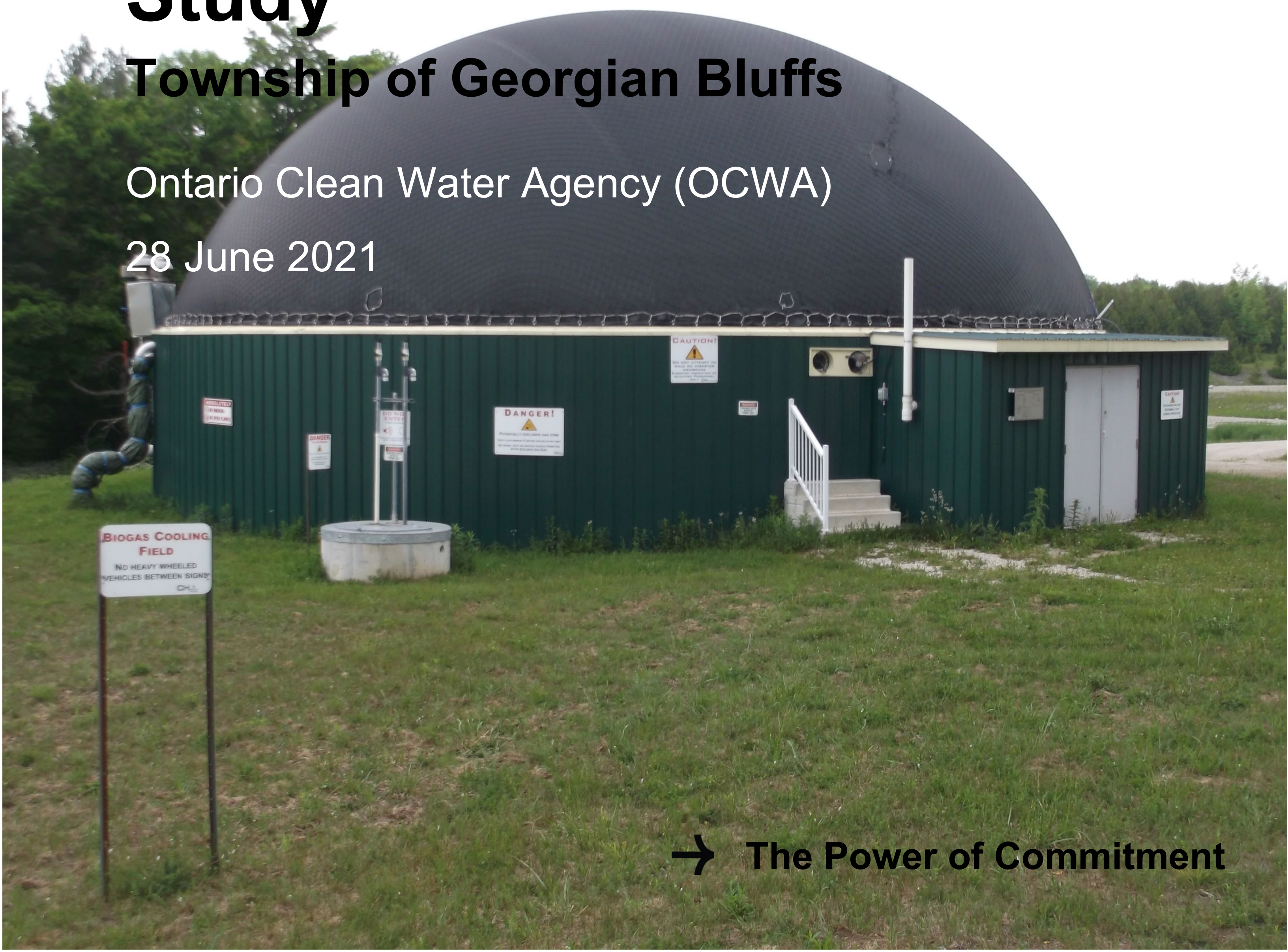
Source Separated Organics Availability, Digestion Technologies, and Beneficial Use of Biogas Feasibility Study

Township of Georgian Bluffs

Ontario Clean Water Agency (OCWA)

28 June 2021



→ **The Power of Commitment**

Executive Summary

The Corporation of the Township of Georgian Bluffs' (Georgian Bluffs) undertook a feasibility study (the Project) for source separated organics (SSO) availability, digestion technologies, and beneficial use of biogas at the Derby Wastewater Treatment Works (WWTW) BioGRID system and sewage lagoons. The BioGRID is owned and managed by the BioGRID Joint Board of Management (Joint Board) comprising Georgian Bluffs and the Township of Chatsworth (Chatsworth). The Project was delivered by Ontario Clean Water Agency (OCWA) with professional engineering support by GHD Limited (GHD).

The purpose of the Project was to study feasibility scenarios for BioGRID system management that:

1. Enable steady-state/optimal operations to assist in maximizing the existing Feed-in Tariff (FIT) contract, existing and potentially enhanced facilities, and the utilization of biogas;
2. Explore organics availability for ongoing supply of feedstock; and
3. Review potential partnership opportunities for project delivery models

The Project has also considered the general findings of a concurrent BioGRID decommissioning/recommissioning and valuation study (GHD, 2021). The concurrent study provides valuation of Site systems and an evaluation of decommissioning, maintenance, and recommissioning tasks and costs for potential BioGRID mothballing over a five-year period. Where the BioGRID system were to be mothballed, the relatively minor interconnectivity of the BioGRID and sewage lagoons would be removed to allow for separate and ongoing operation of the sewage lagoons.

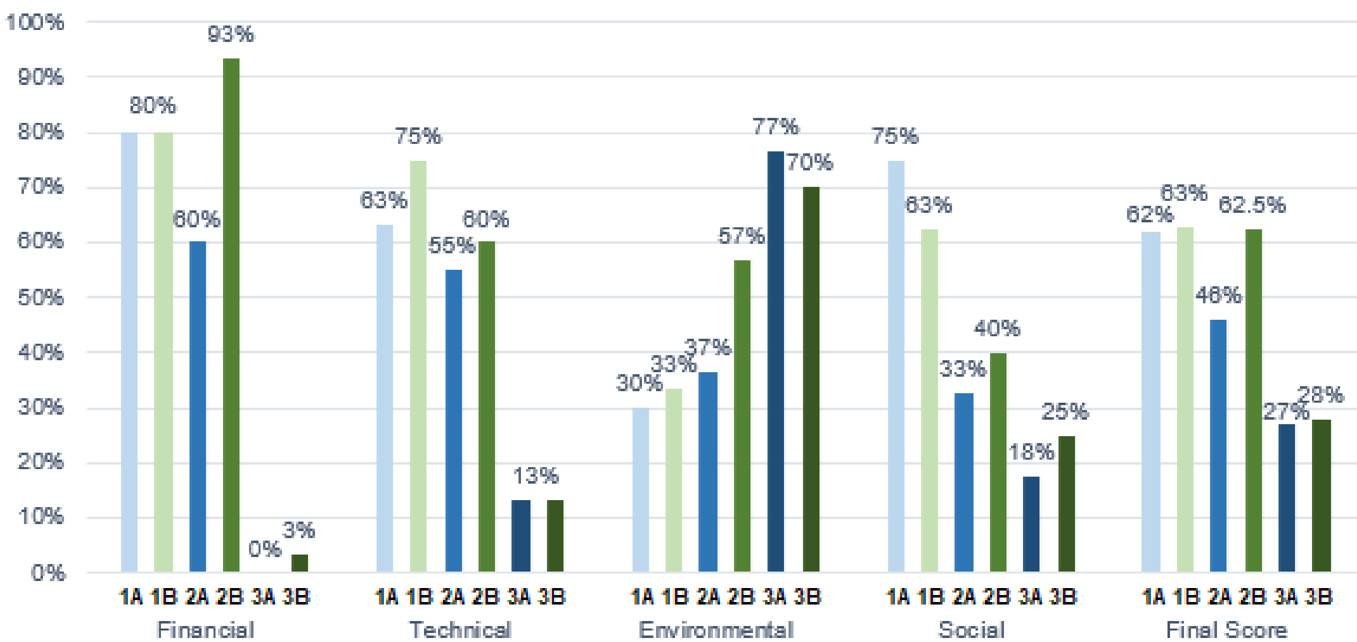
The Project methodology generally comprised a review of background information, a virtual WWTW site visit and workshop with Georgian Bluff's operations staff, a review of sewage lagoons treatment process a capacity for standalone treatment, and the iterative development of technical memoranda for collaborative review, adjustment, and confirmation of the Project understanding. The scenarios defined in the technical memoranda were also further reviewed and updated for assessment as part the Project Final Report. Key elements of the current management of sewage, organic waste, biogas, and digestate at the WWTW were identified as follows:

– The BioGRID system has faced operational and financial challenges relating to: securing organic waste feedstocks; approaches for setting organic waste feedstock tipping fees; downtime, capacity, and bottlenecks of the existing systems; material receiving station and other associated infrastructure; renewable energy generation; and process/operations of the sewage lagoons.
– Georgian Bluffs currently receives and processes a variety of sewage and organic waste feedstocks under related ongoing and individual contractual arrangements. Currently Georgian Bluffs does not have a source separated organics (SSO) curbside collection program. This organic waste feedstock is contained within the mixed waste stream and currently landfilled. The SSO from a potential program within Grey County municipalities (estimated at 4,100 tonnes per year [tpy]), as well as others from neighbouring municipalities (e.g., Township of Chatsworth) and the industrial, commercial and institutional (IC&I) sector could be secured through implementing a program and/or agreements, and this material could be diverted from landfill and processed at the WWTW. The WWTW has capacity to process additional material via AD and generate increased biogas/digestate. Where additional feedstock is secured, there is opportunity to preferentially receive/process 'higher value' feedstocks.
– Georgian Bluffs currently utilizes biogas to generate electricity via CHP unit under an existing FIT contract. A flare is not available onsite and thus the BioGRID system operation is paused when the CHP unit is not useable, to avoid potential for biogas emissions to atmosphere. At the assessed rates of biogas generation, the opportunity for renewable natural gas (RNG) is not present, though the existing FIT contract (through to 2031) can be maximized, and excess biogas could be utilized off-site given notional interest from relevant stakeholders.
– Georgian Bluffs currently stores liquid digestate prior to land application as a Category 3 non-agricultural source material (NASM). This approach generates a cost for disposal via land application, though provides for a closed nutrient loop within the regional area. For this Project, the additional digestate of potentially different quality generated from the potential changes to feedstocks and the AD process was assumed to continue to be managed via the current approach.

There is inherently additional infrastructure that would be needed to assist in diverting waste from landfill and processing it for beneficial uses. Infrastructure requirements are reflected in the assessed scenarios, which have been developed to be stepwise, whereby further scenarios build on initial scenarios and thus, related modifications and investments could be made incrementally to achieve the identified scenario objectives. The scenarios assessed were generally defined as follows based on the noted key considerations:

– Scenarios 0.1 and 0.2 | Status quo or mothball BioGRID system, respectively.
– Scenarios 1A and 1B | Enhanced version of Scenario 0.1 to maximize use of existing FIT contract (ending 2031). Scenario 1A considers pre-processed ICI slurry. Scenario 1B considers pre-processed SSO slurry. Stepwise evaluation period of 2022-2041.
– Scenarios 2A and 2B | Enhance version of Scenarios 1A and 1B, respectively to maximize use of BioGRID digestion capacity (exceeds FIT contract; convey excess biogas to off-site user). Scenario 2A considers pre-processed ICI slurry. Scenario 2B considers raw SSO with pre-processing at Site. Stepwise evaluation period of 2023-2041.
– Scenarios 3A and 3B | Enhance version of Scenarios 2A and 2B, respectively to maximize use of Site (additional digester; convey all gas to off-site user). Scenarios 3A and 3B consider raw SSO with pre-processing at Site and additional digester. Stepwise evaluation period of 2031-2041.

The assessment included multiple criteria within Financial, Technical, Environmental, and Social categories. A total of 16 criteria were used for the weighted assessment under each of these four headings, including both quantitative and qualitative analyses, all scored from 0 to 10 (from less to more favourable). The criteria and the categories were evenly weighted. The categorized rankings and final scores are depicted below.



A visual summary of select findings from the assessment is provided below for key parameters forming the evaluation of Scenarios 1A through 3B.

Key Parameters	Scenarios							
	0.1	0.2	1A	1B	2A	2B	3A	3B
Organics processing (tpy) *incl. sewage/septage*	7,800	0	9,800	6,000	13,300	8,000	31,800	31,600
Tipping fees (2021 $)	162K	0	193K	445K	246K	616K	822K	1.27M
Incremental capital investment (2021 $)	N/A	N/A	1.3M	0.7M	1.3M	1.5M	17.8M	16.6M
Gas production (m^3/hr)	45	0	45	45	105	65	220	210
Electricity generation (kWh/day) *for FIT contract*	1,000	0	2,400	2,400	2,400	2,400	2,400	2,400
Emissions reductions (eCO_2T/yr)	11	0	65	25	1,650	860	9,490	9,260
Digestate production (m^3/day) *has cost to land apply*	15	0	30	35	45	50	100	95

The assessment was concluded in line with the following select notes and related recommendations for next steps:

- There is opportunity to operate the sewage lagoons system separately from the BioGRID system, with minor disconnection at the drum screen. Potential limitations to increasing throughput or feedstock strength from current practice require further evaluation based on recommended feedstock sampling characterization (for both the sewage lagoons and BioGRID systems, as applicable to a preferred next step for ongoing Site operations).
- There is opportunity to address Site operational challenges to maximize the value of existing or potential additional infrastructure. For instance, implementing a flare and reducing CHP unit downtime represents an important step in enhancing Site revenue. This solution, amongst others, require working with the MECP to amend the Site ECA where necessary.
- There is opportunity to mothball the BioGRID system and decrease negative annual revenue by $0.9M over a five-year period. It is anticipated that this timeframe would allow for the implementation period of an SSO collection program within Grey County or other, and for an increase in organic waste feedstocks in the market.
- For biogas utilization and digestate management: maximizing the FIT contract until its expiry is considered the most feasible approach. Excess or post-contract biogas utilization was assessed as ongoing off-site use. The existing NASM program could continue, pending further evaluation of potential changes to digestate quantity and quality, also requiring discussion with the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).
- There is opportunity for shared services between adjacent municipalities. Continue related discussions with neighbouring municipalities and the ICI sector/private waste haulers/brokers, given that fthe overall quantities being managed (and related biogas being generated for utilization) are a vital component of a sustainable Project.
- Define a Project scenario to further develop (e.g., concept/detailed design) as assessed or modified in the context of both a preferred next step and project delivery approach. Related to this, review available funding and consider the project delivery model that is of preference to the Joint Board and/or develop a Request for Expression of interest to gauge the industry’s related interests and capabilities.
- Once a next step is identified and where it consists of proceeding to the design stage with one of the Project scenarios (as assessed or potentially modified), the assumptions and set values would appropriately be further developed along with updated and detailed costing.

Overall, it is recommended that the Project findings and recommendations be reviewed in line with Project stakeholder interests, to take next steps toward optimized operation, mothballing, and/or facility partnerships/divestiture. These next steps would contribute to important waste management objectives around organic waste diversion, renewable energy generation, and beneficial use of digestate.

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1. Introduction

The Ontario Clean Water Agency (OCWA) provided technical guidance and project management to the Corporation of the Township of Georgian Bluffs' (Georgian Bluffs) Source Separated Organics (SSO) Availability, Digestion Technologies and Beneficial Use of Biogas Feasibility Study (the Project) regarding the Derby Wastewater Treatment Works (WWTW) BioGRID system and sewage lagoons. GHD supported OCWA with professional engineering services for the delivery of the technical assessment detailed in this Report.

The WWTW sewage lagoons were implemented in 1975 and the BioGRID system (Bio Green Renewable Industrial Digester) was implemented in 2011. The BioGRID is owned and managed by the BioGRID Joint Board of Management (Joint Board) comprising Georgian Bluffs and the Township of Chatsworth (Chatsworth). Collectively, Georgian Bluffs and Chatsworth are referred to herein as 'Townships'.

The BioGRID system has faced operational and financial challenges relating to: securing organic waste feedstocks; approaches for setting organic waste feedstock tipping fees; downtime, capacity, and bottlenecks of the existing systems; material receiving station and other associated infrastructure; renewable energy generation; and process/operations of the sewage lagoons.

The BioGRID system generates biogas and liquid digestate, for which the Project included consideration of biogas utilization as a renewable fuel (e.g., via existing combined heat and power [CHP] unit or potential industrial use for manufacturing needs) as well as continued digestate utilization for land application as a beneficial soil amendment. The Project has also considered the general findings of a concurrent BioGRID decommissioning/recommissioning and valuation study (GHD, 2021). The concurrent study provides an evaluation of decommissioning, maintenance, and recommissioning tasks and costs pertaining to the potential mothballing of the BioGRID over a five-year period. In a case where the BioGRID system were to be mothballed, the relatively minor interconnectivity of the BioGRID and sewage lagoons would be removed to allow for separate and ongoing operation of the sewage lagoons.

1.1 Purpose

The objective of this Project was to study feasibility scenarios for BioGRID system management that:

- Enable steady-state/optimal operations to assist in maximizing the existing Feed-in Tariff (FIT) contract, existing and potentially enhanced facilities, and the utilization of biogas;
- Explore organics availability for ongoing supply of feedstock; and
- Review potential partnership opportunities for project delivery models

1.2 Study Approach and Reporting

The Project included the iterative development of a Technical Memorandum #1 based on background review, virtual site visit/workshop, and stakeholder inputs. The Technical Memorandum was progressed as Draft Versions A, B, and C, allowing for the ongoing review and consideration of reference documentation/information and review/input by OCWA as well as Georgian Bluffs.

The final Technical Memorandum (Draft Version C) is provided as Appendix A and discusses the information gathered and understood, providing the context for the development and a subsequent evaluation of scenarios. The initial listing of scenarios within the Technical Memorandum were further revised via discussion with OCWA. This report expands upon the final Technical Memorandum with the evaluation of scenarios.

The setting and evaluation of scenarios was undertaken to assist in addressing key challenges generally affecting the performance and cost effectiveness of the BioGRID system. Among those challenges is the potential quantity of organic waste feedstocks and ability for them to be secured for processing at the Site. The potential organic waste feedstocks were surveyed by OCWA through discussions and letters of interest primarily with regional municipalities in Grey and Bruce Counties including the industrial, commercial, and institutional (ICI) sector.

1.3 Study Methodology

The methodology for undertaking the Project is depicted below and further described herein.

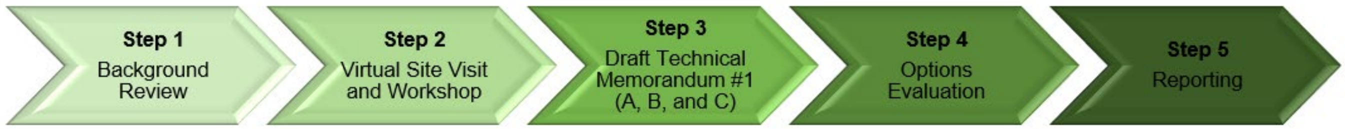


Figure 1 Study Methodology

1. Review and analysis of background documentation provided by OCWA and the Joint Board, including publicly available documentation regarding the WWTW and BioGRID permitting, operation, performance, and assessments.
2. Virtual WWTW Site visit (held November 26, 2020) to walk through the facility and gather operator insights related to current Site operations and bottlenecks, and brainstorm the Project weighed evaluation criteria with Georgian Bluffs.
3. An evaluation of the potential to separate BioGRID system operations from the sewage lagoons and a theoretical estimate of sewage lagoons treatment capacities was undertaken.
4. Project options were developed to assist in addressing key challenges generally affecting the performance and cost-effectiveness of the BioGRID system. The options and scenarios were developed based on input from OCWA and Georgian Bluffs, GHD experience and inputs sought from relevant stakeholders (i.e., organic waste haulers, organic waste processers, and neighbouring municipalities). The following key considerations further guided the development of scenarios to be assessed:
   a. Potentially available organic waste feedstocks for digestion (i.e., SSO, ICI organics, fats, oils and grease [FOG], wastewater, and agricultural waste).
   b. Potential technologies and processes for optimizing/maximizing the facility existing or potentially enhanced processes.
   c. Potential on-site approach to organic waste feedstock reception and pre-processing.
   d. Relevant context and conditions (e.g., regulatory, technical, market).
5. Project methodology items 1 through 3 were detailed in iterative Technical Memorandum #1, with the final document (Draft Version C) provided as Appendix A.
6. The options defined in the final Technical Memorandum were further revised via discussions with OCWA. The selected scenarios were developed to be stepwise, whereby further scenarios build on initial scenarios. Key considerations for the scenarios have included:
   a. Aim to maximize existing FIT contract via use of CHP unit (through to 2031 contract end date)
   b. Aim to maximize capacity of BioGRID digester, exceeding FIT contract, with excess biogas being conveyed for potential industrial use
   c. Aim to maximize use of Site whereby an additional digester system is implemented, with all biogas being conveyed for potential industrial use

Given the Project methodology noted above, this Report provides a discussion on the Scenarios 0.1 and 0.2 as well as assessment of the six scenarios (i.e., Scenario 1A, 1B, 2A, 2B, 3A, and 3B), with review against the Project weighed evaluation criteria, as well as relevant considerations for implementation (project delivery approach and funding opportunities). Recommendations are included as a guide for next steps that Georgian Bluffs may consider toward optimized operation, mothballing, and/or facility partnerships/divestiture. These next steps would contribute to important waste management objectives around organic waste diversion, renewable energy generation, and beneficial use of digestate.

1.4 Organization

This Report is organized in the following sections:

– Section 1: Introduction | Provides the Study purpose, approach, and organization of this Report
– Section 2: Context | Provides high level discussion of the Site history, current operations, and decision-making approach
– Section 3: Project Scenarios, Assessment, and Findings | Provides the Project Scenarios that were assessed based on key assessment parameters and evaluated as part of this Report
– Section 4: Implementation Approaches | Provides information on funding opportunities and project delivery models.
– Section 5: Conclusions and Recommendations | Provides summary of key Study findings and recommends actions to assist with taking next steps
– Section 6: Limitations | Provides the limitations of the Project Scenarios and assumptions made during evaluation.

2. Context

2.1 Overview

The WWTW including BioGRID and sewage lagoons is located at 62111 Side Road 3 in Owen Sound, Ontario. The BioGRID system was implemented in 2011 and is owned and managed by the Joint Board. The WWTW was implemented in 1975 and is currently operated by Georgian Bluffs' personnel.

A Site plan noting entrance and existing facilities is shown below as Figure 2.

Figure 2 Site Plan of the WWTW with BioGRID System and Sewage Lagoons

The process at the Site and current status is provided in Figure 3, and is discussed in greater detail as part of Sections 3 and 4 of the Technical Memorandum Draft Version C, provided as Appendix A.

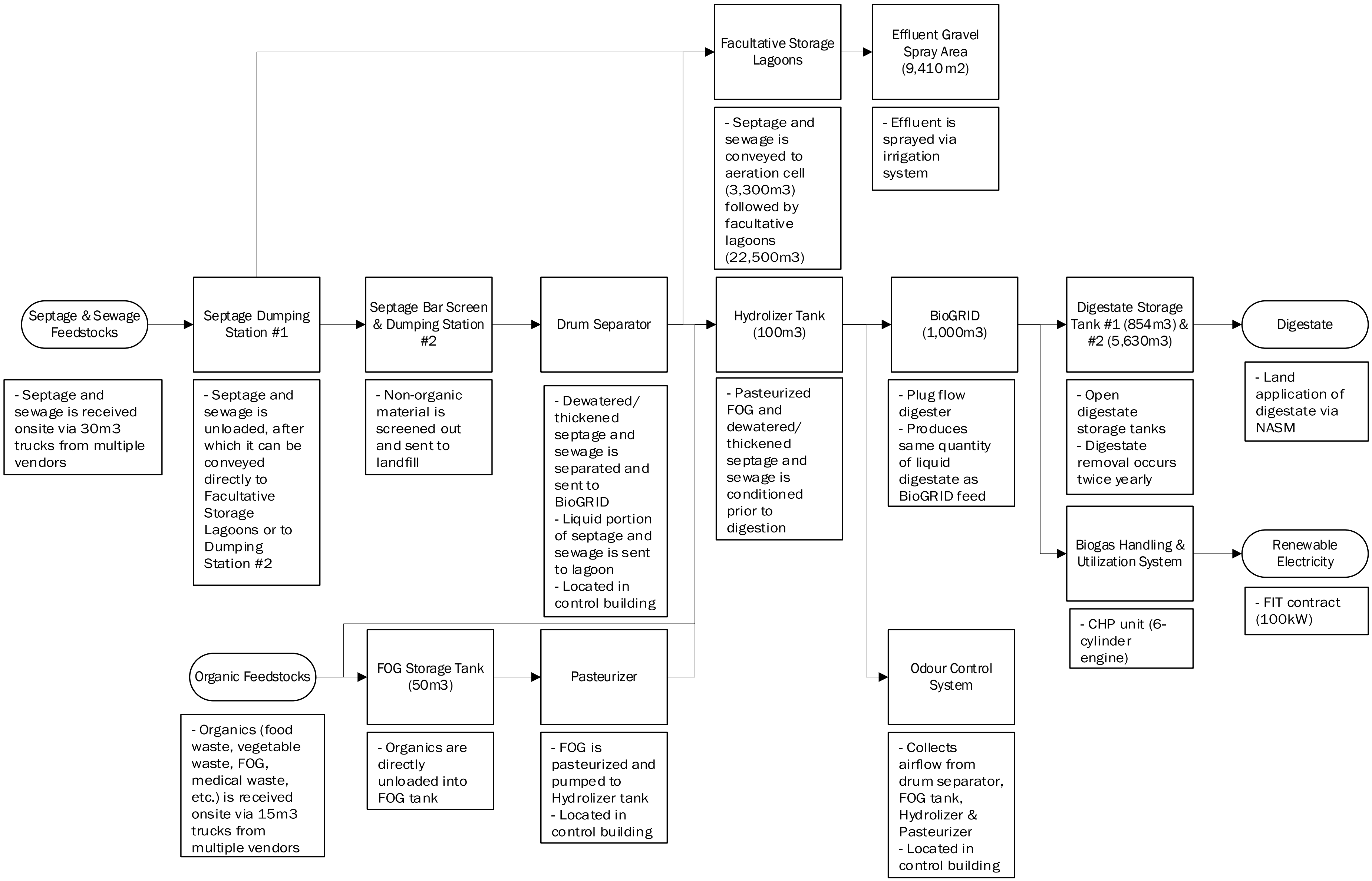


Figure 3 ***Process and Current Status of WWTW with BioGRID System and Sewage Lagoons***

2.2 Review for Sewage Lagoons

A review was undertaken to assess the potential to operate the sewage lagoons system as a standalone treatment process (e.g., where the BioGRID system may be mothballed or where the interconnectivity between the two system may be removed). The review is detailed in Section 4.4 of the Project Technical Memorandum #1 (Draft Version C) provided as Appendix A. Given limitations on available data (e.g., feedstock characteristics and initial design assumptions), there is a set uncertainty in the assessed treatment capacity. Accordingly, key findings from the review and recommendations are summarized as follows:

- Liquid waste received at the Site is treated within the aeration lagoon followed by the facultative lagoon.
- Currently, feedstock that is visually very liquid is directed to Dumping Station #1 and conveyed directly to the aeration lagoon via a 150 mm diameter influent sewer pipe from the septage receiving tank to the aerated lagoon.
- Remaining sewage waste received at the Site is directed to Dumping Station #2 which is then fed through a drum screen. The drum screen separates the solids portion from the sewage waste, and the solids portion is sent to the BioGRID system for AD. The liquid portion which gets separated by the drum screen is then conveyed to the aeration lagoon.
- In a scenario where the BioGRID system is taken offline and all the septage and sewage feedstock is diverted to the aeration lagoon, the expected total yearly flow to the aeration lagoon would be 8,850 m3. Considering a total of 250 operating days, the expected flow to the aeration lagoon would increase from 28 m3/day to 34 m3/day. As per the MECP Amended ECA No. 2206-8KSQZV dated August 23, 2011, the maximum rated flow handling capacity of the Site is 57.2 m3/day (for both the BioGRID system and sewage lagoons system).
- Assumptions applied to the future flow conditions (34 m3/d) indicate BOD loading to the facultative lagoon to be less than and therefore meet the MECP design average BOD loading guideline of less than 22 kg/(ha-d) if the literature reaction rate values are used and are assumed to be representative of summer and winter temperature conditions. However, the facultative lagoon loading condition exceeds MECP design guidelines if the most conservative reaction rate is applied (based on original design report).
- Completing a similar analysis as above at the rated capacity of 57.3 m3/d (to maximize current approved capacity, rather than actual flow of 34 m3/d), the predicted loading to the facultative lagoon exceeds MECP Design Guidelines even at the literature reaction rate assumed representative for winter temperature conditions. To meet the facultative lagoon loading criteria of less than 22 kg/ha.d at the rated capacity of 57.3 m3/d, the BOD concentration of the aerated lagoon effluent should be of lower strength, at less than approximately 360 mg/L.
- Recommendation | Undertake a sampling program to determine the characteristics of all received wastes as well as for the solids and liquid stream coming out of the drum screen to further understand the organics loading rates to the sewage lagoons system (and BioGRID system). The program should include analysis for TS, volatile solids (VS), ammonia, alkalinity, biological oxygen demand (BOD), chemical oxygen demand (COD), and total phosphorous (TP).
- Recommendation | With further definition of the characteristics, the assessment undertaken for this Project is recommended to be reviewed to define the conditions where the sewage lagoons can suitably be operated as a standalone treatment process.

2.3 Design Status and Current Status of BioGRID

The Design Brief for the BioGRID system (Genivar, February 2010) shows that the BioGRID was designed based on parameters and costing that varies significantly from the current status of the Site. Key differences are listed in Table 2.1.

Table 2.1 Design Status and Current Status of Site

Parameter	Design Status	Current Status
Feedstock Type	Primarily corn stalk with solid fraction of septage and sewage	Primarily septage and sewage with some organic waste
Feedstock Quantity (m^3/year)	14,600	4,714

Parameter	Design Status	Current Status
Daily Flowrate (m^3/day)	40	13
Organic Loading Rate (OLR) to BioGRID (kg-VS/m^3)	4	0.3
Total Solids Content (%TS)	5-12	3
Volatile Solids Concentration (mg/L)	25,000	11,273
Biogas Generation Rate	1,200 m^3/day or 50 m^3/hour	490 m^3/day or 20 m^3/hour
Biogas Production Potential (m^3/tonne)	200 to 550	38
Annual Energy Generation Revenue	$128,000	$65,895
Annual Tipping Fee Revenue	$406,531	$162,299
Annual Operating Costs	$212,231	$574,593
Net Annual Revenue	$322,300	-$346,399

Receipt of larger quantities of lower ‘value’ feedstocks directly affected both the revenue streams for this Site:

– Revenue from feedstock tip fee
– Revenue from FIT contract (due to lower biogas potential and biogas production from septage/sewage)

This resulted in a negative net annual revenue as opposed to a positive net annual revenue with payback period of less than eight years as suggested in the Design Brief.

