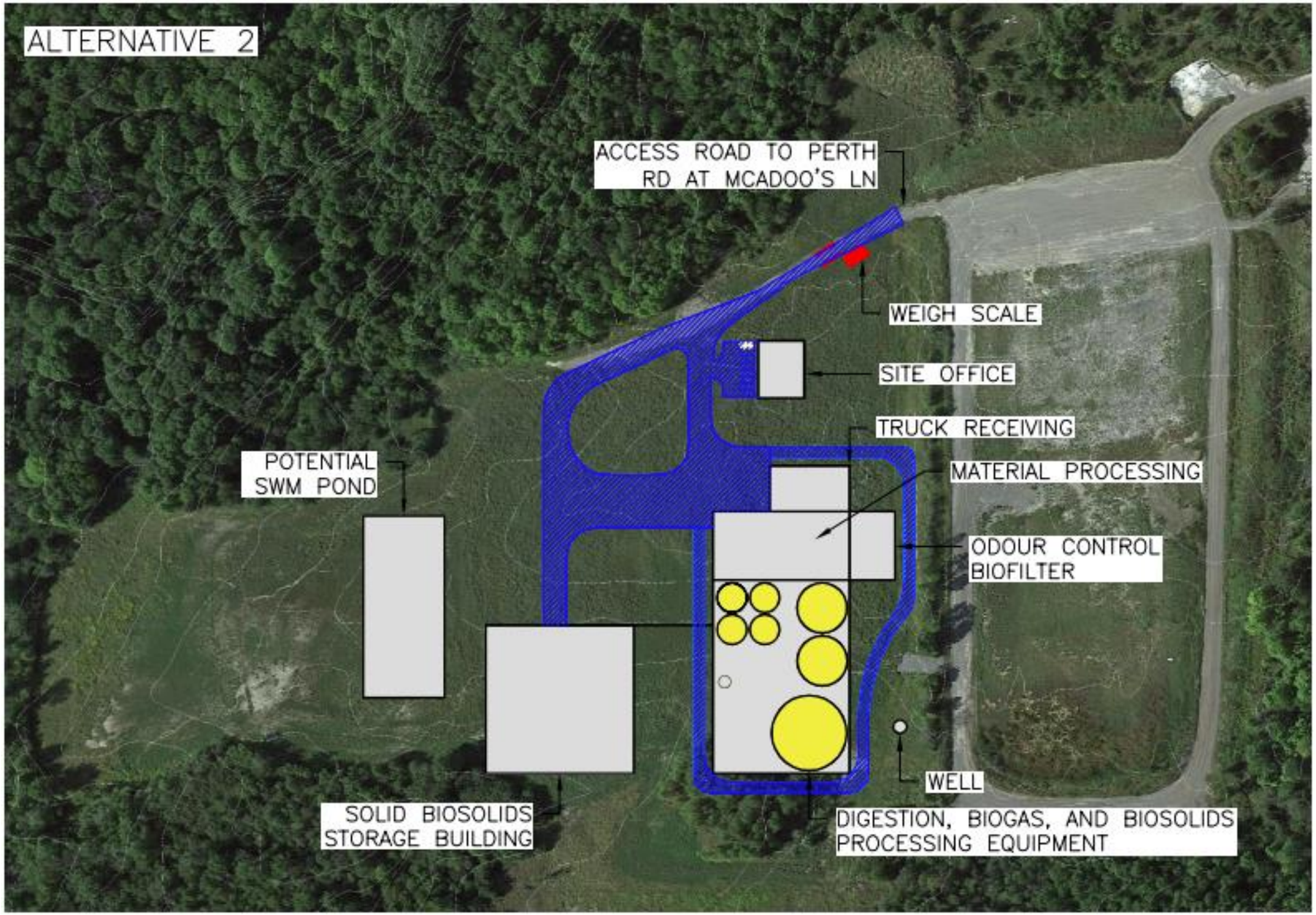
When considering only full trucks carrying materials, 28 trucks (18 inbound trucks containing sludge, SSO and water and 10 outbound trucks containing product and process wastewater) will access the site daily for Design Concept 2.

Table 5-17 summarizes the number of site trips generated during the commuter peak hours for Design Concept 2. Design Concept 2 is estimated to generate 10 net vehicle trips (5 inbound, 5 outbound) during the AM peak hour and 24 vehicle trips (12 inbound, 12 outbound) during the PM peak hour during the summer season.

Table 5-17: Design Concept 2 - Site Generated Peak Hour Trips

Type of Operation	AM peak hour			PM peak hour		
	Total trips	Trips in	Trips out	Total trips	Trips in	Trips out
Sludge Trucks	0	-	-	2	1	1
Waste Collection Vehicles	0	-	-	8	4	4
Wastewater Return Trucks	0	-	-	2	1	1
Water Trucks	0	-	-	2	1	1
Operations Staff	6	3	3	6	3	3
Finished product shipped to end user (summer season)	4	2	2	4	2	2
Finished product shipped to end user (winter season)	0	-	-	0	-	-
Snow Management (winter season)	4	2	2	0	-	-
Total (winter season)	**10**	**5**	**5**	**20**	**10**	**10**
Total (summer season)	**10**	**5**	**5**	**24**	**12**	**12**

Figure 5-4: Design Concept 2 Layout



5.5.3.2 Building Ventilation Requirements

To estimate the ventilation airflow (and odour treatment capacity) for this alternative, the footprint required for large features on the site was estimated (**Table 5-18**). This approach is described in **Section 5.5.2.2**.

Table 5-18: Design Concept 2 – Process Component Sizes and Ventilation Requirements

Process Component	Footprint	Building Height (m)	Ventilation Requirement (m^3/hr)*
Weigh Scalehouse	50 m^2	N/A	-
Site Office	200 m^2	N/A	-
Truck Receiving	700 m^2	13 m	54,600
Material Processing	1,800 m^2	9 m	97,200
Odour Control Biofilter	600 m^2	9 m	N/A
Digestion, Biogas, and Biosolids Processing Equipment	5,100 m^2	N/A	N/A
Solid Biosolids Storage Building	4,225 m^2	N/A	N/A
Total Ventilation Requirement (m^3/hr)			**151,800**

*Based on an assumed six air changes per hour (ACH).

5.5.3.3 Process Components

This section describes the process components associated with Alternative Design Concept 2.

Pre-Treatment

This alternative does not include feedstock pre-treatment.

Post-Treatment

This alternative will include a post-treatment pasteurization step to deactivate pathogens in the biosolids which would otherwise limit the product end-use.

Advantages to product pasteurization include:

- Reduced pathogen content expected to allow the product to meet CFIA guidelines.

Disadvantages to product pasteurization include:

- Utility demand for the post-digestion pasteurization process stage which may be required (lower than required for pre-digestion treatment); and,
- Location of this step after digestion limits potential benefits such as increased biogas generation that could be realized if treatment was performed ahead of digestion.

Should a CFIA pathogen removal standard not be deemed necessary in the future the post-treatment step could be removed.

Digestate Dewatering and Storage

Design Concept 2 will consider the production of a solid digestate. The whole digestate from the digester tanks will be dewatered via a centrifuge. The solid fraction of the digestate will have a cake-like consistency and will be stored in bunkers within a covered building onsite. A portion of the liquid fraction of the biosolids (centrate) will be circulated back to the raw feedstock to provide additional moisture content. A portion of the centrate liquid must be treated at one of the City's wastewater treatment plants. It is assumed that existing facilities that presently treat centrate from digestate dewatering will be able to accommodate centrate generated at Knox Farm. Confirmation of existing facility capacity would be confirmed alongside centrate volume and quality during detailed design.

Advantages to producing a solid digestate include:

- Reduced product volume; and
- Simpler storage requirement and easy handling using mobile equipment such as front-end loaders.

Disadvantages to producing a solid digestate include:

- Generation of a liquid centrate stream. The location of the site away from the City's WWTPs will incur a cost to transport the liquid centrate material back to the WWTPs for treatment;

- Increased load to WWTPs, particularly in the form of ammonia, which may consume capacity that would otherwise be allocated to businesses and residents; and,
- Nutrients contained within centrate are treated (with an associated energy cost) rather than being beneficially reused for agriculture.

Table 5-19 illustrates anticipated digestate production volumes for Design Concept 2 in the 2030 initial operation year and the 2060 ultimate design year. Digestate volumes were calculated based on a preliminary mass balance.

Table 5-19: Design Concept 2 – Anticipated Loading and Digestate Production Volume for 2030 and 2060

Year	Feedstock Tonnage (Wet Tonnes)	Anticipated Digestate Volume (m^3 at 20% TS)
2030	33,100	**16,300**
2060	45,900	**22,520**

Biogas Production

Assuming the complete conversion of organics to methane, the maximum theoretical methane generation potential of an organic feedstock is 0.35 m^3 CH_4/kg Chemical Oxygen Demand (COD) at standard temperature and pressure (STP)[17]. COD is a measure of the oxygen demand required to break down a feedstock and is used to represent organic content. In the RFI submissions, vendors provided anticipated biogas production rates. The vendor-provided biogas production rates per wet tonne of feedstock were validated against currently observed raw biogas production rates at existing UK facilities and were compared to the theoretical maximum methane generation potential of the feedstock to confirm the values were reasonable. Vendors may use their own design values for feedstock biodegradability, solids content, VS content and COD/VSS ratios. The following assumptions were made:

- Biogas Composition:
  - 64% methane (CH_4), 36% carbon dioxide (CO_2), calculated based on historical biogas data provided by UK.

[17] Wastewater Engineering Treatment & Resource Recovery, 5th ed., Metcalf and Eddy

- Sludge Characteristics:
  - Thickened sludge total solids concentration = 15% TS
  - VS/TS ratio = 70%, based on historical data
  - COD/VSS ratio = 1.74[18]
  - Average sludge biodegradability = 54%[19]
- SSO Characteristics:
  - Total Solids concentration = 30% TS[20]
  - SSO VS/TS ratio = 90%[21]
  - COD/VSS ratio = 2.20[22]
  - Biodegradability = 40%[23]

Once confirmed, the biogas production rates were used to calculate the daily biogas production. **Table 5-20** and **Table 5-21** show the estimated future feedstock quantity and daily biogas production rate for the 2030 and 2060 design years.

Table 5-20: Design Concept 2 – Anticipated Loading and Biogas Production (2030 Design Year)

Feedstock	Tonnage (Wet Tonnes)	Biogas Production Rate (m3/wet tonne feedstock)	Biogas Production Rate (m3/day)
Biosolids	26,000	57	4,100
SSO	7,100	130	2,550
Total	**33,100**		**6,650**

[18] Ahnert, Schalk, Bruckner, Effenberger, Kuehn, and Krebs. (2021). Organic matter parameters in WWTP – a critical review and recommendations for application in activated sludge modeling. Water Science & Technology (2021) 84(9), 2093-2112. 10.2166/wst.2021.419

[19] The biodegradability of municipal sludges processed at Cataraqui Bay and Ravensview WWTPs was determined by dividing the 2022 and 2023 reported biogas volumes by the respective tonnages.

[20] Spencer, Robert, High Solids Anaerobic Digestion Of Source Separated Organics. BioCycle (2010), 51(8), 46. https://www.biocycle.net/high-solids-anaerobic-digestion-of-source-separated-organics/

[21] Li, Chenxi, Champagne, Pascale, Anderson, Bruce C., Evaluating and modeling biogas production from municipal fat, oil, and grease and synthetic kitchen waste in anaerobic co-digestions. Bioresource Technology (2011), 102 (20), 9471 – 9480. DOI: 10.1016/j.biortech.2011.07.103

[22] Fisgativa, Tremier, and Dabert (2016). Characterizing the variability of food waste quality: A need for efficient valorisation through anaerobic digestion. Waste Management (2016) 50, 264-274. 10.1016/j.wasman.2016.01.041

[23] Calculated by using 130 Nm3/tonne food waste, as per 2017 City of London study.

Table 5-21: Design Concept 2 - Anticipated Loading and Biogas Production (2060 Ultimate Operation)

Feedstock	Tonnage (Wet Tonnes)	Biogas Production Rate (m3/wet tonne feedstock)	Biogas Production Rate (m3/day)
Biosolids	36,100	57	5,650
SSO	9,800	130	3,500
Total	**45,900**		**9,150**

5.5.3.4 Cost Estimation

Estimated capital and operating and maintenance (O&M) costs were developed for each alternative.

Capital costs considered the equipment cost, site construction requirements (including construction of a stormwater management pond), structural/architectural requirements, and costs for mechanical and electrical works. Costs were established through input from equipment vendors, standard unit pricing and Dillon's professional experience. Costs are shown in 2024 dollars.

Direct capital costs for Design Option 2 are shown in **Table 5-22** include markups such as:

- Equipment installation allowances; and,
- General contractor and subcontractor price markups.

Several indirect costs are also included:

- "Construction allowance" includes a number of other typical Project cost items such as the mobilization and demobilization of contractor equipment from the site, the cost of vendor performance bonds and the cost of startup and trial operation periods by the contractor and design teams;
- "Contingency – Estimating" reflects the uncertainty in pricing at this stage of the Project. We have shown the uncertainty as a cost adder to provide a more conservative estimate at this stage; and,
- Engineering design fees. Estimated at 20% of capital cost but actual costs will vary depending on the detailed designer selection process. Permitting costs are included under this line item.

It is assumed that the following items fall under the relevant item descriptions or contingency cost:

- Waste management operating costs (e.g., residuals are assumed to be hauled to a disposal facility);
- Process and domestic wastewater (assuming any process wastewater would be hauled offsite, with domestic wastewater accommodated by a small onsite septic system);
- Potable and process water (assumed to be trucked to site);
- Connections to natural gas main in Perth Road as source and injection points;
- Transformation/connection to aerial electric in Perth Road;
- Telecom connections; and
- A cost allowance is provided for potential retrofits at the WWTPs. This may potentially include modifications to the existing sludge loading bays to accommodate larger trucks transporting sludge to Knox Farm and loading equipment required for sludge at lower solids content. Further modifications may be required to existing septage receiving facilities to accommodate wastewater generated by the process.

Costs for property taxes are excluded.

Table 5-22: Design Concept 2 – Estimated Capital Cost

Item Description	Estimated Cost*
Direct Costs (i.e., equipment purchase and construction)	**$54,900,000**
Equipment	$22,000,000
Structural/Architectural	$14,600,000
Siteworks	$8,800,000
Electrical, Instrumentation, and Controls	$3,700,000
Mechanical/HVAC	$5,800,000
Existing WWTP Cost Allowance	$600,000
Indirect Costs (i.e., construction allowance, contingency, and engineering)	**$30,000,000**
Construction allowance (bonding, mobilization, trial operation) – 4%	$2,300,000
Contingency – Estimating, 30%	$16,600,000
Engineering – 20%	$11,100,000
Total Cost	**$84,900,000**

*Note: This opinion of probable costs is based on an assumed scope of work only. Actual costs can only be established following detailed design and tendering. Costs do not include taxes, capital replacement, or regulatory approvals. Capital replacement cost is accounted for in net present value calculations presented in the alternative evaluation. A 30% contingency is recommended and included. Subtotals are rounded up to the nearest $100,000.

Estimated annual operating costs for Design Concept 2 are provided in **Table 5-23**. Costs were established through input from equipment vendors, standard unit pricing, and Dillon's professional experience. Costs are shown in 2024 dollars.