Since the Design Brief, several other evaluations have been undertaken for the BioGRID system and are summarized below with key notes as applicable to the Project at this current time. Refer to Section 3 of Appendix A for more details on these other evaluations.

1. ***Feasibility Study to Improve Septage Receiving and Increase Power to 340 kW for the Georgian Bluffs/Chatsworth Biodigester (Genivar Inc., February 2012)* |** In an email dated April 7, 2021, provided as Appendix B, the Independent Electricity System Operator (IESO) noted that it does no longer consents to any increase in capacity of the FIT contract as the final FIT application period was held in 2016.
2. ***Engineering and Operation Review (GHD, 2015)* |** Key recommendation of discontinuing operation of the pasteurizer to pasteurize FOG still applies, along with other challenges regarding quantity and quality of organic waste feedstocks still remain.
3. ***Preliminary Design and Cost Estimates – Upgrades to the Georgian Bluffs/Chatsworth Biodigester (GSS Engineering Consultants Ltd., Aquatech Canada Water Services Inc. and CCI BioEnergy, August 2018)* |** Certain capital and operating related information were utilized as point of reference for the financial assessment in this Project.
4. ***Assessment of WWTW BioGRID Mothballing and Sewage Lagoons Operations (GHD, ongoing)* |** Study summarizes probable costs for decommissioning tasks to be $417,251 and is considered to be the costs for Scenario 0.2. The Study is provided as Appendix C.

2.4 Current Site & Operational Limitations

The Site operator noted several operational pinch points and bottlenecks, which need to be resolved to help improve existing Site conditions and operations. These limitations and identified solutions are summarized below in Table 2.2.

Table 2.2 Current Site and Operational Limitations with Identified Solutions

Operational Limitations	Identified Solutions
Site access roads are currently not suitable, preventing some feedstock vendors from either bringing material to this Site or lowering tip fee in order to do so.	Expand and upgrade existing Site access roads to allow larger organic waste feedstock vehicles to access the Site.

Operational Limitations	Identified Solutions
FOG is currently stored in a 50 m^3 FOG tank and then being pasteurized for one hour before it is fed to the BioGRID.	Discontinue operation of pasteurizer to pasteurize FOG, as pasteurization of FOG requires additional energy and damages the biodegradable cells of organic waste, thereby decreasing the potential of biodegradability and biogas production from FOG. An ECA amendment will be required to implement this process change.
ECA requirement of rated capacity of 57.5 m^3/day for the entire Site limits receipt of additional organic waste feedstock at the Site, as the current daily flow to the sewage lagoons is approximately 34 m^3/day, leaving only 23.5 m^3/day for use in the BioGRID.	An ECA amendment will be required to implement this process change.
Drum separator is unable to dewater/thicken septage and sewage effectively as the current feed rate is twice as fast as the design feed rate. This results in more liquid septage and sewage entering the BioGRID.	Discontinue operation of drum separator by conveying septage and sewage either directly to the sewage lagoons or to the hydrolyzer tank based on Project Scenario selected. An ECA amendment will be required to implement this process change.
CHP unit requires high maintenance/downtime, which stops feed to BioGRID to prevent release of biogas through pressure relief valves on top of BioGRID as there is no contingency biogas flare. Temporary release of biogas is considered a spill and must be reported to the Ontario Ministry of the Environment, Conservation and Parks (MECP). FIT contract is for 100 kW and expires on May 1, 2031.	Install biogas flare as an important contingency along with maximizing use of CHP FIT contract (via additional processing of feedstocks and related biogas generation) for remainder of contract duration. An ECA amendment will be required to implement this process change.
There is no potable water service on Site.	It is assumed that groundwater being pumped from Well #1 for usage in the biogas cooling bed will be sufficient for any dilution requirements of selected Project Scenario.
The characteristics of the various influent feedstocks received at the Site are not well defined. The quality of the material in terms of loading to the BioGRID and sewage lagoons is therefore not well understood. The aerated lagoon effluent discharge characteristics are also not known. Accordingly, it is not possible to determine the actual biomethane potential or sewage lagoons reaction rate and performance. The potential large variability of influent concentrations and flows (from day to day) and required assumptions for the assessment undertaken herein present a considerable challenge to accurately predicting the available sewage lagoons capacity/performance.	Recommendation | Undertake a feedstock sampling program to then also revise/validate the assumptions applied herein for the process review.

2.5 Township Planning Objectives

GHD understands that the Townships have not set formal objectives related to sustainability, greenhouse gas (GHG) reductions, and waste diversion.

According to a recent MIC Waste Management Services Review (Dillon, 2021), Georgian Bluffs has an overall waste diversion rate of 43 percent. This is comparable to Grey County, which includes the Municipality of West Grey, Georgian Bluffs, Municipality of Grey Highlands, Township of Southgate, and Town of The Blue Mountains, together have a population of 93,830, population density of 20.8/km^2, and a waste diversion rate of 40.8 percent in 2018, which dropped from prior years (44.1 percent in 2016 and 46.7 percent in 2017).

Georgian Bluffs has a Long-Term Waste Management Plan (Gamsby and Mannerow, 2009). An update to the Long-Term Waste Management Plan is currently being undertaken by Gamsby and Mannerow Limited on behalf of Georgian Bluffs.

With a population of approximately 10,500 in Georgian Bluffs and 6,500 in Chatsworth, the Townships will not be required to implement a SSO curbside collection program or a waste reduction and resource recovery target by the future province-wide ban of food and organic waste from landfills, as the Food and Organic Waste Framework notes municipal targets in northern Ontario are only applicable only to populations greater than 50,000 and population density greater than 300/km^2.

Should the Townships and/or other adjacent municipalities implement SSO collection programs, this would lead to the availability of SSO in the market for processing. For example, the cities of Petawawa, Oxford, Brantford, Guelph, Belleville, and London are already considering implementation of an SSO collection programs. Recommendation | In alignment with the MIC Waste Management Services Review, there is opportunity for shared services between adjacent municipalities that is recommended to be assessed and/or pursued.

3. Project Scenarios, Assessment, and Findings

3.1 Overview of Scenarios

A visual scenario summary with evaluation timeframe is provided below as Figure 4.

Infrastructure requirements for Scenarios 1A, 1B, 2A, 2B, 3A, and 3B are depicted thereafter as visual summary in Figure 5. As Scenario 0.1 is the Status Quo baseline case (do-nothing), and Scenario 0.2 is representative of the concurrent separate mothballing study, they are not included (no additional infrastructure).

For Scenarios 3A and 3B, pre-processing of residential SSO would occur onsite east of the existing BioGRID and access road. There is approximately 5,000 m² or 0.5 hectares of cleared space available for implementation of a pre-processing facility, slurry buffer tank, and new digester as required based on the Project Scenario. Recommendation | Undertake consultation with the Grey Sauble Conservation Authority where additional infrastructure and related footprint would require clearing of trees.

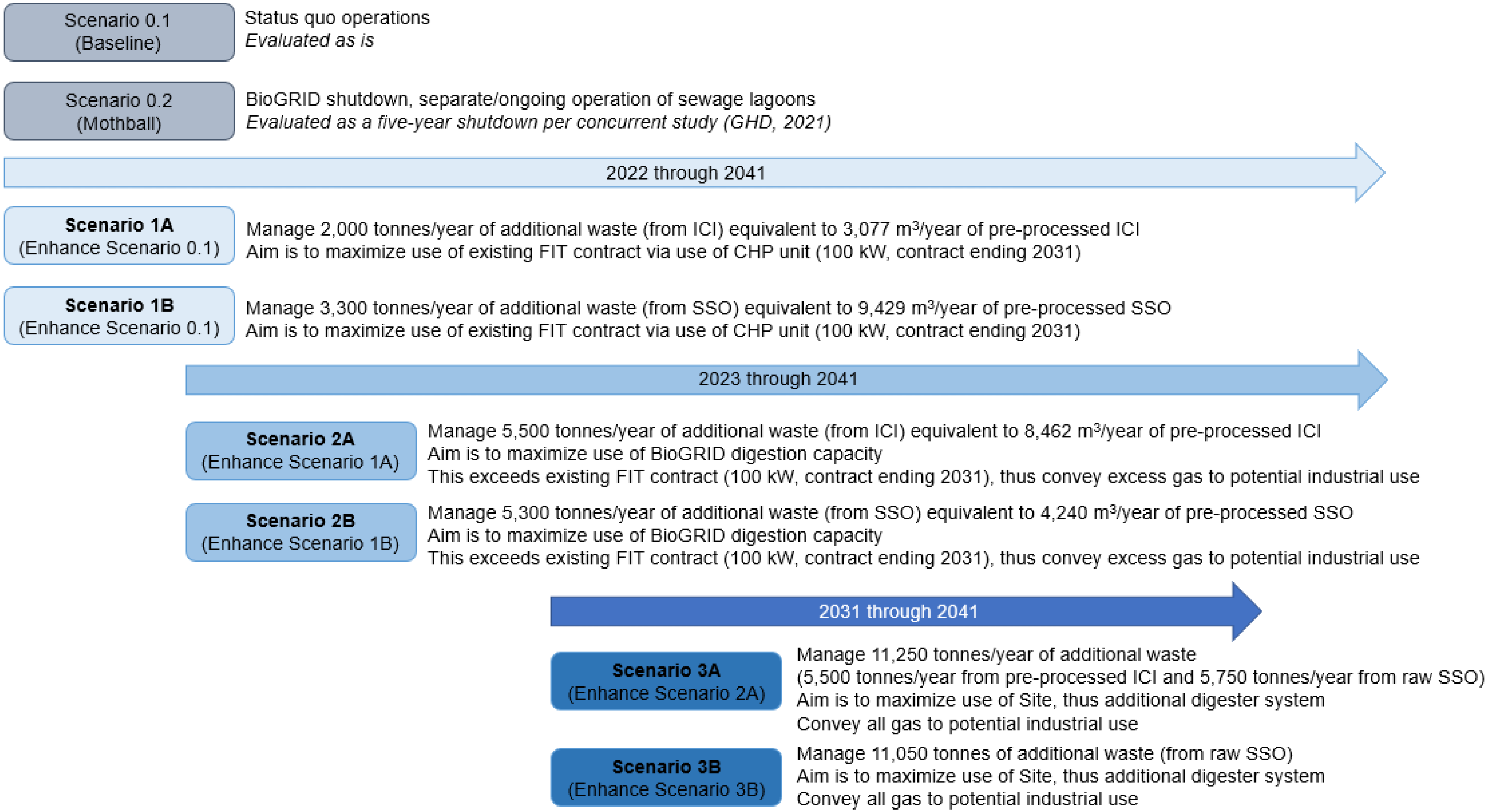


Figure 4 Visual Summary of Study Scenarios with Evaluation Timeframe

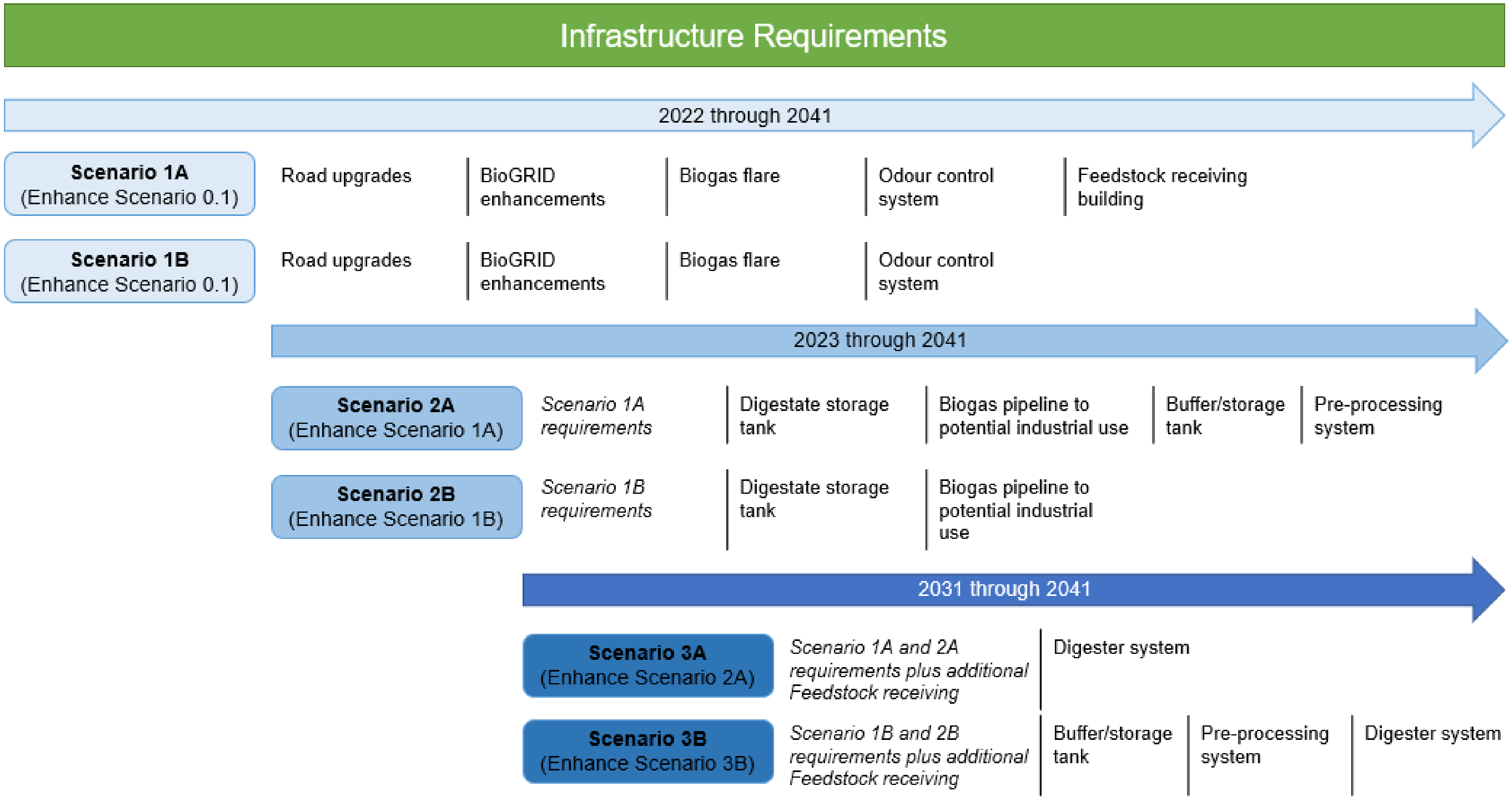


Figure 5 Visual Summary of Infrastructure Requirements for Scenarios 1A, 1B, 2A, 2B, 3A, and 3B

A general overview process flow diagram is provided below as Figure 6, depicting the current arrangement at the Site and adding in the potential arrangements and infrastructure required for all Project Scenarios. The potential arrangements being evaluated as part of the Project Scenarios are discussed as part of Section 3. Detailed Scenario specific process flow diagrams provided as part of Appendix D.

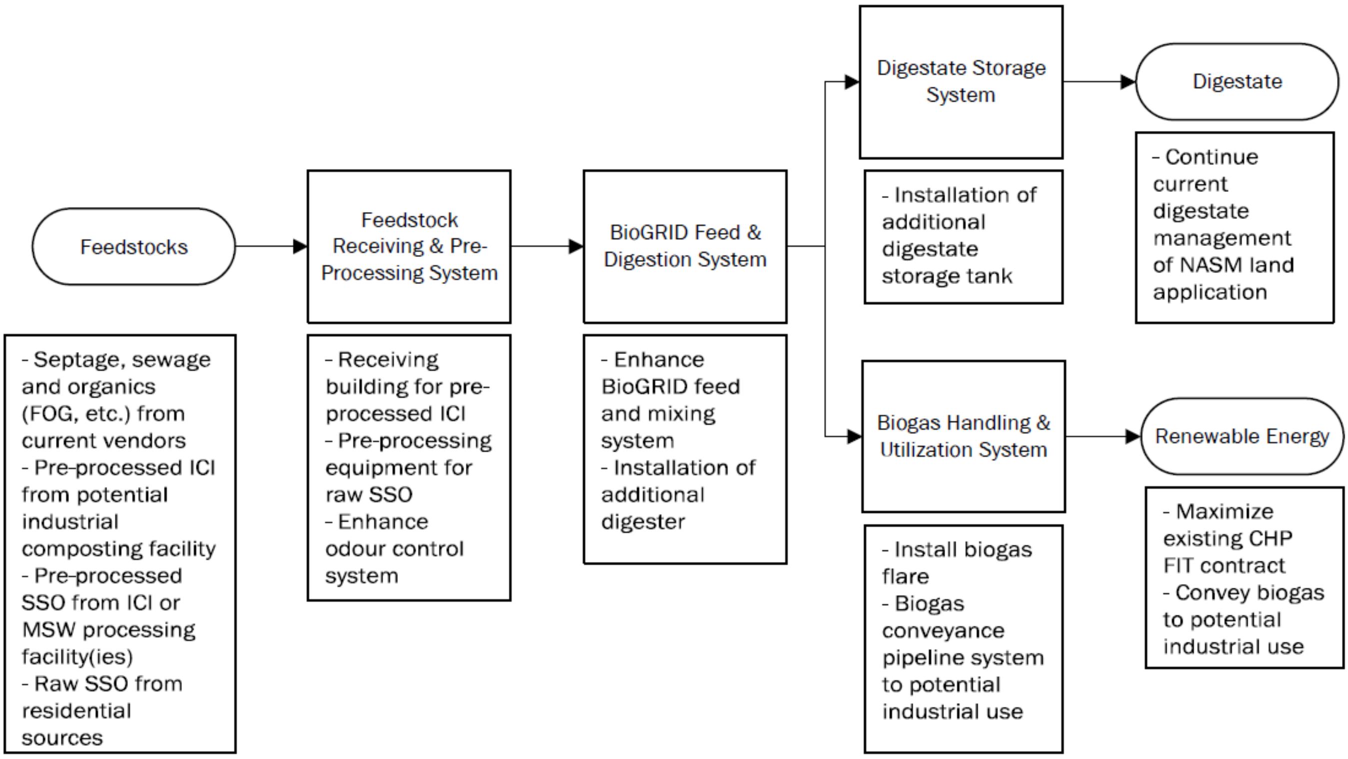


Figure 6 *High-Level Site Process Flow Diagram Considering Infrastructure Requirements of All Scenarios*

The above diagram provides an indication of the following:

– Organic waste feedstocks would primarily affect the hydrolyzer tank onwards, and septage/sewage would bypass the existing dumping station and drum separator process and make its way directly into the hydrolyzer tank for dilution and mixing with organic feedstock.

– Input of organics waste feedstocks to the BioGRID and new digester requires that the material be suitably prepared via dilution in hydrolyzer tank and pre-processing as applicable to the waste type.

– Additional biogas would be generated and could be utilized via existing CHP system, and/or supply to potential industrial use (the reference user assessed was property adjacent to the Site).

– Additional digestate would be generated, which will continue to be managed via NASM program.

3.2 Summary of Comparative Evaluation

A visual summary of select evaluation parameters and findings for each scenario (excluding baseline Scenario 0.1 and mothball Scenario 0.2) is provided below as Figure 7. The findings are approximated to a nearest order of magnitude to simplify the comparison.

A detailed summary of the main evaluation parameters and findings for each scenario (excluding baseline Scenario 0.1 and mothball Scenario 0.2) follows below as Table 3.1.

Key Parameters	Scenarios							
	0.1	0.2	1A	1B	2A	2B	3A	3B
Organics processing (tpy) **incl. sewage/septage*	7,800	0	9,800	6,000	13,300	8,000	31,800	31,600
Tipping fees (2021 $)	162K	0	193K	445K	246K	616K	822K	1.27M
Incremental capital investment (2021 $)	N/A	N/A	1.3M	0.7M	1.3M	1.5M	17.8M	16.6M
Gas production (m^3/hr)	45	0	45	45	105	65	220	210
Electricity generation (kWh/day) **for FIT contract*	1,000	0	2,400	2,400	2,400	2,400	2,400	2,400
Emissions reductions (eCO_2T/yr)	11	0	65	25	1,650	860	9,490	9,260
Digestate production (m^3/day) **has cost to land apply*	15	0	30	35	45	50	100	95

Figure 7 Visual Summary of Scenarios and Select Evaluation Findings

Table 3.1 Detailed Summary of Scenarios and Main Evaluation Findings

Main Parameters	Scenarios					
	1A	1B	2A	2B	3A	3B
Total Feed to BioGRID (m^3/year)	11,000	12,258	16,385	17,972	36,196	34,257
Breakdown for feedstocks						
ICI Slurry (m^3/year)	3,077	N/A	8,462	N/A	8,462	N/A
SSO Slurry (m^3/year)	N/A	9,429	N/A	15,143	N/A	15,143
Raw SSO (tonnes/year)	N/A	N/A	N/A	N/A	5,750 in addition to Scenario 2A pre-processed ICI for total of 11,250 (equivalent to 15,538 m^3/year)	5,750 in addition to Scenario 2B for total of 11,050 (equivalent to 13,600 m^3/year)
Current Septage / Sewage (m^3/year)	5,094	N/A(1)	5,094	N/A(1)	17,828(2)	17,828(2)
Current Organics (m^3/year)	2,829	2,829	2,829	2,829	2,829	2,829
Organic Loading Rate (OLR) to BioGRID (kg-VS/m^3/day)	1.5	1.5	3.6	2.2	3.6	3.5
Tipping Fees (2021 $)	$193K	$445K	$246K	$616K	$822K	$1.27M
Incremental Capital Cost Estimate (2021 $)	$1.3M	$0.7M	$1.3M	$1.5M	$17.8M	$16.6M
Total Capital Cost Estimate (2021 $)	$1.3M	$0.7M	$2.6M	$2.2M	$19.8M	$18.8M
Operating Cost Estimate (2021 $)	$1.0M	$0.9M	$1.2M	$1.0M	$2.1M	$2.5M
Pre-Processing Operating Cost Estimate (2021 $)	N/A	N/A	N/A	N/A	$0.6M	$1.1M
Net Present Value (2021 $)	-$10.8M	-$4.9M	-$11.1M	-$4.8M	-$30.6M	-$28.3M
Biogas Production (m^3/hr)	45	45	107	68	220	214
Digestate Quantity (m^3/day)	30	34	45	49	99	94
GHG Emission Reductions (tonnes CO2e per yr)	66	26	1,654	863	9,489	9,257
Landfill Diversion (tonnes/year)	N/A	N/A	N/A	N/A	5,750	11,050
Estimated Additional Trucks to Site (per day)(3)	4	5.5	6.5	6	12.5	12

Notes:

(1) Scenarios 1B and 2B would continue to accept septage/sewage, though it would not be used as BioGRID feedstock.
(2) Scenarios 3A and 3B require 3.5x additional dilution water.
(3) Percent increase from current conditions cannot be calculated as current number of trucks is unknown.

Each scenario was comparatively evaluated for its financial, technical, environmental and social impacts. A total of 16 criteria were used for the evaluation under each of these four headings, including both quantitative and qualitative analyses. Based on the analyses, a score of 0 to 10 was given for each criterion; 5 meaning comparable to other options, 10 meaning much more favourable as compared to other options, 0 meaning much less favourable as compared to other options. Each criterion was given a weighting within each category and is currently weighted evenly. Each category was given 25 percent of the overall total score.

Supporting documentation for the evaluation are included in the appendices as noted below:

- Appendix E: Evaluation Matrix
- Appendix F: Sample Calculations for Evaluation, including Net Present Value (NPV)
- Appendix G: Estimated Financial Summary, Mass Balance, Truck Estimation, GHG Emissions Calculations

This evaluation does not assess the feasibility of implementation with respect to external factors such as contracts and does not evaluate the implementation of the SSO program within Grey County or adjacent municipalities.

Carbon credits were not included as revenue during this assessment. There will be an environmental benefit associated with this practice, however the structure of potential carbon credits as it relates to the Project was not known at the time of this Report. Recommendation | Georgian Bluffs monitor this space as time progresses, as the implementation of increasing carbon tax prices will lead to investment of renewable energy projects by the federal government.

The Greenhouse Gas Pollution Pricing Act (GGPPA) was passed in 2018, giving the Federal Government a 'backstop' instrument to impose a price on carbon in jurisdictions without their own pricing systems. The GGPPA sets up two distinct elements:

- A carbon levy applied to fossil fuels (fuel surcharge), and
- An Output-Based Pricing System (OBPS) for industrial facilities that emit greater than 50,000 tCO_2e annually

Since Ontario dismantled its cap-and-trade system in 2018, it had fallen under the GGPPA. The federal Supreme Court recently upheld the constitutionality of the legislation[1].

For municipalities, the main implication of the GGPPA is the rising fuel cost that results from the price of carbon. The price on carbon is currently only enshrined in the GGPPA regulations until 2022, but federal policy[1] signals that it will continue to rise by $15 per year at least until 2030 when it will reach $170/$tCO_2e$. This price would affect liquid (e.g., gasoline, diesel) and gaseous (e.g., natural gas) fuels that the municipalities purchase.

The rising fuel cost under the GGPPA will be slightly attenuated by the increasing renewable content in fuels required under the Clean Fuel Standard Regulations (which come under the Canadian Environmental Protection Act). However, the current draft Clean Fuel Standard Regulations[1] (set to pass in late 2021) only target liquid fuels, and not gaseous. This does not directly increase the demand for renewable natural gas through a renewable content standard on natural gas, but it does incentivize fuel switching to natural gas and/or renewable natural gas.

A secondary implication of the GGPPA is the potential opportunity to generate GHG savings which may be sold as offsets to OBPS-covered facilities to help them reach their carbon benchmarks. The draft Greenhouse Gas Offset Credit System Regulations[1] were released in March 2021, with offset protocols themselves to come in the future, however the draft regulation lists both landfill methane projects and soil organic carbon enhancement as areas offsets will be developed for, each of which may have intersections with the organic waste processing system. GHD notes the offsets must be "real, additional, quantified, verified, unique, and permanent".

3.3 Summary of Key Assumptions

The below provides a discussion on key assumptions for the setting of Scenarios. Further assumptions are detailed within this report and in appended supporting documentation.

Key assumptions as discussed herein relate to the potential organic waste feedstock options, pre-processing technologies, capacity for further AD, biogas utilization, and digestate management.

3.3.1 Organic Waste Feedstock Options

Options of organic waste as feedstocks were reviewed and developed as detailed in the Technical Memorandum #1 Draft Version C (Appendix A). Options included: SSO, ICI organics, FOG, hauled septage, agricultural waste, and garburator waste, though only SSO and ICI organics were carried forward for further evaluation as potential organic waste feedstock options for this Project.

The scenarios therefore consider potentially different feedstocks or quantities of feedstock types based on the objectives of the scenario, maintaining differentiation between relatively simpler next steps (e.g., to maximize FIT contract versus maximizing BioGRID digestion capacity), and the relative use of maintaining septage/sewage as part of select scenarios (i.e., where it is can generate a tipping fee and also be used to dilute higher solids feedstocks versus the use of potable water). For clarity, as the scenarios are stepwise and, in this sense, evolve over time, the assessment shifts to higher biomethane potential feedstocks in place of septage/sewage.

***SSO* |** An estimated total of 4,100 tonnes of municipal residential SSO is potentially available annually within Georgian Bluffs, Chatsworth, and neigbouring municipalities/townships within Grey County, including Meaford, Hanover, Grey Highlands, Blue Mountains, and Southgate. See Table 6.6 in Appendix A for more information.

***ICI* |** In addition to existing ICI feedstock sources currently received at the Site, an industrial composting facility can provide pre-processed ICI organic waste for processing at the BioGRID. The ICI organic waste is pre-processed at the facility via a de-packager, which would provide a high-solids feedstock for BioGRID (18-20 percent total solids content [TS]). Loading and unloading equipment will be required at the facility to allow for this material to be transported to the BioGRID. It has been assumed that the pre-processed ICI will be contaminant free (less than 5 percent contamination), with a particle size restriction of <1mm (an important parameter for the proposed feed system upgrades).

Organic material from the ICI sector (e.g., solid organic material and FOG from industry and restaurants) are not mandated or regulated within Ontario to separate this material from its mixed waste. There is a considerable opportunity to capture and divert more organic material from this waste stream as not all businesses separate organics at the source. For general reference, another ICI organic waste source may include the Chapman's ice cream manufacturing facility located in Markdale, Ontario. They may be interested in having some of their waste be processed at the BioGRID facility, as they are reaching capacity at the storage facility they built at another farm.

3.3.2 Pre-Processing Technologies

There are limited demonstrated pre-processing technology applications in Canada, the pre-processing technologies considered include: Biosqueeze by Fitec, Advanced Digestion Technology Re: Sep 2.0 depackager by SUEZ, Organics Extrusion Press OREX by Anaergia, Waste Pulper by BTA, and food de-packer by Haarslev.

Pre-processing technologies are available for Scenarios 2B, 3A and 3B, and their selection and applicability would somewhat vary depending on throughput quantity (due to economies of scale). The Joint Board should consider releasing a Request for Expression of Interest to gauge the industry's capabilities and interest in this project and help select a pre-processing technology.

Consideration was also given to refurbishing/retrofitting pre-processing equipment that was removed from the City of Toronto Dufferin Organics Processing Facility, which is currently being stored at the Site. According to the GSS report (2018), the SSO equipment would have a capacity to process 40,000 tonnes per year (tpy) of SSO or 160 tonnes daily for 250 days. This is significantly larger than the maximum 11,250 tpy of SSO considered in Scenario 3B and would result in larger footprint requirements and operational costs. In addition, GSS also notes that the supply and installation of the old pre-processing system (pulper and grit removal system) will cost $1,155,000. For comparison, a new pre-processing system is estimated to cost $1,728,000. Thus, refurbishing/retrofitting old pre-processing equipment was not considered in the evaluation for the Project Scenarios.

3.3.3 Capacity and Process for AD

The assessment undertaken as part Technical Memorandum #1 Draft Version C (Appendix A) has identified that there currently is capacity in the BioGRID and that it is fed at a much lower rate than its design capacity. Scenarios 2A and 2B consider maximizing the existing BioGRID capacity. An additional anaerobic digester will be implemented to process additional raw SSO as required in Scenario 3A and 3B.

The added infrastructure needed for processing organic waste feedstocks in slurry form includes:

– Receiving pre-processed ICI feedstock in a receiving building to be situated west of the hydrolyzer and a conveyor system to feed the material into the hydrolyzer. This is required in Scenarios 1A, 2A and 3A due to incoming high solids ICI slurry.
– Upgrading chopping/grinding and mixing capabilities in the hydrolyzer tank to help with dilution of high solids ICI slurry with low solids septage and sewage. This is required for all Project Scenarios.

The added infrastructure needed for processing raw organic waste includes:

– Receiving and pre-processing raw SSO in a feedstock receiving building to be situated east of the BioGRID. This is required in Scenarios 3A and 3B.
– Storing pre-processed SSO slurry within buffer/storage tank. This is required in Scenarios 3A and 3B.
– Feeding slurry from the buffer/storage tank to the new digester. This is required in Scenarios 3A and 3B.

All Project Scenarios will require added infrastructure for management of biogas and digestate, including:

– Existing CHP system for biogas utilization and revenue via FIT contract.
– Piping excess biogas to potential industrial use.
– Flaring unused biogas.

The estimated footprint and indicative placement for all necessary infrastructure required for each Project Scenario is included in Appendix H.

A minimum hydraulic retention time (HRT) of 20 days has been used as a limitation in this assessment to be maintained within the BioGRID so the total digester capacity is not surpassed.

The BioGRID was designed for an Organic Loading Rate (OLR) of 4 kilogram of volatile solids (VS) per cubic metre (kg-VS/m^3) of the digester volume per day. That being said, a mesophilic anaerobic digester is typically loaded at an OLR of 3-3.2 kg-VS/m^3/day. A maximum OLR of 3.6 kg-VS/m^3/day has been used as a limitation in this assessment.

3.3.4 Biogas Utilization

Biogas is a mixture of methane (55-65 percent typically), carbon dioxide (30-35 percent typically) and smaller amounts of other gases, including nitrogen, oxygen, hydrogen sulphide, and ammonia. Methane quantity varies depending on the biomethane potential (BMP) of the feedstock source. The BMP of SSO is much higher as compared to sewage sludge. Hydrogen sulphide is corrosive and the concentration of this should be considered when considering biogas utilization. Ammonia could lead to odour issues if not managed properly.

Typical biogas utilization options include:

– Low-grade fuel for direct fuel use and/or heating purposes. The Joint Board can consider using biogas to fuel a portion of heating needs through boiler usage.
– Medium-grade fuel through microturbines, reciprocating engines, gas turbines, and CHP units for electricity and/or heat generation. The Joint Board can continue to produce electricity via the existing CHP unit after the FIT contract expires to fuel a portion of the electricity needs onsite.
– High-grade fuel at natural gas pipeline quality (RNG), vehicle fuel such as compressed natural gas (CNG), or fuel cells. An RNG project involving injection of RNG into Enbridge’s natural gas distribution system is economically

feasible with a minimum of 300 m^3/hour of biogas to be generated on a continuous basis. There is insufficient biogas for consideration of this biogas utilization option at this time.

- Assuming biogas to RNG production at a level suitable for investment as well as agreement with Enbridge, it may be possible at that point in time to discuss with Enbridge the opportunity for net metering for RNG injection and direct-municipal use at other facilities (same end-user), essentially allowing RNG to the natural gas grid for a credit towards municipal natural gas uses/costs. Relevant to this, Enbridge initiated in April 2021 a voluntary 'opt-up' program[1] where natural gas users can sign up to financially contribute to Enbridge purchase and addition of RNG to the grid. This will assist in increasing generation and purchases of RNG content for the grid.

– Hydrogen generation from biogas for fuel cell powered. Further assessment needs to be carried out for potential use as this market is evolving.

The two main biogas utilization options from a revenue standpoint include:

– Revenue from selling electricity via existing FIT contract until it expires

– Revenue from selling excess biogas to potential industrial use

Revenue from selling electricity via existing FIT contract until it expires

Approximately 1,074 m^3/day of biogas is required to maximize the CHP FIT contract capacity of 100 kW. On average, the BioGRID produces 490 m^3/day or 20 m^3/hour of biogas, all of which is utilized in the CHP unit to generate revenue via the FIT contract. This is equivalent to only 45 kW of CHP power. Biogas quantity will increase as additional organic waste is processed via the BioGRID, and a maximum of up to 5,245 m^3/day or 219 m^3/hour can be produced in Scenario 3B. In Scenarios 1A, 1B, 2A and 2B, the revenue potential from the existing CHP FIT contract is maximized, resulting in approximately $140,000 annually. This accounts for a downtime period of approximately 14 days, which is lesser than current operations. Biogas will be flared during the downtime period. Scenarios 3A and 3B commence after the FIT contract expires.

Revenue from selling excess biogas to potential industrial use

For biogas produced in excess of the CHP FIT contract capacity in Project Scenarios 2A and 2B, and for all of the biogas produced in Scenarios 3A and 3B after the CHP FIT contract expires on May 2, 2031, other sources of revenue were explored. A reference use was considered for the Project as being the adjacent property, which includes the Harold Sutherland Construction Ltd. Downs Asphalt Plant[2] (HSC). In this reference arrangement, the excess biogas would be piped and sold to the HSC, where it could displace the use of natural gas. The use of natural gas at this reference industrial use would vary seasonally due to the nature of the facility operations and this could result in flared biogas at the WWTW during the months from November through April (when heating demands are minimal). The potential demand at the HSC has not been confirmed.

As part of the stakeholder engagement process conducted by OCWA, additional information on the potential biogas demand of HSC, biogas pricing, along with other potential revenue options for excess biogas may be gathered from stakeholders. From stakeholder engagement to date, OCWA has advised there are other options also for future review and biogas utilization in excess of the FIT contract with noted stakeholder interest, whereby these could be further explored, and as alternatives to the reference arrangement assessed in this Project as an example potential industrial use.

Select relevant considerations for the assessment include:

– Piping the biogas to the property line, whereby there could be discussion with the potential user as to cost sharing for the remainder of the pipeline capital costs. A 200 m pipeline capital cost is approximately $600,000 based on $3,000/m. A purchase agreement with the potential industrial user could provide for some revenue to the Joint Board, either similar to existing natural gas pricing based on energy content or slightly higher if the potential industrial user is interested in paying a premium for renewable fuel. Energy content of biogas is approximately 60

[1] https://www.enbridge.com/Stories/2021/April/Enbridge-Gas-OptUp-voluntary-renewable-natural-gas-initiative.aspx
[2] http://hsc-ltd.com/products/aggregates/

percent of that in natural gas. In line with the above note on the Enbridge voluntary RNG opt-up program, it is considered that discussion and agreement with Enbridge, as well as ongoing stakeholder engagement, could further define and set a potential arrangement for industrial use.

– The fuel delivery requirements may entail gas treatment to remove corrosive elements, constituents that could foul the end users gas fired appliances and allow the end user to exhaust to atmosphere without significant gas treatment. To make the distribution practical, compressors will be required to convey the gas. There may also be retrofit costs for the fuel gas train to supply biogas to the receiving system. It is typically recommended that any heating system using biogas also be fed with another fuel supply for potential periods when the biogas may, for any reason, be unavailable. Associated costs would be the responsibility of the receiver of the gas.

3.3.5 Digestate Management

Currently, the digestate from the BioGRID is trucked offsite for land application via NASM for $9/m^3 and is classified as Category 3 NASM. This is considered to be one of the cheapest digestate management options, primarily comprised of transportation costs, and was continued throughout all Project Scenarios. It should be noted that while digestate TS percent is currently low at 1-3 percent in Scenario 0.1, it may increase in other Project Scenarios (Scenarios 2 and 3) due to the increase in BioGRID feed TS percentage. It is assumed that the increase in digestate TS percent and feedstock quality will not affect current digestate management contracts and that an increase in digestate volume will continue to be accepted by current farm contracts.

3.4 Scenario 0.1 – Status Quo

This Scenario considered the current operations of the Site as is to provide a baseline condition for comparison with other Project Scenarios. Digestate is currently managed via NASM land application program and biogas is utilized in CHP to generate electricity via FIT Contract.

A summary of the main evaluation parameters for this scenario is provided below in Table 3.2.

Table 3.2 Summary of Scenario 0.1 Evaluation Parameters

Parameters	Scenario 0.1
Septage / Sewage to Site (m^3/year)	8,773
Direct Septage / Sewage to Lagoon (m^3/year)	3,679
Septage / Sewage to BioGRID (m^3/year)	5,094
Dewatered Septage / Sewage to BioGRID (m^3/year)	1,885
Remaining Septage / Sewage to Lagoon (m^3/year)	3,593
Organics to BioGRID (m^3/year)	2,829
Total Feed to BioGRID (m^3/year)	4,714
Total Feed to BioGRID (m^3/day)	13
Annual Operating Cost ($/year)	$574,593
Annual Tip Fee Revenue ($/year)	$162,299
Annual CHP FIT Contract Revenue ($/year)	$65,895
Total Annual Revenue ($/year)	$228,194
Net Annual Revenue ($/year)	-$346,399
Biogas Production (m^3/hr)	20
Digestate Production Rate (m^3/day)	13

Parameters	Scenario 0.1
GHG Emission Reductions (tonnes of carbon dioxide equivalent [CO2e/year]) *based on landfill with 70 percent methane recovery	11.9
Landfill Diversion (tpy)	0
Estimated Additional Trucks to Site (per day)	N/A

A process flow diagram for this Scenario was developed and is provided in Section 2.1 as Figure 3.

3.5 Scenario 0.2 – Mothball BioGRID

This Scenario considered the findings of the concurrent study, which provides an evaluation of decommissioning, maintenance, and recommissioning tasks and costs pertaining to the potential mothballing of the BioGRID for a period of five years, and separate operation of the sewage lagoons. A copy of the concurrent study Technical Memoranda #1 and #2 are provided as Appendix C.

The concurrent study summarizes probable costs for decommissioning tasks to be around $420K or $84K on an annualized basis. This Scenario was not included in this Project evaluation. However, the Joint Board has the option of decommissioning the BioGRID for a five-year period in place of implementing Scenario 1A or 1B and recommissioning the BioGRID part way through the assessed Scenario 2A or 2B timeframe. It is anticipated that this timeframe would allow for the implementation period of an SSO collection program within Grey County or other, and for an increase in organic waste feedstocks in the market.

Upon decommissioning the BioGRID, the sewage lagoons can be operated separately with the current septage/sewage customers (refer review of sewage lagoons undertaken as part of this project and summarized above in Section 2.2). The sewage lagoons cannot accept current FOG and other organic waste due to the high strength of the material. Accordingly,, that tip fee revenue stream would need to be stopped during the five-year mothballing period. This would result in a loss of around $56K annually of FOG and organic waste material from the overall $162K annual tip fee revenue, resulting in annual tip fee revenue of $106K.

The CHP would not be generating revenue (currently around $66K per year). The standalone annual operation costs of the sewage lagoons were estimated at around $158K (further definition and needs for standalone operation and costs should be undertaken, based on operations data not available to GHD). This results in an estimated net annual revenue of -$347K, which is greater than continuing current operations at a net annual revenue of -$52K. The concurrent study identifies recommissioning costs of around $140K (or $28K on an annualized basis).

A summary of the above costing discussion is provided in Table 3.3, providing comparison of Scenario 0.1 (baseline status quo) and Scenario 0.2 (mothball).

Table 3.3 Summary of Scenario 0.1 and Scenario 0.2 Evaluation Parameters

Cost Item	Scenario 0.1	Scenario 0.2
Total Decommissioning Cost (five-year period) ($)	$0	$420K(1)
Annualized Decommissioning Cost ($/year)	$0	$84K
Total Recommissioning Cost ($)	$0	$140K(2)
Annualized Recommissioning Cost ($/year)	$0	$28K
Annual Operating Cost ($/year)	$575K	$158K
Total Annual Cost ($/year)	**$575K**	**$270K**
Annual Tip Fee Revenue ($/year)	$162K	$106K
Annual CHP FIT Contract Revenue ($/year)	$66K	$0

Cost Item	Scenario 0.1	Scenario 0.2
Total Annual Revenue ($/year)	**$228K**	**$106K**
Net Annual Revenue ($/year)	**-$347K**	**-$164K**
Difference in Annual Revenue (over five-year period) ($)	**$0.9M**	
Notes: (1) Around 75% of the estimated decommissioning cost (at $307K) is based on the cleanout of BioGRID system contents within the digester. The cleanout for decommissioning is an activity also undertaken on a facility-specific frequency for the management of AD performance. That is, generally inert material accumulates over time and displaces capacity for AD performance. Accordingly, digesters are cleaned out as needed based on the facility feedstock (characterization is recommended as part of this Report) and the monitoring and management of expected performance. Operations staff have indicated cleanout has been budgeted for a frequency of every 8-10, though not approved to go ahead to date, and thus a cleanout has not yet been undertaken since the facility was put into operation during 2011. (2) Estimated cost based on set activities to restart operation of BioGRID system. Costing does not account for potential changes to regulation that may require additional activities or infrastructure to be implemented at the time of recommissioning. While it is possible that additional scrutiny or requirements be put in place, it cannot be known at this time, consultation with MECP is recommended. Noting it is possible the MECP review and revise requirements for existing facilities and their approvals, whether operating or mothballed. For instance, an ECA amendment allows the MECP to review/revise the complete conditions of an ECA.		

3.6 Scenario 1A – Receive Pre-Processed ICI Slurry & Maximize CHP FIT Contract

3.6.1 Description

This Scenario considered enhancing Status Quo Scenario 0.1 by managing an additional 3,077 m^3/year of pre-processed ICI waste and processing it in the BioGRID with the current septage/sewage and organic waste feedstock accepted. In this scenario, biogas is continued to be used as a renewable fuel for the existing CHP unit to maximize use of FIT contract of 100 kW.

The following list summarizes key Scenario details, process changes, and infrastructure required:

– High-solids pre-processed ICI slurry at 20 percent TS may require loading equipment to be installed at the industrial composting facility to allow for this material to be loaded into trucks and transported to the BioGRID. The capital and operating costs for this equipment were not considered in the evaluation.

– A building will be required to allow for the ICI slurry to be unloaded on a tip floor and a loader operator will be required to load the material into the hydrolyzer tank. Current setup of the hydrolyzer tank does not allow for direct unloading of such a thick slurry. The capital and operating costs for this feedstock building were considered in the evaluation.

– All of the septage and sewage that is currently fed to the drum separator route will be directly conveyed to the hydrolyzer tank instead. Operation of the drum screen separator will no longer be required. Organic waste that is currently being fed into the FOG tank will continue to be conveyed into the hydrolyzer tank to add to mixing. All the substrates will be taken into the hydrolyzer, and grinded and mixed with the enhanced chopper and feed pump. Mixed and diluted slurry will be then conveyed to the BioGRID. There is enough septage/sewage (which is noted to be approximately 1 percent TS) and organic waste (which is noted to be approximately 4 percent TS) quantities available to allow for dilution of the ICI high solids. Modification of the hydrolyzer feeding system and the mixing system is needed to repurpose the hydrolyzer as a feed dilution and buffer tank for the BioGRID. The capital and operating costs for the mixing equipment were considered in the evaluation.

– The combined slurry feedstock slurry TS percent will be lowered to 7 percent prior to being fed to the BioGRID. Installation of additional mixing system for the BioGRID might need to be considered to allow for additional mixing in the BioGRID. The capital and operating costs for the mixing equipment were considered in the evaluation.

– A new odour control system will need to be implemented to process additional air flows from the new feedstock receiving building in addition to current process flows from the FOG tank, hydrolyzer, and pasteurizer. The capital and operating costs for a new lower cost containerized odour control system with woodchips were considered in the evaluation.
– Digestate will continue to be managed via current NASM land application program. There is sufficient capacity in the existing two digestate storage tanks.
– Biogas will be utilized in CHP to generate electricity via FIT Contract. A biogas flare will need to be installed to allow for biogas to be flared after the FIT contract expires. The capital and operating costs for the new flare were considered in the evaluation.
– Road infrastructure upgrades will be required at the Site entrance and near the new feedstock receiving building to allow for better movement of trucks within the Site. The capital costs for road upgrades were considered in the evaluation.
– This Scenario was modelled to commence on May 2, 2022. Additional 3,077 m^3/year of pre-processed ICI material (equivalent to 2,000 tpy of raw ICI material) will be sufficient to maximize the CHP FIT Contract until it expires on May 1, 2031. Beginning May 2, 2031, biogas will be flared until project end on May 2, 2041.

The estimated footprint and indicative placement for all necessary infrastructure required for this Scenario is included in Figure 1 of Appendix H.

A summary of the main evaluation parameters for this scenario was provided earlier above in Table 3.2.

A detailed process flow diagram for this Scenario was developed and is provided as Figure 1 of Appendix D.

3.6.2 Cost Estimate

The capital cost of Scenario 1A is estimated to be $1,325,500. Considerations for capital cost include design, approvals, permits, construction management, site works, as well as construction of above-mentioned infrastructure.

The annual revenue is estimated to be $333,000 (2021 dollars). The annual operating cost is estimated to be $960,000 (2021 dollars), an incremental increase of approximately $385,000 from status quo (Scenario 0.1). Considerations for operating cost include:

– 1 additional full-time employee for receipt and managing of pre-processed ICI slurry, and 1 full-time employee to oversee BioGRID operations, CHP operations, as well as utility costs, operator costs, and maintenance costs.
– Value of the project after 20 years was calculated to be $316,667 assuming 30-year lifespan on new infrastructure for which 3 percent discount rate was used.
– Increase in digestate disposal costs was incorporated in the evaluation.
– The Net Present Value is estimated at -$10.8 million for a 20-year time period.

3.6.3 GHG Emissions Reductions

In general, key sources of GHG emissions for all Study Scenarios include: organic waste diversion from landfill, organic waste diversion from a composting facility to an AD facility, biogas usage via CHP, and/or biogas usage via neighbour. For this scenario, GHG emissions are realized by diverting ICI material from the composting facility and for generating electricity for the grid. Approximately 66 t CO_2e could be offset annually.

3.6.4 Evaluation Assessment Results

A summary of the results of the evaluation, using stop light colours to signify highest score (green), middle score (yellow), and lowest score (red), is presented in Appendix E. Scenario 1A ranked third out of the six options.

Highlights for Scenario 1A include:

– Only one additional feedstock contract would need to be managed to receive the pre-processed ICI slurry.

– Tip fee of $10/tonne can be realized for the ICI slurry.
– Annual revenue from CHP FIT Contract can be maximized, resulting in approximately $140,000 annually.

Drawbacks for Scenario 1A include:

– Additional pre-processing infrastructure could be required at the composting facility site.
– GHG emissions reductions potential are not high as this material is not being diverted from landfill.
– Increased truck traffic at the Site to 4 trucks per day.

3.7 Scenario 1B – Receive Pre-Processed SSO Slurry & Maximize CHP FIT Contract

3.7.1 Description

This Scenario considered enhancing Status Quo Scenario 0.1 by managing an additional 9,429 m^3/year of pre-processed SSO (equivalent to 3,300 tpy of raw SSO) waste from ICI and MSW processing facility(ies) at the Site and processing it in the BioGRID with the current organic waste feedstock accepted. In this scenario, biogas is continued to be used as a renewable fuel for the existing CHP unit to maximize use of FIT contract of 100 kW.

The following list summarizes key Scenario details, process changes, and infrastructure required:

– Typical pre-processed SSO slurry at 7 percent TS will be transported to the Site and fed directly into the hydrolyzer tank, for which enhancements (e.g., mixers, etc.) to the current hydrolyzer feeding system will be needed. The capital and operating costs for this equipment were considered in the evaluation.
– All of the septage and sewage that is currently fed to the BioGRID via Dumping Station No. 2, followed by the drum screen and drum separator route will be bypassed and this material will be conveyed directly into lagoon. The drum screen and drum separator will no longer be required. This material is not needed for dilution purposes as the BioGRID can be fed at 7 percent TS. Organic waste that is currently being fed into the FOG tank will continue to be conveyed into the hydrolyzer tank to add to mixing to prepare a more homogeneous material.
– The combined slurry feedstock slurry TS of 6 percent will be fed to the BioGRID. Mixers within the BioGRID will need to be upgraded to allow for additional mixing to occur. The capital and operating costs for the mixing equipment were considered in the evaluation.
– A new odour control system will need to be implemented to process additional air flows from current process flows from the FOG tank, hydrolyzer, and pasteurizer. The capital and operating costs for a new containerized odour control system were considered in the evaluation.
– Digestate will continue to be managed via current NASM land application program. There is sufficient capacity in the existing two digestate storage tanks.
– Biogas will be utilized in CHP to generate electricity via FIT Contract. A biogas flare will need to be installed to allow for biogas to be flared after the FIT contract expires. The capital and operating costs for the new flare were considered in the evaluation.
– Road infrastructure upgrades will be required at the Site entrance and near the hydrolyzer tank to allow for better movement of trucks within the Site. The capital costs for road upgrades were considered in the evaluation.
– This Scenario would commence on May 2, 2022. Additional 9,429 m^3/year of pre-processed SSO (equivalent to 3,300 tpy of raw SSO) will be sufficient to maximize the CHP FIT Contract until it expires on May 1, 2031. Beginning May 2, 2031, biogas will be flared until project end on May 2, 2041.

The estimated footprint and indicative placement for all necessary infrastructure required for this Scenario is included in Figure 2 of Appendix H.

A summary of the main evaluation parameters for this scenario was provided earlier above in Table 3.2.

A detailed process flow diagram for this Scenario was developed and is provided as Figure 2 of Appendix D.

3.7.2 Cost Estimate

Capital cost is estimated to be $760,000. Considerations for capital cost include design, approvals, permits, construction management, site works, as well as construction of above-mentioned infrastructure.

The annual revenue is estimated to be $584,000 (2021 dollars). Annual operating cost is estimated to be $843,000 (2021 dollars), an incremental increase of approximately $269,000 from status quo (Scenario 0.1). Considerations for operating cost include:

– 1 full-time employee to oversee BioGRID operations, CHP operations, as well as utility costs, operator costs, and maintenance costs.
– Value of the project after 20 years was calculated to be $150,000 assuming 30-year lifespan on new infrastructure for which 3 percent discount rate was used.
– Increase in digestate disposal costs was incorporated in the evaluation.
– The Net Present Value is estimated at -$5.0 million for a 20-year time period.

3.7.3 GHG Emissions Reductions

GHG emissions are realized by diverting SSO material from an existing organic waste processing facility for this scenario, and for generating electricity for the grid. It was determined that there would be no increase in GHG emission reduction from one AD facility to another. Depending on where the organic waste processing facility is located, in comparison to the BioGRID, driving distance for transporting feedstock to the BioGRID could increase GHG emissions. Approximately 26 t CO_2e could be offset annually.

3.7.4 Evaluation Assessment Results

A summary of the results of the evaluation, using stop light colours to signify highest score (green), middle score (yellow), and lowest score (red), is presented in Appendix E. Scenario 1B ranked first out of the six options.

Highlights for Scenario 1B include:

– Potential of only requiring one additional feedstock contract to be managed to receive the pre-processed ICI or SSO slurry.
– Tip fee of $30/tonne can be realized for the SSO slurry based on current organic waste contracts.
– Annual revenue from CHP FIT Contract can be maximized, resulting in approximately $140,000 annually.
– No significant enhancements to the BioGRID would be required (when compared with other Project Scenarios).

Drawbacks for Scenario 1B include:

– GHG emissions reductions potential are not high as this material is not being diverted from landfill.
– Increased truck traffic at the Site to 5 trucks per day.

3.8 Scenario 2A – Receive Pre-Processed ICI Slurry & Maximize BioGRID Capacity

3.8.1 Description

This Scenario considered enhancing Scenario 1A by maximizing use of existing BioGRID capacity through management of an additional 8,462 m^3/year of pre-processed ICI waste (incremental increase of 5,385 m^3/year from Scenario 1A) from an industrial composting facility at the Site and processing it in the BioGRID with the current septage/sewage and organic waste feedstock accepted. In this scenario, biogas in excess of the CHP FIT Contract, is conveyed for potential industrial use.

The following list summarizes key Scenario details, process changes, and infrastructure required:

- Feedstock receiving building was already implemented at the Site via Scenario 1A. Thus, no additional capital costs for the feedstock receiving building were considered in the evaluation.
- All the septage and sewage that are currently fed to the drum separator route will be directly conveyed to the hydrolyzer tank instead. Operation of the drum screen separator will no longer be required. Organic waste that is currently being fed into the FOG tank will continue to be conveyed into the hydrolyzer tank to add to mixing. All the substrates will be mixing in the Hydrolyzer and will be grinded and mixed with the enhanced chopper and feed pump. Mixed and diluted slurry will be then conveyed to the BioGRID. There is sufficient quantity of septage/sewage (which is noted to be 1 percent TS) and organic waste (4 percent TS) quantities available to allow for dilution of the ICI high solids. Mixers were already installed in the hydrolyzer tank to allow for dilution and mixing to occur as part of Scenario 1A. Thus, no additional capital costs for the mixing equipment were considered in the evaluation.
- The combined slurry feedstock slurry TS percentage will be lowered to 11 percent prior to being fed to the BioGRID. Mixers within the BioGRID will not need to be upgraded further to allow for additional mixing to occur. Sufficient mixing capacity was ensured as part of Scenario 1A. Thus, no additional capital costs for the mixing equipment were considered in the evaluation.
- As per the BioGRID preliminary design report, the BioGRID was designed for an OLR of 4 kg-VS/m^3 of the digester volume per day. OLR for the BioGRID has been estimated to be 3.6 kg-VS/m^3/day to provide maximum utilization of the BioGRID capacity and higher ultimate biogas production.
- Odour control system was already implemented at the Site as part of Scenario 1A. Thus, no additional capital costs for the odour control system were considered in the evaluation.
- Digestate will continue to be managed via current NASM land application program. However, one additional digestate storage tank of 2,000 m^3 will be required. The capital and operating costs for the new digestate storage tank was considered in the evaluation.
- Biogas will be utilized in CHP to generate electricity via FIT Contract. Biogas in excess of the CHP FIT Contract, and in its entirety after the FIT contract expires, will be conveyed for potential industrial use, for which an underground pipeline conveyance system will need to be implemented. The capital costs for the biogas conveyance system were considered in the evaluation.
- During CHP or biogas downtime, biogas can be flared via existing flare that was already implemented as part of Scenario 1A. Thus, no additional capital and operating costs for the new flare were considered in the evaluation.
- Road infrastructure upgrades will already be implemented at the Site entrance and near the new feedstock receiving building to allow for better movement of trucks within the Site. Further road infrastructure upgrades will be required around the new digestate storage tanks. The capital costs for these additional road upgrades were considered in the evaluation.
- This Scenario would commence on May 2, 2023 Revenue from FIT Contract will be maximized until it expires on May 1, 2031, and excess biogas will be sold for potential industrial use. Beginning May 2, 2031, biogas will be sold until project end on May 2, 2041.

The estimated footprint and indicative placement for all necessary infrastructure required for this Scenario is included in Figure 3 of Appendix H.

A summary of the main evaluation parameters for this scenario was provided earlier above in Table 3.2.

A detailed process flow diagram for this Scenario was developed and is provided as Figure 3 of Appendix D.

3.8.2 Cost Estimate

Capital cost is estimated to be $1,309,000. Considerations for capital cost include design, approvals, permits, construction management, site works, as well as construction of above-mentioned infrastructure.

The annual revenue is estimated to be $415,000 (2021 dollars). Annual operating cost is estimated to be $1,142,000 (2021 dollars), an incremental increase of approximately $182,000 from Scenario 1A. Considerations for operating cost include:

- 1 additional full-time employee for receipt and managing of pre-processed ICI slurry, and 1 full-time employee to oversee BioGRID operations, CHP operations, as well as utility costs, operator costs, and maintenance costs.
- Value of the project after 20 years was calculated to be $333,333 assuming 30-year lifespan on new infrastructure for which 3 percent discount rate was used.
- Increase in digestate disposal costs was incorporated in the evaluation.
- The Net Present Value is estimated at -$11 million for a 20-year time period.

3.8.3 GHG Emissions Reductions

GHG emissions are realized by diverting ICI material from the composting facility for this scenario, for generating electricity for the grid, and for offsetting natural gas at potential industrial user for their onsite needs. Approximately 1,654 t CO_2e could be offset annually.

3.8.4 Evaluation Assessment Results

A summary of the results of the evaluation, using stop light colours to signify highest score (green), middle score (yellow), and lowest score (red), is presented in Appendix E. Scenario 2A ranked fourth out of the six options.

Highlights for Scenario 2A include:

- Only one additional feedstock contract would need to be managed to receive the pre-processed ICI slurry.
- Tip fee of $10/tonne can be realized for the ICI slurry.
- Annual revenue from CHP FIT Contract can be maximized until contract expiry, after which biogas can potentially be utilized by the potential industrial user.

Drawbacks for Scenario 2A include:

- Additional digestate storage tank and road upgrades would be required.
- GHG emissions reductions potential are not high as this material is not being diverted from landfill.
- Increased truck traffic at the Site to 6 trucks per day.

3.9 Scenario 2B – Receive Raw SSO, Build Pre-Processing Facility & Maximize BioGRID Capacity

3.9.1 Description

This Scenario considered enhancing Scenario 1B by maximizing use of existing BioGRID capacity to manage additional 15,143 m^3/year of pre-processed SSO (equivalent to 5,300 tpy of raw SSO) waste from MSW with the current organic waste feedstock accepted at the Site. In this scenario, biogas in excess of the CHP FIT Contract is conveyed for potential industrial use.

The following list summarizes key Scenario details, process changes, and infrastructure required:

- Typical pre-processed SSO slurry at 7 percent TS will be transported to the Site and fed directly into the hydrolyzer tank, for which enhancements (e.g., mixers, etc.) to the current hydrolyzer feeding system will have been implemented as part of Scenario 1B. Thus, no additional capital and operating costs for this equipment were considered in the evaluation.
- All of the septage and sewage that is currently fed to the BioGRID via Dumping Station No. 2, followed by the drum screen and drum separator route will be bypassed and this material will be conveyed directly into lagoon. The drum screen and drum separator will no longer be required. This material is not needed for dilution purposes as the BioGRID can be fed at 7 percent TS. Organic waste that is currently being fed into the FOG tank will continue to be conveyed into the hydrolyzer tank to add to mixing to prepare a more homogeneous material.
- The combined slurry feedstock slurry TS of 7 percent will be fed to the BioGRID. Mixers within the BioGRID will have been upgraded to allow for additional mixing to occur as part of Scenario 1B. Thus, no additional capital and operating costs for the mixing equipment were considered in the evaluation.
- Odour control system was already implemented at the Site as part of Scenario 1B. Thus, no additional capital costs for the odour control system were considered in the evaluation.
- Digestate will continue to be managed via current NASM land application program. However, an additional digestate storage tank of 3,000 m^3 will be required. The capital and operating costs for the new digestate storage tank was considered in the evaluation.
- Biogas will be utilized in CHP to generate electricity via FIT Contract. Biogas in excess of the CHP FIT Contract, and in its entirety after the FIT contract expires, will be conveyed for potential industrial use, for which an underground pipeline conveyance system will need to be implemented. The capital costs for the biogas conveyance system were considered in the evaluation.
- During CHP or biogas downtime, biogas can be flared via existing flare that was already implemented as part of Scenario 1B. Thus, no additional capital and operating costs for the new flare were considered in the evaluation.
- Road infrastructure upgrades will already be implemented at the Site entrance and near the new feedstock receiving building to allow for better movement of trucks within the Site. Further road infrastructure upgrades will be required around the new digestate storage tanks. The capital costs for these additional road upgrades were considered in the evaluation.
- This Scenario would commence on May 2, 2023 Revenue from FIT Contract will be maximized until it expires on May 1, 2031, and excess biogas will be sold to potential industrial user. Beginning May 2, 2031, biogas will be sold until project end on May 2, 2041.

The estimated footprint and indicative placement for all necessary infrastructure required for this Scenario is included in Figure 4 of Appendix H.

A summary of the main evaluation parameters for this scenario was provided earlier above in Table 3.2.