Revenue from the sale of RNG was conservatively estimated using the anticipated daily biogas production value for 2060 (as calculated under **Biogas Production** in **Section 5.5.2.3**) and multiplying by the UK Natural Gas Block 1 Rate ($0.37/$m^3$ natural gas). Block 1 natural gas rates include the costs of transmission in addition to raw natural gas commodity price. Nevertheless, it was decided to select this value as a minimum RNG price understanding that at least some price premium over conventional natural gas would be applied. It is noted that there is current precedent for RNG to be priced at a more substantial premium compared to current natural gas rates than assumed in our base case (e.g., RNG in British Columbia can be priced up to $30/GJ or $1.12/$m^3$ natural gas[24], Enbridge prices RNG at $24/GJ or $0.90/$m^3$). Should UK secure a contract where RNG is priced at $25/GJ ($0.90/m^3), a 74% net reduction in annual operating and maintenance costs could be observed. Actual RNG value depends on many factors including market pricing, offset credits and cost recovery requirements.

It is assumed that there would be no net revenue savings from the sale of the treated digestate since the value of processed biosolids is highly variable. Future changes in biosolids quality standards (e.g., changes to CFIA standards related to per and polyfluoroalkyl substances (PFAS)) have not been considered in this cost estimate.

[24] Renewable Natural Gas Developments in Ontario: An Evolving Outlook, August 2017 - Canadian Biogas Association

Table 5-23: Design Concept 2 - Estimated Annual Operating and Maintenance Costs

Item Description	Variable Cost?***	Estimated Cost*
Utility Costs	No	$570,000
Chemical Costs	Yes	$100,000
Biogas Upgrading and Processing	Yes	$450,000
Revenue from Sale of RNG	Yes	- $710,000
Labour	No	$500,000
Preventative Maintenance** (i.e., assumed to be 2% of equipment capital cost)	No	$440,000
Total Cost		**$1,350,000**

*Note: This estimation of probable costs is based on an assumed scope of work only. Actual costs can only be established following detailed design and tendering. Costs do not include taxes or regulatory approvals. All values are rounded up to the nearest $1,000.

**Preventative Maintenance includes regular inspection and cleaning of equipment and buildings, including some work by external contractors.
***Variable costs and revenues are assumed to be dependent on the tonnage processed at the facility. Fixed costs are associated with maintaining operations and are assumed to remain constant.

Costs and revenues displayed above are associated with the proposed alternative only and do not consider the potential cost impacts at the existing WWTPs, existing SSO management, or the net financial impact of the proposed alternative as compared to what UK would be required to undertake if the proposed alternative is not implemented.

Costs above do not include the following:

- Trucking sludge from WWTPs to Knox Farm;
- Trucking of additional water required for digestion and removal of centrate for offsite treatment;
- Potential revenue from feedstock tipping fees;
- Facility vehicle(s);
- Equipment replacement;

- Contracted services except preventative maintenance;
- Major building repairs (e.g., roof replacement); and,
- Site maintenance.

Trucking costs for final biosolids product are assumed to be equivalent to revenue from final product sale.

A lifecycle cost analysis, considering both capital costs, operating costs, and RNG revenues for each operating year between 2030 and 2060, was performed by Watson. This analysis considered inflation and increases in processed tonnages throughout the Facility operating life. Lifecycle costs are discussed as part of the Design Concept Evaluation. The Watson report is provided in **Appendix D**.

5.6 Evaluation Process and Criteria

5.6.1 Approach to Identification of Evaluation Criteria

The Municipal Class EA process requires a 'systematic evaluation of alternatives in terms of their advantages and disadvantages, to determine their net environmental effects'. Evaluation criteria were developed related to technical, socio-economic, natural, physical, cultural environments and financial and technical considerations. These criteria were chosen based on their ability to identify potential positive and negative impacts of each alternative and distinguish the advantages and disadvantages between them. The criteria that are used for the evaluation of alternative design concepts are presented in the subsection below.

To develop the evaluation criteria and indicators for this Project, the Municipal Class EA requirements, UK and City strategic plans and documents related to corporate goals and objectives, as well as applicable provincial policies were reviewed and are summarized in **Section 2**. The evaluation criteria were developed based on their conformance to the Class EA requirements and alignment to the principles, goals and strategies within these documents.

5.6.2 Evaluation Criteria

Table 5-24 provides the evaluation criteria identified to evaluate the two Facility design alternatives.

Table 5-24: Evaluation Criteria

Criteria Category	Criteria
Natural Environment	• Vegetation/Trees: potential to impact or remove vegetation or trees. • Terrestrial Habitat & Wildlife: potential to impact wildlife, significant wildlife habitat, habitat connectivity. • Fisheries/Aquatic Habitat & Wildlife: potential to impact aquatic habitat & wildlife. • Species at Risk: potential to impact SAR and SAR habitat.
Physical Environment	• Groundwater: potential to impact groundwater resources and source water protection areas. • Surface Water: potential to impact surface water and area drainage. • Climate Change: potential to impact emission of greenhouse gases, carbon removal, carbon storage/sink (e.g., trees and vegetation), and trucking-related GHG impacts. • Climate Change Resilience: potential impact of the effects of climate change on the undertaking. • Noise & Vibration: potential to impact noise and vibration levels. • Air Quality: potential to impact air quality emissions. • Odour: potential to impact odour emissions.
Socio-economic	• Conformity to and Consistency with Local, Provincial and Municipal Policies (including Provincial Policy Statement, City Official Plan, Kingston Climate Leadership Plan, and Ontario Resource Recovery and Circular Economy Act). • Community Nuisance Impacts During Construction: potential to impact nearby land uses and activities, including residential, recreational, transportation, public service facilities, and infrastructure. • Community Nuisance Impacts During Operation: potential to impact nearby land uses and activities, including residential, recreational, transportation, public service facilities, and infrastructure.

Criteria Category	Criteria
Cultural Heritage	• Heritage Resources: potential to impact built heritage resources and/or cultural heritage landscapes. • Archaeological Resources: potential to impact archaeological resources. • Indigenous Communities: potential to impact traditional land and resource use and treaty rights.
Financial	• Estimated capital costs (includes engineering and construction costs). • Estimated operating & maintenance costs. • Estimated lifecycle costs.
Technical	• Construction Complexity. • Process and Maintenance Complexity. • Quantity of Biogas Production. • Expandability. • Process Wastewater Treatment Requirements. • Residuals Nutrient Content. • Residuals Volume. • Proven Technology (including design life).

5.6.3 Evaluation Process

The purpose of the evaluation is to identify the potential impacts and advantages of each alternative design concept to determine which alternative should be carried forward.

The evaluation process included the development of a detailed evaluation matrix applying the six criteria categories and associated criteria discussed in **Section 5.6.2**. Each criterion was given five levels of choice for scoring the alternative design concepts:

- Highest negative impacts or lowest benefits;
- Higher negative impacts or lower benefits;
- Moderate negative impacts and benefits;
- Lower negative impacts or greater benefits; and
- Lowest negative impacts or greatest benefits.

The evaluation of alternative design concepts was then completed based on an assessment of the potential impacts and a review of the input received from the public and review agencies during the MCEA process.

5.7 Design Concept Evaluation

A detailed matrix that includes the scoring and supporting rationale for each criteria for the evaluation of Alternative Design Concepts is provided in **Appendix E**. **Table 5-25** provides a summary of the Alternative Design Concept evaluation results. In general, if the alternative had lower negative impacts/higher benefits it was deemed most/more preferred or preferred. If it had moderate impacts and benefits it was considered somewhat preferred.

Table 5-25: Summary of the Evaluation of Alternative Design Concepts

Evaluation Criteria	Design Concept #1 (maximize resource recovery)	Design Concept #2 (minimize utility demand)
Natural Environment (vegetation/trees, terrestrial habitat & wildlife, aquatic habitat & wildlife, Species at Risk [SAR])	Somewhat Preferred	More Preferred
Physical Environment (groundwater, surface water, climate change, noise & vibration, air quality, & odour)	Somewhat Preferred	Somewhat Preferred
Socio-economic Environment (land use, community nuisance impacts)	Somewhat Preferred	Somewhat Preferred
Cultural Environment (cultural heritage resources, archaeological resources)	Most Preferred	Most Preferred

Evaluation Criteria	Design Concept #1 (maximize resource recovery)	Design Concept #2 (minimize utility demand)
Financial Factors (capital, operating & maintenance, lifecycle costs)	Somewhat Preferred	Somewhat Preferred
Technical Factors (complexity, biogas production, servicing requirements, technology, etc.)	More Preferred	Somewhat Preferred

5.7.1 Financial Lifecycle Cost Analysis

A further analysis was conducted on the financial evaluation factors used to evaluate each of the design concepts. Overall cost assessment requires evaluation of annual operating costs, revenues and the need for periodic upgrades in addition to a comparison of the initial capital cost of construction.

To augment Dillon's the financial analysis of the two design concepts, a report was prepared by Watson Associates (Watson). Watson's report developed an overall lifecycle cost estimate for each alternative for the years 2030 through 2060 including capital costs, operating expenditures, biogas revenues and an annual allowance for future capital replacement. The net present value of each design concept was calculated and presented in 2024 dollars by applying a discount rate of 5%. The net present value lifecycle of the two design concepts are generally comparable. The overall lifecycle design concept 2 is approximately 4.3% less than design concept 1, specifically when assuming biogas revenue equal to the present Utilities Kingston "Block 1" rate. higher biogas revenue rate of $24/GJ which has been referenced by other utilities. When increased revenue offsets to operating costs from sale of RNG at this higher rate are conserved, the net present value lifecycle cost for both design concepts decrease substantially, with design concept 1 approximately 1.5% less than design concept 2. Values are shown below in **Table 5-26**. Watson's complete analysis is provided in **Appendix D**.

Table 5-26: Financial Net Present Value Analysis

Value of Rates	Design Concept 1	Design Concept 2
Net Present Value (2030-2060) Aggregate: current natural gas rates*	$122,700,000	$117,400,000
Net Present Value (2030-2060) Aggregate: increased biogas rates*	$94,500,000	$95,700,000

*present value estimates are rounded to the nearest $100,000

5.8 Recommended Alternative

The majority of evaluation criteria except Natural Environment and Technical resulted in equal scoring. With all criteria considered the final evaluation of both alternatives was comparable. A recommended alternative was identified by considering UK and the City's overall Project goals (e.g., accommodating future servicing requirements, maximizing biogas production, and production of a high quality digestate for beneficial reuse). Notably, Design Concept 1 can achieve substantially higher biogas production than Design Concept 2, which would likely result in a greater overall net reduction in GHG emissions, another project goal identified in the problem/opportunity statement. In addition, Design Concept 1 will produce a liquid digestate, which is typically more favoured for agricultural applications, as discussed in **Section 5.5.2.3.** The recommendation to proceed with Design Concept 1 is based on the following factors:

- Greater contribution towards achieving UK's and the City's climate change leadership goals;
- Not expected to generate wastewater that would require treatment at or with a wastewater treatment plant;
- Higher amount of biogas generated;
- Increased revenue potential from RNG production which is assumed to be distributed into the Utilities Kingston natural gas pipeline; and
- More attractive end-use biosolids product (i.e., liquid product).

6.0 Public and Stakeholder Consultation

The following section summarizes the consultation activities undertaken for the Project which were in accordance with the requirements of the MCEA. Comments received throughout the Project were considered in the recommendations of the ESR.

6.1 Overview of Public and Stakeholder Consultation Activities

A comprehensive public and stakeholder consultation program was undertaken for the Project. The first round of consultation activities, including a Public Drop-In Session, was conducted in March 2023 to inform the public of the results of the reconfirmation work and the findings from the Knox Farm Suitability Report and to seek feedback on the suitability of Knox Farm for the proposed Facility (**Appendix F-1**). The feedback received as part of this first round of consultation contributed to understanding the suitability of developing the proposed Facility at the Knox Farm location, before the Project was formally re-initiated through the MCEA process.

The second round of consultation activities was initiated in Fall 2023 with the issuance of the Notice of Commencement for the MCEA process. A Public Information Centre was held in March 2024 to provide the public with the opportunity to be informed and provide feedback regarding the findings of Phase 3 (Alternative Design Concepts and Preliminary Preferred Alternative) of the MCEA process.

Copies of consultation materials, discussed in the following subsections, including the contact list, copies of notices, display boards and comments received are included in **Appendix F**.

6.2 Contact List

A comprehensive Project contact list (**Appendix F-2**) was maintained through the duration of the Project. The list was used for the circulation of Project notifications to interested parties including members of the public, agencies, Indigenous Communities, and interest groups. The contact list was updated throughout the Project.

6.3 Indigenous Communities

The following Indigenous communities were consulted as part of the Project:

- Alderville First Nation
- Algonquins of Ontario
- Algonquins of Pikwàkanagàn
- Curve Lake First Nation
- Kawartha Nishnawbe First Nation
- Hiawatha First Nation
- Huron-Wendat Nation
- Métis Nation of Ontario (including MNO Peterborough and District Wapiti Métis Council)
- Mississaugas of Scugog Island First Nation
- Mohawk Council of Akwesasne
- Mohawk Nation Council of Chiefs
- Mohawks of the Bay of Quinte
- Shabot Obaadjiwan First Nation
- Six Nations of the Grand River
- Williams Treaties First Nations

As part of the Knox Farm Suitability Assessment:

A Notice of Project & Opportunity for Consultation (**Appendix F-3**) was circulated to the above Indigenous communities in November 2022. The notice introduced the Project, provided an overview of the archaeological and cultural heritage studies that would be undertaken, and invited communities to let the Project team know if they wish to participate in a further consultation on the archaeological, cultural, or any other aspects of the Project.

A Notice of Public Drop-In Session (**Appendix F-3**) was circulated to the above Indigenous communities in March 2023 for the drop-in session held on March 28, 2023, regarding the Knox Farm Suitability Assessment (refer to **Section 6.4.1**).

A copy of the draft Stage 1 Archaeological Assessment was circulated to Huron-Wendat First Nation and Alderville First Nation who were interested in reviewing the report in April and December 2023, respectively.

As part of this MCEA study:

A Notice of Commencement (**Appendix F-3**) signaling the start of the MCEA process was circulated in September 2023 (refer to **Section 6.6**).

In November 2023, a letter (**Appendix F-3**) was sent to the above Indigenous communities regarding the Stage 2 Archaeological Assessment fieldwork inviting them to contribute to the Project. Follow up calls were undertaken in November 2023 following circulation of the letters to:

- Confirm receipt of the Notice of Commencement and letter regarding the Stage 2 Archaeological Assessment fieldwork;
- Ensure the appropriate contact had been identified; and
- Ensure the community was aware of the Project and the opportunity to participate.

Comments received from Indigenous communities are detailed in the Indigenous Consultation Log in **Appendix F-7**. A copy of the draft Stage 2 Archaeological Assessment was circulated to Huron-Wendat First Nation and Alderville First Nation who were interested in reviewing the report in April, 2024.

6.3.1 Consultation with Huron-Wendat First Nation

Huron-Wendat First Nation sent a field representative to participate in the Stage 2 archaeological fieldwork which was completed in November 2023. The community reviewed the draft Stage 2 Archaeological Assessment report and confirmed (May 2024) that they found everything satisfactory and had no modification requests or comments.

6.3.2 Consultation with Alderville First Nation

The Project team met with Alderville First Nation on February 5, 2024 to provide an overview of the Project, alternative design concepts, and next steps in the process. An opportunity to ask questions and provide comments was included as part of the meeting. Feedback received during the meeting covered:

- Impacts to natural environment features of interest (e.g., Black Ash, Alderville Tall Grass Prairie and Black Oak Savanna);
- The process used for natural environment field work (i.e., timing, study area, data collected);
- Approach to consultation with Treaty rights holders; and

- Impacts to air quality and implementation of air quality monitoring programs.

The Project team sent the Stage 2 Archaeological Assessment to the community on April 11, 2024, for review. Alderville First Nation responded on April 18, 2024, and stated they did not have comments regarding the Stage 2 Archaeological Assessment report. Alderville First Nation also provided oral historical context which was considered in the Project and Utilities Kingston will retain for historical understanding of the area.

6.4 Public Drop-In Session – Knox Farm Suitability Assessment

6.4.1 Notice of Public Drop-In Session

A Notice of Public Drop-In Session (**Appendix F-3**) provided an overview of the Project and advertised an in-person session to be held on March 28, 2023. The Notice was circulated to the Project contact list, posted online on UK's Project website and news webpage (https://utilitieskingston.com/News/Article/Kingston-Regional-Biosolids-Biogas-Facility-public-drop-in), advertised via social media, and published March 14, 2023 and March 21, 2023 in the Kingston Whig Standard newspaper.

6.4.2 Summary of Public Drop-In Session

The in-person Public Drop-In Session was held on Tuesday, March 28, 2023, between 4:00 p.m. and 8:00 p.m. at Utilities Kingston's main office (85 Lappan's Lane) in Kingston, Ontario. Poster-sized boards displayed information including:

- How biosolids from the wastewater treatment plants and "Green Bin" organics are currently managed;
- An overview of the Master Plan;
- The reconfirmation of Phase 1 and Phase 2 of the Master Plan;
- The proposed site location;
- An overview of the suitability assessment of Knox Farm;
- Next steps; and,
- How to stay informed.

Representatives from Utilities Kingston, City and Dillon were in attendance to respond to questions. A total of 32 individuals attended the Public Drop-In Session. A copy of the display boards can be found in **Appendix F-4**.

Survey

A survey was available at the Public Drop-In Session and online for two weeks on the Project webpage. The survey was used to gather public feedback on Project understanding, the proposed Facility, and the proposed site location. The survey launched on March 28, 2023, and ran until April 14, 2023. An email was sent to the Project contact list on April 11, 2023, to remind interested persons about the survey. Additional reminders were posted to social medial and the related Utilities Kingston news article webpage. The survey received 35 responses. A copy of the survey and survey results are included in **Appendix F-5**.

Social Media

General notices for the upcoming Public Drop-In Session and the survey were created by Dillon. Utilities Kingston created posts on their social media channels, including Twitter, LinkedIn, and Facebook.

Correspondence

The Project team received ten emails, which related to attendance at the Public Drop-In Session, requests for the display boards, Project notification requests, and providing resources related to the MCEA process.

6.4.2.1 What We Heard

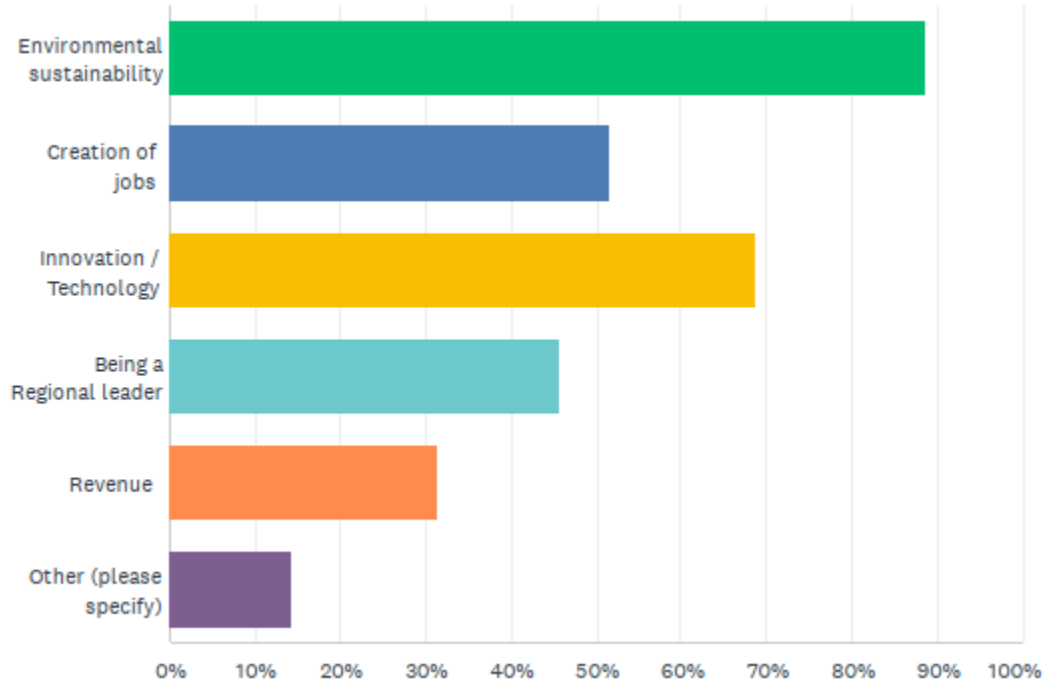
During the Drop-In Session, attendees were provided with the option to walk through and read the information on the display boards or have a staff person walk them through each board. Staff were available to answer questions. **Table 6-1** provides a summary of key themes that emerged through the Public Drop-In Session.

Table 6-1: Public Drop-In Session Feedback

Theme	Feedback
Financial	• Concerns about cost and tax payers' dollars to fund. • Interest in understanding provincial or federal funding opportunities.
Odour and Contamination	• Questions about odour potential of the Facility. • Inquiries about the expertise Utilities Kingston and the City have in operating facilities with smelly materials. • Questions about plastics and per- and polyfluoroalkyl substances (PFAS) contamination in municipal biosolids and requesting monitoring measures.
Process Clarification	• Concern or misunderstanding the difference between biosolids processing site versus landfilling. • Questions about how these facilities operate. • Questions about how biosolids are managed today: How much is generated, where does it go and if it makes money?
Project Clarification	• Questions about the motivation for the Project and whether 'do nothing' is an option. • Questions about whether other sites were reviewed.
Awareness of Project	• Advertising, making sure people hear about the Project and know when these sessions are being held. • Reaching seniors through advertising.
Collaboration Opportunities	• Feedback from neighbouring municipalities with an interest in using the Facility through co-pickup options using a trucking company. • Interest to provide assistance and collaborate on information (i.e., sharing information from previous feasibility studies). • Questions about taking septic waste from rural areas.

When asked through the survey if respondents had heard about the proposed Facility before, almost 80% of the 35 respondents said yes. Respondents were asked if they supported the proposed site location at Knox Farm and almost 63% said yes and 31% were unsure at this time. **Figure 6-1** shows the response to the question about the top priorities for the proposed Facility.

Figure 6-1: Priorities for Proposed Facility



Other key feedback identified through the survey is summarized in **Table 6-2**.

Table 6-2: Survey Feedback

Theme	Feedback
Environmental Sustainability	• Highlighted both environmental sustainability and environmental responsibility as priorities for a facility like this.
Facility Benefits	• The top three benefits for a facility like this included reducing greenhouse gas emissions, creating a renewable energy source, and managing our own organic wastes.
Facility Concerns	• The top three concerns for a facility like this, included impacts to the environment (e.g., wildlife, water quality), odour, and cost to taxpayers. • Other concerns identified included noise, whether the facility can run efficiently under commercial competitive conditions, and that it does not function as intended.

Theme	Feedback
Proposed Site Location	• Positive commentary about the proposed site location included the site's proximity to Highway 401, being within the City, City ownership, and an underused site. • Concern about the proposed site location included the site's proximity to Little Cataraqui Creek trails, Conservation Area, and potential environmental impacts (e.g., contamination, groundwater, natural environment). • Other concerns included noise and odour, and the feasibility of servicing the site (e.g., water, sewer). • Inquiries about what other site options are available.
Engagement and Transparency	• Encouragement to have a transparent engagement process to raise public awareness and information about Project such as operational information.
Operational and Design Considerations	• Questions regarding operational/design considerations including Net Zero Design and retrofitting existing facilities to meet carbon neutral goals with consideration for the new facility. • It was also noted that a facility like this should accept biosolids from outside municipalities, and should prioritize the quality of the end product, and resource circularity.

Respondents were asked about the best ways to be informed in future consultation events and the common responses were by email, Utilities Kingston website, in-person events and through social media. In addition, several people were added to the Project contact list based on their desire to stay informed via email.

6.5 Vendors

In May 2023, Utilities Kingston released a Request for Information (RFI) entitled *Request for Information (UK 23-17) for Prospective Vendors for the Kingston Regional Biosolids and Biogas Facility*. The intent of the RFI was to solicit information from qualified anaerobic digestion vendors and seek feedback on the ability to develop the proposed Facility on Knox Farm.

The RFI provided available information on site characteristics and location, potential feedstock, and operational requirements. Forecasted feedstock tonnages were also provided as design criteria for the proposed Facility. The methodology used to

determine future feedstock volumes is discussed in detail in **Section 5.1.2.** Vendors were asked to provide input on site suitability, facility design (e.g., technology recommendations, digestate management, biogas handling and processing, etc.), utility requirements, proposed ownership model, and facility costs.

Responses were received from eight vendors. Vendor submissions were summarized and compared to understand available technology that reflects the existing marketplace. Information gathered from these submissions were used to assist with the development of the alternative design concepts in Phase 3 of the MCEA process (see **Section 5.4**).

6.6 Notice of Commencement

A Notice of Commencement (**Appendix F-3**) was first issued on September 19, 2023, to the Project contact list including relevant federal agencies, provincial agencies, municipalities, Indigenous Communities, interest groups, and members of the public (**Appendix F-7**).

The Notice included the purpose of the Project and a description of the study.

6.7 Public Information Centre – MCEA

6.7.1 Notice of Public Information Centre

A Notice of Public Information Centre (PIC; **Appendix F-3**) provided an overview of the Project and advertised in-person and virtual sessions to be held on March 27, 2024. The Notice was circulated to the Project contact list (**Appendix F-7**), posted online on UK's Project website, advertised via social media, and published March 12, 2024, and March 19, 2024 in the Kingston Whig Standard newspaper.

6.7.2 Summary of Public Information Centre

The in-person PIC was held on Wednesday March 27, 2024, between 4:00 p.m. and 8:00 p.m. at Utilities Kingston's main office (85 Lappan's Lane) in Kingston, Ontario. The PIC was presented as an open house format with display boards for self-guided review and an opportunity to discuss with the Project team.

The virtual PIC was held on Wednesday March 27, 2024, between 7:00 p.m. and 8:00 p.m. The PIC included a 30-minute presentation followed by a question and answer period.

The content of the display boards and the virtual presentation included an overview of the following:

- Project Purpose;
- The Proposed Facility;
- Municipal Class EA Process (Phases 1 through 4);
- The Proposed Location;
- Summary of the Technical Assessment of Knox Farm;
- The Alternative Design Concepts;
- The Evaluation of the Alternative Design Concepts;
- The Preliminary Preferred Alternative;
- Potential Greenhouse Gas (GHG) Impacts; and,
- The Preliminary Costs

Representatives from Utilities Kingston, City and Dillon were in attendance to respond to questions. A total of 23 individuals attended the in-person PIC and 12 individuals attended the virtual PIC. A copy of the display boards can be found in **Appendix F-6**.

Survey

A survey was available at the PIC and online for two weeks on the Project webpage. The survey was used to gather public feedback on the alternative design concepts and evaluation process. The survey included the following questions:

- There are two alternative design concepts being considered for the proposed Facility. Do you have any comments or concerns on the two alternatives?
- Do you have any comments on the evaluation process and results?
- Is there anything else that we should consider when it comes to the:
  - Study Area;
  - Preliminary Preferred Design; and

  - The ways to reduce or remove potential impacts from the Facility; and,
- Please share any additional questions or comments.

The survey launched on March 27, 2024, and ran until April 12, 2024. One response was received and included comments noting no concerns and positive commentary on the presented information.

Social Media

Notifications for the upcoming PIC and the survey were posted by Utilities Kingston on their social media channels, including Twitter, LinkedIn, and Facebook.

Correspondence

No comment sheets were received by email or following the in-person or virtual PICs.

6.7.2.1 What We Heard

During the in-person PIC, attendees were provided with the option to walk through and read the information on the display boards or have a staff person walk them through each board. Staff were available to answer questions.

During the virtual PIC, attendees were provided with an opportunity to ask questions to staff following the 30-minute presentation.

Table 6-3 provides a summary of key themes that emerged through the PIC session. All comments compiled in **Table 6-3** were resolved during the virtual PIC.

Table 6-3: Feedback from in-person and virtual PICs

Theme	Questions/Feedback
Biosolids	• Questions about whether there is community buy-in to land application of biosolids. • Question about the fraction of wastewater sludge in the overall feedstock.
Groundwater Impacts	• Concern was raised by a member of the public regarding the potential for groundwater contamination from site activities.

Theme	Questions/Feedback
GHG Emissions	• Questions about whether the trucking of liquid biosolids has been factored into the impact of the Project on carbon emissions. • Questions about whether the processing of wastewater at the Facility was considered as an alternative to trucking.
CRCA Trails	• Concern about the Facility being planned adjacent to the CRCA trail.
Odour	• Concerns about odour impacts and whether this has been assessed.
RNG	• Questions about whether there are issues with mixing RNG and LNG.
Anaerobic Digestion	• Questions about whether anaerobic digestion technology has been used in other jurisdictions in Ontario.
Cost	• Concerns with justification for high cost of the Preferred Alternative.

6.8 Other Interested Parties

Consultation with interested parties was undertaken throughout the Project to provide an overview of the Project and solicit feedback. Meetings were held with the City's Transportation Services division and various provincial agencies including the Ministry of Environment, Conservation, and Parks (MECP), Cataraqui Region Conservation Authority (CRCA), and the Ministry of Transportation (MTO). Correspondence also occurred with Holiday Inn Express & Suites (and Soloway Wrights Lawyers, their legal representative).

6.8.1 Meeting with City of Kingston Transportation Services Department

On November 23, 2023, a meeting was held with the City's Transportation Services division. An overview of the Project was provided and input was received. The City indicated a desire to have a northbound left turn lane provided at the existing site driveway location due to the grade of Perth Road, background traffic volumes and the size and weight of vehicles accessing the site. Truck volumes relating to the snow management facility were provided, which was minimal during the peak commuter

hours. The City confirmed interest in the comparison of two driveway location options, including a cost/benefit analysis. The City recommended that a consultation meeting be held with MTO. The City is aware of subsequent engagement with MTO and indicated a preference for the driveway location identified through these discussions (see **Section 6.8.4**).

6.8.2 Meeting with the Ministry of Environment, Conservation, and Parks (MECP)

The Project team met with MECP on December 7, 2023 to provide an overview of the Project, alternative design concepts, and next steps in the process. An opportunity to ask questions and provide comments was included as part of the meeting. Feedback received during the meeting covered:

- Suggestion to consult with the CRCA;
- Questions about feedstock receipt and storage, biogas storage and the planned end-use of the biogas;
- Pasteurization approach;
- Questions about the nearest sensitive receptors;
- Environmental Compliance Approval (ECA) process and overall Project timeline; and
- Potential air quality, odour, and noise impacts to sensitive receptors.