A detailed process flow diagram for this Scenario was developed and is provided as Figure 4 of Appendix D.

3.9.2 Cost Estimate

Capital cost is estimated to be $1,500,000. Considerations for capital cost include design, approvals, permits, construction management, site works, as well as construction of above-mentioned infrastructure.

The annual revenue is estimated to be $765,800 (2021 dollars). Annual operating cost is estimated to be $957,000 (2021 dollars) an incremental increase of approximately $114,000 from Scenario 1B. Considerations for operating cost include:

- 1 full-time employee to oversee BioGRID operations, CHP operations, as well as utility costs, operator costs, and maintenance costs.
- Value of the project after 20 years was calculated to be $375,000 assuming 30-year lifespan on new infrastructure for which 3 percent discount rate was used.

- Increase in digestate disposal costs was incorporated in the evaluation.
- The Net Present Value is estimated at -$4.8 million for a 20-year time period.

3.9.3 GHG Emissions Reductions

GHG emissions are realized by diverting SSO material from an existing organic waste processing facility for this scenario, for generating electricity for the grid, and for offsetting natural gas at potential industrial user for their onsite needs. It was determined that there would be no increase in GHG emission reduction from one AD facility to another. Depending on where the organic waste processing facility is located, in comparison to the BioGRID, driving distance for transporting feedstock to the BioGRID could increase GHG emissions. Approximately 863 t CO2e could be offset annually.

3.9.4 Evaluation Assessment Results

A summary of the results of the evaluation, using stop light colours to signify highest score (green), middle score (yellow), and lowest score (red), is presented in Appendix E. Scenario 2B ranked second out of the six options.

Highlights for Scenario 2B include:

- Has the potential of only requiring one additional feedstock contract to be managed to receive pre-processed SSO. Majority of the pre-processed SSO required for this Scenario can be made available via an SSO collection program for Grey County.
- Tip fee of $30/tonne can be realized for the SSO slurry based on current organic waste contracts.
- Annual revenue from CHP FIT Contract can be maximized until contract expiry, after which biogas can potentially be utilized by the potential industrial user.
- No significant enhancements to the BioGRID would be required (when compared with other Project Scenarios).

Drawbacks for Scenario 2B include:

- Additional digestate storage tank and road upgrades would be required.
- GHG emissions reductions potential are not high as this material is not being diverted from landfill.
- Increased truck traffic at the Site to 6 trucks per day.

3.10 Scenario 3A – Receive Raw SSO, Build Pre-Processing Facility, New Digester & Maximize Site

3.10.1 Description

This Scenario considered enhancing Scenario 2A by building a new pre-processing and digester system to manage an additional 11,250 tpy (or 5,750 tpy incremental) of raw SSO waste from MSW with the current organic waste feedstock accepted at the Site. In this scenario, biogas in excess of the CHP FIT Contract is conveyed for potential industrial use.

The following list summarizes key Scenario details, process changes, and infrastructure required:

- Pre-processing system infrastructure (i.e., processing building and structure, admin building, pre-treatment equipment with grit removal, mechanical pumps, conveyors, etc., and residue management), instrumentation and controls will be required at the Site. The capital and operating costs for pre-processing system infrastructure were considered in the evaluation.
- A new digester of similar capacity to the existing BioGRID (1,000 m^3) will be required. The capital and operating costs for the new digester system infrastructure were considered in the evaluation.

- Pre-processing equipment will require potable or very low solids water to process the raw SSO into a slurry. Raw SSO is assumed to be 25 percent TS and contain 20 percent contamination. Contamination will be removed through pre-processing. Current septage and sewage quantities would have already been used for dilution as part of Scenario 2A for dilution within the existing BioGRID. An additional three times the volume of dilution water will be required, which amounts to an additional 12,734 m^3/year. This dilution water can potentially be used from the existing well on Site, provided via new potential septage and sewage customers, or brought via tankers to the Site. The related costs for this dilution water were not considered in the evaluation.
- In order for the SSO slurry to be fed to the existing hydrolyzer tank, new equipment for feeding system (i.e., buffer/storage tank, mechanical pumps, etc.) will be required. The capital costs for the new buffer/storage tank (200 m^3 double current hydrolyzer) were considered in the evaluation.
- As per the BioGRID preliminary design report, the BioGRID was designed for an OLR of 4 kg-VS/m^3 of the digester volume per day. OLR for the BioGRID has been estimated to be approximately 3.6 kg-VS/m^3/day to provide maximum utilization of the BioGRID capacity and higher ultimate biogas production.
- Odour control system was already implemented at the Site as part of Scenario 1A. Thus, no additional capital costs for the odour control system were considered in the evaluation.
- Digestate will continue to be managed via current NASM land application program, and one 2,000 m^3 digestate storage tank will have already been built as part of Scenario 2A. However, an additional digestate storage tank of 8,5000 m^3 will be required, for a total digestate storage volume of 11,500 m^3. The capital and operating costs for the new digestate storage tank was considered in the evaluation.
- Biogas will be conveyed for potential industrial use, for which an underground pipeline conveyance system will have already been implemented as part of Scenario 2A. Thus, no capital costs for the biogas conveyance system were considered in the evaluation.
- During biogas conveyance system downtime, biogas can be flared via existing flare that was already implemented as part of Scenario 1A. Thus, no additional capital and operating costs for the new flare were considered in the evaluation.
- Road infrastructure upgrades will already be implemented at the Site entrance and near the new feedstock receiving building to allow for better movement of trucks within the Site. Further road infrastructure upgrades will be required around the new digestate storage tanks, pre-processing facility and digester. The capital costs for these additional road upgrades were considered in the evaluation.
- This Scenario would commence on May 2, 2031 until project end on May 2, 2041.

The estimated footprint and indicative placement for all necessary infrastructure required for this Scenario is included in Figure 5 of Appendix H.

A summary of the main evaluation parameters for this scenario was provided earlier above in Table 3.2.

A detailed process flow diagram for this Scenario was developed and is provided as Figure 5 of Appendix D.

3.10.2 Cost Estimate

Capital cost is estimated to be $17,213,000. Considerations for capital cost include design, approvals, permits, construction management, site works, as well as construction of above-mentioned infrastructure.

The annual revenue is estimated to be $1,040,000 (2021 dollars). Annual operating cost is estimated to be $2,111,000 (2021 dollars), an incremental increase of approximately $970,000 from Scenario 2A. Considerations for operating cost include:

- 1 full-time employee for receipt and managing of raw SSO, and 1 full-time employee to oversee BioGRID operations, CHP operations, as well as utility costs, operator costs, and maintenance costs.
- Value of the project after 20 years was calculated to be $3,944,000 assuming 30-year lifespan on new infrastructure for which 3 percent discount rate was used.
- Increase in digestate disposal costs was incorporated in the evaluation.

– The Net Present Value is estimated at -$30.6 million for a 20-year time period.

3.10.3 GHG Emissions Reductions

GHG emissions are realized by diverting SSO material from landfill for this scenario, and for offsetting natural gas at potential industrial user for their onsite needs. Approximately 9,489 t CO2e could be offset annually.

3.10.4 Evaluation Assessment Results

A summary of the results of the evaluation, using stop light colours to signify highest score (green), middle score (yellow), and lowest score (red), is presented in Appendix E. Scenario 2B ranked sixth (or last) out of the six options.

Highlights for Scenario 3A include:

- Tip fee of $100/tonne can be realized for the raw SSO.
- GHG emissions reductions potential are higher as this material is being diverted from landfill.

Drawbacks for Scenario 3A include:

- Significant pre-processing system infrastructure would be required.
- A new digester and related infrastructure would be required.
- Acquiring contracts for this quantity of SSO be difficult.
- Potential financial risk with a project due to quantity of feedstock necessary and increased digestate management.
- Acceptance of organic material required from outside Grey County, which may influence public perception of project.
- Anticipated changes to operations more significant compared to Scenarios 1A, 1B 2A and 2B, including increased operations and maintenance needs. Operating costs of a new digester facility are on par with the revenue generated from tip fees and could even be higher up to $120/tonne.
- Increased truck traffic at the Site to 12 trucks per day.
- Residue will need to be hauled offsite to a nearby landfill.

3.11 Scenario 3B – Receive Raw SSO, Build New Digester & Maximize Site

3.11.1 Description

This Scenario considered enhancing Scenario 2B by building a new digester system to manage additional 11,250 tpy (or 5,750 tpy incremental) of raw SSO waste from MSW with the current organic waste feedstock accepted at the Site. In this scenario, biogas in excess of the CHP FIT Contract is conveyed for potential industrial use.

The following list summarizes key Scenario details, process changes, and infrastructure required:

- Pre-processing system infrastructure (i.e., processing building and structure, admin building, pre-treatment equipment with grit removal, mechanical pumps, conveyors, etc., and residue management), instrumentation and controls will be required at the Site. The capital and operating costs for pre-processing system infrastructure were considered in the evaluation.
- A new digester of similar capacity to the existing BioGRID (1000 m^3) will be required. The capital and operating costs for the new digester system infrastructure were considered in the evaluation.
- Pre-processing equipment will require potable or very low solids water to process the raw SSO into a slurry. Raw SSO is assumed to contain 20 percent contamination, which will be removed, and 25 percent TS. An additional three times the volume of dilution water will be required, which amounts to an additional 12,734 m^3/year. This

dilution water can potentially be used from the existing well on Site, provided via new potential septage and sewage customers, or brought via tankers to the Site. The related costs for this dilution water were not considered in the evaluation.

– In order for the SSO slurry to be fed to the existing hydrolyzer tank, new input system equipment (i.e., buffer/storage tank, mechanical pumps, etc.) will be required. The capital costs for the new buffer/storage tank (200 m^3 double current hydrolyzer) were considered in the evaluation. In order for the SSO slurry to be fed to the existing hydrolyzer tank, a new underground pipeline connection will be required. The capital costs for this conveyance system were considered in the evaluation.
– Odour control system was already implemented at the Site as part of Scenario 1B. Thus, no additional capital costs for the odour control system were considered in the evaluation.
– Digestate will continue to be managed via current NASM land application program, and one 3,000 m^3 digestate storage tank will have already been built as part of Scenario 2B. However, an additional digestate storage tank of 7,5000 m^3 will be required, for a total digestate storage volume of 10,500 m^3. The capital and operating costs for the new digestate storage tank was considered in the evaluation.
– Biogas will be conveyed for potential industrial use, for which an underground pipeline conveyance system will have already been implemented as part of Scenario 2B. Thus, no capital costs for the biogas conveyance system were considered in the evaluation.
– During biogas conveyance system downtime, biogas can be flared via existing flare that was already implemented as part of Scenario 1B. Thus, no additional capital and operating costs for the new flare were considered in the evaluation.
– As per the BioGRID preliminary design report, the BioGRID was designed for an OLR of 4 kg-VS/m^3 of the digester volume per day. OLR for the BioGRID has been estimated to be 3.5 kg-VS/m^3/day to provide maximum utilization of the BioGRID and higher ultimate biogas production.
– Road infrastructure upgrades will already be implemented at the Site entrance, feedstock receiving building, digestate storage tanks and pre-processing facility to allow for better movement of trucks within the Site. Further road infrastructure upgrades will be required around the digester. The capital costs for these additional road upgrades were considered in the evaluation.
– This Scenario would commence on May 2, 2031 until project end on May 2, 2041.

The estimated footprint and indicative placement for all necessary infrastructure required for this Scenario is included in Figure 6 of Appendix H.

A summary of the main evaluation parameters for this scenario was provided earlier above in Table 3.2.

A detailed process flow diagram for this Scenario was developed and is provided as Figure 6 of Appendix D.

3.11.2 Cost Estimate

Capital cost is estimated to be $16,588,000. Considerations for capital cost include design, approvals, permits, construction management, site works, as well as construction of above-mentioned infrastructure.

The annual revenue is estimated to be $1,482,000 (2021 dollars). Annual operating cost is estimated to be $2,453,000, an incremental increase of approximately $1,495,000 from Scenario 2B. Considerations for operating cost include:

– 1 full-time employee for receipt and managing of raw SSO, and 1 full-time employee to oversee BioGRID operations, CHP operations, as well as utility costs, operator costs, and maintenance costs.
– Value of the project after 20 years was calculated to be $3,736,000 assuming 30-year lifespan on new infrastructure for which 3 percent discount rate was used.
– Increase in digestate disposal costs was incorporated in the evaluation.
– The Net Present Value is estimated at -$28.3 million for a 20-year time period.

3.11.3 GHG Emissions Reductions

GHG emissions are realized by diverting SSO material from landfill for this scenario, and for offsetting natural gas at potential industrial user for their onsite needs. Approximately 9,257 CO2e could be offset annually.

3.11.4 Evaluation Assessment Results

A summary of the results of the evaluation, using stop light colours to signify highest score (green), middle score (yellow), and lowest score (red), is presented in Appendix E. Scenario 2B ranked fifth out of the six options.

Highlights for Scenario 3B include:

– Tip fee of $100/tonne can be realized for the raw SSO.
– GHG emissions reductions potential are higher as this material is being diverted from landfill.

Drawbacks for Scenario 3B include:

– Significant pre-processing system infrastructure would be required.
– A new digester and related infrastructure would be required.
– Acquiring contracts for this quantity of SSO be difficult.
– Potential financial risk with a project due to quantity of feedstock necessary and increased digestate management.
– Acceptance of organic material required from outside Grey County, which may negatively influence public perception of project.
– Anticipated changes to operations more significant compared to Scenarios 1A, 1B, 2A and 2B, including increased operations and maintenance needs. Operating costs of a new digester facility are on par with the revenue generated from tip fees and could even be higher up to $120/tonne.
– Increased truck traffic at the Site to 12 trucks per day.
– Residue will need to be hauled offsite to a nearby landfill.

3.12 Sensitivity Analysis

The scenarios developed herein are specific to the objectives set for the Project and relevant to the stepwise approaches assessed. That is, they inherently incorporate a number of assumptions and set values that require further definition and confirmation as part of a next step where a preferred approach for the Site and systems is selected. Accordingly, a high-level sensitivity analysis was completed for the Project simply to identify key assumptions or set values that have potential to substantially influence the further development (e.g., concept and detailed design) and implementation of one of the scenarios. The following parameters were identified as having key effects on the evaluation:

a. Capital cost for implementation of new infrastructure ($)
b. Rate at which biogas is sold for potential industrial use ($/m^3)
c. Tipping fee for pre-processed ICI slurry ($/m^3)
d. Tipping fee for raw SSO ($/tonne)

The above-listed parameters were modified as following to understand the relative extent of their effects on the evaluation:

a. Increase capital cost for each Scenario by 50 percent. This has a negative impact on the NPV for all Project Scenarios by approximately $370K to $8.4M.
b. Increase biogas selling rate from $0.10/m^3 (price of natural gas) to $0.20/m^3 (assuming arrangement with Enbridge including potential industrial user opting to pay a premium in support of relevant drivers toward sustainability). This will not have an impact on Scenarios 1A and 1B as biogas will be used in its entirety for CHP

unit. This has a positive impact on the NPV for Scenarios 2A, 2B, 3A and 3B by approximately $130,000 to $500,000.

c. Increase ICI slurry tip fee from $10/tonne to $20/tonne. This will not have an impact on Scenarios 1B, 2B, and 3B as they do not utilize ICI slurry material. This has a positive impact on NPV for Scenarios 1A, 2A and 3A by approximately $440K to $1.2M.

d. Decrease raw SSO tip fee from $100/tonne to $50/tonne. This will not have an impact on Scenarios 1A and 2A as they do not utilize raw SSO material. This will have a negative impact on NPV for Scenarios 3A and 3B by approximately $2M to $3.8M.

Recommendation | As noted above, once a next step is identified and where it consists of proceeding to the design stage with one of the Project scenarios (as assessed or potentially modified), the assumptions and set values would appropriately be further developed along with updated and detailed costing.

3.13 Risks and Mitigation

Potential risks and related mitigation identified for the Project are discussed below.

General Feasibility of Scenarios

– Only SSO generated from Georgian Bluffs and Chatsworth present a ‘guaranteed’ feedstock. Securing sufficient feedstock is a vital component of a sustainable AD project. This is why the Project Scenarios are set up as a staged approach whereby initially SSO within Grey County can be processed (Scenario 2B) and then seek to secure additional feedstock from neighbouring municipalities (Scenarios 3A and 3B) (e.g., following the pending Ontario landfill ban on organics) and the ICI sector (e.g., from waste haulers).

Site Layout

– There is sufficient available space at the Site for implementation of additional digestion related infrastructure as assessed in this Project (e.g., buffer/storage tank, pre-processing system, flare, digestate storage tanks, odour control system, feedstock receiving building, digester and biogas utilization system).

Financial, Environmental, Socio-Political

– A review of the tree removal required onsite for implementation of additional infrastructure was not undertaken for the Project. Such a review is recommended as required to implement additional infrastructure.

– Residences are located within approximately 500m of the Site. Though the Site is located in a rural area, several odour complaints have been made be nearby residents. It is assumed that this is primarily due to the odours escaping from the open-top digestate storage tanks. The public may be sensitive to more odours potentially generated by the new digestate storage tanks required as part of Scenario 2B, 3A and 3B. Accordingly, odour modeling would need to be undertaken and potential mitigation strategies implemented.

Approvals and Consultation

– Current waste ECA will need to be amended initially in Scenarios 1A and 1B to incorporate process changes, feedstock types received, and additional infrastructure required. For implementation of each Scenario thereafter (2A or 2B, then 3A or 3B) will require further amendment of the waste ECA.

– The current Site ECA would require additional air and noise approvals for all Project Scenarios.

– Consultation with the Grey Sauble Conservation Authority[3] would be required as part of the permitting process.

– An Environmental Assessment (EA) is not anticipated to be required for the pre-processing facility and new digester as the amount of material removed on a daily basis is below the trigger amounts as per Ontario Regulation 101/07 for the scenarios assessed.

[3] https://www.greysauble.on.ca/

Revenue and Expenses

- Biogas sales prices are based on the receiver and are highly variable based on quality, quantity, and location.
- Electricity consumption and related costs will increase based on the extent of digestion (Scenarios 3A and 3B will consume more electricity than Scenarios 1A and 1B). Discussions with utility suppliers are necessary to confirm capacity to support the Scenarios.

3.14 Stakeholder Engagement

OCWA has undertaken engagement with relevant stakeholders (i.e., organic waste haulers, organic waste processers, and neighbouring municipalities), with the general aim of defining potential quantities and availabilities of feedstocks, interest levels within the public and private sectors, and indicative market pricing. Where the information could be gathered from stakeholders it has been considered and relied on in the Project were suitable.

Details on the activities undertaken by OCWA and relayed to the Project are being prepared by OCWA under separate cover.

4. Implementation Approaches

4.1 Project Delivery Approach

There are many contract structures to be considered for a project of this nature. The following represent contract structures for projects financed solely by the Joint Board:

- Design-Bid-Build (DBB)
- Design-Build (DB)
- Design-Build-Operate (DBO)
- Design-Build-Operate-Maintain (DBOM)
- Build, Own, Operate, Transfer (BOOT)
- Build, Own, Operate (BOO)

The following contract structures represent integrated project delivery (IPD) options (or public private partnerships PPP, P3) whereby the project is still publicly owned:

- Build-Finance (BF)
- Design-Build-Finance (DBF)
- Design-Build-Finance-Maintain (DBFM)
- Design-Build-Finance-Operate-Maintain (DBFOM)

The Canadian Council for P3 depicts a spectrum of public/private sector involvement and risk allocation to the private sector for P3 contract structures, as shown below in Figure 8.[4]

[4] Canadian Council for Public-Private Partnerships. https://www.pppcouncil.ca/web/P3_Knowledge_Centre/About_P3s/Definitions_Models.aspx Website accessed June 25, 2021.

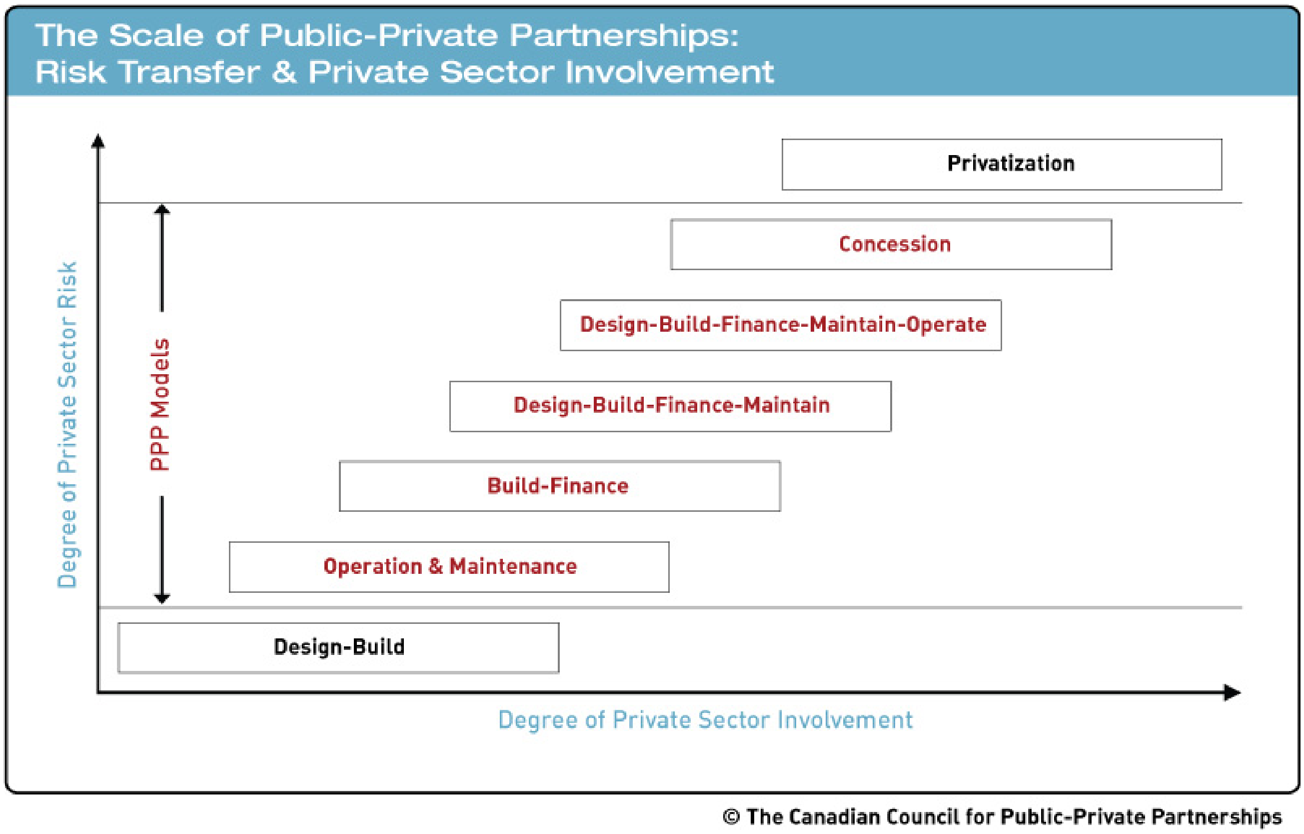


Figure 8 Spectrum of Contract Structures (Canadian Council for P3)

It is anticipated that Scenarios 2B, 3A, and 3B would be suitable for a P3 partnership, whereby a private entity would finance a portion of the project. The P3 model helps alleviate the financial burden on the municipality. Industry is required to invest in a project in partnership with the Joint Board and OCWA as applicable. Some examples of waste projects that have undergone a P3 partnership model or a DBOM project delivery approach in Ontario include:

- Stratford co-digestion project pursued P3 partnership model
- Petawawa co-digestion project is pursuing P3 partnership model
- Both of the City of Toronto's stand-alone AD facilities (Disco Road Organics Processing Facility and Dufferin Organics Processing Facility) pursued DBOM contracts.

There are also other new potential arrangements entering the market in Ontario, such as the integrated project delivery (IPD) model. In this model, a complete team is formed in advance of the project, comprising the owner, engineer, contractor, and/or operator. All team members divulge relevant stakeholder interests such as financials in a manner that builds a collaborative contract with positive and negative performance impacting all parties.

Feedstock security is important when financing projects of this nature due to the associated risks. A staged approach to the project could be taken, where capacity of the pre-processing facility accommodates Grey County's SSO with some contingency and plans for expansion if feedstock from the ICII sector can be secured over time. This would allow for deferred capital investments.

Another approach would be for the Joint Board to release a Request for Expression of Interest to industry to gauge interest in such as project, followed by the preparation of a design prior to selecting a project delivery model.

The current Site operations contract and approval-related requirements should be reviewed to potentially identify efficiencies and/or incentives that assist in maximizing the Site assets. A shift in responsibility can be made whereby the Site operator is required to ensure feedstock revenue is realized and maximized as material is brought to the Site.

We understand that the BioGRID facility inherently has value whether or not it continues to be operated by the Joint Board. The value of the current permit is approximated at $150K. The inherent value stems from the approved ECA for an organic waste processing facility, to be considered in addition to the infrastructure described below. A new permit for a similar facility could be considered as requiring around $500,000 and take approximately 48 months for the permitting planning, design, and review process (i.e., engineering and approval). There can be significant risk and liability involved if an ECA application is rejected by the MECP.

In addition, the value stems from the infrastructure built, with construction costs of the existing BioGRID facility in 2010 being $3.8 million, which is assumed to have a relatively minimal monetary value of $125,000 at the end of a 20-year period. However, the lifespan of the major assets (i.e., pre-processing equipment, digestate storage tanks, digester, flare, odour control system, biogas utilization system) is considered herein as being approximately 30 years, contingent on regular maintenance and replacement of spare parts as required. Accordingly, and based on straight-line depreciation with the facility at year 11 of a 30-year life expectancy, the BioGRID facility value is estimated to be approximately $2.4 million, in addition to the land value. The land value is estimated to be $200,000 based on, and to match, Joint Board financial statement tangible capital asset data. A further assessment of potential market value for the land was not undertaken, noting there are various considerations for a land of this historical/current use, not necessarily limited to the site setting (e.g., zoning and potential wetland; not part of this Project scope) and potential impacts from operations to site soil or water (ground and surface) and related potential remediation in the context of a site divestiture.

Together, the value of the land, ECA and the existing infrastructure around $2.75 million. This is not an appraisal of actual infrastructure value, though is intended to provide an indication only of the inherent value of the BioGRID facility. Should the Joint Board select to stop operating the BioGRID facility at the end of the Project term for financial reasons or otherwise, it can be leased or sold to another entity for continued operations. For example, Miller Waste Systems purchased the Town of Grimsby's biodigester facility known as Grimsby Energy Inc. in June 2020 for an undisclosed price[5].

4.2 Funding Opportunities

A variety of funding opportunities to be further assessed in the context of a preferred next step and project delivery approach have been identified herein, though the list is not necessarily exhaustive.

The Federation of Canadian Municipalities (FCM) have several funding programs that provide funding to Canadian municipalities and municipal project partners for a variety of environmental projects including plans, studies, pilot projects, and capital projects (Federation of Canadian Municipalities, 2020). Funding is available in the form of both loans and grants. The programs that may pertain to energy efficiency and GHG emission reduction projects are discussed in more detail below.

Green Municipal Fund

The Green Municipal Fund (GMF) provides funding for various sustainability initiatives. Examples of projects receiving funding in 2018-2019 include the following (Federation of Canadian Municipalities):

– Completion of a pilot project to encourage zero waste on a household basis.
– Construction of a wastewater treatment upgrade in a northern community.

[5] Asset data provided by Joint Board also included values for overall Site buildings and accessories (at $1.6M), overall vehicles and equipment (at $1.2M), and others (at $0.1M). Including land value, the Joint Board asset data totals $3.1M. There is a relatively small discrepancy between this value and the total assessed for the sewage lagoons system ($1.18M, per concurrent study, refer Appendix C), BioGRID system, and land value (at total of $3.78M). Further evaluation of this discrepancy could not be made as details on how the asset data were derived were not available to GHD.

Municipalities for Climate Innovation Program

The Municipalities for Climate Innovation Program provides funding for climate change projects. Examples of projects receiving funding in 2018-2019 include the following (Federation of Canadian Municipalities):

- Building retrofits and energy upgrades
- Community energy plans
- Stormwater management project
- Climate change adaptation implementation plan

Federal Budget 2021

The 2021 Federal budget (April 19, 2021) included initiatives and related spending to support transition/decarbonization of Canada's energy industry, generally also to reduce greenhouse gas emissions. Select initiatives included:

- Tax incentives via accelerated deduction (estimated $142M over five years) for investments into 'clean' energy generation and energy efficiency equipment.
- Funding (estimated $67.2M over seven years) for implementation and administration of the Clean Fuel Standard, including opportunities for Canada's biofuel producers.

Natural Resources Canada

NRCan includes a list of current funding opportunities with the Government of Canada. Funding opportunities on the website are updated as they open and close for applications. NRCan is responsible for establishing the Clean Fuels Fund, which is intended to support production/distribution of fuels that are low-carbon or zero-emission.[6]

Ontario Centre of Excellence (OCE)

The OCE is in partnership with provincial and federal governments to accelerate emerging technologies in Ontario. Both the City of Stratford and the Town Petawawa co-digestion projects have received funding through FCM and/or Ontario Centre of Excellence.[7]. There is the opportunity for the Joint Board to receive funding from multiple sources.

Canada Infrastructure Bank

The Government of Canada announced a new federal funding program for $10 billion.[8] in new major infrastructure initiatives in October 2020 through the Canada Infrastructure Bank's (CIB) Growth Plan. One of the major initiatives includes clean power to support renewable energy generation.

5. Conclusions and Recommendations

Based on the findings of the Project, the following conclusions are provided:

- The sewage lagoons system capability to operate as a standalone system was estimated using available and theoretical information. This demonstrated there is opportunity to operate the system separately from the BioGRID system, with minor disconnection at the drum screen, though there may be limitations to increasing throughput or feedstock strength from current practice.
- Organic waste feedstocks considered as being available for digestion at the BioGRID include the following:
  - Raw SSO from Grey County: 4,100 tpy

[6] https://www.nrcan.gc.ca/science-and-data/funding-partnerships/funding-opportunities/current-funding-opportunities/12398
[7] https://oce-ontario.org/programs
[8] https://pm.gc.ca/en/news/news-releases/2020/10/01/prime-minister-announces-infrastructure-plan-create-jobs-and-grow#:~:text=The%20Prime%20Minister%2C%20Justin%20Trudeau,60%2C000%20jobs%20across%20the%20country.

- Pre-processed ICI from industrial composting facility: up to 8,460 m^3/year
- Pre-processing SSO from organic waste processing facility: up to 15,140 m^3/year
- Raw SSO from other municipalities: up to 7,150 tpy (11,250 tpy – 4,100 tpy)
  – Note that these waste materials are in addition to existing tonnage of septage, sewage, and organic waste currently managed at the Site.

– There is opportunity to address Site operational challenges to maximize the value of existing or potential additional infrastructure. For instance, implementing a flare and reducing CHP unit downtime represents an important step in enhancing Site revenue. Alternatively, there is also opportunity to mothball the BioGRID system and decrease negative annual revenue by $0.9M over a five-year period. It is anticipated that this timeframe would allow for the implementation period of an SSO collection program within Grey County or other, and for an increase in organic waste feedstocks in the market.