6.8.3 Meeting with Cataraqui Region Conservation Authority (CRCA)

The Project team met with the CRCA on January 31, 2024 to provide an overview of the Project, alternative design concepts, and next steps in the process. An opportunity to ask questions and provide comments was included as part of the meeting. Some of the feedback received during the meeting covered:

- Level of interest from other potential feedstock providers;
- Inquiry about if there would be outdoor storage;
- Potential odour impacts;
- Surface runoff and source water protection and the importance of maintaining existing drainage patterns and avoiding significant changes in watershed boundaries to the extent possible;
- Potential impacts to the CRCA trail system and to design the Facility so that potentially odour producing elements are directed away from the trail; and
- Potential traffic impacts and discussion on potential site access route.

CRCA indicated they did not have concerns with the natural environment assessment and that the most important issues are odour, groundwater and well protection.

6.8.4 Meeting with the Ministry of Transportation (MTO)

The Project team met with MTO on February 23, 2024, to provide an overview of the Project, review alternative design concepts, and discuss the next steps in the process. Feedback received during the meeting covered:

- The MTO inquired about the level of detail to be provided during the development of the alternative design concepts. It was indicated that the alternative design concepts will be provided in the draft ESR;
- The preliminary preferred alternative would be developed as part of the Environmental Compliance Approval (ECA) process and during the detailed design phase;
- Drainage impacts, sedimentation and proposed stormwater management controls;
- MTO noted that Highway 401 is planned to be widened in the future, which may extend through the Division Street interchange; and
- MTO indicated their preference for the site access to be relocated opposite McAdoo's Lane.

MTO indicated they did not have concerns regarding drainage provided the appropriate stormwater management controls are in place. They asked to review the draft traffic assessment once completed and that they may have future additional questions. The Project team sent MTO the draft Traffic Impact Assessment Report for their review on March 13, 2024. MTO provided comments on May 27, 2024, which included a request to provide a recommendation as to which site access alternative is recommended or preferred. MTO noted their preference would be to relocate the existing entrance to the signalized intersection (Option 1).

6.8.5 Holiday Inn Express & Suites

In response to the Notice of Public Session 1, and on behalf of the Holiday Inn Express & Suites, the Quality Inn and the Comfort Suites located on Benson Street in Kingston, the Project team received a letter from Soloway Wright Lawyers (SW LLP) on May 25, 2023, providing their concerns on the potential impacts related to the proposed biosolid and biogas Facility at Knox Farm. It was also noted that the Holiday Inn Express & Suites, the

Quality Inn and the Comfort Suites also owns other lands along the Highway 401 corridor at Division Street and Sir John A. MacDonald Boulevards. A letter of response from the Project team was issued to the SW LLP on June 8, 2023, describing the general Utilities Kingston approach in maintaining a commitment to customer and community satisfaction in all its operations and values safety in delivering services to the community, with a history of successfully and safely handling sludge, biogas, natural gas, etc. and being a respectful neighbor in doing so. It was also noted that should the Project proceed to implementation, it would rely on successfully securing and demonstrating compliance with appropriate operating approvals from the Ministry of the Environment, Conservation and Parks, particularly those related to noise and air emissions.

A similar correspondence was received from Soloway Wright Lawyers on October 5, 2023 (similar content as the May 25, 2023, letter). A response letter was issued on October 24, 2023, noting the issuance of an official Notice of Commencement on September 19, 2023, and an upcoming PIC planned for early 2024, encouraging an attendance by SW LLP and their clients.

6.9 Notice of Completion

A Notice of Completion (**Appendix F-3**) was issued on August 13, 2024, to the Project contact list (including relevant federal agencies, provincial agencies, municipalities, Indigenous Communities, interest groups, and members of the public).

The Notice included the purpose of the Project, a description of the study, information on where to review the ESR (online and in-person), the 30-day comment period deadline, and the provisions to request a Section 16 Order.

Comments received on the ESR during the public review period and responses to the core themes of the comments are provided in **Appendix F-7-4**.

7.0 Preferred Design Concept

Design Concept 1 was identified as the recommended alternative. The preferred design concept is estimated to provide a design capacity up to 45,900 wet tonnes per year, with the potential to accommodate additional tonnages through future expansion. The capital cost of a facility of this size is estimated to cost $71.1 million (approximately $1,550/wet tonne/year of waste processing capacity). **Table 7-1** summarizes key components of the preferred design concept and the recommended configuration.

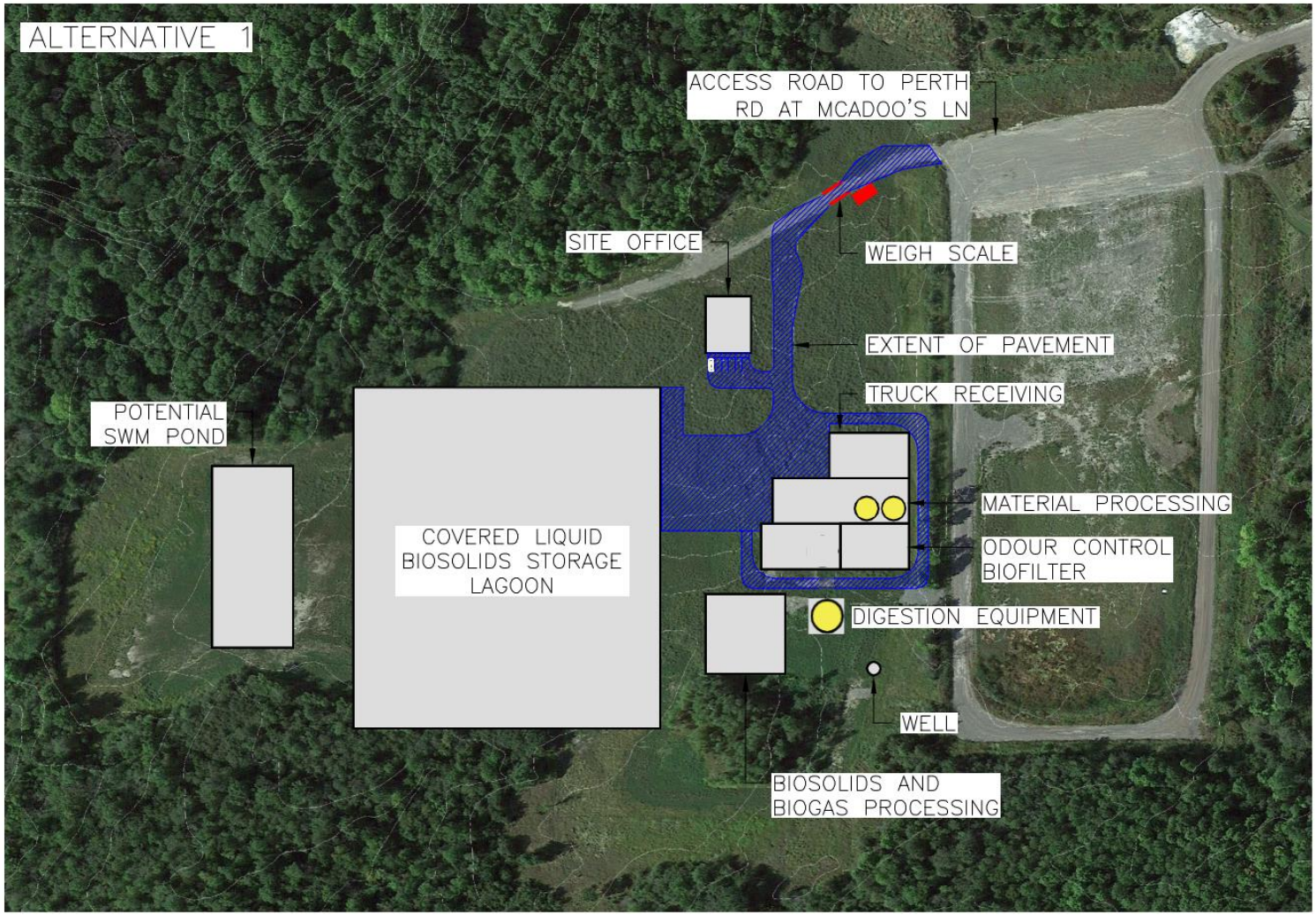
Table 7-1: Components of Preferred Design Concept

Component	Preferred Design Concept
Receipt and Storage of Sludge and SSO	• Feedstock trucks will pass over a weigh scale before entering the site. Thickened municipal sludges (assuming transport in 40 m^3 tanker trailers) and SSO (assuming transport in co-collection trucks with a 60% and 40% split between SSO and garbage by volume, respectively) will enter the facility via site access roadways and pass over a weigh scale before releasing feedstock in a common enclosed receiving building. Feedstock will be stored in dedicated collection bunkers and bins.
Physical Feedstock Preparation	• SSO will be processed to remove inorganic materials/contaminants through physical processing (i.e., milling, extrusion, or hydropulping) and a polishing process.
Feedstock Pre-treatment	• SSO and Sludge will undergo pre-treatment prior to AD to improve the combined feedstock biodegradability.
Core Digestion Process	• The bulk feedstock will undergo single or two-stage anaerobic digestion to break down organics and produce biogas.
Biogas Treatment	• Biogas captured from the digestion process will be upgraded to RNG.

Component	Preferred Design Concept
Digestate Treatment and Storage	• A high-solids, concentrated liquid CFIA-regulated fertilizer will be produced and stored on site in a covered lagoon prior to transportation to end use. The site is capable of providing 240 days of storage.
Water Management	• It is assumed that process water needs are minimal and will be trucked to the site to provide servicing. It may be possible to provide process water requirements via the onsite well, however further analysis would be required to confirm the capacity (e.g., a pumping test and possible installation of an additional well). Potable water needs may be met via a small onsite well if required. • The preferred design concept is not anticipated to produce a process wastewater stream from dewatering. As such, no onsite or off-site treatment of process-generated wastewater is expected. Onsite treatment of domestic wastewater will be required.
Off-site Modifications	• SSO will be transported directly to the proposed Facility following completion of the collection route. • Larger trucks than are presently used to transport dewatered, digested sludge for land application are anticipated to be required to transport the thickened sludges to the proposed Facility.

The site layout for the preferred design concept (Alternative 1, as previously shown) is provided in **Figure 7-1**.

Figure 7-1: Preferred Design Concept – Site Layout



7.1 Expandability

A fundamental vision of the Project is to consider the possibility of the proposed Facility to be a regional Facility that could potentially receive organics generated from other municipalities and the IC&I sector in addition to handling City-managed organic wastes. This would allow for increased GHG reduction potentials from increased RNG production.

In October 2022, Dillon issued an introductory letter and survey to various potential feedstock providers (e.g., nearby municipalities, institutions, food and beverage facilities, and local breweries) to gauge the level of interest in the proposed AD Facility. Survey questions included organization contact information, type and estimated quantities of organic waste produced that could be sent to the proposed Facility, available audit data, and any contract restrictions or limitations. Results were received by December 2022 from a total of 11 organizations. Based on the high level responses received through this informal survey, it was estimated that there could be between 7,000 – 10,000 tpy of SSO and 40,000 – 46,000 m^3 of biosolids potentially available to a regional Facility.

To further refine the proposed's design loading, it was assumed that at minimum, the preferred design concept is assumed to manage the biosolids and SSO collected by the City, and modest external contributions from adjacent communities and the IC&I sector. Various loading scenarios were provided in **Section 5.2.1**. Through the 2023 RFI submissions (UK 23-17), vendors were asked to ensure that treatment technology should be designed to accommodate municipal and IC&I waste streams, as well as accommodate a modular-based design to account for future growth.

As a conservative approach the tipping floor, the sludge, storage room, and the process rooms were oversized from originally provided information obtained during the RFI process. This is intended to allow necessary space for the facility to expand in the future in the event that additional feedstocks become available.

7.2 Additional Assessments

Additional stormwater, noise, air, traffic, and greenhouse gas assessments were carried out to further refine the preferred design concept and assess the potential impacts and associated mitigation measures (**Section 7.3**).

7.2.1 Noise Assessment

The purpose of the noise assessment (**Appendix G**) was to determine the potential noise impacts associated with the proposed Facility's operations at the nearby sensitive receptors under a predictable worst-case operating scenario (considering the known tonnages identified in this study) and to determine compliance with the applicable noise criteria in accordance with the Ontario Ministry of Environment, Conservation and Parks (MECP) publication NPC-300 *Environmental Noise Guideline – Stationary and Transportation Sources – Approval and Planning* (August 2013).

The proposed Facility is anticipated to include a biofilter, renewable natural gas plant flare, various natural gas-fired comfort heating equipment, and a diesel-fired emergency generator. Potential on-site noise sources associated with the proposed on-site operations from these sources were modelled using Dillon's inhouse data from a similar facility and implementing conservative assumptions.

As per MECP noise guideline NPC-300, a Point of Reception (POR) / receptor is defined as "any location on a noise sensitive land use where noise from a stationary source is received" and includes the following land uses:

- Permanent, seasonal, or rental residences;
- Hotels, motels and campgrounds;
- Schools, universities, libraries and daycare centres;
- Hospitals and clinics, nursing/retirement homes; and
- Churches and places of worship.

Representative PORs within 1 km of the proposed Facility were selected and assessed.

The noise impacts from the proposed Facility were calculated using the predictive computer model CADNA/A noise prediction software developed by DataKustik GmbH.

Per MECP noise publication NPC-300, the sound level limit at sensitive points of reception due to the operation of stationary sources are the greater of the exclusionary minima values specified in the applicable MECP NPC-300 document or the lowest background hourly sound level equivalent (Leq (1hr)) (See **Section 4.8** for more details) occurring at the sensitive point of reception at the same time of day that the equipment is operating.

The predicted noise impacts from the proposed Facility were compared against the sound level limit (performance limit), established in **Section 4.8**, as shown in **Table 7-2.**

Table 7-2: Acoustic Assessment Summary

Point of Reception ID	**Point of Reception Description**	**Time of Day**	**Design Sound Levels (L_{EQ})** (dBA)	**Performance Limit (L_{EQ})** (dBA)	**Compliance with Performance Limit** (Yes/No)
Steady State Noise Impact					
POR1	Single Storey House	07:00–19:00	44	52	Yes
		19:00–23:00	43	50	Yes
		23:00–07:00	43	45	Yes
POR2	Two Storey House	07:00–19:00	44	50	Yes
		19:00–23:00	43	50	Yes
		23:00–07:00	43	45	Yes
POR3	Two Storey House	07:00–19:00	45	51	Yes
		19:00–23:00	44	50	Yes
		23:00–07:00	44	45	Yes
POR4	Two Storey Hotel	07:00–19:00	50	65	Yes
		19:00–23:00	50	63	Yes
		23:00–07:00	50	53	Yes
POR5	Five Storey Hotel	07:00–19:00	45	66	Yes
		19:00–23:00	45	63	Yes
		23:00–07:00	45	54	Yes

Point of Reception ID	Point of Reception Description	Time of Day	Design Sound Levels (L_{EQ}) (dBA)	Performance Limit (L_{EQ}) (dBA)	Compliance with Performance Limit (Yes/No)
POR6	Three Storey Hotel	07:00–19:00	46	66	Yes
		19:00–23:00	46	64	Yes
		23:00–07:00	46	54	Yes
POR7	Two Storey Hotel	07:00–19:00	45	68	Yes
		19:00–23:00	45	65	Yes
		23:00–07:00	45	54	Yes
POR8	Four Storey Hotel	07:00–19:00	49	63	Yes
		19:00–23:00	49	61	Yes
		23:00–07:00	49	51	Yes
VL1	Vacant Lot	07:00–19:00	51	61	Yes
		19:00–23:00	50	59	Yes
		23:00–07:00	50	53	Yes
Emergency Noise Impact					
POR1	Single Storey House	07:00–19:00	25	52	Yes
		19:00–23:00	25	50	Yes
		23:00–07:00	25	45	Yes
POR2	Two Storey House	07:00–19:00	10	50	Yes
		19:00–23:00	10	50	Yes
		23:00–07:00	10	45	Yes

Point of Reception ID	**Point of Reception Description**	**Time of Day**	**Design Sound Levels (L_{EQ})** (dBA)	**Performance Limit (L_{EQ})** (dBA)	**Compliance with Performance Limit** (Yes/No)
POR3	Two Storey House	07:00–19:00	9	51	Yes
		19:00–23:00	9	50	Yes
		23:00–07:00	9	45	Yes
POR4	Two Storey Hotel	07:00–19:00	8	65	Yes
		19:00–23:00	8	63	Yes
		23:00–07:00	8	53	Yes
POR5	Five Storey Hotel	07:00–19:00	6	66	Yes
		19:00–23:00	6	63	Yes
		23:00–07:00	6	54	Yes
POR6	Three Storey Hotel	07:00–19:00	8	66	Yes
		19:00–23:00	8	64	Yes
		23:00–07:00	8	54	Yes
POR7	Two Storey Hotel	07:00–19:00	7	68	Yes
		19:00–23:00	7	65	Yes
		23:00–07:00	7	54	Yes
POR8	Four Storey Hotel	07:00–19:00	12	63	Yes
		19:00–23:00	12	61	Yes
		23:00–07:00	12	51	Yes
VL1	Vacant Lot	07:00–19:00	9	61	Yes
		19:00–23:00	9	59	Yes
		23:00–07:00	9	53	Yes

The findings of noise assessment indicate that when operating under a predictable worst-case scenario, the proposed Facility's noise sources are anticipated to result in noise levels that comply with the applicable criteria.

7.2.2 Air Assessment

The air quality assessment (**Appendix H**) of the preferred design concept considered the potential for impacts from the proposed Facility's significant sources of odour and air emissions.

Indicator compounds were selected for this assessment based on the typical emissions from biosolids and biogas facilities. When considering typical emissions from these types of facilities, the following compounds are expected to have the highest potential for impacts in regard to the atmospheric environment:

- Nitrogen oxides (expressed as NO_2);
- Carbon monoxide (CO);
- Sulphur dioxide (SO_2);
- Particulate matter (TSP, PM_{10}, and $PM_{2.5}$);
- Hydrogen sulphide (H_2S); and,
- Odour.

The proposed Facility is anticipated to include a biofilter, renewable natural gas plant flare, various natural gas-fired comfort heating equipment, and a diesel-fired emergency generator. Potential air emissions from these sources were estimated using industry accepted methodologies (e.g., manufacturing data, engineering calculations, and available emission factors). In-stack concentration limits were determined for the biofilter through the use of air dispersion modelling for H_2S and odour that would demonstrate compliance with relevant air quality criteria and guidelines.

The predicted impact of emissions was calculated using the air dispersion model AERMOD version 22112.

An assessment of environmental effects was completed and includes a combination of the background air quality for the region and the contribution of all air emission generating activities from the Facility on the atmospheric environment. The predicted

impact was determined at discrete receptors (e.g., residences, hotels, walking trails, etc.).

The predicted impact from the environmental effects assessment were compared against the criteria for air quality in Ontario established in O.Reg. 419/05 (Air Contaminant Benchmark [ACB] List Point of Impingement [POI] standards) and in Ontario's Ambient Air Quality Criteria (AAQC). The AAQCs developed by the MECP are commonly used in environmental assessments across the province. A summary of the environmental effects assessment is provided in **Table 7-3**.

Table 7-3: Emission Summary Table – Environmental Effects Assessment

Notes:

1. Criteria listed in the MECP Air Contaminants Benchmarks (ACB) List: Standards, Guidelines, and Screening Levels for Assessing POI Concentrations of Air Contaminants, Version 3.0, dated April, 2023 or the MECP's Ambient Air Quality Criteria (AAQC).
2. Maximum concentration corresponding to 99.5% frequency occurrence at sensitive receptors. The frequency analysis is calculated as per Section 3.1 of Methodology for Modeling Assessments of Contaminants with 10 Minute Average Standards and Guidelines under O. Reg. 419/05.

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Air Dispersion Model Used	Maximum POI Concentration [ug/m^3]	Background Concentration [ug/m^3]	Cumulative POI Concentration [ug/m^3]	Averaging Periods [hrs]	MECP POI Limit [ug/m^3] (1)	Regulation/ Guideline	Percentage of MECP POI Limit [%]
Nitrogen Oxides (as NO_2)	10102-44-0	1.31E-01	AERMOD v. 22112	24.60	38.2	62.8	1	400	O.Reg. 419/05/AAQC	15.7%
Nitrogen Oxides (as NO_2)	10102-44-0	1.31E-01	AERMOD v. 22112	3.88	13.7	17.6	24	200	O.Reg. 419/05/AAQC	8.8%
Nitrogen oxides – Emergency	10102-44-0	1.32E+00	AERMOD v. 22112	267.40	38.2	305.6	0.5	1880	Emergency Generator	16.3%
Sulphur dioxide	7446-09-05	1.98E-02	AERMOD v. 22112	0.44	2.1	2.5	10-min	180	AAQC	1.4%
Sulphur dioxide	7446-09-05	1.98E-02	AERMOD v. 22112	0.19	2.1	2.3	1	100	O.Reg. 419/05/AAQC	2.3%

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Air Dispersion Model Used	Maximum POI Concentration [ug/m^3]	Background Concentration [ug/m^3]	Cumulative POI Concentration [ug/m^3]	Averaging Periods [hrs]	MECP POI Limit [ug/m^3] (1)	Regulation/ Guideline	Percentage of MECP POI Limit [%]
Sulphur dioxide	7446-09-05	1.98E-02	AERMOD v. 22112	0.02	0.4	0.4	Annual	10	O.Reg. 419/05/AAQC	4.2%
Carbon monoxide	630-08-0	1.00E-01	AERMOD v. 22112	26.86	0.5	27.4	0.5	6,000	O.Reg. 419/05	<1%
Carbon monoxide	630-08-0	1.00E-01	AERMOD v. 22112	1.60	0.5	2.1	1	36,200	AAQC	<1%
Carbon monoxide	630-08-0	1.00E-01	AERMOD v. 22112	1.60	0.3	1.9	8	15,700	AAQC	<1%
TSP	N/A – TSP	3.24E-02	AERMOD v. 22112	0.32	33.6	33.9	24	120	O.Reg. 419/05/AAQC	28.3%
TSP	N/A – TSP	3.24E-02	AERMOD v. 22112	0.03	18.4	18.4	Annual	60	AAQC	30.7%
PM10	N/A – PM10	3.24E-02	AERMOD v. 22112	0.32	18.7	19.0	24	50	AAQC	38.0%
PM2.5	N/A – PM2.5	3.24E-02	AERMOD v. 22112	0.32	10.1	10.4	24	27	AAQC	38.6%
PM2.5	N/A – PM2.5	3.24E-02	AERMOD v. 22112	0.03	5.5	5.5	Annual	8.8	AAQC	62.8%
Hydrogen sulphide(2)	7783-06-04	1.18E+00	AERMOD v. 22112	11.10	1.4	12.5	10-min	13	O.Reg. 419/05/AAQC	96.2%
Hydrogen sulphide	7783-06-04	1.18E+00	AERMOD v. 22112	4.27	1.4	5.7	24	7	O.Reg. 419/05/AAQC	81.1%

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Air Dispersion Model Used	Maximum POI Concentration [ug/m^3]	Background Concentration [ug/m^3]	Cumulative POI Concentration [ug/m^3]	Averaging Periods [hrs]	MECP POI Limit [ug/m^3] (1)	Regulation/ Guideline	Percentage of MECP POI Limit [%]
Odour – Sensitive Receptors(2)	N/A – Odour	1.05E+05 OU/s	AERMOD v. 22112	1.00	-	1.0	10-min	1 OU/m3	MECP Guideline	100.0%

A compliance assessment was also completed to determine whether the Facility would be anticipated to operate in compliance under O.Reg. 419/05. The predicted air impacts from the compliance assessment were compared against the applicable MECP's ACB List POI standards. A summary of the compliance assessment is provided in **Table 7-4**.

Table 7-4: Emission Summary Table – Compliance Assessment

Notes:

1. Criteria listed in the MECP Air Contaminants Benchmarks (ACB) List: Standards, Guidelines, and Screening Levels for Assessing POI Concentrations of Air Contaminants, Version 3.0, dated April, 2023 or the MECP's Ambient Air Quality Criteria (AAQC).
2. Maximum concentration corresponding to 99.5% frequency occurrence at sensitive receptors. The frequency analysis is calculated as per Section 3.1 of Methodology for Modeling Assessments of Contaminants with 10 Minute Average Standards and Guidelines under O. Reg. 419/05.

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Air Dispersion Model Used	Maximum POI Concentration [ug/m^3]	Averaging Periods [hrs]	MECP POI Limit [ug/m^3](1)	Limiting Effect	Benchmark	Percentage of MECP POI Limit [%]
Nitrogen Oxides (as NO_2)	10102-44-0	9.09E-02	AERMOD v. 22112	43.10	1	400	Health	B1	10.8%
Nitrogen Oxides (as NO_2)	10102-44-0	9.09E-02	AERMOD v. 22112	14.57	24	200	Health	B1	7.3%
Nitrogen oxides – Emergency	10102-44-0	1.32E+00	AERMOD v. 22112	1,765	0.5	1880	Emergency	EGEN	93.9%
Sulphur dioxide	7446-09-05	1.98E-02	AERMOD v. 22112	1.25	1	100	Health & Vegetation	B1	1.3%
Sulphur dioxide	7446-09-05	1.98E-02	AERMOD v. 22112	0.05	Annual	10	Health & Vegetation	B1	<1%
Carbon monoxide	630-08-0	1.00E-01	AERMOD v. 22112	7.61	0.5	6000	Health	B1	<1%

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Air Dispersion Model Used	Maximum POI Concentration [ug/m^3]	Averaging Periods [hrs]	MECP POI Limit [ug/m^3](1)	Limiting Effect	Benchmark	Percentage of MECP POI Limit [%]
TSP	N/A – TSP	3.24E-02	AERMOD v. 22112	1.36	24	120	Visibility	B1	1.1%
Hydrogen sulphide(2)	7783-06-04	1.18E+00	AERMOD v. 22112	11.10	10-min	13	Odour	B1	85.4%
Hydrogen sulphide	7783-06-04	1.18E+00	AERMOD v. 22112	3.94	24	7	Health	B1	56.3%
Odour – Sensitive Receptors(2)	N/A – Odour	1.05E+05 OU/s	AERMOD v. 22112	1.00	10-min	1 OU/m3	Odour	Guideline	100.0%

The air quality assessment demonstrates that the Facility can be designed to meet relevant air quality criteria and can operate under relevant O.Reg. 419/05 regulatory compliance guidelines.

7.2.3 Traffic Assessment

The traffic assessment was completed following the MTO Traffic Impact Assessment guidelines which require an evaluation of the traffic operations following the opening of the proposed Facility, plus a five-year and ten-year post-occupancy horizon.

Traffic analyses have been prepared for the weekday AM and PM peak hours. Three future horizon years have been assessed:

- 2030, corresponding to the anticipated build-out year of the Facility;
- 2035, corresponding to five years following the anticipated build-out year; and
- 2040, corresponding to ten years following the anticipated build-out year.

Background Conditions

Existing traffic volumes were grown to the future horizon years assuming a 1.8% annual traffic volume growth rate which considered recently updated population growth forecasts. Known potential developments were explicitly accounted for within the background traffic volume projections.

The Study Area intersections are anticipated to work well with background traffic volume growth to 2040, except for the eastbound right turn movement at the Division Street and Highway 401 South Ramp Terminal which is expected to operate well over capacity during the weekday AM peak hour with a v/c of 1.37. During the weekday PM peak hour, the eastbound right turn movement at the South Ramp Terminal is forecast to operate with a v/c of 0.93. The northbound right-turn queue at the South Ramp Terminal is forecast to exceed the available storage.

Driveway Access Location

The traffic analysis considered two potential site access locations. Option 1 considered relocating the existing midblock access on Perth Road to form a new west leg at the Perth Road and McAdoo's Lane intersection. Option 2 maintains the existing midblock

access on Perth Road which is located approximately 170 metres south of the Perth Road and McAdoo's Lane intersection.

If the driveway is relocated to form a new west leg at the Perth Road/McAdoo's intersection as per Option 1, the following intersection modifications are required:

- Provide a northbound left-turn lane on Perth Road (pavement marking modification);
- Modify the existing traffic signals to accommodate the new west leg access; and
- Reconfigure the internal driveway to the intersection (approximately 350 metres).

The high-level construction cost estimate is approximately $900,000.

To maintain the existing midblock access as per Option 2, the following would be recommended:

- Provide a northbound slip-around lane on Perth Road at the existing driveway access.

Runout of the northbound slip-around lane at the existing driveway location may conflict with the northbound right turn lane at McAdoo's Lane and further engineering work will be required at the design stage to confirm the layout, which may not be feasible. The high-level cost estimate is also approximately $900,000.

Preliminary discussions with the MTO indicate a preference for relocating the entrance to the Perth Road/McAdoo's intersection (Option 1). Given this and the analysis of the two options noted above, the preliminary preferred site access is Option 1. However, additional studies such as environmental studies, geotechnical investigation, drainage studies and lane geometry will be required as part of the site plan process to confirm.

Future Traffic Operations

The proposed biogas Facility will have a negligible impact on the study area intersections. Due to background traffic volume growth, two of the study area intersections are forecast to operate with at least one movement exceeding levels considered to be critical by either the City or the MTO. The following summarizes those movements that should be improved by the MTO or the City.

At the Highway 401 South Ramp Terminal and Division Street intersection, the eastbound right-turn lane should be improved to provide a double right-turn lane with fully protected signal phasing. With the proposed modifications, the intersection operations are expected to improve, however, some critical movements remain. This improvement is unrelated to the Biosolids & Biogas Facility site and should be considered by MTO irrespective if the site is developed.

At Perth Road and McAdoo's Lane, minor signal timing adjustments may be required, by the City, to address background traffic volume increases on Perth Road, irrespective if the site is developed. Should the site access be relocated to form the west leg of Perth Road and McAdoo's Lane intersection, the modifications previously identified along with minor signal timing adjustments will allow the intersection to operate efficiently. If the site access remains in the existing location, minor signal timing adjustments will be required at Perth Road and McAdoo's Lane to allow the intersection to operate efficiently.

The Highway 401 North Ramp Terminal and Perth Road intersection is forecast to operate acceptably without modification.