– SSO pre-processing technologies are available as assessed for Scenarios 3A and 3B, and their selection and applicability would somewhat vary depending on the level of throughput (due to economies of scale). Pre-processing would be completed onsite east of the existing BioGRID system and access road.

– The potential benefits (e.g., waste diversion, revenue, and costs) of all of the Project Scenarios are entirely dependent on secured and ongoing feedstocks being input to the system, and the system process being operated effectively with minimal downtime, along with the specific assumptions and set values defined as part of this assessment.

– For biogas utilization, maximizing the CHP FIT Contract until its expiry is considered the most feasible option for all Project Scenarios. After Contract expiry, biogas utilization by potential industrial user (with reference assessment of adjacent property) was assessed as a feasible option applicable for Scenarios 2A, 2B, 3A and 3B due to relatively lower biogas generation rates.

– Digestate management would continue via existing NASM program for all Project Scenarios.

The following actions are recommended:

– Implement identified solutions to operational challenges to maximize value of Site in accordance with preferred approach for ongoing Site use, working with the MECP to amend Site ECA where necessary.

– Undertake a sampling program to determine the characteristics of all received wastes as well as for the solids and liquid stream coming out of the drum screen to further understand the organics loading rates to the sewage lagoons system and the BioGRID system, as applicable to the preferred approach(es) for ongoing Site operations. The program should include analysis for TS, volatile solids (VS), ammonia, alkalinity, biological oxygen demand (BOD), chemical oxygen demand (COD), and total phosphorous (TP).

– With further definition of the waste characteristics, the assessment of sewage lagoons undertaken for this Project is recommended to be reviewed to define the conditions where the sewage lagoons can suitably be operated as a standalone treatment process. The waste characteristics would also serve to review/revise/validate assumptions and set values for operation of the BioGRID system in a preferred approach.

– In alignment with the MIC Waste Management Services Review, there is opportunity for shared services between adjacent municipalities. Continue discussions with neighbouring municipalities and the ICI sector/private waste haulers to further understand the potential for SSO shared services, as the overall quantities being managed (and related biogas being generated for utilization) are a vital component of a sustainable Project. An organic waste broker could further assist the Joint Board with potentially securing other organic feedstocks.

– With regard to biogas utilization, discuss with potential industrial users the possibility of biogas utilization for their onsite needs. Alternative opportunities not assessed herein were identified by OCWA based on stakeholder interest noted during related engagement, to be further explored where there may be value.

– Monitor the carbon credits space, as the implementation of increasing carbon tax prices will lead to investment of renewable energy projects by the federal government. Also review available funding and discuss with the responsible organizations to confirm suitability/eligibility such that funding model and estimates can be considered as part of a next step.

- Define a Project scenario to further develop (e.g., concept/detailed design) as assessed or modified in the context of both a preferred next step and project delivery approach. Related to this, consider the project delivery model that is of preference to the Joint Board and/or develop a Request for Expression of interest to gauge the industry's related interests and capabilities.
- Once a next step is identified and where it consists of proceeding to the design stage with one of the Project scenarios (as assessed or potentially modified), the assumptions and set values would appropriately be further developed along with updated and detailed costing. Further, consultation with relevant stakeholders should be undertaken (e.g., Grey Sauble Conservation Authority, MECP, and OMAFRA).

6. Limitations

This Report has been prepared by GHD for Georgian Bluffs and may only be used and relied on by Georgian Bluffs for the purpose agreed between GHD and OCWA. GHD otherwise disclaims responsibility to any person other than Georgian Bluffs arising in connection with this report.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report. The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared nor arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by OCWA, Georgian Bluffs and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has prepared the preliminary cost estimates set out in this report using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD including access to reference projects. The cost estimates have been prepared for the purpose of preliminary feasibility assessment via a high-level net present value and must not be used for any other purpose. The cost estimates are preliminary estimates only. Actual prices, costs and other variables may be different to those used to prepare the cost estimates and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the project can or will be undertaken at a cost which is the same or less than the cost estimates. Sections 2.1.2 and 3.2 of this Report provides a summary of additional relevant limitations to be considered. The supporting documentation further contains specific settings/parameters that directly influence the estimated costs.

Appendix A

Technical Memorandum Draft Version C

Technical Memorandum

February 8, 2021

To:	Jane Ho	Ref. No.:	11220446
	EA		
From:	Dilshad Mondegarian/Efath Ara/mg/MEM-1	Tel:	519-884-0510
CC:	Indra Maharjan (OCWA), Michael Cant (GHD), Etienne Bordeleau (GHD)		

Subject: **Technical Memorandum #1 (Draft Version C)**
Georgian Bluffs Source Separated Organics Availability, Digestion Technologies, and Beneficial Use of Biogas Feasibility Study
RFS ITAG-02-2020

1. Introduction

GHD Limited (GHD) has been retained by the Ontario Clean Water Agency (OCWA) under Request for Services (RFS) ITAG-02-2020 to provide professional engineering services for the Corporation of the Township of Georgian Bluffs' (Georgian Bluffs) Source Separated Organics (SSO) Availability, Digestion Technologies and Beneficial Use of Biogas Feasibility Study (the Project) regarding the Derby Wastewater Treatment Works (WWTW) BioGRID system and sewage lagoons.

The BioGRID system (Bio Green Renewable Industrial Digester) is owned and managed by the BioGRID Joint Board of Management (Joint Board) comprising the Township of Georgian Bluffs (Georgian Bluffs) and the Township of Chatsworth (Chatsworth). Collectively, Georgian Bluffs and Chatsworth are referred to herein as 'Townships'.

The WWTW sewage lagoons were implemented in 1975 and the BioGRID system was implemented in 2011. The BioGRID system has faced operational and financial challenges relating to securing organic waste feedstocks, approaches for setting organic waste feedstock tipping fees, capacity and bottlenecks of the existing anaerobic digestion (AD) process, material receiving station and other associated infrastructure, renewable energy generation, as well as process/operations of the sewage lagoons.

1.1 Purpose

The objective of the Project is to study potentially viable options for enhancements to the operations and performance of the BioGRID system, and assess the potential independent use of the sewage lagoons, with the aim of maximizing the benefits of existing and possible infrastructure.

1.2 Study Approach

The Project includes the iterative development of a Technical Memorandum #1. The Technical Memorandum has been progressed as Draft Versions A, B, and C, allowing for the ongoing review and consideration of reference documentation/information and review/input by OCWA as well as Georgian Bluffs.

This Technical Memorandum represents Draft Version C and discusses the information known to date, providing the context for the development and a subsequent evaluation of options. Options to be defined are to assist in addressing key challenges generally affecting the performance and cost-effectiveness of the BioGRID system. Among those challenges is the potential quantity of and ability to secure organic waste feedstocks. The potential organic waste feedstocks are being surveyed by OCWA through discussions and letters of interest primarily with regional municipalities in Grey and Bruce Counties including the industrial, commercial, and institutional (IC&I) sector. Following this Technical Memorandum, a Project Report will be developed. The Project Report will include the evaluation of the options defined in this memorandum.

1.3 Organization

This memorandum is organized in the following sections:

Section 1	Introduction | Provides the Study purpose, approach, and organization of this Technical Memorandum
Section 2	Reference Documentation/Information | References a listing of documentation received and reviewed and details on a virtual site visit/walkthrough and ongoing communications, supporting the historical and current status of the BioGRID system and sewage lagoons
Section 3	Background on Site and Key Evaluations | Discusses at a high-level the WWTW Site with a focus on the BioGRID system and key prior evaluations undertaken, providing context for the current BioGRID system status
Section 4	Derby Wastewater Treatment Works | Discusses the WWTW treatment processes for the BioGRID system and the sewage lagoons, detailing the recent/current performance needs of the BioGRID system and the potential independent use of the sewage lagoons
Section 5	Organic Waste Feedstocks and Approach to Tipping Fees | Reviews the recent/current materials received for treatment via the BioGRID system as well as the applied tipping fees, setting the baseline quantity, quality, and tipping revenue data for an assessment of options
Section 6	Regional Waste Management Systems | Defines the potentially available SSO within Georgian Bluffs and Chatsworth, as well as SSO estimates for neighbouring townships, providing an indication of likely available SSO quantities for future organic waste feedstock to the BioGRID system should SSO collection programs be implemented in the future (currently not in place)
Section 7	Feasibility Study Options | Lists the options to be assessed based on the current context, along with key assessment parameters, to be evaluated as part of the Project Report

2. Reference Documentation/Information

We have reviewed and relied on project reference documentation/information as follows for the development of this Technical Memorandum:

- Background documentation provided by OCWA (and the Townships)
- Publicly available documentation
- Information from virtual site visit with WWTW walkthrough and ongoing communications

We understand that information from stakeholder engagement around organics waste feedstocks is being developed by OCWA and may influence the material types and quantities of Study options (refer Section 7) that are intended to be evaluated as part of the Project Report. The Study options will be confirmed with OCWA and Georgian Bluffs prior to completing the assessment.

The listing of background documentation is provided as Attachment 1.

2.1 Virtual Site Visit and Ongoing Communications

A virtual site visit and workshop was held on November 26, 2020 with Troy Unruh - Site Operator, Georgian Bluffs, OCWA, and GHD in attendance. The Site Operator provided a virtual walkthrough of the Site, discussed process flow, current operations and bottlenecks. Information shared during the virtual site visit was reviewed and relied on for the development of this Technical Memorandum.

A question and response log was prepared with further questions regarding Site operations. Through progressing this Study, further discussions were held via email correspondences and conference calls. Key information from the log and ongoing communications has been captured in this memo.

3. Background on Site and Key Evaluations

The WWTW including BioGRID and sewage lagoons is located at 62111 Side Road 3 in Owen Sound, Ontario. The BioGRID system is owned and managed by the Joint Board. The WWTW is currently operated by Georgian Bluffs' personnel.

The BioGRID system was constructed in 2010 at a capital cost of $3.8 million (funded jointly by the Townships at around $1 million and by the Federal Government for the remainder). In 2011, an additional digestate storage tank (Digestate Storage Tank #2) was constructed at the WWTW, which resulted in an amended Ontario Ministry of Environment, Conservation and Parks (MECP) Environmental Compliance Approval (ECA) No. 2206-8KSQZV issued on August 23, 2011. According to the amended ECA, the WWTW has a rated capacity of 57.5 cubic metres per day (m^3/d), and per the MECP is applicable to the entire Site (BioGrid system and sewage lagoons). Accordingly, an ECA amendment would be required to increase throughput/capacity, as may be relevant to optimization of the operations and cost-effectiveness of the Site.

A Site plan noting entrance and facilities is shown below as Figure 3.1. The process at the Site and current status is discussed as part of Section 4. The Site operator noted that the WWTW access roads are currently not suitable and would need upgrading to allow for larger organic waste feedstock vehicles to acces the Site.

Figure 3.1 – Site Plan of the Derby WWTW with BioGrid System and Sewage Lagoons

The Design Brief for the BioGRID system (Genivar, February 2010) defined the parameters and costing for the implementation of the system to process organic waste feedstocks and generate electricity. Key design parameters and assessments included:

- Biogas generation at a rate of 1,200 m^3/day (or 50 m^3/hour), and biogas production ranging from 200 to 550 m^3/tonne (primarily as a result of organic wastes not septage, which is noted as producing 18 m^3/tonne). The potential balance of higher and lower 'value' feedstocks is noted.
- Addition of the liquids portion from a drum screen to the existing sewage lagoons, whereby estimated BOD (800 mg/L) would be lower than the design value (850 mg/L), though estimated TKN (103 mg/L) would be higher than the design value (85 mg/L). The existing sewage lagoons are noted as being capable of treating the additional liquids portion based on demonstrated results.

The costing assessment undertaken identified a positive net annual revenue and improvement infrastructure payback period of less than eight years. The assessment relied on maximized digester feed rate, biogas production, and electricity generation.

Overall, the BioGRID was developed with the notion and aim of utilizing AD technology to provide required treatment of septage from the parent municipalities while also aiming to provide a sustainable revenue source to offset, or possibly even exceed, treatment costs. The business case for the BioGRID project was challenged when the province of Ontario did not follow through with a ban on land application of septage (comparing to BioGRID this is a lower-cost option for septage management selected by the majority of those needing septage disposal). Accordingly, the BioGRID system did not achieve revenue neutral or positive results despite best efforts by the Townships to source alternative organic waste feedstocks and/or alternative operating arrangements. Some notable challenges include feedstock quantity/quality and inconsistent processing system reliability for feedstock providers. Given the challenges, several evaluations have been undertaken for the BioGRID system at the Site. As noted above in Section 1, an aim of this Study is to identify potential feasible options that would generally assist in countering these challenges. Select key evaluations undertaken prior to this Study are discussed below.

Feasibility Study to Improve Septage Receiving and Increase Power to 340 kW for the Georgian Bluffs/Chatsworth Biodigester (Genivar Inc., February 2012)

- A study undertaken to define improvements for the receipt of septage at the Site and to increase electrical production from 100 kW to 340 kW.
  - The study provides for recommendations and related costing to increase septage receiving capacity and related odour control system; and increase electrical power via extending a 3-phase power line and upgrading the SCADA system for a new 240 kW gas generator. The study includes an assumption of additional waste heat available from operation of the engine for the potential additional revenue from waste heat being utilized for electrical energy via a turbine engine.

The costing assessment undertaken identified a positive net annual revenue and improvement infrastructure payback period of less than three years. The assessment relied on maximized digester feed rate, biogas production, and electricity generation. The recommended improvements were not made.

Engineering and Operation Review (GHD, 2015)

- Assessment of current operations and costs as compared to design information, with recommendations generally made for maximizing the asset as-is.
  - The assessment provided overall mass balance ‘requirements’ for operation of the BioGRID system such that the estimated financial review would be realized. These requirements reflect an increase in the digester feed rate, organic loading rate, and reduction in hydraulic retention time, all contribution to increased biogas generation and therefore increased electricity generation (a source of revenue). Varying tipping fees were also considered.

The mass balance presented therein for current operations (2015), are similar to those reported in 2017, 2018, and 2019 annual reports. The challenges regarding quantity and quality of organic waste feedstocks remain.

Preliminary Design and Cost Estimates – Upgrades to the Georgian Bluffs/Chatsworth Biodigester (GSS Engineering Consultants Ltd., Aquatech Canada Water Services Inc. and CCI BioEnergy, August 2018)

- Development of design and related costing for upgrades to the BioGRID system to fully-utilize and expand upon existing infrastructure to generate further revenue.
  - Upgrade/additional infrastructure included a septage receiving station, SSO pre-processing equipment and building, access road improvements and parking, fats, oils, and grease (FOG)

storage, pasteurizer, dewatering centrifuge, digestate storage, biogas flare, and biogas upgrade system to compressed natural gas (CNG).

  - Organic waste feedstock strength minimum value of approximately 67 m^3 biogas/m^3 waste (or approximately 112 m^3/tonne, based on units conversion by GHD using average SSO density) and solids content of feedstock slurry at 10%, to fully utilize the AD capacity and generate biogas at a rate of 3,700 m^3/day.

The costing assessment undertaken identified a positive net annual revenue. The assessment relied on maximized digester feed rate, biogas production, electricity generation, and CNG generation.

Assessment of WWTW BioGRID Mothballing and Sewage Lagoons Operations (GHD, ongoing)

- Development of cost and analysis to decommission the BioGRID facility into stasis for re-commissioning at a later date. Further, development of a cost and analysis of operation the sewage lagoons as a standalone system (fully disconnected from the BioGRID system).
  - This ongoing concurrent assessment will provide information needed to cease the current BioGRID system operation and continue the treatment process provided via the sewage lagoons.

The work of this Study is alternatively reviewing potentially feasible options for the enhanced operation of the BioGRID system, providing information needed to proceed with operations in preferred manner.

As detailed above, the BioGRID facility was developed to cost-effectively manage organic wastes and generate renewable electricity. With the challenges faced and previously evaluated at the facility, this Study looks to confirm the feasibility and costs of operating the BioGRID system going forward (e.g., available organic waste feedstocks and necessary infrastructure). The noted concurrent study looks to confirm the feasibility and costs associated with BioGRID system mothballing and sewage lagoons operations. These two current studies will assist the Townships in making informed decisions on the continued, mothballed, and/or separate operations of the BioGRID system and sewage lagoons.

4. Derby Wastewater Treatment Works

4.1 General

This section provides a discussion on the following the existing infrastructure and status of the WWTW, along with reviews of the treatment processes provided by, and design/theoretical treatment capacities of, the BioGRID system and sewage lagoons. Accordingly, this section provides key information on the following:

- BioGRID system | Current infrastructure, operations, energy consumption/generation, and biogas/digestate generation and use.
  - This provides definition of current challenges and related opportunities to be assessed as part of the Study options in the Project Report. As part of that assessment, capital and operations costs will be detailed for options that further utilize the BioGRID system and introduce additional infrastructure where needed.

- Sewage lagoons | Current infrastructure, operations, and sludge/treated effluent generation and use.
  - This provides definition of the current connectivity to the BioGRID system and the potential for ongoing and ECA-compliant operations if disconnected from the BioGRID system. The concurrent study (GHD, 2021) regarding BioGRID system mothballing will identify costs associated with the disconnection and individual operation of the sewage lagoons.

The further utilization of the BioGRID system generally requires additional organic waste feedstocks. The potential feasibility of securing and receiving additional organic waste feedstocks (i.e., SSO) for processing via the BioGRID system is discussed below as part of Sections 5 and 6.

4.2 WWTW Overview

The Townships' high-level process flow diagram of the management of organic waste feedstocks via the BioGRID system is shown below as Figure 4.1. The sewage lagoons are identified therein as 'Lagoon', though are designed and operated as a pre-aeration treatment cell and facultative sewage lagoon (providing treatment and storage), with a percolation (effluent gravel spray) area for disposal of the treated effluent.

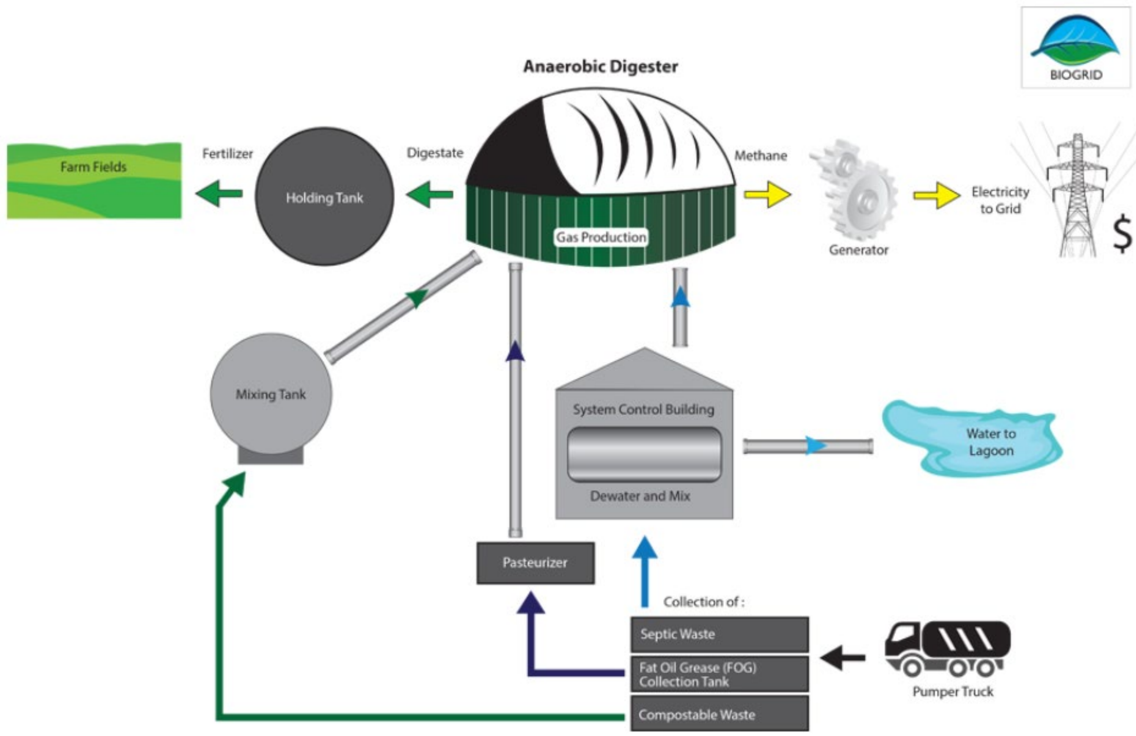


Figure 4.1 – BioGRID System Process Flow Diagram (Georgian Bluffs' website, 2021)

The WWTW consists of the following infrastructure:

- **Inlet Works:** includes septage receiving tank at the main Site entrance (otherwise known as Septage Dumping Station #1); a 150 mm diameter influent sewer from the septage receiving tank to the aerated sewage lagoon; a secondary septage receiving station with camlock fitting (otherwise known as Septage Dumping Station #2); influent chamber equipped with a manual bar screen with 9 mm spacing; a valve-chamber and a 200 mm diameter sewer to direct all influent to the septage dewatering building; existing 150 mm diameter sewer to be maintained and utilized as an emergency or maintenance bypass; secondary septage receiving station and manual bar screen with the opening size between the bars of 12 mm.

The plastic and other non-organics materials are screened off using the manual bar screen and collected for disposal to landfill. The amount of plastic and non-organic material is not significant. Two to four 40 L garbage bags of reject material is collected and disposed at the Sullivan Transfer Station weekly, and bi-weekly for less contaminated feedstocks.

Septage and hauled sewage are hauled to the Site by tanker trucks with an approximate septage handling capacity of 15.45 m^3. Septage and hauled sewage are dumped at the dumping station from where it is conveyed to the bar screens. The bar screen was design for a feed rate of 2 m^3/min, which indicates a 15 m^3 truck would require approximately 11 to 12 minutes to be emptied. The inflow at the WWTW consists of three separate streams, all of which are hauled to the Site (no sewer system connections exist). The streams include septage, hauled sewage, and organic waste feedstocks.

Pre-processing equipment for SSO is not installed at the Site. Currently, refurbished pre-processing equipment removed City of Toronto Dufferin Organics Processing Facility is in storage at the Site, and could be installed for use with ECA amendment.

- **Septage Dewatering Components:** From the bar screen, the material goes to the dewatering unit located in the control building. A Baycor mds drum screen separator is used as a dewatering unit at the Site along with a polymer mixing tank, which utilizes a formula CP 9310 polymer dosing.

During the virtual Site visit, it was noted that a 30 m^3 truck normally takes 6 minutes to be emptied, which indicates feed is going to the dewatering unit twice as fast compared to the design feed rate, which is 300 gpm. The Site Operator is knowingly overfeeding the drum screen at a rate of 520 to 550 gpm as the

Operator has no control over the number of trucks entering the Site or the rate at which material is dumped from each truck.

While there is a valve, it has already been manually throttled back as far as it can be to back up the bar screen, yet it will still overflow the bar screen if the material is not sent to the drum screen separator. The faster feeding rate indicates that the drum screen is not able to achieve the desired solids capturing capacity as per the design. The liquid portion that comes out of the drum screen goes directly to the sewage lagoons and the solid portion goes to the BioGRID via a hydrolyzation tank with a capacity of 100 m^3.

- **Odour Control Station:** There is a carbon drum filter within the control and dewatering building. The drum separator, FOG tank, hydrolizer, and the pasteurizer are connected to the odour control station.

- **Anaerobic Digester and Process Tanks**: There is a single anaerobic digester (BioGRID) equipped with a mechanical mixing system with a capacity/working volume of 1,000 m^3. The AD process is maintained within a mesophilic temperature range of 35-40°C by utilizing biogas to heat the BioGRID. The BioGRID is process heat is supplemented during the Winter months via electrical loops and rental boilers. The Site Operator noted that the temperature in the BioGRID dropped to 32°C in December 2019 and January 2020 due to low biogas generation. During Winter months and if process heat supplementing has been required, a backup boiler has been used at the Site.

  As mentioned in the 2017, 2018 and 2019 annual performance reports for the WWTW, organic waste feedstocks (i.e., vegetable waste; FOG; processing waste for supplements; hospital food and medical waste; and food waste from Canadian Forces Base Borden) are received in a 50 m^3 FOG tank and then pumped into a 100 m^3 hydrolyzer tank. FOG is pasteurized at 70°C for one hour before it is fed to the BioGRID. One of the recommendations in a 2015 report prepared by GHD was to discontinue operation of the pasteurizer to pasteurize FOG, as pasteurization of FOG requires additional energy and damages the biodegradable cells of organic waste, thereby decreasing the potential of biodegradability. ***Note*** | The MECP has informed the Site Operator that an amendment to the current ECA will be required to implement this process change.

Approximately 2-3 m^3/h of substrate is fed to the BioGRID over a 24-hour period at a semi-continuous rate. The Site Operator noted that on average, the BioGRID is fed at a rate of 12-15 m^3/d. Data from the 2018 and 2019 annual performance reports however, suggest an average feed rate of 25.59 m^3/d and 20.89 m^3/d to the BioGRID, respectively. In regular conditions, the BioGRID is fed for 15-20 minutes, after which the feedstock is mixed with the mechanical mixer for 30-40 minutes. The Site Operator noted that the BioGRID working volume height is maintained at a steady level.

Biogas from the BioGRID is conveyed to a CHP unit (a 100 kW, 6-cylinder engine), approved under separate air and noise ECA No. 9930-8AFH7R issued on December 15, 2010.

- **Digestate Storage Tanks:** From the BioGRID, the liquid digestate is transferred to two digestate storage tanks and then hauled off Site for land application. The BioGRID is a plug flow anaerobic digester, which suggests that the height of the liquid level will remain steady in the tank. In other words, the same quantity of liquid digestate is withdrawn/transferred to the digestate storage tanks when the BioGRID feeding takes place. The 2017, 2018 and 2019 annual performance reports however, record BioGRID liquid level fluctuating from 30-186 cm over time. The Site Operator noted that the level sensor in the BioGRID often provides a faulty reading as it has not been calibrated or maintained over the years.

  Hydraulic retention time (HRT) of the BioGRID does not vary based on the liquid level in the tank for a plug-flow digester, thus BioGRID liquid level is not a critical item for the assessment of the digestion process.

- **Sewage Lagoons:** The liquid sewage, which is dumped at Septage Dumping Station #1 as well as the liquid portion that comes out of the drum screen is conveyed to the aerated lagoon followed by facultative lagoon. The aerated cell has a capacity of 3,300 m^3 and equipped with aerators complete with air headers and laterals. Capacity of the facultative lagoon is 22,500 m^3. Effluent from the facultative lagoon is pumped to the spray irrigation system. The Site operates under ECA No. 2206-8KSQZV issued on August 23, 2011, for the sewage treatment collection, transmission, treatment, and disposal of domestic sewage with a rated capacity of 57.5 m^3/d. Effluent criteria as per the ECA should meet $cBOD_5$ of 30 mg/L and Total Suspended Solids (TSS) of 40 mg/L.

- **Spray Area**: There is a 9,410 m^2 designated spray irrigation area complete with containment berms, spray irrigation pipes and sprinklers for disposal of treated effluent from the facultative lagoon.

Total waste materials received on a monthly basis at the WWTW during 2017, 2018, and 2019 are summarized below in Table 4.1.

Table 4.1 Total Waste Materials Received on a Monthly Basis at WWTW (2017 to 2019)

Month	2017				2018				2019			
	Total Septage Fed Directly to Lagoon (m^3)	Total Septage Fed to Drum Screen (m^3)	Total Septage Received at Site (m^3)	Total Organics Received at Site (m^3)	Total Septage Fed Directly to Lagoon (m^3)	Total Septage Fed to Drum Screen (m^3)	Total Septage Received at Site (m^3)	Total Organics Received at Site (m^3)	Total Septage Fed Directly to Lagoon (m^3)	Total Septage Fed to Drum Screen (m^3)	Total Septage Received at Site (m^3)	Total Organics Received at Site (m^3)
January	944.5	-	944.5	165.4	197.9	553.4	751.3	192.3	231.3	442.8	674.1	136.8
February	865.1	-	865.1	188.5	223.9	468.0	691.9	110.8	198.3	379.0	577.3	118.8
March	896.9	-	896.9	109.4	277.1	585.5	862.6	199.8	255.5	495.0	750.5	85.8
April	836.8	-	836.8	158.5	208.8	521.1	729.9	223.8	250.8	547.2	798.0	161.0
May	739.9	-	739.9	185.7	47.7	580.5	628.3	267.0	212.1	476.7	688.7	267.6
June	187.2	571.4	758.6	222.4	98.6	481.3	580.0	272.4	132.0	492.5	624.5	203.6
July	155.5	603.5	759.0	333.4	111.0	490.3	601.3	326.8	193.0	453.7	646.7	433.0
August	119.6	722.1	841.7	349.0	323.2	605.6	928.9	429.0	114.3	555.0	669.3	338.6
September	143.2	479.6	622.8	415.9	302.3	396.0	698.3	378.0	74.9	538.3	613.2	288.3
October	153.5	577.1	730.6	347.3	249.7	565.3	815.0	266.1	320.7	218.1	538.8	227.4
November	198.1	473.2	671.3	236.3	250.8	617.1	867.9	218.1	452.7	326.1	778.7	211.4
December	149.9	514.9	664.8	145.5	232.4	495.3	727.7	98.5	688.7	55.8	744.5	175.5
Total	**5,390.1**	**3,941.9**	**9,332.1**	**2,857.4**	**2,523.5**	**6,359.4**	**8,882.9**	**2,982.6**	**3,124.3**	**4,979.9**	**8,104.3**	**2,647.8**

Note: There was no feeding of septage to the BioGRID from January to May 2017.

4.3 BioGRID AD Process Review

As identified above in Section 4.2, grey wastewater/liquid septage received at the WWTW is directly fed to the aeration lagoon and the remaining sewage waste received at the Site is directed to Dumping Station #2 which is then fed through a drum screen. The drum screen separates the solids portion from the sewage waste, and the solids portion is sent to the BioGRID for AD. The liquid portion which gets separated by the drum screen is then conveyed to the aeration lagoon. Organic waste feedstocks coming from several suppliers are managed in the FOG tank or hydrolyzer and then conveyed to the BioGRID.

A routine sampling program of the incoming feedstocks is not in place at the Site. The Site operator has noted however, that periodical analysis of the feedstock is performed to determine the total solids (TS) percentage. Annual performance reports for 2017, 2018 and 2019 indicate that the liquid digestate from the BioGRID system consisted of a solids content between 1 to 1.8%. A characterization study of the influent feedstock received at the Site was performed in 2009 (prior to the implementation of the BioGRID system). ***Recommendation*** | A sampling program to determine the characteristics of all received wastes as well as for the solids and liquid stream coming out of the drum screen would clarify the organics loading rates to the BioGRID and the sewage lagoons. The program should include analysis for TS, volatile solids (VS), ammonia, alkalinity, biological oxygen demand (BOD), chemical oxygen demand (COD), and total phosphorous (TP).

The discussion/assessment herein uses available data and theoretical assumptions as appropriate to understand treatment process capacities.