7.2.4 Greenhouse Gas Assessment

The greenhouse gas (GHG) assessment was completed for the existing conditions (do-nothing scenario) which assumed that UK's current practice of processing sewage sludge separately at the WWTPs will continue as well as the City's current practice of transferring source separated organics (SSO) for the aerobic generation of compost. The WWTPs currently employ an anaerobic digestion (AD) process which produces biogas directed to destruction devices (e.g., boiler, cogeneration, and flare).

The assessment of the do-nothing scenario with respect to GHG considers the following emission sources:

- Stationary combustion equipment at the existing WWTPs;
- Electricity consumption at the existing WWTPs;
- Transportation of biosolids;
- Transportation of SSO; and
- SSO aerobic composting.

The estimated emissions for the do-nothing scenario are presented in **Table 7-5.**

Table 7-5: Existing Conditions GHG Emission Summary

Year	Ravensview WWTP (t CO_2e)	Cataraqui Bay WWTP (t CO_2e)	SSO (t CO_2e)	Total (t CO_2e)
2024	1,045	619	54	1,719
2030	1,151	681	60	1,891
2060	1,598	946	82	2,626

The assessment of the preferred design concept with respect to GHG considers the following emissions sources when compared to a do-nothing scenario:

- Stationary combustion equipment at the existing WWTPs (modified to remove the AD process);
- Electricity consumption at the existing WWTPs (modified to remove the AD process);
- Transportation of biosolids (modified to adjust for transporting thickened undigested sludge at 15% TS to Knox Farm, rather than thickened digested biosolids cake at 20-22% TS to land application sites);
- Transportation of SSO (modified to adjust for transporting to Knox Farm instead of private aerobic composting facility);
- Diversion of SSO from aerobic composting;
- Stationary combustion equipment at the proposed Facility at Knox Farm; and
- Electricity consumption at the proposed Facility at Knox Farm.

The estimated emissions for the preferred design concept are presented in **Table 7-6**.

Table 7-6: Preferred Design Concept Emissions Summary

Year	Ravensview WWTP [as modified] (t CO_2e)	Cataraqui Bay WWTP [as modified] (t CO_2e)	Proposed Facility (Knox Farm) (t CO_2e)	SSO Transfer (t CO_2e)	Total (t CO_2e)
2024	489	315	1,117	22	1,943
2030	563	400	1,135	24	2,122
2060	879	761	1,212	33	2,885

The comparison of GHG emissions for the do-nothing scenario to the preferred design concept is shown in **Table 7-7**.

Table 7-7: GHG Emissions of Preferred Design Concept Compared to Status Quo

Year	Do-Nothing (t CO_2e)	Preferred Design (t CO_2e)	Difference (+/- t CO_2e)
2024	1,719	1,943	+ 224
2030	1,891	2,122	+ 231
2060	2,626	2,885	+ 259

The comparison shows that the preferred alternative would demonstrate a small net increase in GHG emissions from the do-nothing scenario, without considering diversion of natural gas with the introduction of renewable natural gas (RNG) generated at the proposed Facility at Knox Farm.

Diversion of natural gas by RNG presents a substantial GHG reduction potential. **Table 7-8** provides an emissions comparison including the emissions reductions that would result from the diversion of RNG with the preferred design.

Table 7-8: Preferred Design Concept with RNG Diversion Emissions Comparison with Do-Nothing

Year	Preferred Design Incremental Change from Do-Nothing Scenario (t CO_2e/year)	Potential Diverted biogenic CO_2 from RNG (t $CO_{2/year}$)	Difference (+ / - t CO_2e/year)
2023	+ 224	- 2,664	-2,440
2030	+ 231	- 2,928	-2,697
2060	+ 259	- 4,056	-3,797

The comparison shows that, with the diversion of natural gas from the Utilities Kingston's gas distribution lines, the preferred design concept provides a net GHG reduction from the do-nothing scenario. The assessment also implies that any increase in feedstock addition (especially SSO materials) would provide a proportional increase in net GHG reduction.

7.3 Potential Impacts and Mitigation

Table 7-9 provides an overview of the potential direct and indirect environmental impacts of the Preferred Design Concept as well as associated mitigation measures that are recommended to be incorporated into the detailed design and construction phases.

Table 7-9: EA Impacts and Measures for Avoidance, Mitigation, and Monitoring

Criteria Group	Potential Impacts	Proposed Mitigation and Monitoring	Net Effects
Natural Environment			
Vegetation / Trees	• Impacts to vegetation and trees are anticipated to accommodate the Project footprint. Removal of trees and ground vegetation will be limited to the removal of shrubs and meadow vegetation and minor tree removal to accommodate the Project footprint. • The majority of vegetation removal occurs within disturbed meadow and invasive Common Buckthorn (*Rhamnus cathartica*) thicket areas, therefore overall impact to terrestrial ecosystems is anticipated to be minimal. • Physical site disturbance may increase the likelihood that non-native and/or invasive species will be introduced to the surrounding vegetation communities.	Vegetation removals will be minimized to the extent practical, and replanted/seeded with compatible vegetation as required. The following general industry best practices/measures for trees should be followed where trees and woodlands are to be retained nearby or adjacent to the Project footprint: • Erect a fence at the critical root zone (CRZ) of trees (or around the perimeter of the portions of tree groupings to be retained that occur nearby the Project works, ideally approximately 10 m from the dripline of the outermost trees [if possible] or along the dripline of the outermost trees); • Do not place any material or equipment within the CRZ of the tree (or the retained woodland areas, or dripline boundary); • Do not attach any signs, notices or posters to any tree; • Do not raise or lower the existing grade within the CRZ without approval; • Tunnel or bore when digging within the CRZ of a tree; • Do not damage the root system, trunk or branches of any tree; and • Ensure that exhaust fumes from all equipment are not directed towards any tree's canopy. Construction access and laydown areas should be restored following completion of construction. A Landscaping and Planting Plan should be prepared during detailed design of proposed development to protect or off-set vegetation removal and propose enhancements to natural areas where possible. The use of native botanical species from local nurseries that are tolerant to local soil conditions and resilient to climate change should be incorporated as part of the planting plan. The following monitoring and maintenance measures are also recommended for landscaped areas associated with the Project: • Removal of invasive tree and shrubs, where applicable; • Watering and weeding of newly planted areas as required for proper establishment of plantings; and	No net effects are anticipated following implementation of the recommended mitigation measures.

Criteria Group	Potential Impacts	Proposed Mitigation and Monitoring	Net Effects
		• Replacement of dead material from previous year's planting. To prevent the spread of invasive species: • Machinery is to arrive and depart clean to prevent spread of invasive species to and from other sites; • Stands of invasive plant species will be avoided to the extent practical during construction; and • Construction crews will be educated and informed on invasive species and the importance of avoiding them.	
Terrestrial Habitat & Wildlife	• Potential direct impacts may occur to terrestrial and associated wildlife habitat in relation to the removal of shrubs and meadow vegetation within the Project footprint which may provide cover, foraging, refuge, and nesting habitat for migratory breeding birds and general habitat for mammalian and anuran terrestrial wildlife.	• Clearing of naturalized vegetation outside of the breeding bird season (April 1 – August 31). Should any clearing be required during the breeding bird season, nest searches conducted by a qualified person must be completed 48 hours prior to clearing activities. If nests are found, work within the vicinity of the nest should cease until the nest has fledged. If no nests are present, clearing may occur. This is in accordance with the federal MBCA. • Tree removal should be conducted outside of the bat active window (May – October) to avoid impacts to bat maternal roosts. • Pre-stress the area on a regular basis leading up to construction to encourage wildlife to leave the area before construction starts. • Fencing should be installed around the perimeter of the work area to clearly demarcate the development. • Ensure perimeter fencing does not prevent wildlife from leaving the site during clearing activities by clearing the area prior to installing the fence. • Wildlife located within the construction area should be re-located to an area outside of the development into an area of appropriate habitat, as necessary. • Construction crews working on site should be educated on local wildlife and take appropriate measures for avoiding wildlife. • Should an animal be injured or found injured during construction, they should be transported to an appropriate wildlife rehabilitation center for care.	No net effects are anticipated following implementation of the recommended mitigation measures.
Fisheries/Aquatic Habitat & Wildlife	• No potential direct or indirect impacts to aquatic habitat & wildlife are anticipated due to the absence of surface water features (i.e., watercourses and waterbodies) within and adjacent to the Proposed footprint.	N/A	N/A
Species at Risk (SAR)	• Direct impacts to SAR and SAR habitat are not anticipated, however, there is the potential for operational indirect anthropogenic impacts (i.e., noise, light, vibration and	• Boundaries of SAR habitat should be identified and flagged off and protected. • Limit the use of lighting where possible. Avoid light effects entering woodland areas.	No net effects are anticipated following implementation of

Criteria Group	Potential Impacts	Proposed Mitigation and Monitoring	Net Effects
	human presence) to affect nearby potential SAR and SAR habitat. SAR habitat has the potential to occur within the woodlands nearby the Project footprint located within and adjacent to the northern boundary of the Project footprint and the southeast portion of Project footprint.	• Incorporate landscape plantings along the boundary of the Project footprint to provide a buffer/shield for woodland areas where operational indirect anthropogenic impacts (i.e., noise, light, vibration and human presence) are anticipated. • Should SAR be encountered during construction activities, activities should be stopped until it has been determined that harm will not occur. The required activities should be assessed to determine whether the work/schedule can be modified, or mitigation measures employed, to avoid potential effects on SAR and their habitat. If avoidance of SAR and/or SAR habitat is not possible, MECP and/or DFO should be consulted to mitigate the impact of the activities and/or assess the need for permitting/approvals under the ESA, SARA. • If as SAR is harmed or killed as a result of work activities, the MECP should be notified, and the relevant work activities should cease within the immediate area until the species has been removed by personnel authorized to handle SAR. • SAR observed during construction activities should be reported to the MECP.	the recommended mitigation measures.
Physical Environment			
Groundwater	• Potential for localized groundwater impacts, in an HVA and SGRA, through spills, discharge or dumping of materials, fluids, and other wastes during construction and operation of the Facility.	• Best Management Practices and Operations guidelines should be developed prior to construction and operation of the Facility. • All fuels, chemicals, and other lubricants should be placed in certified containers and follow applicable regulations and best practices (e.g., labelling, developing spill contingency plans, secondary containment, etc.). • Spill response measures should also be developed and promptly implemented in the event of any leaks/spills. • Equipment should be maintained in good working condition such that equipment and vehicles are free of leaks.	No net effects are anticipated following implementation of the recommended mitigation measures.
Surface Water and Area Drainage	• Potential for impacts to surface water quality and quantity on the site and within the receiving drainage system.	• A site-specific stormwater management strategy should be prepared to minimize or mitigate impacts to surface water resources and satisfy applicable regulations and should include one or more measures to provide the necessary level of water quality and quantity controls. This could consist of various conveyance and/or end-of-pipe controls including stormwater management pond(s). • A 'treatment train' approach should be used to ensure that the stormwater management objectives are achieved. • Consideration of the impacts of climate change should be included. • Consideration of low impact development (LID) best practices (e.g. infiltration, rainwater harvesting, and water quality enhancement) should be included where applicable.	No net effects are anticipated following implementation of the recommended mitigation measures.

Criteria Group	Potential Impacts	Proposed Mitigation and Monitoring	Net Effects
		• Development and implementation of an erosion and sediment control (ESC) plan should be required to mitigate construction related impacts to the receiving drainage environment.	
Greenhouse Gas Emissions	• A net reduction in GHG emissions are anticipated with the implementation of the Preferred Design Concept as a result of substitution of generated Renewable Natural Gas for petroleum natural gas.	• GHG emissions related to construction and operation of the proposed Facility may be further reduced through the consideration of electrification of equipment and feedstock transportation, and the use of generated RNG for operational combustion or heating requirements. Increased attraction of organic waste feedstocks (especially SSO) would provide a proportional increase in RNG production and net GHG reductions. Facility detailed design may also allow for generation of electricity through roof or ground mounted solar PV equipment.	Positive effects due to anticipated reduction in GHG emissions.
Climate Change Resilience (impact of the effects of climate change on the undertaking)	• Minimal impacts to Project activities as a result of variation in climate parameters such as temperature (extreme cold/heat), precipitation, and wind are anticipated. However, there is potential for utility disruption and changes in energy demands for conditioned spaces in the facilities. • There is potential for temporary impacts (e.g., delays) to the Project during construction due to extreme weather events.	• Consider providing backup power systems to allow for the operation of the Facility in longer periods of utility disruption. • Sizing for heat and air systems should be appropriate to accommodate any changes in loads that are needed in the event of extreme cold/heat.	No net effects are anticipated following implementation of the recommended mitigation measures.
Noise & Vibration	• Noise impacts during construction are expected to be higher than the operating Facility, but are temporary works with fluctuating levels depending on the type and locations of the work. • Noise impacts from the Facility (post construction) will be designed to meet the provincial MECP noise limits, and in doing so are expected to be generally at or below the existing background sound levels from road traffic (primarily HWY 401) at the majority of the identified sensitive receptors. Although not a formal assessment location, this includes the CRCA trail which is expected to meet the provincial MECP daytime noise limits. • Vibration impacts are expected to be negligible based on the separation distances.	• Final design and equipment selections should be reviewed to ensure noise objectives are met. • Construction should comply with City Noise By-law (2004-52).	Temporary, localized increase in nuisance noise and dust during construction. No net effects are anticipated during operations following implementation of the recommended mitigation measures.
Air Quality	• Air emissions from the Facility (post construction) will be designed and mitigated to meet the provincial air quality standards at the property line and at all off-property	• Operational air emissions associated with off-spec biogas combustion should be assessed for a worst-case release scenario through air dispersion modelling to ensure maximum off-property impacts are within provincial air quality limits.	No net effects are anticipated following implementation of

Criteria Group	Potential Impacts	Proposed Mitigation and Monitoring	Net Effects
	locations. In many cases, the predicted off-property air contaminant concentrations at nearby receptors will be below existing background concentrations. • With the design and implementation of an effective air quality and fugitive dust management plan, construction-related dust and air emissions will be minimized at nearby receptor locations.	Stack design should be optimized, and mitigation measures should be implemented as needed to minimize off-property impacts. • Air quality impacts associated with construction activities should be minimized through the development and implementation of air quality/fugitive dust best management practices plans. Inspection/monitoring of fugitive dust releases should be conducted during construction to ensure mitigation measures are effective or to identify periods when additional mitigation needs to be implemented.	the recommended mitigation measures.
Odour	• Odour emissions from the Facility (post construction) will be mitigated to meet the provincial odour and air quality standards at all nearby odour receptor locations.	• Potential odour emissions from the RNG plant should be mitigated through the use of a biofilter. The maximum allowable odour emissions from the biofilter should be determined through air dispersion modelling to ensure off-site odour impacts are within provincial limits for odour and/or odorous compounds.	No net effects are anticipated following implementation of the recommended mitigation measures.
Socio-Economic Environment			
Community Nuisance	• Refer to potential impacts under Air Quality, Odour, Noise & Vibration. • Construction can result in temporary increase in dust impacts that could be experienced by local property owners. • Potential for higher traffic volumes during construction. • Temporary disruption of the CRCA trail and/or inconvenience to users of trail during construction.	• Refer to mitigation measures under Air Quality, Odour, Noise & Vibration. • Implement dust control measures during dry and windy conditions. • Limit construction activities during high wind events. • Appropriate traffic management procedures and signage should be put in place. • Emergency access should be maintained.	Temporary, localized increase in nuisance noise and dust during construction. Temporary traffic and trail disruptions during construction.
Cultural Environment			
Built Heritage Resources and Cultural Heritage Landscapes	• No built heritage resources or cultural heritage landscapes were identified within or adjacent to the property in the Cultural Heritage Assessment Report (CHAR) (ARA, Dec 2022). • No potential impacts to built heritage resources and/or cultural heritage landscapes are anticipated.	N/A	N/A
Archaeological Resources	• The Stage 2 Archaeological Assessment (AA) found no significant archaeological resources within the areas of archaeological potential identified in the Stage 1 AA (ARA, October 2023). • Low potential for impacts to archaeological resources are anticipated however, there is potential for disturbance of	• Should previously undocumented archaeological resources be discovered, the proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out an archaeological assessment, in compliance with section 48(1) of the Ontario Heritage Act. • The Funeral, Burial and Cremation Services Act, 2002, S.O. 2002, c.33 requires that any person discovering human remains must cease all activities immediately and notify the police or coroner. If the coroner does not suspect foul play in the	No net effects are anticipated following implementation of the recommended mitigation measures.