The 2006 preliminary design report for AD assessment of septage indicates that feedstock for the BioGRID was assumed to consist of the solid faction of septage/sewage and corn stalks. The combined organics material was estimated to have a TS% of 5-7%. During the design of the BioGRID, estimated TS of the incoming feedstock septage and sewage was assumed to be approximately 1-1.5%. Source of the high solids feed to the BioGRID was the combination of high solids organics and thickened septage material.

A summary of the waste materials received for and generated from treatment at the Site is provided below in Table 4.2, as per Tables D3 and D4 of the annual performance reports from 2017 to 2019.

Table 4.2 Waste Materials Received and Generated (2017 to 2019)

Parameter	2017	2018	2019	Average
Grey wastewater/liquid septage fed directly to aeration lagoon (m^3)	5,390	2,523	3,124	3,679
Septage/sewage fed to drum screen (m^3)	3,942	6,359	4,980	5,094
Total septage/sewage waste received at the Site (m^3)	9,332	8,883	8,104	8,773
Organic waste feedstocks received at Site (m^3)	2,857	2,983	2,647	2,829
Digestate production based on volume gained in digestate storage tanks (m^3)	4,896	5,553	5,565	5,338

Parameter	2017	2018	2019	Average
Estimated excess precipitation (0.38 m x tank area) (m^3)	625	625	625	625
Estimated digestate produced from septage (m^3)	1,414	1,945	2,293	1,884
Septage/sewage solids portion fed to BioGRID equivalent to digestate produced from septage (m^3)	1,414	1,945	2,292.6	1,884
Total feed to BioGRID (total of organics waste + solids portion from septage/sewage) (m^3)[1]	4,316	5,336	4,490	4,714
Daily average BioGRID feed rate, considering 365 days a year (m^3/day)	12[2]	15	12	14[3]

Note:

1. Total feed to BioGRID based on an assumed dewatering effectiveness from the drum screen
2. BioGRID was only fed with organic waste from January to May in 2017, thus feed rate was comparatively lower during that period.
3. Average daily feed rate based on sum of daily flow quantities divided by 365 operating days in a year.

As listed above, the average feed rate to the BioGRID during 2017, 2018 and 2019 was approximately 12-14 m^3/d. Original design data indicates that the BioGRID was designed for a throughput of 20-40 m^3/day. ***Note*** | The BioGRID is currently fed at a much lower rate than its design capacity.

A mesophilic anaerobic digester is typically loaded at an OLR of 3-3.2 kg-VS/m^3/day. Biogas production depends on OLR. The BioGRID was also designed for an Organic Loading Rate (OLR) of 4 kg-VS/m^3 of the digester volume per day. Further, the BioGRID was designed for VS concentration of 25,000 mg/L considering higher total solids and volatile solids contribution from other organic waste feedstocks such as FOG. The limited available data from characterization undertaken in 2009 indicated VS in the waste materials at the time of design was on average 11,273 mg/L.

The BioGRID design parameters are summarized below in Table 4.3.

Table 4.3 BioGRID – Select System Parameters & Capacity Evaluation

BioGRID System	Value
FOG Storage Tank	50 m^3
Hydrolyzer Tank	100 m^3
Hydrolyzer Tank Height	2.8 m
Hydrolyzer Tank Diameter	6.775 m
BioGRID Diameter	15.966 m
BioGRID Height	5.198 m
BioGRID Volume	1,000 m^3
HRT (assumed)	20 days
Average Flow Rate	14 m^3/d

BioGRID System	Value
Volume Utilized	280 m^3
Available space in BioGRID for additional feedstock	700 m^3

The Annual Report for 2019 noted variation of ammonia concentration in the BioGRID from 800 to 3,200 mg/L with a pH variation from 7.09 to 8.1. High concentration of ammonia was noted at the beginning of 2019 until mid-2019. The Site operator has noted that the quality of incoming feedstock does not vary significantly; source separated organics (SSO), leachate and other organics such as dewatered thickened sludge from other wastewater treatment plants are brought to the Site occasionally. The analysis performed on the digestate for volatile fatty acid and FOS/TAC (ratio is an indicator for assessing fermentation process) shows the acid accumulation rate in the BioGRID is very low.

4.3.1 Existing Biogas Production

Biogas quality data for the period of September 2019 to September 2020 was provided and is summarized below in Table 4.4. The average methane content during that period was 58.77%. The biogas quality measurements are performed by external biogas monitors; accuracy of the measurements with an external handheld device can be vary based on the calibration of the unit. The Site does not have a biogas flow measuring unit to record the amount of biogas produced on an hourly or daily basis. A previous study performed by GHD in 2015 indicated that based on 2013, 2014 and 2015 data the BioGRID produces biogas that contains methane in the range of 53-55%.

Table 4.4 BioGRID – Biogas Quality Parameters (Sept 2019-Sept 2020)

Month/Year	CH_4%	CO_2%	H_2S (ppm)	O_2%
September 2019	56.53	32.83	43.73	1.44
October 2019	56.74	32.70	7.33	2.01
November 2019	57.63	34.77	5.33	2.15
December 2019	51.45	39.30	1,297.60	2.73
January 2020	60.16	26.50	1,766.56	3.70
February 2020	63.07	32.83	97.55	1.79
March 2020	53.00	30.10	11.45	2.97
April 2020	55.43	33.43	10.33	2.44
May 2020	59.67	32.77	4.20	1.14
June 2020	63.26	29.90	2.33	0.88
July 2020	61.97	29.47	0.07	1.09
August 2020	63.71	29.97	0.93	0.82
September 2020	61.33	31.63	1.00	0.92
Average	**58.77**	**32.02**	**16.75**	**1.85**

Month/Year	CH_4%	CO_2%	H_2S (ppm)	O_2%
Notes: 1. O2 values are higher than expected for the year - should be less than 0.5ppm on average. 3. Site Operator noted that Dec 2019 and Jan 2020 data is not representative due to BioGRID not having back up heat, losing temperature, and foaming problems.				

Electricity consumption data in Table 4.7 and an energy potential factor 0.45 was used to estimate biogas production from 2017 to 2019, as presented in Table 4.5. The energy potential factor is based on a calculation provided in the 2012 Genivar feasibility study to improve septage receiving and increase power of the CHP unit to 340 kW. The formula is as follows: number of kWh (kWh/day) = biogas produced (m^3/d) / 0.45.

Table 4.5 BioGRID – Average Monthly Electricity Production (2017-2019)

Year	Monthly Average Electricity Produced (Kwh)	Monthly Average Biogas Production (m^3)	Average Hourly Biogas Production (m^3/h)
2017	38,816	17,917	24.88
2018	37,419	17,266	23.98
2019	19,815	8,917	12.38

The Site does not contain a flare to burn biogas that is not consumed by the CHP unit.

4.3.2 Existing Natural Gas Consumption

It is understood that while there is a 4-inch high pressure natural gas pipeline available on Side Road 3 (approximately 100 m from the CHP unit), there is no natural gas utility pipeline connection to the Site. Thus, natural gas is not being consumed by the Site to heat the BioGRID or other processes.

4.3.3 Existing Electricity Consumption

There is a separate brown meter on site which is used for site utility consumption. The average annual electricity consumption data for the entire Site is summarized below in Table 4.6 for the years 2017 to 2019. January 2021 onwards, a flat price of $0.085 per kilowatt-hour (kWh) will be applied 24 hours, 7 days a week as per HydroOne's website.

Table 4.6 Average Annual Electricity Consumption for the Site (2017-2019)

Year	Annual Total Electricity Consumption (kWh)	Rate of Electricity ($/kWh)	Annual Total Cost of Electricity ($)
2017	177,363	0.1014	17,978
2018	198,062	0.0888	17,591

Year	Annual Total Electricity Consumption (kWh)	Rate of Electricity ($/kWh)	Annual Total Cost of Electricity ($)
2019	178,989	0.0947	16,949

4.3.4 Existing Electricity Generation & FIT Contact

Biogas from the BioGRID is collected and used to fuel a CHP unit (a 100 kW, 6-cylinder engine). The CHP unit drives a generator to produce electricity, which is currently under a 20-year Feed-in-Tariff (FIT) Contract No. F-000981-BIG-130-203 with the Ontario Power Authority (OPA).

The FIT Contract with the OPA period commenced May 2, 2011 and is valid for 20 years, until May 2, 2031, after which it will not be renewed. ***Note*** | The FIT Contract price is $0.1658/kWh of electricity produced, and the electricity is added to the distribution grid for general use via the green meter. Hydro One pays the Joint Board for this added electricity.

The average annual electricity production data for the BioGRID is summarized below in Table 4.7 for the years 2017 to 2019.

Table 4.7 BioGRID – Average Monthly Electricity Production (2017-2019)

Year	Monthly Average Electricity Produced (Kwh)	Monthly Average Generator Run Time	Monthly Average FIT Contract Revenue ($)	Annual Total FIT Contract Revenue ($)
2017	38,816	655	$6,601.45	$79,217.42
2018	37,419	652	$6,361.50	$76,337.97
2019	19,815	407	$3,285.24	$39,422.93

While 2017 and 2018 had relatively constant electricity production, there was a significant drop in 2019. During November and December 2019, there was a lack of organic material to feed the BioGRID, which caused the temperature of the BioGRID to drop, and any biogas produced was used in the existing boiler to heat the BioGRID. CHP maintenance was also being performed in December 2019. However, these two months account for approximately $10,000 to 12,000 of the lost revenue. The remaining $25,000 loss is attributed to feeding lower feedstock quantity and quality to the BioGRID throughout the year.

According to the Air/Noise ECA, the CHP unit can discharge the products of combustion into the atmosphere at a maximum volumetric flow rate of 0.037 m^3/s at an approximate temperature of 470 degrees Celsius, through a stack, having an exit diameter of 0.15 metre, extending 1.3 metres above the roof and 2.9 metres above grade.

It was noted during the technical workshop that the CHP unit is operating at a single phase and considered obsolete. In addition, the CHP unit has gone through several maintenance since its installation and requires rebuilding at every 20,000 hours of operation (rebuilt once in 2013, engine replacement in 2016 and rebuilding in 2020). Recent rebuilding exercise has cost approximately $40,000. The following relevant information was noted during a call with the Facility Operator on December 16, 2020:

- There is no biogas pre-cleaning step prior to the CHP unit. It is anticipated that the lack of pre-scrubbing of biogas is a suspected cause of the more frequent maintenance required for the CHP unit.
- During November and December 2019, there was a lack of organic material to feed the biodigester. The temperature of the digester fell, and biogas produced was used in the existing boiler to heat the digester. The generator was rarely used during those two months. The intermittent gas production prevents continuous operation of the CHP unit as intended.
- The current 100kW CHP unit is too small for this Site. A new twin four-cylinder CHP is preferred to allow for continued operations should one engine require maintenance. For comparison, nearby on-farm digesters utilize 500kW CHP units.

Note | For these reasons, continued operations of the current CHP unit should not be considered as a biogas utilization option when evaluating the feasibility study options. A new CHP unit can be considered.

4.3.5 Existing Digestate Production and Management

Since 2017, digestate has been applied as a Non-Agricultural Source Material (NASM) on agricultural land at several farm sites twice a year, either in May or in October/November. ***Note*** | The Site digestate is classified as Category 3 NASM.

NASM is part of an agricultural beneficial use program administered through the Ontario Ministries of Agriculture, Food and Rural Affairs (OMAFRA) and enforced by the MECP. NASM is a unique-to-Ontario term for a soil nutrient derived from a non-agricultural source and was introduced to intentionally distinguish it from biosolids and organic waste as it must be capable of being applied to land as a nutrient[1].

According to the Annual Performance Reports for 2017, 2018 and 2019 prepared by GSS Engineering Consultants Ltd. for the WWTW and BioGRID, 7,790 m^3, 2,687 m^3, and 9,705 m^3 of total digestate was applied to agricultural land in 2017, 2018 and 2019 respectively. Digestate was not land applied in Fall 2018 due to an unexpected increase in rainfall experienced during those months. Disposal of digestate costs $9 per m^3 according to the 2018 Preliminary Design and Cost Estimates for Upgrades to the Georgian Bluffs/Chatsworth Biodigester report. The digestate disposal costs are mainly associated with transportation and would be higher if farmers did not contribute as part of the NASM contract. A summary of the land application from 2017 to 2019 is provided below in Table 4.8.

[1] Ontario Regulation (O. Reg.) 267/03 under the Nutrient Management Act, 2002

Table 4.8 Digestate – Summary of Land Application from 2017 to 2019

Date	2017			2018			2019			Average (2017-2019)
	May	November	Total	May	Fall	Total	May	October	Total	
Digestate Applied to Land (m^3)	2,666	5,124	7,790	2,687	0	2,687	3,900	5,805	9,705	6,727
Farms	Cook	N/A		Cook	N/A		Elevator & Patchell	Brookham & Kraemer		
Excess Precipitation (m)			0.40			0.38			0.55	0.44
Disposal Cost ($)	$23,994	$46,116	$70,110	$24,183	$0	$24,183	$35,100	$52,245	$87,345	$60,546

Digestate Storage Tank #1 has a design volume of 854 m^3 and Digestate Storage Tank #2 has a design volume of 5,630 m^3, for a combined total volume of 6,484 m^3 available for storage of liquid digestate. These tanks can provide approximately 6 months of storage of the liquid digestate at a daily flow of 36 m^3 per day or approximately 8 months of storage at a daily flow of 27 m^3 per day. According to Chapter 18 of the MECP Design Guidelines for Sewage Works, regarding sludge storage and disposal, a minimum of 240 days storage should be provided when designing for the ultimate design capacity of a facility. This allows for contingency storage due to weather related unpredictability. For example, if wet weather is experienced during the month of November, and the biosolids cannot be land applied during that month, an extra month of storage will be required, thereby increasing the minimum storage time from 120 to 150 days. ***Note*** | Based on 2019 data, 73% of the total digestate storage tank capacity is utilized for a period of 6 months (without excess precipitation), and 80% with excess precipitation. However, only 51% is being utilized based on an average of 2017-2019 data (without excess precipitation), and 56% with excess precipitation. The MECP storage guidelines are important to be considered when assessing inclusion of additional feedstock.

NASM is divided into three basic categories: unprocessed plant material (e.g. culled fruits and vegetables), processed plant material (e.g. bakery or brewery waste), and animal-based material, pulp and paper mill biosolids or any material not listed in Schedule 4 of O. Reg. 267/03 (e.g. sewage biosolids). Appendix G of the 2018 Annual Performance Report includes a Post-Application NASM Report, which notes the digestate is considered a Category 3 NASM as it consists of a mixture of anaerobically digested materials. These reports are prepared twice a year for this Site, or each time land application of NASM occurs.

SSO is not defined in Schedule 4 of O. Reg. 267/03. For use of SSO as an organic waste feedstock to the BioGRID, the digestate would likely still be considered a Category 3 NASM. ***Recommendation*** | Georgian Bluffs should consult with OMAFRA to define whether input of SSO to the BioGRID will change the categorization of the NASM. The NASM criterion for metals, pathogen and odour sub-categories in the digestate must still be met as per Schedules 5 and 6 of O. Reg. 267/03.

In 2019, a higher concentration of selenium was noticed in the digestate than is allowed by the NASM program. A portion of the digestate was in turn placed in a geotube and is still stored on Site; it will eventually be landfilled as it cannot not be land applied. Chloride levels in the digestate have been increasing since 2017. In 2019, the incoming material was analyzed for chloride concentrations to identify the major sources of incoming chloride. Laboratory test results noted that three select IC&I sewage contributors (identified within results) with the highest chloride levels accounted for approximately 83% of the total chloride received by the entire Site.

Digestate can generate unpleasant odours. During 2019, the MECP was notified of three odour complaints (dated June 27, July 24, and September 2). Following the initial odour complaint, a mitigation approach was taken on July 10, and consisted of adding canola straw to cover the top of the larger Digestate Storage Tank #2. Odour complaints were not received during 2020.

4.3.6 Process Review Summary

The Process Review detailed above is summarized with key items as follows and as relevant to the development and subsequent assessment of Study options:

1. The characteristics of influent feedstock received at the Site are not well defined. The quality of the material in terms of useful feedstock for biogas generation is therefore not well understood.
    a. ***Recommendation*** | A sampling program to determine the characteristics of all received wastes as well as for the solids and liquid stream coming out of the drum screen would clarify the organics loading rates to the BioGRID and the sewage lagoons. The program should include analysis for TS, volatile solids (VS), ammonia, alkalinity, biological oxygen demand (BOD), chemical oxygen demand (COD), and total phosphorous (TP).
2. The average feed rate to the BioGRID system was calculated as being 12 to 15 m^3/day, using data provided in annual reporting. Design data indicates the BioGRID has capacity for a throughput of 20 to 40 m^3/day. Further, the organic loading rate was designed for an influent VS concentration of 25,000 mg/L (insufficient characterization data is available to confirm whether the influent VS concentration design value is being met).
    b. ***Recommendation*** | A field program/flow meter to confirm the feed rate, and undertaking the above-noted sampling program would assist in confirm the current utilization of the BioGRID system and the 'organic value' of the influent feedstock.
3. The Site access roads do not allow for larger organic waste feedstock vehicles.
    c. ***Note*** | The upgrade to Site access roads will be considered as applicable for the assessment of Study options.
4. The Site receiving infrastructure does not allow for suitable flow control or the management of un-processed SSO.
    d. ***Note*** | A new buffer/holding tank and the use of refurbished pre-processing equipment currently at the Site will be considered as applicable for the assessment of Study options.
5. The biogas generation rate has ranged between 12 and 24 m^3/hour during years 2017 to 2019, with an average methane content of 58%.
    e. ***Note*** | The recent and potential biogas generation rate is well-below the level whereby biogas to renewable natural gas could be considered as a feasible utilization approach. The current

utilization approach includes a FIT contract valid through to 2030. This approach will be considered for the assessment of Study options.

6. The biogas utilization is currently via CHP unit. The current unit has required a relatively substantial level of maintenance for continued operation. Given a flare is not present on site and the downtime presented with maintaining the CHP unit, it is considered undersized.

   f. ***Note*** | A new twin four-cylinder CHP is preferred to allow for continued operations when maximized to design capacities, in the event one engine require maintenance. The replacement CHP unit will be considered as suitable for the assessment of Study options.

7. The management of liquid digestate is currently via land application as a Category 3 NASM. The addition of SSO (and related quantity/quality) would need to be defined to confirm with OMAFRA the potential impact on the NASM categorization of the liquid digestion.

   g. ***Note*** | For the assessment of Study options, it will be assumed that the addition of SSO could be completed while maintaining the current liquid digestate management approach and NASM categorization.

4.4 Sewage Lagoons Process Review

The WWTW was originally constructed in 1975 and consists of a pre-aeration treatment cell, facultative sewage lagoon (providing treatment and storage) and a percolation area for final effluent disposal. According to the expansion Design Report (July 1980), the system was expanded in 1978 and again in 1980 with the provision of additional facultative lagoon and percolation area. An improved aeration system for the pre-aeration treatment cell was also installed in the 1980 expansion. The facility is currently subject to the requirements as identified in Amended ECA No. 2206-8KSQZV dated August 23, 2011, with monitoring and parameter compliance requirements for the effluent discharge from the facultative lagoon by seasonal spray irrigation, as well as groundwater and surface water monitoring requirements. The lagoon effluent limits consist of a monthly average concentration less than 30 mg/L and 40 mg/L for CBOD5 and TSS parameters respectively.

As indicated in MECP Design Guidelines, sewage treatment lagoons are generally classified based on either the bioactivity type (facultative and/or aerated lagoons) or mode of operations (i.e. seasonal discharge or continuous discharge). A primary difference between a facultative lagoon and an aerobic flow-through lagoon is that sludge accumulates internally in a facultative lagoon, whereas solids in an aerated lagoon are generally removed in a downstream process. Since the solids accumulate in a facultative lagoon with limited (or no) supplemental energy input, biological conversion occurring in a facultative lagoon is partially aerobic and partially anaerobic and decomposition is subject to unmanaged natural processes such as wind driven circulation or photosynthetic activity. Typically, facultative lagoons are periodically dewatered for the removal of accumulated sludge material.

In the current operation at the site, liquid waste received at the site is conveyed directly to the aerated lagoon, and the liquid portion that comes off the drum screen (from the BioGRID process) is also conveyed to the aerated lagoon. The facultative lagoon received partially treated wastewater discharged from the aerated lagoon. Further description of the current operation is provided in subsequent sections.

4.4.1 Sewage Lagoons Flow Distribution and Hydraulic Capacity Assessment

Liquid waste received at the Site is treated within the aeration lagoon followed by the facultative lagoon. Currently, feedstock that is visually very liquid is directed to Dumping Station #1 and conveyed directly to the aeration lagoon via a 150 mm diameter influent sewer pipe from the septage receiving tank to the aerated lagoon. Total yearly volumes of 5,390 m^3, 2,523 m^3 and 3,124 m^3 of grey wastewater/liquid septage was fed to the aeration lagoon directly in 2017, 2018 and 2019 respectively. Remaining sewage waste received at the Site is directed to Dumping Station #2 which is then fed through a drum screen. The drum screen separates the solids portion from the sewage waste, and the solids portion is sent to the BioGRID for anaerobic digestion. The liquid portion which gets separated by the drum screen is then conveyed to the aeration lagoon. Total yearly volumes of 9,332 m^3, 8,883 m^3 and 8,104 m^3 of septage/sewage was fed to the drum screen in 2017, 2018, and 2019, respectively.

The BioGRID is a plug flow reactor, which means its feed rate is equivalent to the amount of digestate produced on a monthly or yearly basis. In addition to septage/sewage waste, FOG and other organic waste is received at the Site, which is dumped in the FOG tank and conveyed to the BioGRID via a hydrolyzer tank. Total yearly volumes of 2,857 m^3, 2,983 m^3 and 2,647 m^3 of organic waste was received at the Site in 2017, 2018, and 2019, respectively. As per the annual performance reports prepared by GSS, yearly volumes of 4,896 m^3, 5,553 m^3 and 5,565 m^3 of digestate was produced in 2017, 2018, and 2019, respectively. By subtracting the quantity of organic materials fed to BioGRID from the total waste fed to the BioGRID, the solids portion fed to the BioGRID can be estimated. Though the Site Operator records total septage/sewage received at the Site daily, there is no flowmeter to record the flow to the BioGRID nor the liquid portion that is fed to the aeration lagoon. Thus, the flow to the aeration lagoon can be estimated by subtracting the solids fed to the BioGRID from the total feedstock fed through the drum screen.

The total feed to the aeration lagoon was estimated to be 7,917 m^3, 6,939 m^3 and 5,811 m^3 in 2017, 2018, and 2019, respectively. Considering waste is received at the Site during weekdays from Monday to Friday, and no waste is received during weekends and statutory holidays, this results in a total of 250 operating days in a year. Based on this assumption, average daily flowrate to the aeration lagoon was 32 m^3/day, 28 m^3/day and 23 m^3/day in 2017, 2018, and 2019, resulting in a 3-year average daily flow of 28 m^3/day to the aeration lagoon. It is highlighted that using an assumed daily average flow does not account for significant flow variability that may occur as truck loads received are not directly managed/controlled.

Table 4.9 provides a summary of the influent flows to the Site from 2017 to 2019.

Table 4.9 Total Estimated Material received at the Site from 2017 to 2019

Feedstock Type	2017	2018	2019
Grey wastewater/liquid septage fed to aeration lagoon directly	5,390 m^3	2,523 m^3	3,124 m^3
Septage/sewage fed to drum screen	9,332 m^3	8,883 m^3	8,104 m^3
Organic waste received at Site	2,857 m^3	2,983 m^3	2,647 m^3
Digestate produced	4,896 m^3	5,553 m^3	5,565 m^3

Feedstock Type	2017	2018	2019
Total feed to aeration lagoon	7,917 m^3	6,938 m^3	5,811 m^3
Daily flowrate to aeration lagoon	32 m^3/day	28 m^3/day	23 m^3/day

Total septage and sewage feedstock received at the Site was 9,332 m^3, 8,883 m^3 and 8,104 m^3 in 2017, 2018 and 2019 respectively, resulting in an average yearly flow of 8,850 m^3. Considering a scenario in which the BioGRID is taken offline and all the septage and sewage feedstock is diverted to the aeration lagoon, the expected total yearly flow to the aeration lagoon would be 8,850 m^3. Considering a total of 250 operating days, the expected flow to the aeration lagoon would increase from 28 m^3/day to 34 m^3/day. As per the MECP Amended ECA No. 2206-8KSQZV dated August 23, 2011, the maximum rated flow handling capacity of the Site is 57.2 m^3/day.

4.4.2 Wastewater Influent Quality

A characterization study of the influent feedstock received at the Site was performed in 2009. No recent feedstock characterization data was made available for this Study. Historical influent characterization data is represented in Table 4.10.

Table 4.10 Historical Influent Characterization Data (2009)

Parameter	Units	McDonald's Owen Sound	Tim Hortons Owen Sound	Deals Plaza Owen Sound	Combined Samples (all locations)	Various Residential Units Sample #1	Various Residential Units Sample #2	Average	Recommended for Design
Total Solids	mg/L	50,000	3,000	1,000	3,900	11,000	11,000	13,317	40,000
Total Volatile Solids	mg/L	45,250	1164	436	3,615	8,415	8,767	11,273	25,000
Total Suspended Solids	mg/L	33,900	236	127	22,200	10,100	10,400	12,800	15,000
Carbon/Nitrogen (C/N)	mg/L	73	6	5	84	9	9	31	40
Total Nitrogen	mg/L	307	84	46	212	468	375	250	250
TKN	mg/L	307	84	46	212	468	375	250	250
BOD	mg/L	18,400	1,460	252	7,440	2,280	1,120	5,160	7,000
Phosphorus	mg/L	69	46	13	43	176	171	86	100
Total Phosphorus	mg/L	26	22	53	17	90	63	0.0045	250
Copper	mg/L	1.96	0.053	0.057	1.07	6.87	6.06	2.68	3
Volatile Fatty Acids	mg/L	793	937	49	699	242	449	530	600
Volatile Solids (Dry Weight)	%	90.5	98.8	42.6	92.7	76.5	79.7	70	80

From a wastewater treatment perspective, biochemical oxygen demand (BOD) is an important parameter for lagoon design and operations. Historical data indicates a wide range of BOD concentration for influent samples from different sources. For example, wastewater generated at McDonald's was reported to have BOD of 18,400 mg/L, while other sources such as the Deals Plaza in Owen Sound reported BOD as low as 252 mg/L. BOD of all combined samples collected from various locations was noted to be in the range of 7,000 mg/L to 7,500 mg/L, while samples taken at the residential units varied from 1,100 mg/L to 2,200 mg/L. A wide range of BOD concentrations of the influent wastewater coming from various sources indicates inconsistency of the BOD loading to the aeration lagoon on a given day. This suggests that there is variability and uncertainty of the treatment within the lagoons. Average BOD concentration of all the samples collected was 5160 mg/L. However, as per current operational practice, flow to the aeration lagoon is not consistent daily. For the purpose of this assessment study, design BOD concentration is assumed to be 7,000 mg/L to accommodate any peaking factor and daily uncertainties for the loading rate. The significant assumptions required for this analysis (i.e. flow averaging, influent concentration) constitute considerable uncertainty in defining treatment capacity.

4.4.3 Original Design Basis

The 1980 Township of Derby Wastewater Treatment Works Expansion Design Report was reviewed, along with construction design drawings of the aeration and facultative lagoons, and the current ECA to obtain design data for further assessment of the lagoon treatment capacity. Original design data as noted in the 1980 design report is represented Table 4.11.

Table 4.11 Original Design Data

Parameter	Design	Reference
Aeration Cell		
Width (m)	30	Construction Design Drawing
Length (m)	63	Construction Design Drawing
Depth (m)	1.746	Calculated
Total Volume (m^3)	3,300	ECA
Number of aerators	7	Design Report, 1980
Size of the aerators (mm)	300	Design Report, 1980
Aeration system design efficiency	80%	Design Report, 1980
Expected BOD removal in Aeration cell (mg/L)	400	Calculated
Detention time in Aerated Cell (days)	60	Calculated and rounded
Facultative Cell		
Width (Cell 1)	80	Construction Design Drawing
Length (Cell 1)	70.5	Construction Design Drawing
Width (Cell 2)	62	Construction Design Drawing
Length (Cell 2)	60	Construction Design Drawing

Parameter	Design	Reference
Depth (m)	2.40	Calculated
Total Volume (m^3)	22,500	ECA

The WWTW was originally designed for an annual flow rate of 21,240 m^3 and a daily flow rate of 58.2 m^3, as waste was considered to be received at the Site seven (7) days a week. According to the 1980 design report, influent BOD of 500 mg/L was assumed to be entering the aeration lagoon, with a removal efficiency of 80%.

The design of an aerated lagoon for BOD removal is based on first-order kinetics and the complete mix hydraulics model, resulting in a conservative design even if the system is not completely mixed (US EPA Wastewater Technology Fact Sheet for Aerated, Partial Mix Lagoons). The model commonly used is as follows:

$$C_e = \frac{C_o}{[1 + (K_T)(t)/n]^n}$$

Where:

C_e is effluent BOD
C_o is influent BOD
K_T = temperature dependent rate constant
t is total detention time in system
n is number of equal sized cells in system

It is important to account for the reduced biological activity that occurs during cold weather, with the reaction rate requiring temperature adjustment.

Based on the design report, influent BOD for the aeration cell was 500 mg/L and effluent BOD was 100 mg/L. Thus, the first order reaction rate constant K_T value is estimated to be 0.06 d^{-1} by calculation from design influent and effluent concentrations Note that the K_T value is dependent on temperature. However, temperature corresponding to the K_T value remains unknown for the original design basis. As per practical design and application of aerated-facultative lagoon process by Gary A. Boulier and Thomas J Atchisan and US EPA Fact Sheet, calculated K_T value of 0.06 d^{-1} is a very conservative value when considering low temperatures at the lagoon.

Since the original design lagoon temperature is unknown, for the purpose of the lagoon treatment capacity assessment, summer lagoon temperature of 20˚C was assumed with winter temperature of 0.5˚C, with K_T values at 20˚C and 0.5˚C of 0.276 d^{-1} and 0.138 d^{-1} respectively. Original design data as noted in the 1980 design report is represented in Table 4.12 and Table 4.13.

Table 4.12 Evaluation of Original Design Conditions

Aeration Cell	Design	Reference
Design Annual Flow (m^3)	21,240	Design Report 1980
Design flow rate (m^3/day)	58.2	Design Report 1980
Influent BOD (mg/L)	500	Design Report 1980
Aeration cell loading rate (kg/d)	29.1	Design Report 1980

Aeration Cell	Design	Reference
Aeration cell effluent (mg/L)	28.5	Using first order kinetic model with 1 cell and at 20˚C When, K_T = 0.276 d-1
Aeration cell effluent (mg/L)	53.9	Using first order kinetic mode with 1 cell and at 0.5˚C When, K_T = 0.138 d^{-1}

Table 4.13 Evaluation of Original Design Based on Summer & Winter Conditions

WWTW Treatment Assessment	Design
Summer Conditions (20°C)	
Effluent discharged from aeration cell to facultative lagoon (mg/L)	28.5
BOD loading in facultative lagoon (kg/day)	1.7
Facultative lagoon surface area (m^2)	9,360
BOD loading rate to facultative lagoon (kg/ha-day)	1.77
Winter Conditions (0.5°C)	
Effluent discharged from aeration cell to facultative lagoon (mg/L)	53.9
BOD loading in facultative lagoon (kg/day)	3.1
Facultative lagoon surface area (m^2)	9360
BOD loading rate to facultative lagoon (kg/ha-day)	3.35

As noted in the MECP wastewater treatment design guideline, the ability to introduce raw sewage to all lagoon cells is desirable, but at minimum, there should be capability to divide raw sewage flows among enough cells to reduce the design average BOD loading to less than 22 kg/(ha-d) at the mean operating depth in the primary cells. The original design conditions satisfy this MECP guideline.