Criteria Group	Potential Impacts	Proposed Mitigation and Monitoring	Net Effects
	previously undiscovered archaeological resources during construction.	disposition of the remains, in accordance with Ontario Regulation 30/11 the coroner shall notify the Registrar, Ontario Ministry of Public and Business Service Delivery, which administers provisions of that Act related to burial sites. In situations where human remains are associated with archaeological resources, the Ministry of Citizenship and Multiculturalism should also be notified (at archaeology@ontario.ca) to ensure that the archaeological site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act.	

8.0 Implementation

8.1 Permits and Approvals

Permits and approvals will be required for a facility of this nature. Any required permits, approvals, or exemptions required should be obtained prior to the start of construction. Permits anticipated to be required are identified in **Table 8-1** below. It is noted that additional permits could be required and will be identified during subsequent design and construction stages. In addition to the environmental and by-law permits listed below, local building and site plan permits will be required.

Table 8-1: Potential Permits, Approvals, or Notifications

Agency	Legislation, Regulation, or Standard	Permit/Approval/Notification
Ministry of Environment, Conservation, and Parks (MECP)	*Endangered Species Act, 2007 (ESA)* (SO 2007, c. 6)	A permit or approval is required for activities that may affect a provincially listed species at risk (SAR) Endangered or Threatened and/or their habitat.
Ontario Energy Board (OEB)	*Ontario Energy Board (OEB) Act, Sec. 90(1).*	The OEB has licensed the City to be a natural gas marketer and does not set rates for natural gas delivery for the City[25]. Based on this, UK would be able to set the rates they charge to customers for RNG delivery and distribution. Under this license, UK would be obligated to report compliance with the Code of Conduct for Gas Marketers on an annual basis[26]. Further, a Leave to Construct application may need to be

[25] Ontario Energy Board, Natural Gas Rates
[26] Ontario Energy Baord, Code of Conduct for Gas Marketers

Agency	Legislation, Regulation, or Standard	Permit/Approval/Notification
		sought out if the proposed pipeline to injection is: • More than 20 km in length; or • Projected to cost more than the amount prescribed by regulations (currently $2 million); or • Any part of the pipeline has a nominal pipe size of 12 inches or more and has an operating pressure of 2,000 kPa or more[27]. Inspections may be required by regulators for onsite equipment, including from the Electrical Safety Authority (ESA) and Technical Standards and Safety Authority (TSSA)[28].
MECP	*Ontario Water Resources Act (OWRA)* (RSO 1990, c. O.40), O.Reg. 387/04: Water Taking Regulation, and *Environmental Protection Act (EPA)* (RSO 1990, c. E. 19)	Registration under the Environmental Activity and Sector Registry (EASR) is required if the Project will result in dewatering of more than 50,000 litres per day (L/day) but less than 400,000 L/day. A Permit to Take Water (PTTW) will be required if water taking is greater than 400,000 L/day. This approval may be necessary for the construction phase only but not for ongoing operation.

[27] Ontario Energy Board (OEB), Environmental Guidelines for the Location, Construction, and operation of Hydrocarbon O
[28] QUEST, Renewable Natural Gas (RNG) Handbook for Canadian Municipalities, May 2021

Agency	Legislation, Regulation, or Standard	Permit/Approval/Notification
		Given that Knox Farm is the former site of the Cataraqui River Dredged Material Storage and Dewatering Facility, a Section 46 approvals application may be required.
MECP	*Environmental Protection Act (EPA)* (RSO 1990, c. E. 19)	ECAs are required for Air and Noise, Waste Disposal Site (Transfer/Processing) and Section 53 of the OWRA for stormwater and industrial wastewater management.
Cataraqui Region Conservation Authority	*Conservation Authorities Act* and O.Reg. 148/06	Consultation with CRCA permitting department is recommended during the detailed design stage.
City	Noise By-Law (No. 2004-52)	A Noise By-Law Exemption is required if construction noises will occur outside of the allowable hours.
City	Zoning By-Law (No. 2022-62)	A Zoning By-Law amendment may be required in order to develop the proposed Facility.

Further studies may be required to support the development of the proposed Facility or apply for the permits identified above. Additional recommendations include:

- **Natural Environment:** Depending on the location and adjacency of the proposed development footprint to potential and confirmed natural heritage features within the Study Area and Proposed Site Location, additional ecological field studies (e.g., grassland breeding bird surveys) may be required to support development. The requirements for an EIA have been incorporated into this ESR as a substitute for the EIA. However, if there are changes to the footprint that would impact additional areas, it is recommended that an additional EIA exercise be undertaken to support the Project as required.

8.2 Future Commitments

The following potential actions or commitments are likely to be required in addition to the mitigation measures proposed in **Section 7.3** should the Project proceed to construction.

- A Soil Management Plan should be prepared by a Qualified Professional as defined in Ontario Regulation 160/06 for managing soil materials on site (includes excavation, location of stockpiles, reuse of off-site disposal);
- An Excess Soil Management Report should be prepared by a Qualified Professional as defined in Ontario Regulation 406/19, On-site and Excess Soil management;
- A complaint response protocol for nuisance impacts including construction noise should be prepared during the detailed design phase of the Project and implemented prior to construction;
- All Indigenous communities previously engaged should be contacted if there are any substantial changes to the Project/process or if Utilities Kingston applies for subsequent permits from MECP that may be of interest or concern to communities;
- A Landscaping and Planting Plan should be prepared during detailed design to protect or off-set vegetation removal and propose enhancements to natural areas where possible;
    - Best Management Practices and Operations guidelines for the protection of groundwater should be developed prior to construction and operation of the Facility;
    - A site-specific Stormwater Management Strategy should be prepared during detailed design to minimize or mitigate impacts to surface water resources and satisfy applicable regulations;
    - An Erosion and Sediment Control (ESC) Plan should be prepared during detailed design to mitigate construction related impacts to the receiving drainage environment;
    - Air dispersion modelling to assess operational air emissions should be undertaken during detailed design to ensure maximum off-property impacts are within provincial air quality limits. This modeling should be completed as part of the requirements for the ECA (air and noise) which will be required for site operations;

- An Air Quality/Fugitive Dust Best Management Practices Plan should be prepared during detailed design to minimize or mitigate air quality impacts associated with construction activities; and
- Inspection and monitoring of fugitive dust releases should be conducted during construction to ensure mitigation measures are effective or to identify periods when additional mitigation needs to be implemented.

8.3 Anticipated Timeline

The MCEA ESR was submitted for public review from August 13 to September 11, 2024. Utilities Kingston is currently undertaking a separate business case analysis of the proposed Facility to support an ultimate recommendation to proceed with or not proceed with implementation. If the Project is recommended to proceed, Phase 5: Project Implementation will be initiated in 2025 with an anticipated timeline for the Facility to obtain additional approvals and be constructed over the approximately five years and be operational in 2030.

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Appendix A

Knox Farm Suitability Report

Appendix B

Archaeological Assessments

Appendix C

Cultural Heritage Assessment Report

Appendix D

Financial Assessment Report

Appendix E

Evaluation Matrix

Appendix F

Consultation Materials

Appendix F-1

Knox Farm Suitability Assessment Consultation Records

Appendix F-1-1

Agencies and Provincial/Local Organizations

Appendix F-1-2

Indigenous Communities and Organizations

Appendix F-1-3

Public

Appendix F-2

Project Contact List

Appendix F-3

Notices and Letters

Appendix F-4

Public Drop-In Session Boards

Appendix F-5

Public Drop-In Session Survey Results

Appendix F-6

Public Information Centre Boards

Appendix F-7

MCEA Consultation Records

Appendix F-7-1

Agencies and Provincial/Local Organizations

Appendix F-7-2

Indigenous Communities and Organizations

Appendix F-7-3

Public

Appendix F-7-4

Comments and Responses to ESR

Appendix G

Acoustic Assessment Report

Appendix H

Air Impact Assessment

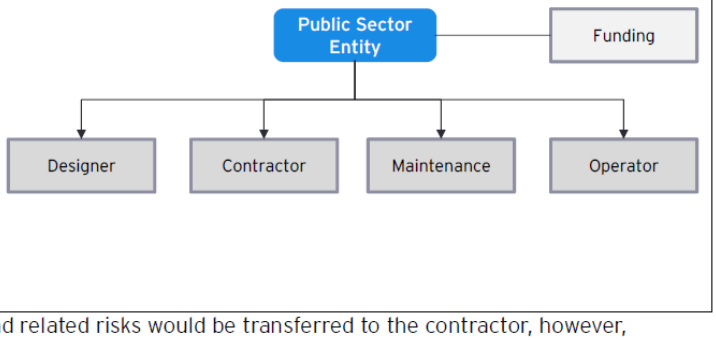
Exhibit B

Project Delivery and Procurement Options

Design-Bid-Build

Under the DBB model, the procuring Authority (public sector) is fully responsible for the engineering and design of the asset. As defined, the City retains ownership of the project/asset and designs are either done in-house or contracted to private design firms.

The Authority then invites bids from qualified bidders and the contract is awarded to the most suitable evaluated bidder. Following the completion of construction, the asset is commissioned and handed over to the public sector for operation and maintenance. This is the most common method of infrastructure procurement applied by the public sector and noted as the “traditional model” for UK and City infrastructure projects.

Scope Element / Responsibility	Public Sector	Contractor	Illustrative Structure (DBB)
Ownership	•		
Design	•		
Construction		•*	
Financing / Funding	•		
Operations	•		
Maintenance	•		
Lifecycle Maintenance	•		

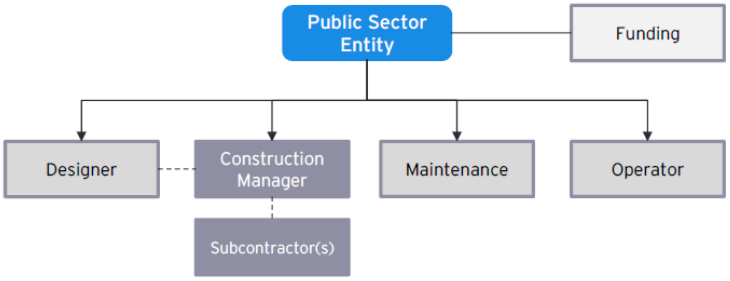
*It is noted that the responsibility for construction and related risks would be transferred to the contractor, however, depending on the contract conditions, any additional costs related to unforeseen events would ultimately be the responsibility of UK.

Construction Management

Under the CM model, the Authority engages a construction manager, through a competitive process, to manage design, documentation and construction works on its behalf. Subcontractors are contracted directly by the Authority and managed by the construction manager. The City retains ownership of the project/asset and the construction manager is typically paid its actual costs and management fee (fixed or % of actual project costs).

The construction manager may take on some degree of time/schedule risk based on an incentive regime. The Authority assumes operation and maintenance responsibilities following construction completion under the typical CM model.

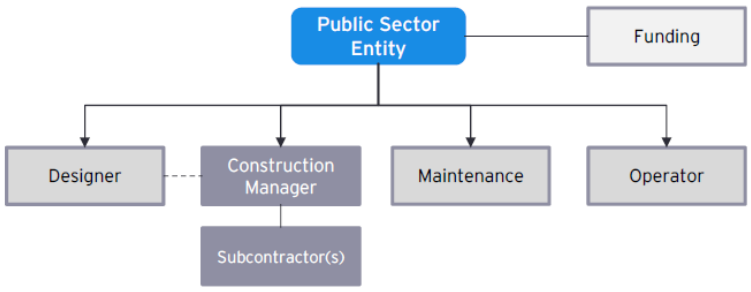
Scope Element / Responsibility	Public Sector	Contractor	Illustrative Structure (CM)
Ownership	•		
Design	•		
Construction	•	•	
Financing / Funding	•		
Operations	•		
Maintenance	•		
Lifecycle Maintenance	•		



Construction Management At-Risk

Under the CM-AR model, the Authority engages a construction manager, through a competitive process, to manage design, documentation and construction works on its behalf. The City retains ownership of the project/asset. Under the CM-AR model, the construction manager commits to the Authority that they will deliver a project (i.e., construction) within a guaranteed maximum price ("GMP"). The CM-AR model is similar to the CM model, except for the fact that under the CM-AR model, the construction manager also holds the contracts for the subcontractors. This allows for the Authority to transfer construction risks to the construction manager. It is important to note that the construction manager is only at risk once the GMP has been set, usually after procurement of nearly all the trades under fixed price contracts. As such, the owner retains cost risks up until that point. The construction manager may take on time/schedule risk based on an incentive regime. The Authority assumes operation and maintenance responsibilities following construction completion under the typical CM model.

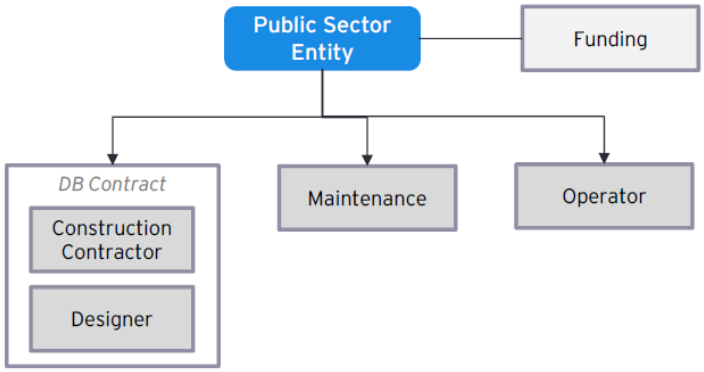
Scope Element / Responsibility	Public Sector	Contractor	Illustrative Structure (CM-AR)
Ownership	•		
Design	•		
Construction		•	
Financing / Funding	•		
Operations	•		
Maintenance	•		
Lifecycle Maintenance	•		



Design-Build

The DB model includes a single bid for the integrated design and construction of the project per defined specifications, obtained from qualified bidders. Under this model, the City retains ownership of the project/asset. The bidder develops its detailed design in accordance with the output specifications and functional program. Following design approval, the selected contractor (or a partnership between a designer and construction contractor) proceeds with construction of the asset. The Authority assumes operation and maintenance responsibilities following completion. DB combines the design and construction schedules, thus streamlining the procurement process and allowing innovation. In addition, due to the integration of design and construction under a single contract, this model eliminates the ability of the contractor to claim against the owner for errors, gaps or delays in design. This approach is well suited to more complicated projects where there is scope for innovation.