4.4.4 Treatment Capacity Assessment for the Current Operating Condition

The total feed to the aeration lagoon was 7,917 m^3, 6,938 m^3 and 5,811 m^3 in 2017, 2018 and 2019 respectively, resulting in an average total annual flow to the aeration lagoon of 6,889 m^3. Table 4.14 provides design details based on current operating conditions.

Table 4.14 Design Details based on Current Operating Conditions

Design Details at Current Operating Conditions	Design	Reference
Design Annual Flow m^3	6,880	Average based on 2017-2019 data
Design flow rate (m^3/day)	26.5	Calculated (260 days/year)
Influent BOD (mg/L)	7,000	Assumed based on historical data obtained from 2009
Aeration cell loading rate (kg/d)	185	Calculated
Aeration cell detention time (days)	125	Calculated
K_T @20°C (d^{-1})	0.276	EPA
K_T @0.5°C (d^{-1})	0.138	EPA

Design Details at Current Operating Conditions	Design	Reference
K_T (design) d^{-1}	0.06	Calculated
Aeration cell effluent (mg/L) @ 20˚C	198	Using first order kinetic model with 1 cell and at 20°C When, K_T = 0.276 d^{-1}
Aeration cell effluent (mg/L) @ 0.5˚C	384	Using first order kinetic model with 1 cell and at 0.5°C When, K_T = 0.138 d^{-1}
Design effluent BOD k_{dT} (mg/L)	825	When, K_T = 0.06 d^{-1}
BOD loading to facultative lagoon (kg/d) @ 20˚C	5.2	Calculated
BOD loading to facultative lagoon (kg/d) @ 0.5˚C	10.2	Calculated
BOD loading to facultative lagoon (kg/d) @ design	21.8	Calculated
facultative lagoon surface area (ha)	0.936	Calculated
BOD Loading to facultative lagoon (kg/ha.d) @20˚C	5.6	Calculated
BOD Loading to facultative lagoon (kg/ha.d) @0.5˚C	10.9	Calculated
BOD Loading to facultative lagoon (kg/ha.d) @design	23.3	Calculated

Assumptions applied to current operating conditions indicate BOD loading to the facultative lagoon to be less than MECP design average BOD loading guideline of less than 22 kg/(ha-d); effluent quality requirements have also been achieved. As noted in the annual 2017, 2018, and 2019 performance reports prepared by GSS, effluent quality are in compliance with ECA requirement of BOD of 30 mg/L and TSS of 40 mg/L. Note that effluent characterization is only performed when there is a discharge from the facultative lagoon. Normally, spray from the facultative lagoon takes place in spring and summer months. Effluent characterization data is presented in Table 4.15.

Table 4.15 Effluent Characterization Data (2017-2019)

Month	2017			2018			2019		
	BOD (mg/L)	TSS (mg/L)	TKN	BOD (mg/L)	TSS (mg/L)	TKN	BOD (mg/L)	TSS (mg/L)	TKN
April	14	19	-	-	-	-	-	-	-
May	13.3	19.3	-	7	4	9.3	8	16	9.2
June	3	30	7.7	<3	<2	8.3	<3	5	7
July	3	4.3	10.2	4	11	3.5	5	45	5.8
August	3	9	8.4	4	14	2.7	13	15	4.6
September	<3	11	4.1	13	25	5.5	6	11	3.9
October	-	-	-	8	14	5.7	4	16	4.9

4.4.5 Treatment Capacity Assessment for Future Operating Condition (BioGRID offline)

Total septage and sewage received at the Site was 9,332 m^3, 8,883 m^3 and 8,104 m^3 in 2017, 2018 and 2019 respectively. Considering a scenario in which the BioGRID is taken offline and all the septage and sewage feedstock is diverted to the aeration lagoon, the expected total yearly flow to the aeration lagoon would be 8,850 m^3. Considering a total of 250 operating days, the expected flow to the aeration lagoon would increase from 28 m³/day to 34 m³/day. Table 4.16 provides design details based on future operating conditions.

Table 4.16 Design Details based on Future Operating Conditions

Design Details at Future Operating Conditions	Design	Reference
Design Annual Flow (m^3)	8,850	Average based on 2017-2019 data
Design flow rate (m^3/day)	34.0	Calculated (250 days/year)
Influent BOD (mg/L)	7,000	Assumed based on historical data obtained from 2009
Aeration cell loading rate (kg/d)	238	Calculated
Aeration cell detention time (days)	97	Calculated
K_T @20°C (d^{-1})	0.276	EPA
K_T @0.5°C (d^{-1})	0.138	EPA
K_T (design) d^{-1}	0.06	Calculated
Aeration cell effluent (mg/L) @ 20˚C	252	Using first order kinetic model with 1 cell and at 20°C When, K_T = 0.276
Aeration cell effluent (mg/L) @ 0.5˚C	487	Using first order kinetic model with 1 cell and at 0.5°C When, K_T= 0.138 d-1
Design effluent BOD K_T (mg/L)	1,027	When, K_T = 0.06 d^{-1}
BOD loading to facultative lagoon (kg/d) @ 20˚C	8.6	Calculated
BOD loading to facultative lagoon (kg/d) @ 0.5˚C	16.6	Calculated
BOD loading to facultative lagoon (kg/d) @ design	35.0	Calculated
Facultative lagoon surface area (ha)	0.936	Calculated
BOD Loading to facultative lagoon (kg/ha.d) @20˚C	9.2	Calculated
BOD Loading to facultative lagoon (kg/ha.d) @0.5˚C	17.7	Calculated
BOD Loading to facultative lagoon (kg/ha.d) @design	37.3	Calculated

Assumptions applied to the future flow conditions (34 m³/d) indicate BOD loading to the facultative lagoon to be less than MECP design average BOD loading guideline of less than 22 kg/(ha-d) if the literature reaction rate values are used and are assumed to be representative of summer and winter temperature conditions. However, the facultative lagoon loading condition exceeds MECP design guidelines when the most conservative reaction rate is applied (based on original design report).

As per the current ECA, the rated capacity of the WWTW is 57.3 m^3/d. Completing a similar analysis as above at the rated capacity of 57.3 m^3/d (rather than actual flow of 34 m^3/d) results in BOD loading to the facultative lagoon as follows

- BOD loading at 20 oC: 15.1 kg/ha.c
- BOD loading at 0.5 oC: 28.5 kg/ha.d
- BOD loading using design reaction rate: 57.3 kg/ha.d

The predicted loading to the facultative lagoon exceeds MECP Design Guidelines even at the literature reaction rate assumed representative for winter temperature conditions. To meet the facultative lagoon loading criteria of less than 22 kg/ha.d at the rated capacity of 57.3 m^3/d, the BOD concentration of the aerated lagoon effluent should be less than approximately 360 mg/L.

4.4.6 Process Review Summary

1. The characteristics of influent feedstock received at the Site are not well defined. The quality of the material in terms of loading to the sewage lagoons is therefore not well understood.
    a. ***Recommendation*** | A sampling program to determine the characteristics of all received wastes as well as for the solids and liquid stream coming out of the drum screen would clarify the organics loading rates to the BioGRID and the sewage lagoons. The program should include analysis for TS, volatile solids (VS), ammonia, alkalinity, biological oxygen demand (BOD), chemical oxygen demand (COD), and total phosphorous (TP).
2. The sewage lagoons receive liquid feedstock conveyed directly from Dump Station #1 as well as the liquid portion from the feedstock that is directed to Dumping Station #2 and then fed through the drum screen.
    a. ***Note*** | In a scenario where the BioGRID system is mothballed, use of Dump Station #1 with liquid feedstock could theoretically continue, meeting design guidelines based on the use of literature reaction rates and with a throughput at 34 m^3/day that is below the total WWTW rated capacity of 57.3 m^3/day. Design guidelines would are note met when based on the use of the conservative reaction rate listed in the original design data.
    b. The potential for operations at a throughput of 57.3 m^3/day to meet design guidelines are further restricted, with a theoretical limit to BOD concentrations (requiring a lower strength feedstock) to meet loading rate design guidelines

4.4.7 Limitations on the Process Review

It is not possible to determine the actual reaction rate when there is no data available on the aerated lagoon performance (i.e., aerated lagoon effluent discharge concentration). The potential large variability of influent concentrations and flows (from day to day) and required assumptions present a considerable challenge to accurately predicting the available lagoon capacity. The recommended sampling program should be undertaken to then also revise/validate the assumptions applied herein for the process review.

5. Organic Waste Feedstocks and Approach to Tipping Fees

This section provides a discussion on the current organic waste feedstocks processed at the WWTW for the beneficial production and use of biogas, the potential additional organic waste feedstocks that may be procured for processing, and the approach to tipping fees for the materials received and processed.

5.1 Current Organic Waste Feedstocks

Currently, the following feedstocks are received by various suppliers and processed at the WWTW:

- Septage (equivalent to approximately 212 septic systems in 2019)
- Hauled Sewage (approximately 22 individual customers in 2019)
- Organic Waste such as vegetable waste, FOG, processing waste for supplements, hospital food waste and food waste from residents and commercial units such as Base Borden (approximately 17 individual customers in 2019)

Table 5.1 provides a summary of the total estimated material received at the Site from 2017 to 2020.

Table 5.1 Total Estimated Material received at the Site from 2017 to 2020

Feedstock	2017	2018	2019	2020 (anticipated)
Septage (m^3)	1,150.4	976.3	847.1	1,000
Hauled Sewage (m^3)	8,180.6	7,906.8	7,258.8	8,000
Organic Waste (m^3)	2,857.4	2,982.6	2,647.8	2,700
Total (m^3)	12,188.4	11,865.7	10,753.7	11,700

It was anticipated that approximately 100 m^3 of organic material from agricultural sources (i.e. straw, hay, canola, etc.) would be purchased and processed at the Site for the purposes of feeding the BioGRID during low feedstock months in the winter. However, according to the Site operator, none of this material was brought to the Site in 2020.

5.2 Potential Additional Organic Waste Feedstocks

Various organic waste feedstocks are currently managed via the BioGRID AD process. These include: vegetable waste; FOG; processing waste for supplements; hospital food waste; food waste from CFB Borden. Biogas is produced and is currently utilized to generate electricity.

Additional organic waste feedstocks (e.g., SSO, agricultural wastes, and wastewater) may be procured for input to the BioGRID, each presenting its own opportunities and challenges. The input of additional organic waste feedstocks will increase biogas production and provide further opportunity for its beneficial use, as it is highly biodegradable and has a much higher volatile solids destruction rate than sewage sludge. It should be noted that while the addition of more sewage sludge as a feedstock will increase the quantity of biogas produced at the BioGRID, it will also increase total and organic nitrogen, potassium, sulphur, phosphorus, alkalinity, pH, alkalinity, fats, oils, and grease, and other solids. Currently, higher quantities of sewage feedstocks (with lower total solids) are received than organic waste feedstocks (with higher total solids); thereby limiting biogas production within the BioGRID. Pilot-scale co-digestion results have shown that the optimum mixture for maximum biogas yield is a 1:2 ratio of food waste and sludge.

A description of potential additional organic waste feedstocks is provided below in .

Table 5.2 Summary of Potential Additional Organic Waste Feedstocks

No.	Feedstock	Description	Biogas Production Potential
1.	FOG	• FOG produced within the IC&I sector	• Relatively very high biogas production potential (approximately 500 m^3 biogas per fresh tonne)
2.	SSO (e.g., from residential and IC&I sectors)	• Residential SSO and SSO from the IC&I sector not limited to commercial food processing, restaurants, and grocery stores (pre-consumer and post-consumer)	• Relatively high biogas production potential (approximately 225 m^3 biogas per tonne and 110 m^3 biogas per wet tonne)
3.	Agricultural Waste (e.g., manure and crop residue)	• Manure produced by livestock including dairy and beef cattle, swine, sheep, goats, and poultry • Agricultural crop residue includes material left in a field/orchard/vineyard after crop harvest	• Relatively low biogas production potential due to high water content (approximately 15-25 m^3 biogas per tonne for pig and cattle manure) • Agricultural waste is commonly managed via on-farm digesters and may be processed with another waste stream (co-digestion) for the purposes of increasing biogas production and its beneficial use
4.	Wastewater (e.g., sludge)	• Sludge from the treatment of wastewater within municipal and IC&I sectors (e.g., pulp and paper industry)	• Relatively low biogas production potential due to high water content

With the pending organics landfill ban in the province, currently scheduled to be phased in beginning 2022, many municipalities are considering the concept of co-digestion, including the cities of Petawawa, Oxford, Kingston, Brantford, Guelph, Belleville, and London. Thus, it may be worthwhile to continue operations and co-digestion of feedstocks at the BioGRID system, as its value may be realized in the upcoming years.

5.3 Approach to Tipping Fees

According to the Site operator, tipping fee of \$25/m^3 is currently charged per customer regardless of feedstock type, except for the SSO leachate from the Region of Huronia Environmental Services (2013) Ltd. (ROHES), which has been negotiated for tipping fee of \$30/m^3 from August 1, 2019 to July 22, 2022.

Table 1 in the 2019 Annual Performance Report notes maximum allowances in terms of volume of feedstock accepted for each customer. It was noted by the Site operator that maximum allowances and exceedance fees only apply to septage quantities received from the Sunset Strip Businesses.

Table 5.3 provides a summary of the current tip fees based on feedstock type.

Table 5.3 Current & Market Tip Fees

Description	Current & Market Tip Fee ($/m³)	Current & Market Tip Fee ($/tonne)
Hauled Sewage from Sunset Strip Businesses	$8.33	$6.01
Residential Septage	$25.00	$18.03
Commercial Septage	$25.00	$18.03
SSO Leachate (from Region of Huronia Environmental Services)	$30.00	$28.50
FOG (from Planet Earth Recycling)	$10.00	$9.50
Blood waste (from Grey & Bruce County)	$10.00	$9.50
Additional Feedstock (FOG, vegetable waste, farm waste)	$25.00	$23.75
Residential SSO	N/A	$100.00
IC&I SSO	N/A	$100.00

As part of the assessment of options to be completed in the Study Report, recommendations on tip fee will be made. These will be undertaken concurrently because the options assessment will define capital and operations costs for the options, and accordingly the potential or required tipping fee to provide for profitability of the BioGRID system. The recommendations will consider relative market values and the assessment will identify sensitivity to changing tipping fees to further define feasibility of any given option. With regard to potential relative market values, the following is noted:

- According to the 2018 Green Bin Organic Waste Processing and Capacity in the Province of Ontario report prepared for the City of Toronto, it costs on average $110 per tonne in tipping fee and $30 per tonne for the transfer and haulage of the SSO material to have SSO processed at organic waste processing facilities currently available in Ontario. Future SSO waste management costs will be impacted by the availability of processing capacity as well as the price of fuel at that time.
- For another point of comparison, the Ottawa Valley Waste Recover Centre, a composting facility, is currently charging a tipping fee of $95 per tonne of organic waste (green cart material).

Operating costs of an AD facility are generally on par with the revenue generated from tip fees and can help determine what the tip fees should be. For example, composting facilities tend to have less equipment, which can translate to lower operating costs than an AD facility, and thus lower tip fees.

6. Regional Waste Management Systems

This section describes the regional waste management systems for Georgian Bluffs, Chatsworth, and neighbouring townships/municipalities.

6.1 Township of Georgian Bluffs

Georgian Bluffs has a Long-Term Waste Management Plan (Gamsby and Mannerow, 2009). An update to the Long-Term Waste Management Plan is currently being undertaken by Gamsby and Mannerow Ltd on behalf of Georgian Bluffs.

Garbage

Garbage is collected weekly by Waste Management on behalf of Georgian Bluffs. In 2009, Council enacted By-law 74-2009 wherein all garbage bags require bag tags costing $2 each, with a limit of 4 bags per collection week. The Miller Waste Systems receives all solid waste from Georgian Bluffs' residents at their waste transfer station located at 2085 20th Avenue East in Owen Sound, Ontario. Table 6.1 notes the waste management tipping fees applicable at the Miller Waste Systems Transfer Station.

Table 6.1 Tipping Fees – Miller Waste Systems Transfer Station

Waste Type	Tipping Fees
Residential Car	$6.00/bag
Residential Minimum Charge	$25.00
Residential Garbage in excess of 4 bags/furniture	Weigh in and out at $135.71/tonne
Recycling	$5/load
Metal (No CFCs)	$0/tonne
White Good Appliances (CFCs present)	$35/unit

Georgian Bluffs owns the former Keppel Landfill Site located on Part Lot 30, Concession 2, South Centre Diagonal Road in the County of Grey, Ontario, (Google Map address is 104-192 Stone School Rd, Hepworth, Ontario), which was operated under amended MECP ECA No. 5011-4VEKSL issued on March 14, 2016. According to the 2017 annual landfill monitoring report prepared by GM Blue Plan Engineering, the landfill reached its maximum capacity and stopped receiving waste from the public in May 2017.

According to Statistics Canada, the population within Georgian Bluffs has seen a steady increase since 2001. Total waste generated in 2006 and 2007 was 2,816 and 2,921 tonnes respectively, which translates to approximately 268.5 kg/capita/year, based on a population of 10,785 (10,506 residents plus 279 seasonal population) in 2006. There is no recent waste generation data available. As for future population increase within the residents, the 2009 Long Term Waste Management Plan considered three projection models, and recommended the low growth scenario as summarized below in Table 6.2.

Table 6.2 Georgian Bluffs Population Projection (Low Growth Scenario)

Year	Percent Growth	Population
2001	N/A	10,152
2006	3.4%	10,506
2011	3.0%	11,214
2016	4.1%	11,677
2021	4.5%	12,198
2026	4.4%	12,730
2031	3.8%	13,212

A summary of the reported waste generation and diversion rates at the Keppel Landfill Site from 2001 to 2007 is provided below in Table 6.3. This is the only publicly available waste data found for Georgian Bluffs. There is no recent waste generation and diversion data post 2007 to 2019 is available.

Table 6.3 Keppel Landfill Site Reported Waste Generation and Diversion Rates (2001-2007)

Year	Population	Waste Generated (tonnes)	Waste Generated (kg/cap)	Waste Diverted (tonnes)	Waste Diverted (kg/cap)	Total Waste Generated (tonnes)	Total Waste Generated (kg/cap)	Diversion Rate
2001	7,070	2,008	284.0	718	101.6	2,726	385.6	26.3%
2002	9,869	2,030	205.7	634	64.2	2,664	269.9	23.8%
2003	10,000	2,560	256.0	841	84.1	3,401	340.1	24.7%
2004	9,869	2,175	220.4	768	77.8	2,943	298.2	26.1%
2005	9,900	2,175	219.7	1,212	122.4	3,387	342.1	35.8%
2006	10,506	1,595	151.8	1,221	116.3	2,816	268.0	43.2%
2007	10,860	2,033	187.2	888	81.8	2,921	269.0	30.4%

Recycling

Recycling is collected bi-weekly by Waste Management on behalf of the Township. According to the 2009 Long Term Waste Management Plan, the average blue box recycling diversion rate was 30.5% for 2005-2007.

Leaf & Yard Waste

According to the Georgian Bluffs website, backyard Earth Machine composters are available for $44.50 each including taxes to allow for and encourage backyard composting of food waste and leaf and yard waste (L&YW) by residents.

Organic Food Waste

Georgian Bluffs does not currently have a curbside SSO collection program. The forecasted estimated quantities from year 2021 through 2041 of SSO from Georgian Bluffs that may be available for input to the BioGRID as an organic waste feedstock are listed below in Table 6.4. These estimates were calculated using waste generation information averaged for the available data in years 2005-2007 (Table 6.3) and forecasted using the population projections listed within the table below. Using also a 50% organic composition in the residual waste, the calculation provides estimated organic waste generated in tonnes per year. Assuming a 50% participation rate in an SSO collection program, the estimated organic waste capture quantities were also calculated.

Table 6.4 Estimated Total Waste Generation and Collection (Georgian Bluffs)

Year	Population	Residual Waste Generated (tonnes)	Residual Waste Generated (kg/capita)	Organic Waste Generated (tonnes)	Organic Waste Captured (tonnes)
Average Estimated					
2001-2007	9,725	2,082	218	1,041	521
Forecast Estimated					
2021	12,198	3,241.0	265.7	1,621	810
2026	12,730	3,382.4	265.7	1,691	846
2031	13,212	3,510.4	265.7	1,755	878

As listed above, the forecasted estimated quantities of SSO captured via a collection program range from 810 in 2021 to 880 tonnes per year in 2031. Public participation rates in SSO collection programs tend to vary across municipalities, with higher levels of public acceptance noted in programs allowing the use of plastic bags as liners, personal hygiene products and pet waste in their SSO collection program, and bi-weekly collection of residual waste.

Organic Waste - FOG

FOG organic waste material is procured with Base Borden and brought to the BioGRID for processing. Further research and study into this feedstock will be required to better understand the quantity and characteristics of the FOG material currently processed at the Site, and to determine the potential for securing additional FOG material within reasonable proximity from the Site.

Organic Waste – Industrial, Commercial and Institutional (IC&I)

Organic waste including processing waste for supplements, hospital food waste, and food waste is procured with Base Borden and brought to the BioGRID for processing. Further research and study into this feedstock will be required to better understand the quantity and characteristics of the IC&I material currently processed at the Site, and to determine the potential for securing additional IC&I material within reasonable proximity from the Site.

Based on a call with OCWA on January 27, 2021, it was determined that Chapman's ice cream manufacturing facility, located in Markdale, Ontario, may be interested in having some of their waste be processed at the BioGRID facility, as they are reaching capacity at the storage facility they built at another farm.

Agricultural Waste – Manure

Manure is typically processed in on-farm anaerobic digesters along with other organic waste from farming operations such as crop residue. Securing contracts for this organics feedstock can be challenging and since

Georgian Bluffs has partnered with the farming community for land application of digestate via NASM, it is recommended that this feedstock not be considered further as a potential organics feedstock option.

Agricultural Waste – Crop Residue

Crop residue such as corn silage is sometimes used at the Site to cover the digestate holding tanks to prevent odour releases in the summertime. It cost Georgian Bluffs $35/m^3$ in 2019 to receive this material from farmers and is hence considered to be cost prohibitive as a potential feedstock option. Similar to manure, crop residue is typically processed in on-farm anaerobic digesters along with other organic waste from farming operations. Also since Georgian Bluffs has partnered with the farming community for land application of digestate via NASM, it is recommended that this feedstock not be considered further as a potential organics feedstock option.

Hauled Septage

Majority of the hauled sewage and septage is procured through Sunset Strip and brought to the BioGRID for processing. It was noted by the Site operator that the septage is very low in total solids percentage and is practically water. It is not recommended for additional hauled sewage and septage to be considered further as a potential organics feedstock option, as this material will not contribute to increasing the biogas production at the BioGRID.

6.2 Township of Chatsworth

Garbage

According to Chatsworth's website, garbage is collected every week by Waste Management on behalf of Chatsworth. There is currently no bag limit for the residents, though only one bag can be left untagged. Bag tags can be purchased for $2.50 each. Garbage is taken to the Sullivan Transfer Station, located at 702320 Sideroad 5 in Desboro, Ontario, which is approximately 13 km away from the BioGRID and WWTW.

While there are two landfill sites within the municipality, according to a recent Chatsworth newsletter, the Sullivan Landfill is closed and has been converted to a transfer station. Markdale Landfill, located at 775557 Highway 10 in Markdale, Ontario, is an active landfill site available to Chatsworth residents for garbage disposal. it is located approximately 27 km from the Sullivan Landfill Station, and 34 km from the BioGRID WWTW. Chatsworth owns 50% shares of the Markdale Landfill.

Recycling

Recycling is collected every week by Waste Management on behalf of Chatsworth.

Leaf & Yard Waste

No publicly available information was found.

Organic Food Waste

Chatsworth does not currently have a curbside SSO collection program. With a population of 6,630 according to the 2016 Census, a waste generation rate per capita similar to Georgian Bluffs was assumed in order to estimate the quantities of SSO that may be available from Chatsworth for input to the BioGRID as an organic waste feedstock. Using a 50% organic composition in the garbage, the calculation provided organic waste generated in tonnes per year. Assuming a 50% participation rate in an SSO collection program, the organic waste captured quantities were calculated and are shown in Table 6.5.

Table 6.5 Estimated Total Waste Generation and Collection (Chatsworth)

Year	Population	Georgian Bluffs - Averag e Residual Waste Generated (kg/capita/year)	Estimated Residual Waste Generated (tonnes)	Organic Waste Generated (Assumed 50% of Garbage)	Organic Waste Captured (Assumed 50% Participation in SSO Program)	Organic Waste Captured (tonnes/capita /year)
2016	6,630	266	1,762	881	440	0.07

6.3 Combined SSO Quantities from Townships

As noted in Section 5.1, it is estimated that approximately 810 tonnes of SSO can be captured via a collection program within Georgian Bluffs annually. Section 5.2 notes that an estimated 440 tonnes SSO can be captured via a collection program within Chatsworth annually, which brings the combined total to approximately 1,300 tonnes annually.

It is recommended that Georgian Bluffs and Chatsworth conduct waste audits for all collected waste streams and waste streams received at the Miller Waste Systems Transfer Station (for Georgian Bluffs), as well as the Sullivan Transfer Station and Markdale Landfill (for Chatsworth). A waste audit provides data on waste quantities being collected/received, potential organic wastes within various waste streams (e.g., residential and IC&I[2] sectors), participation rates, and contamination rates within waste streams. When undertaken during different seasons, it also provides data on the seasonality of quantities, participation, and generation/diversion. Such data would assist in confirming assumptions within this study and others (e.g., the current update to the Georgian Bluffs' Long Term Waste Management Plan) to support a holistic understanding of waste within Georgian Bluffs, as a measure of waste management system performance, and to define potential opportunities for sustainable and valuable improvements.

6.4 Neighbouring Townships/Municipalities

Grey County is comprised of Georgian Bluffs and Chatsworth, along with three other townships are two municipalities. These surrounding townships and municipalities could be approached to discuss the potential arrangements and quantities to define a volume of additional SSO that could be digested at the BioGRID, where possible. The quantity of SSO that can be secured is estimated to be approximately 2,800 tonnes annually based on the following surrounding townships and municipalities:

- Municipality of Meaford: 700 tonnes of SSO per year (44 km from the Site)

[2] IC&I – Industrial, Commercial, and Institutional

- Town of Hanover: 500 tonnes of SSO per year (45 km from the Site)
- Municipality of Grey Highlands: 650 tonnes of SSO per year (47 km from the Site)
- Town of The Blue Mountains: 450 tonnes of SSO per year (54 km from the Site)
- Township of Southgate: 500 tonnes of SSO per year (67 km from the Site)

When procuring organics feedstocks, the distance from the pre-processing facility at the Site can be an important consideration, whereby a maximum distance of approximately 25 to 50 km can be considered as a good guide. Majority of the townships and municipalities within Grey and Bruce Counties are within 50 km from the Site.

There are municipalities of similar size and population to Georgian Bluffs that are proceeding with the implementation of organic waste collection programs. For example, the Municipality of North Grenville, approximately 60km south of Ottawa, with a population of 17,700 people, passed a resolution on September 2020 to provide a new service that will encompass both rural and urban residents and will see solid waste collection reduced from weekly to bi-weekly, with organic waste collection taking place weekly. This decision was to get ahead of the game, recognizing that at some point the province is going to legislate an end to organic waste at landfills. A high-level cost estimate of what a new SSO collection program could cost for Georgian Bluffs and Chatsworth, based on established costs for the Municipality of North Grenville, is provided below in .

Table 6.6 Comparison of SSO Collection Programs in Other Municipalities

Parameter	Municipality of North Grenville (2019)	Georgian Bluffs (2021)	Chatsworth (2016)	Georgian Bluffs & Chatsworth Combined
Total Waste Disposed (tonnes)	4,830	3,241	1,762	5,003
Organic Waste Composition (%)	50%	50%	50%	-
Organic Waste Disposed (tonnes)	2,415	1,621	881	2,501
Residential Participation Rate (%)	60%	50%	50%	-
Organic Waste Available (tonnes)	1,449	810	440	1,251
Total # of Households	7,070	5,069	2,988	8,057
Collection Contract Cost ($)	$1,000,000	$716,973	$422,631	$1,139,604
One-Time Cost of Green Bins ($)	$175,750	$126,008	$74,277	$200,285
Organic Waste Disposal Cost ($)	$275,000	$153,774	$83,582	$237,357

For additional reference to SSO collection programs in larger municipalities, Table 6.7 below provides such a comparison for the Regions of York, Durham, Peel, Halton, and the City of Toronto based on 2008 data, and in the City of Ottawa and Stratford based on current available data. The majority of the municipalities listed are large municipalities with SSO collection programs in place for over 10 years. While initial participation may be low at the onset of a SSO collection program, it has been observed to increase with time as residents become more comfortable with the collection schedules and program details. Education has proven to be a key contributor to SSO collection success.

Table 6.7 Comparison of SSO Collection Programs in Other Municipalities

Municipality	York	Durham	Peel	Toronto	Halton	Ottawa	Stratford
SSO Collection Frequency	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly
Residual Waste Collection Frequency	Bi-Weekly	Bi-Weekly	Weekly	Bi-Weekly	Bi-Weekly	Bi-Weekly	Weekly
Weekly Average SSO Collection Program Participation Rate (%)	85-90	70	50	90	71	48, 64 by 2023	33% in first week
SSO Residual Waste Rate (%)	15	4	5-10	20	7-8	4	Data not available
Diapers/Pet Waste/Sanitary Products Accepted	Yes	No	No	Yes	No	Pet waste & L&YW only	No
Acceptable Liners	Plastic or compost-able bags	Compost-able bags only	Compost-able bags only	Plastic bags	Compost-able bags only	Plastic or compost-able bags	Compost-able bags only
Initial Start Date of SSO Program	2004	2003	1990's	2002	2005	2010	April 2020
Note: City of Stratford's participation rate of 33% was estimated based on their first week of collection data.							

7. Recommended Study Options for Assessment

Several Study options have been developed with regard to the current and potentially infrastructure for processing organic waste feedstocks at the site and generating electricity via the existing FIT contract.

The recommended Study options are provided below in Table 7.1. With the exception of Option 0 (Baseline – do nothing), the implementation of the Study options would require an ECA amendment based on the specific parameters implemented (e.g., new infrastructure).