Scope Element / Responsibility	Public Sector	Contractor	Illustrative Structure (DB)
Ownership	•		
Design		•	
Construction		•	
Financing / Funding	•		
Operations	•		
Maintenance	•		
Lifecycle Maintenance	•		



Integrated Project Delivery / Alliance

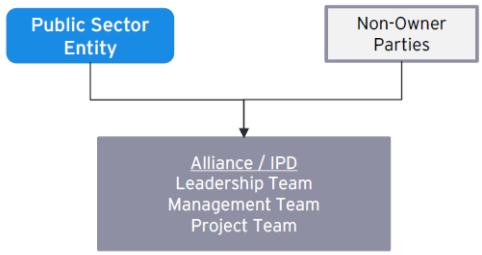
The IPD/Alliance model aims to optimize project results by integrating people, systems and business structures and practices into a process that collaboratively harnesses the talents or insights of the owner, the design team and the construction team. Multi-party agreements which encourage a “we” mentality rather than an “us vs them” due to shared risk rather than allocated risk (i.e., a no blame mentality). The City ultimately retains ownership of the project/asset under this model.

The IPD/Alliance design phase utilizes significant stakeholder involvement early in the project design phase to leverage the experience and expertise of all stakeholders. This helps to achieve the optimal design development which in turn, can result in less time spent during the implementation or pre-construction phase. Through facilitating early contribution across all teams, there is buy-in from all project phases and a more productive and effective working environment to design and build the project. Renumeration under the IPD/Alliance model is typically comprised of three (3) components:

- Cost reimbursement to cover costs and agreed profit margin.
- Incentives for achieving or bettering agreed project cost targets.
- Rewards for accomplishing set project goals.

The Alliance delivery method is often used for complex projects with unknown or hard to quantify risks, as the method fosters a collaborative team environment between the contractors at each project phase, allowing coordinated and efficient responses to risk that may arise. Under this model, the contractor is still responsible for completing construction works and the designer is responsible for design; however, financial risk for both scope elements remains mainly with the Project Owner. Furthermore, the extent of contractor risk on construction cost is limited to its profit during the execution phase and subject to an established gainshare/painshare mechanism related to the target price. It is noted that in some jurisdictions the terms Alliance and IPD are used interchangeably.

Scope Element / Responsibility	Public Sector	Contractor	Illustrative Structure (IPD / Alliance)
Ownership	•		
Design	•		
Construction	•	•*	
Financing / Funding	•		
Operations	•		
Maintenance	•		
Lifecycle Maintenance	•		



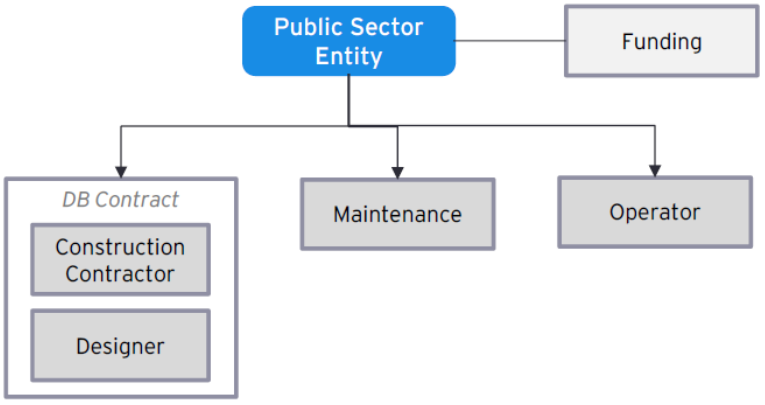
**Contractor risk on design and construction is usually limited to the amount of its profit*

Progressive Design-Build

This P-DB model is comprised of a qualifications-based or best value selection approach is used to select a design-builder who then “progresses” towards a final design and contract price proposal in two (2) phases. The initial phase includes budget level design development, preconstruction services and the negotiation of a firm contract price (either lump sum or guaranteed maximum price) for the subsequent phase of work. The second phase involves the final design and construction of the asset. Under this model, the City retains ownership of the project/asset. The Authority assumes operation and maintenance responsibilities following construction completion.

The difference between the P-DB and DB models is that under the P-DB model, the design is progressed to the level needed to estimate a lump sum price by a single selected contractor, rather than during a competitive bid/procurement process. This can result in a loss of competitive tension, which may outweigh any benefits of owner/contractor collaboration during the progressive phase.

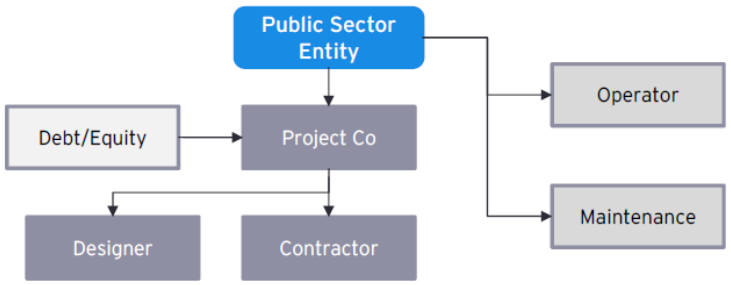
Scope Element / Responsibility	Public Sector	Contractor	Illustrative Structure (P-DB)
Ownership	•		
Design	•	•	
Construction		•	
Financing / Funding	•		
Operations	•		
Maintenance	•		
Lifecycle Maintenance	•		



Design-Build-Finance

Under the DBF model, the Authority transfers the responsibilities and associated risks for the design and construction of an asset to the private sector, and the risks associated with short-term debt financing for these activities. The City retains ownership of the project/asset under the DBF model. This consortium is typically referred to as the "Project Co". Upon the satisfactory completion of construction, the Authority makes a single payment to the private provider, which pays out the private financing used through construction. The DBF is an extension of the DB option, but with payments linked to satisfactory completion, which incentives the private sector to complete construction on a timely basis and ensure specifications for the asset are met.

Scope Element / Responsibility	Public Sector	Contractor	Illustrative Structure (DBF)
Ownership	•		
Design		•	
Construction		•	
Financing (Debt)		•	
Operations	•		
Maintenance	•		
Lifecycle Maintenance	•		



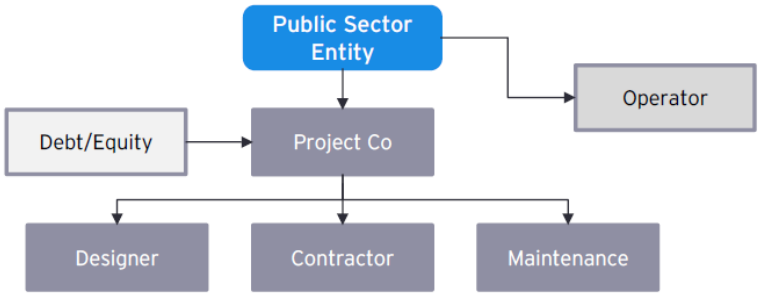
Design-Build-Finance-Maintain

Under the DBFM model, the Authority transfers the responsibilities and associated risks for the design, construction and long-term maintenance of an asset to the private sector, and the risks associated with financing these activities. The City ultimately retains ownership of the project/asset.

Upon the satisfactory completion of construction, the Authority may make a single payment to the private provider. Alternatively, payments related to construction can also be made during the operating period, linked to availability and performance of the asset. Service payments are a unitary payment to cover reimbursement of capital and maintenance costs subject to availability and serviceability of the asset. The DBFM model combines a DB contract with financing and long-term maintenance under a single contract. Payments are linked to availability of the asset to perform its function, which incentivizes the private sector to complete construction on a timely basis and ensure specifications for the asset are met and to ensure continued availability and serviceability of the asset through the term of the contract (operating period).

A private sector partner (Project Co) is procured through a competitive tendering process to design, build, finance and maintain the asset in a manner that meets the requirements and specifications of the Authority. Some elements of operations may be transferred to the private sector under DBFM; however, these services are typically retained by the Authority. The scope of maintenance services would need to be defined by the Authority and included in the terms of the agreement.

Scope Element / Responsibility	Public Sector	Contractor	Illustrative Structure s(DBFM)
Ownership	•		
Design		•	
Construction		•	
Financing		•	
Operations	•		
Maintenance		•	
Lifecycle Maintenance		•	



Design-Build-Finance-Operate-Maintain

Similar to the DBFM model, under the DBFOM model solicitations are sought for an integrated service to comprise design, construction, and maintenance of a new asset and long-term operation by the contractor to meet defined specification objectives. The City retains ultimate ownership of the project/asset.

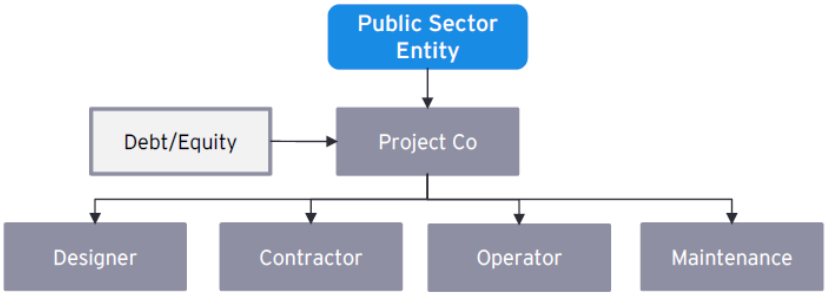
The DBFOM differs from DBFM in that it transfers greater operational responsibilities and related risks to the private sector. DBFOM incentivizes Project Co to meet performance requirements, as the private sector partner would be subject to financial penalties for poor performance and lack of facility availability during the operations phase. Upon the satisfactory completion of construction, the Authority makes a single payment to the private provider. Alternatively, payments related to construction can also be made during the operating period, linked to availability and performance of the asset. Annual service payments related to operations and maintenance are based on a fixed price contract, or subject to a periodic indexation adjustment. Payments are linked to availability of the asset to perform its function, which incentivizes the private sector to complete construction on a timely basis and ensure specifications for the asset are met and to ensure continued availability and serviceability of the asset through the term of the contract (operating period).

During the operating period, revenues may be based on availability payments (as for DBFM), third party revenues or some combination thereof.

The transfer of the operations may not be feasible for some public sector projects or services. However, there may be some cases where there is potential to transfer some operational elements to the private sector, where applicable or appropriate. The definition of the operations and maintenance scope would need to be defined and detailed in the agreement.

In addition, an alternative version of this model could be defined as the design-build-operate-maintain (“DBOM”) model, under which the financing responsibility remains with the City. Under this alternative, the private sector partner would take on a singular contract for the required services, or the City may seek to engage two (2) separate parties under a standalone design-build (DB) contract and separate operations and maintenance (“OM”) contract (i.e., DB+OM contract).

Scope Element / Responsibility	Public Sector	Contractor	Illustrative Structure (DBFOM)
Ownership	•		
Design		•	
Construction		•	
Financing		•	
Operations		•	
Maintenance		•	
Lifecycle Maintenance		•	



Progressive P3

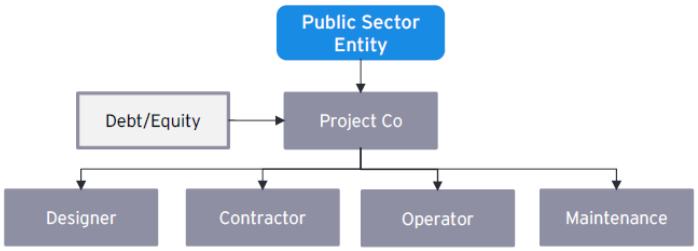
In a Progressive P3 model the Authority selects a team based largely on qualifications and, potentially, a concept design and indicative budget, choosing the team that is best positioned to deliver the project based primarily on the firm's track record of success and key personnel. The City retains ownership of the project/asset under this model.

Once selected, the development team closely collaborates with the public authority to develop design, estimate costs, and efficiently allocate risks, all in a very transparent manner. It is noted, however, that in practice there can be information asymmetry between the contractor and owner, which may reduce transparency, and hence competitiveness.

If financing is included in the delivery model, the process of refining the financing structure/selecting lenders is advanced in parallel to design. This period of initial design development and financial structuring is usually governed by an exclusive negotiating agreement, often taking the form of an interim agreement or pre-development agreement (PDA). During the collaborative period, design is progressed to 30% to 60% (sometimes up to 90%) or until a price is agreed upon between the selected team and the authority, after which long-term contracts are finalized and financial close is achieved. A Progressive P3 essentially combines progressive design-build with the finance, operations, and maintenance scopes typically involved in P3 delivery.

- Progressive P3 models include:
- Progressive Design Build Finance (P-DBF)
- Progressive Design Build Finance Maintain (P-DBFM)
- Progressive Design Build Finance Operate Maintain (P-DBFOM)
- Progressive Design Build Operate Maintain (P-DBOM)

Scope Element / Responsibility	Public Sector	Contractor	Illustrative Structure (P-DBFOM)
Ownership	•		
Design	•	•	
Construction		•	
Financing		•	
Operations		•	
Maintenance		•	
Lifecycle Maintenance		•	



Private Delivery

Under the Private Delivery option, the private sector leases the land (under a long lease term) from the City and manages all responsibility and risk related to the development and delivery of the asset. The public sector is completely “hands off” once the asset is transferred to the private sector.

This model allows for predictable lease payments to the City for the duration of the lease term. Terms of the lease agreement would be subject to negotiation, and as such, a few elements could be considered for allocation between the public and private sector:

Obligations of the City/UK:

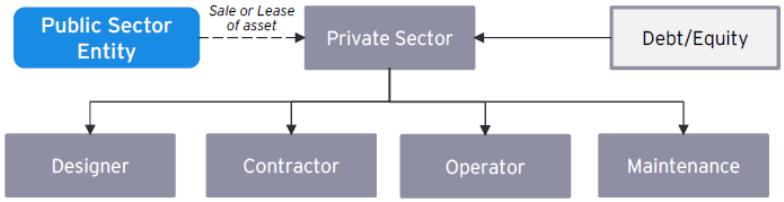
- Provide the land
- Provide feedstock volume/quality (scheduled)
- Private Partner Obligation
- Build facility on site
- Accept and process feedstock
- Deliver saleable commodities
- GHG obligations
- Reporting on specified targets
- Maintenance of facility according to handback provisions

To be determined/negotiated:

- Financial benefits (share of revenue or financial benefits from sale of processing outputs)
- Subsidies

Under the private delivery option, the private sector entity constructs and operates the processing facility and establishes contracts with UK, the City and other customers to receive feedstock in exchange for payment. For this model, the private sector entity also has the opportunity to generate and retain revenues from any saleable outputs from the process (i.e., RNG, fertilizer, etc.).

Assuming the City would represent the landlord, main feedstock supplier (SSO) and potentially a purchaser/user of process outputs (i.e., RNG), the City could seek to negotiate a shared risk arrangement relating to one or more of these cost and revenue streams. This would allow for some sharing of the risks (costs) and benefits (revenues) related to the facility.

Scope Element / Responsibility	Public Sector	Contractor	Illustrative Structure (Private Delivery)
Ownership		●	
Design		●	
Construction		●	
Financing		●	
Operations		●	
Maintenance		●	
Lifecycle Maintenance		●	

**Ownership of the facility would revert back to the City at the end of the lease term.*