Table 7.1 Summary of Recommended Study Options

Parameter	Option 0	Option 1	Option 2	Option 3	Option 4
Description	• Baseline (do nothing)	• Add 800 tonnes of SSO from Georgian Bluffs	• Add 1,300 tonnes of SSO from Georgian Bluffs and Chatsworth	• Add 4,100 tonnes of SSO from Georgian Bluffs, Chatsworth, and neighbouring townships • Do not include current septage/sewage from drum screen	• Add 7,000 SSO to maximize BioGRID capacity • Do not include current septage/sewage and organic material from drum screen
Feedstock Composition	• 60% current organics (2,829 m^3/year) • 40% current septage/sewage from drum screen (1,885 m^3/year) • 0% SSO (0 m^3/year)	• 48% current organics (2,829 m^3/year) • 32% current septage/sewage from drum screen (1,885 m^3/year) • 13% added SSO (1,231 m^3/year)(1)	• 42% current organics (2,829 m^3/year) • 28% current septage/sewage from drum screen (1,885 m^3/year) • 19% added SSO (2,000 m^3/year)(1)	• 31% current organics (2,829 m^3/year) • 45% SSO (6,308 m^3/year)(1)	• 100% SSO (10,769 m^3/year)(1)
Feedstock Total	• Total of 4,714 m^3/year • Equivalent to 12.91 m^3/day(2)	• Total of 5,945 m^3/year • Equivalent to 16.29 m^3/day(2)	• Total of 6,714 m^3/year • Equivalent to 18.39 m^3/day(2)	• Total of 9,137 m^3/year • Equivalent to 25.03 m^3/day(2)	• Total of 10,769 m^3/year • Equivalent to 29.50 m^3/day(2)
Infrastructure Requirements	• None	• SSO pre-processing equipment(3) • Road improvements(4) • Buffer/holding tank(5) • Digestate storage tank(6)	• SSO pre-processing equipment(3) • Road improvements(4) • Buffer/holding tank(5) • Digestate storage tank(6)	• SSO pre-processing equipment(3) • Road improvements(4) • Buffer/holding tank(5) • Replacement CHP unit(5) • Digestate storage tank(6)	• SSO pre-processing equipment(3) • Road improvements(4) • Buffer/holding tank(5) • Replacement CHP unit(5) • Digestate storage tank(6)
CHP Power Required (kW)	• 45	• 52	• 69	• 290(7)	• 246(7)

Table 7.1 Summary of Recommended Study Options

Parameter	Option 0	Option 1	Option 2	Option 3	Option 4
Biogas Flare	• No change, limiting feedstock to BioGRID during CHP downtime	• No change, limiting feedstock to BioGRID during CHP downtime	• No change, limiting feedstock to BioGRID during CHP downtime	• Required for safety purposes[(8)]	• Required for safety purposes[(8)]
Biogas Generation (m^3/hour)	• 20	• 23	• 31	• 130	• 111
Revenue from FIT Contract ($/year)	• $65,895	• $74,923	• $100,447	• $420,660	• $357,340
Digestate Management	• No change, liquid digestate land applied as Category 3 NASM	• No change, liquid digestate land applied as Category 3 NASM	• No change, liquid digestate land applied as Category 3 NASM	• No change, liquid digestate land applied as Category 3 NASM	• No change, liquid digestate land applied as Category 3 NASM

Notes:

[(1)] Conversion of SSO tonnage to m^3/day is based on a food waste density of 650 kg/m^3.

[(2)] Current daily flow to the sewage lagoons is calculated as being around 34 m^3/day. The WWTW has a total rated capacity of 57.5 m^3/day. Accordingly, the flow to the BioGRID system cannot exceed 23.5 m^3/day without reduction in the flow to the sewage lagoons and/or without ECA amendment.

[(3)] Pre-processing equipment from City of Toronto Dufferin Organics Processing Facility could be retrofitted for use at the Site, already in storage at the Site and as opposed to new infrastructure. A comparison of the potential benefit of using the existing available equipment or using a new unit tailored for Site use will be made.

[(4)] Site operator has advise that road upgrades are necessary to permit Site access for larger organic waste feedstock vehicles.

[(5)] To provide short term storage of the incoming feedstocks and will help reduce the flows to the drum screen separator, which will in turn increase the efficiency of the drum screen separator. This will also provide the Site operator with greater operational flexibility downstream of the drum screen separator, including the BioGRID system.

[(6)] A digestate storage tank will be required to allow for a minimum of six months of digestate storage; MECP guidelines recommend at least eight months of storage.

[(7)] Existing 100kW CHP unit will need to be expanded. Genivar's 2012 feasibility study considered cost estimates for an additional 180 kW and 240 kW 3-phase gas generator.

[(8)] Inclusion of an open or enclosed flare prior to the biogas cooling bed and the CHP unit will provide a contingency plan for biogas utilization, especially when the CHP unit is taken offline for maintenance. Currently, during CHP maintenance, feeding to the BioGRID is stopped to prevent release of biogas through the pressure relief values on top of the digester. Temporary release of biogas is considered a spill and must be reported to the MECP.

Appendix B

IESO Email Dated April 7, 2021

Dilshad Mondegarian

From:	Adam Greer <Adam.Greer@ieso.ca>
Sent:	Wednesday, April 7, 2021 11:30 AM
To:	Dilshad Mondegarian
Cc:	Chris Polito; Efath Ara; Etienne Bordeleau
Subject:	RE: Question Regarding FIT Contract ID#F-000981-BIG-130-203 & REF#FIT-FNUHBG5

Dilshad,

Thank you for your email. The IESO does not consent to the increase in Contract Capacity described in your email below.

Per a December 16, 2016 directive from the Minister of Energy, the final FIT Application Period was held in 2016 and the IESO ceased accepting applications under the FIT Program. While this ended the possibility of future iterations of the FIT Program, Contracts that had previously been entered into between the IESO and Suppliers are still in force and effect. This includes, among other things, Section 2.1(b) below:

ARTICLE 2
DEVELOPMENT AND OPERATION OF THE FACILITY

2.1 Design and Construction of the Facility

(a) The Supplier shall design and build the Contract Facility using Good Engineering and Operating Practices and meeting all relevant requirements of the IESO Market Rules, Distribution System Code, Transmission System Code, the Connection Agreement, in each case, as applicable, and all other Laws and Regulations. The Supplier shall ensure that the Facility is designed, engineered and constructed to operate in accordance with the requirements of this Agreement.

(b) The Supplier shall at no time after the date of this Agreement modify, vary or amend in any material respect any of the features or specifications of the Contract Facility or the Facility as outlined in the Application or the FIT Contract Cover Page (including for greater certainty, the Site) or make any change as to the Facility's status as a Registered Facility (a "**Contract Facility Amendment**"), without first notifying the OPA in writing and obtaining the OPA's consent in writing, which consent shall not be unreasonably withheld. For the purpose of this Section 2.1(b), it shall not be unreasonable for the OPA to withhold its consent to any modification, variation or amendment which would, or would be likely to,

(i) materially adversely affect the ability of the Supplier to comply with its obligations under this Agreement;

(ii) increase the Gross Nameplate Capacity of the Facility or otherwise cause Electricity generated by another facility to affect the Facility's meter reading, until such time as the Supplier and the OPA agree, acting reasonably, on any changes to the metering configuration or Exhibit B that are necessary to ensure that payments under this Agreement reflect only Delivered Electricity from the Contract Facility prior to any such Contract Facility Amendment; or

(iii) increase the Gross Nameplate Capacity of the Facility such that a lower Contract Price would have applied to the Contract Facility if, at the time of the original Application, the Contract Facility had an increased Contract Capacity corresponding to such increased Gross Nameplate Capacity.

Regards,
Adam

Adam Greer | Specialist, Contracts | Legal Resources and Corporate Governance
Independent Electricity System Operator (IESO) | T: (416) 969-6588 | E: Adam.Greer@ieso.ca
120 Adelaide Street West, Suite 1600, Toronto, ON M5H 1T1
Web: www.ieso.ca | Twitter: IESO_Tweets | LinkedIn: IESO

From: Dilshad Mondegarian <Dilshad.Mondegarian@ghd.com>
Sent: March 31, 2021 5:34 PM
To: FIT contract <FITcontract@ieso.ca>; IESO Customer Relations <IESOCustomerRelations@ieso.ca>
Cc: Etienne Bordeleau <Etienne.Bordeleau@ghd.com>; Efath Ara <Efath.Ara@ghd.com>
Subject: Question Regarding FIT Contract ID#F-000981-BIG-130-203 & REF#FIT-FNUHBG5
Importance: High

Hello,

I'm working on a feasibility study with the Township of Georgian Bluffs in regards to their BioGrid digester project site located at Side Road 3, Owen Sound, Georgian Bluffs, Ontario. This site currently has a OPA FIT contract with 100 kW capacity, which commenced on May 2, 2011 and will expire on May 2, 2031. Please see attached contract documentation for reference.

As part of the feasibility study, my project team is considering implementing a new 240kW CHP unit at the site, thereby expanding the overall capacity from 100kW to 340kW. Understanding that the FIT program ended in 2016, please confirm whether it is still possible to increase the FIT contract capacity past 100kW.

Regards,

DILSHAD MONDEGARIAN, P.Eng.
Waste Management

GHD
Proudly employee owned | ghd.com
455 Phillip Street Unit #100A Waterloo Ontario N2L 3X2 Canada
D +1 519 340 4202 **M** +1 519 729 0932 **E** dilshad.mondegarian@ghd.com

Appendix C

Assessment of BioGRID System Mothballing and WWTW Systems Valuation

Technical Memorandum

June 14, 2021

To	Patty Sinnamon, Township of Chatsworth	**Tel**	519 794-3232 x 124
Copy to	Étienne Bordeleau	**Email**	psinnamon@chatsworth.ca
From	Ben Samuell	**Ref. No.**	11223233
Subject	**BioGRID System Decommissioning and Recommissioning Plan Derby WWTW Asset Evaluation – Technical Memorandum #1**		

1. Introduction

GHD Limited (GHD) has been retained by the Township of Chatsworth, in collaboration with Ontario Clean Water Agency (OCWA), to provide an evaluation of decommissioning, recommissioning, and costs pertaining to the potential mothballing of the BioGRID system located at the Derby Wastewater Treatment Works (WWTW or Site).

1.1 Purpose

The purpose of this memorandum is to discuss the plan for decommissioning and recommissioning of the BioGRID system should it be mothballed, for an evaluation/mothballing period of five years.

1.2 Site and evaluation context

The BioGRID system (Bio Green Renewable Industrial Digester) is owned and managed by the BioGRID Joint Board of Management (Joint Board) comprising the Township of Georgian Bluffs (Georgian Bluffs) and the Township of Chatsworth (Chatsworth). Collectively, Georgian Bluffs and Chatsworth are referred to herein as "Townships". The Site is approved under Ontario Ministry of Environment, Conservation and Parks (MECP) Environmental Compliance Approval (ECA) No. 2206-8KSQZV, issued on August 23, 2011.

The WWTW sewage lagoons were implemented in 1975 and the BioGRID system was implemented in 2011. The sewage lagoons receive liquid sewage directly from the input to the WWTW Dumping Station #1 and are interconnected with the BioGRID system via a drum screen (i.e., the screened liquid portion of materials input to the BioGRID system process are conveyed to the sewage lagoons). The BioGRID system has faced operational and financial challenges related to securing organic waste feedstocks, approaches for setting organic waste feedstock tipping fees, capacity, and bottlenecks of the existing anaerobic digestion (AD) process, material receiving station and other associated infrastructure, renewable energy generation, as well as process/operations of the sewage lagoons. With the challenges faced and previously evaluated at the facility, this evaluation looks to the requirements around BioGRID system mothballing and separated sewage lagoons operations.

This evaluation is understood as supplementing a concurrent study (GHD, 2021) that looks to confirm the feasibility and costs of operating the BioGRID system going forward (e.g., whether as baseline/do-nothing scenario or as modified scenarios via changes to organic waste feedstocks and infrastructure). Accordingly, this means:

– This evaluation is intended to provide information needed to cease the current BioGRID system operation and continue a standalone treatment process provided via the sewage lagoons system.
– The work of the concurrent study is alternatively reviewing potentially feasible options for the enhanced operation of the BioGRID system and is intended to provide information needed to proceed with operations in a preferred manner.

These two current projects are intended to assist the Townships in making informed decisions on the continued, mothballed, and/or standalone operations of the BioGRID system and sewage lagoons system.

1.3 Organization

This memorandum is organized in the following sections:

– **Section 1 Introduction |** Provides the evaluation purpose, context with decision-making intent, and organization of this memorandum.
– **Section 2 Site infrastructure and systems |** Discusses the Site infrastructure and systems identified as requiring specific attention to mothball the BioGRID system.
– **Section 3 Probable costs |** Defines the estimated probable costs to mothball the BioGRID system and undertake annual maintenance of the decommissioned infrastructure.
– **Section 4 Referenced information |** Lists the key relevant documentation reviewed/referenced for the development of this memorandum.
– **Section 5 Attachments |** Lists the enclosed documentation.

2. Site infrastructure and systems

Site infrastructure and systems have been identified as requiring specific attention/action for longer-term storage as part of potential mothballing of the BioGRID system. For purpose of this memo, these have been categorized within the following sub-systems:

1. Septage Receiving System
2. Drum Separator System (including Polymer System)
3. Fats, Oils, and Grease (FOG) System (including Pasteurizer and Hydrolyzer)
4. Digester and Digestate Storage
5. Air Pump, Compressor, and Odour Control System
6. Biogas Genset (including Cooling Bed and Monitoring Well)
7. Biogas Genset Electrical (Connections to Grid)
8. Building Cold Water Supply
9. Building and Site (Building, Fencing, Access).

The grouping of the sub-systems has been outlined as a marked-up overlay for the Genivar record drawing "Process Flow and Instrumentation Diagram for the Septage Biogas Project", dated 06/05/2011, included as Attachment 1. General instructions and specific recommendations are provided herein for the systems/components.

The tasks, instructions, and costs for decommissioning, maintenance, and recommissioning are separate and additional to each other for mothballing the BioGRID system.

2.1 Preparation by operations

Preparation by operations staff is recommended prior to initiating a separate general contract for decommissioning and cleaning. By undertaking the following tasks, the Townships will reduce outside costs and ensure compliance with the existing regulatory requirements.

The intent of the preparation is to reduce the amount of material within the tanks and systems so that the general contractor is only required to clean up and dispose of the minimum amount.

The steps recommended for preparation of the Dewatering system by Operations staff are as follows:

1. Run down the stocks of polymer in the mixing tank to the lowest levels.
2. Cease operations receiving septage to be dewatered by the system.
3. Polymer feed system can be disconnected from polymer bottle and connected to clean water. Run clean water through the system as polymer to flush the lines into the Polymer mixing tank and avoid polymer set up.
4. If desired, undertake the caustic flushing and blow out of the lines as described in the supporting tables.
5. A polymer mixing tank can be drained and the dilute contents transferred to the treatment lagoons.
6. Run backwash cycle for the Drum separator and flush any additional points until no visible material is present on the screen.

The steps recommended for preparation of the BioGRID feed system by Operations staff are as follows:

1. Cease receiving FOG material, and pump FOG storage tank manually (over-riding normal low setpoint) to lowest level permitted by pump operation, transferring contents to the pasteurizer.
2. Allow the pasteurizer to operate normally. Once the pasteurization cycle is complete (1 hour) and the material is pasteurized, drain, or pump the full contents of the pasteurizer to the Hydrolyzer tank.
3. The contents of the hydrolyzer tank should then be pumped through to the digester, running the pump manually (over-riding the normal low-level setpoint) to the lowest level permitted by pump operation.
4. If possible (and for further cost savings), the existing FOG Storage, Pasteurizer, and Hydrolyzer tanks could be pressure washed by Operations staff and the washing material diverted to the septage receiving station or the digester.

Once the systems feeding the BioGRID digester cease operations (Dewatering and BioGRID feed systems as described above), the material within the digester be processed until it meets the requirements for Digestate (25-50 days). At this stage, the following steps are recommended to be taken by Operations:

1. Process the liquid digestate in the digestate storage tanks as normal for land application under existing approvals.
2. Lower digester temperatures below 25 degrees Celsius (intent includes lowering biogas production to a level that cannot support combustion).
    a. Continue to operate the mixer until temperature reaches below 25 degrees Celsius).
3. Open drain valve from BioGRID digester to drain liquid contents (now digestate) into the monitoring well chamber and pump from the chamber into digestate storage tanks, or directly into truck for normal Land Application under existing approvals.
    a. If the drain valve is not free draining, the drain line should be snaked from the drain valve end in an attempt to clear.
    b. If standard snaking does not clear the blockage, connection of a temporary pump to the drain valve, to flush water back through the pipe and up into the digester may clear the pipe and restore flow.
4. Transfer as much of the liquid contents of the digester as possible to the digestate storage tank or directly to tanks for off-site hauling and land application under current approval.

2.2 General decommissioning tasks

This section provides the identified decommissioning tasks for the BioGRID system.

2.2.1 Process liquid piping

All liquid process piping (and plumbing, refer to Section 2.2.2) should be mothballed as follows, unless otherwise indicated:

1. Flushed for solids.
2. Drained.
3. Blown out with compressed air.

GHD understands that the water supply is limited on-site. As such, flushing water may be settled/filtered and re-used to flush process lines clear of solids. Any chemically treated flushing should be monitored if being re-used to ensure levels of chemical remain suitable for the flushing and equipment.

2.2.2 Plumbing

Plumbing items such as the pressure tank, water heater, and hose bibs should be mothballed as follows:

1. Drained
2. Powered off (e.g., in the case of the water heater and UV system)
3. Cartridge filter housings should be drained and left open and dry.

2.2.3 Pumps

Pumps should be mothballed as follows, unless otherwise noted:

1. Drained.
2. Shaft is rotated.
3. Sprayed interior of the pump volute with an oil mist of suitable product (e.g., BioCorr Rust Preventative):
    a. The spraying of the interior of the pump volute would include removal of inspection covers to confirm coverage, and re-installing inspection covers. Any oil-lubricated cavities (e.g., seals) should be fully flooded to prevent moisture intrusion.
4. Suction and discharge ports:
    a. Capped suction and discharge ports (i.e., where the pump has been removed from piping); or
    b. Closed suction and discharge ports (i.e., where the pump has been left in place and not removed from piping).

2.2.4 VFDs and motor starters

For decommissioning, VFDs and motor starters can be powered down at the MCC level or main disconnect level to avoid any parasitic energy use over the mothballed period.

2.2.5 Valves

Generally, valves can be left in place and will be cleaned as the piping is flushed. Valves should be exercised periodically during mothballing to prevent seizing.

2.2.6 Instruments

Instruments such as magnetic flow meters should be mothballed as follows:

1. Powered down for duration.

They may be left in place if the piping can be confirmed to have been flushed clean and blown dry, though it is recommended that these be removed and capped at the ends (similar to the procedure outlined for pumps, refer to Section 2.2.3 Pumps).

Inline instruments such as temperature probes and ultrasonic level sensors should be mothballed as follows:

1. Drained
2. Flushed

They may be left in place, with the exception of the pH meter as noted in the supporting tables, which will require replacement.

2.2.7 Building and security

Power should be maintained to the building and control panels to provide some heat to the building (to a nominal temperature of five (5) degrees Celsius for freeze protection), and operation of control panel internal heaters to prevent condensation within the panels.

Site fencing, doors, and gates should be checked and locked.

2.2.8 Equipment specific instructions

Refer to a break-out of the major sub-components and equipment that are included decommissioning (and recommissioning) in Table 2.1 (attached).

2.2.9 BioGRID digester (and digestate storage tank)

The general steps for the BioGRID digester system shutdown are included below, though the detailed procedure is required to be reviewed and implemented prior to issuing a contract for cleaning and shut down:

1. Close isolation valve of the digester biogas to cooling field.
2. Ventilate freeboard space until 10 air exchanges have occurred.
    a. Use a grounded, non-sparking air mover. Monitor air exiting the air mover to verify whether the freeboard space has been sufficiently ventilated. Monitoring should include the following parameters: methane, hydrogen sulphide, and carbon monoxide.
3. Purge biogas piping with nitrogen
4. The membrane roof will need to be opened and partially removed to permit safe entry and removal of material. The membrane removal procedure is outlined in detail in the operations manual, but the steps generally are as follows:
    a. Relieve pressure in the membrane securement system.
    b. Shut off compressor.
    c. Bleed out excess air from the securement hose.
    d. At this point, the membrane will relax and can be folded back.
5. Once the digester has been purged of biogas, empty any remaining liquid contents.
    a. Drain liquid contents via drain line to the monitoring well.
    b. Solids can be re-fluidized by the addition of water to facilitate removal via a vacuum truck. The disposal of solids is discussed below given the general requirements and potential costs.

Once empty, the digester and digestate tanks become more susceptible to ice or frost formation under the base slab. Since the method of construction below the slab (e.g., drainage and insulation), is unknown, GHD recommends that some method of insulation be utilized to prevent frost formation and reduce potential for frost heave and subsequent damage.

One method of insulating is to fill the tank partially (to depth of 1.5-2.0 m with clean water. The water provides insulative protection for the base slab. Measures also would have to be taken to try to avoid damage from ice formation within the tank. Some methods put into practice may be to provide recirculation (either by submerged tank mixer or by separate circulation pump), or to put in material that would be “crushed” during ice formation, to take the lateral strain that is generated as ice forms – this often takes the form of either wood logs or barrels. Regular inspection should be made during the winter months particularly to gauge the ice formation and any potential for damage. As an alternative to water, insulation could be placed in the form of board insulation, batt insulation, straw, or sand. Each of these would be more costly and difficult to replace though would reduce the potential for ice damage.

2.3 General recommissioning tasks

This section provides the identified recommissioning tasks for the BioGRID system.

For all of the equipment and infrastructure noted below, a visual inspection is recommended prior to the specific recommissioning tasks. The visual inspection should be undertaken to look for signs of corrosion, deterioration, cracks/spalling, coating delamination, or other potential modes of failure.

2.3.1 Process liquid piping

Where possible, leak testing should be completed for process liquid piping. For gravity lines, leak testing of the infrastructure can be as simple as filling with clean water and then observing liquid level for change over a period of 24 to 48 hours, along with visual inspection (where possible) for leaks.

For pressurized piping, GHD recommends a pressure test prior to bringing the lines back into service. Services/piping sections recommended for pressure test include:

- Main Process line from pumps at the Drum Separator discharge, up to both the hydrolyzer discharge and digester isolation valves.
- Line from hydrolyzer pump to digester isolation valve.
- Line from FOG pump (submersible, inside FOG tank) to Pasteurizer
- Chemical Dosing Lines
- Gas system lines from Digester to Biogas Genset (including cooling bed)

The liquid process lines are recommended to be tested with hydraulic test at pressure 1.5 times the pump dead-head pressure. The gas lines operate under vacuum, but a pressure test in accordance with current TSSA guidelines, or minimum 15 psig, would be recommended as well.

2.3.2 Plumbing

On re-start, the plumbing system should be checked for leaks, and the following actions are recommended:

1. Visually inspected for evidence of corrosion or degradation
2. Flushing and super-chlorination of water lines
3. Vents and drain valves closed
4. New Cartridge filters reinstalled
5. New UV lamp (bulb) installed
6. Pressure tank bladder pressure checked
7. Power up system and observe for leakage and confirm pressure and operation of well pump.

2.3.3 Pumps

Prior to re-start, the pumps should have the following actions undertaken:

1. Inspected visually for corrosion or degradation.
2. Oil and seal lubrication checked for quality and quantity.
3. Rotated by hand to confirm no seizing has occurred prior to bump test using power once confirmation is made.

On re-start the pump flow rate and operation under normal operating conditions (ideally with clean water testing) should be completed.

2.3.4 VFD’s and motor starters

Procedure for re-start of VFDs is manufacturer-specific and should be followed in all cases, given that most VFDs and some motor starters have procedures specific to the manufacturer for re-start after storage for more than 12 months. For example, Eaton VFD drives require capacitors to be reformed before full voltage is applied after storage for more than 12 months.

It is recommended that re-start of VFD’s be preceded by checkout by a technician certified by the manufacturer of the equipment in place.

2.3.5 Valves

Other than checking open/closed position is correct for the desired operation, there are no specific requirements for restart for process valves.

Valve leakage and seating will be checked as part of pressure testing of process lines, and the maintenance program in place over the shut down period should reduce the potential for full valve seizing or failure to operate.

2.3.6 Instruments

On restart, instruments generally should be checked and recalibrated.

The pH meter specifically will require a new probe attachment, as they are not designed for long-term shelf storage once in use.

2.3.7 Building and security

No recommissioning tasks are anticipated for the Building or building security, aside from any upkeep noted during the maintenance/inspections over the shut-down period.

2.3.8 Equipment specific instructions

Refer to a break-out of the major sub-components and equipment that are included recommissioning (and decommissioning) in Table 2.1 (attached).

2.3.9 BioGRID digester

A structural integrity inspection is recommended immediately prior to recommissioning, followed by a clean-water (potential to use lagoon effluent as available) fill and leak test.

Restart of the system should follow the procedure for start-up as outlined in the Operations and Maintenance manual prepared by CH4BioGas and will include a pressure test of the membrane and membrane seal, which typically will need to be witnessed or documented for TSSA.

2.3.10 Biogas handling and utilization unit

Restart of the system should follow the procedure for Startup as outlined in the Operations and Maintenance manual prepared by CH4BioGas.

Note that gas handling pipe and pressure systems will require witnessed pressure testing in accordance with CSA requirements by licensed technicians to satisfy TSSA requirements.

2.3.11 Odour control system

Restart of the system will require turning on power and checking the media state. Note that media may require replacement after extended storage.

3. Probable costs

3.1 Decommissioning tasks

GHD has prepared an estimate of probable costs for the initial work to clean and shutter the facility, with details provided in Table 3.1 (attached).

Several assumptions have been made with respect to quantities of material and disposal costs that would need to be confirmed by operations, or by general contractor for some items where confirmation is not possible while the facility is online. The chief assumption that creates the highest degree of price uncertainty is the assumption for the quantity and quality of the settled solids at the base of the digester tank. GHD has assumed that 1 m of solids will not drain out and be available for land application under existing approvals. This quantity is highly dependent on the quality of incoming feed, operation of digester, effectiveness of digester mixing, and time elapsed since the last cleanout. The removal and disposal of this material constitutes nearly half of the decommissioning costs, so the discovery of the real field conditions will have a high degree of influence on the costs to the Townships.

The disposal of the majority of the tank contents will be via land application under existing approvals for the digestate, and distribution back to the lagoon treatment system for the small amounts of wash water generated during cleaning.

3.2 Recommissioning tasks

Prior to recommissioning, Table 2.1 (attached) highlights specific items as broken out by component or system.

Several administrative or inspection tasks are highlighted below as key items for consideration as general tasks and/or risks.

The overall opinion of probable cost for recommissioning of the facility is detailed in Table 3.2 (attached) and summarized in the table below with further discussion.

Summary of probable recommissioning cost

Component	Probable Cost
Equipment (rounded probable cost)	$ 80,000
Permitting: ECA	$ 5,000
Permitting: TSSA	$ 15,000
Tank Structural Inspection	$ 20,000
Pre-Start Equipment Inspection	$ 20,000
Total	$ 140,000

In addition to the above known costs, GHD recommends that the inspections be performed ideally in the fiscal year immediately prior to the re-start plans, so that the cost of any required replacement or refurbishment can be updated and considered for subsequent budget/planning.

At a conceptual, 5% of the overall value of the installed equipment (1% equivalent maintenance per year of shut down) would amount to approximately $250,000, and at this stage of assessment would be reasonable to plan for future allotment.

3.2.1 Pre-start inspections: Equipment

While the provisions for decommissioning are anticipated to prepare the equipment and infrastructure for long term storage, in any situation when equipment is placed into and then re-started from storage there is a reasonable assumption some parts of the equipment or infrastructure will require refurbishment or repair.

Planning for Pre-Start equipment inspection is recommended to provide updated information on condition of equipment immediately prior to re-start. The goal of this inspection would be to plan for replacement of any obviously deteriorated equipment and update the anticipated cost for re-start to include any specific repair or refurbishment.

3.2.2 Pre-start inspections: Structural

A structural inspection prior to re-start is a requirement from TSSA for the digester tank.

It is recommended that a pre-start inspection also be completed by a structural Engineer licensed in the Province of Ontario for the other large outdoor tanks and at least visual inspection of in-ground structures.

The goal of this inspection is to satisfy TSSA requirements as well as to highlight any areas in need of repair, refurbishment, or recoating prior to re-start, and to provided updated information about cost and timing for any required repairs.

3.2.3 Permitting: MECP ECA

While the MECP ECA process does not specifically outline the requirements for a temporary facility shutdown, the MECP is typically most concerned about discharge compliance. Since the facility will be shut down there will be no discharge, so the requirements from MECP are not anticipated to be arduous. The anticipated regulatory approach for the ECA would include an administrative letter advising MECP of the temporary shut-down of the facility (no discharge or emissions during the shut-down period), with intent to restart. On re-start, a similar letter indicating the plan for re-start and re-commissioning of the facility would be required.

Preparation of anticipated letters and submission to MECP would be assumed to have nominal costs of ~$5k.

3.2.4 Permitting: TSSA

For TSSA, there is a more formalized procedure for inspection prior to start-up or in this case re-start of the system.

On re-start, a witnessed pressure test of each gas holding, or utilization system will be required as dictated by CSA codes. The testing will be completed by licensed technicians, and TSSA personnel will require inspection access at key points (after any structural repairs, but before any coatings), and during the water tightness test and then gas-tightness test. Pressure testing under current regulations is typically over a 24-hour period.

Costs for TSSA coordinating, permit applications, and inspections are on an hourly rate basis, but recent project experience had indicated a cost range for TSSA works from $10 k-$20 k dependent on the local requirements and the local inspector knowledge of the existing system (if any).

3.2.5 Permitting: Risks

For any regulatory agency, there is a risk that the policies, regulations, or enforcement approach and philosophy may change between shut-down and re-start.

Historically the pace of regulatory change is relatively slow, but over the time period for shut down being discussed (up to 5 years) it is likely that there will be updates to applicable codes, and adoptions by regulatory agencies (TSSA) of new or revised standards.

The shut-down and re-start of the facility may also result in a closer examination of the facility by regulatory agencies that could result in requirements for changes or updates to the facility to comply with new or revised permits, new or updated applicable codes and standards, or new or updated compliance requirements.

It is not possible to predict financial or technical implications of future updates to codes and standards at this time.

3.3 Annual maintenance tasks

In general, most of the annual maintenance tasks and related costs are routine visual checks by operations staff for signs of leakage, corrosion, or degradation. GHD recommends the following annual maintenance tasks:

- Once monthly walkthrough
  - Includes exercising valves and running the hot water system circulation pump.
- Bi-monthly walkthrough
  - Includes a somewhat more comprehensive checklist as compared with the once-monthly event.
- Semi-annual walkthrough
  - Includes a more comprehensive checklist as compared with the once-monthly event, comprising opening vaults, manholes, and tanks for detailed visual inspection.
- Annual walkthrough
  - Includes inspection and maintenance (e.g., rotating shafts) of the CHP system and the Boiler by a licensed technician.

The base cost for the once monthly and semi-annual walk-throughs is anticipated to be less than twelve person-days per year by personnel familiar with operating water or wastewater facilities. The additional cost for the annual walkthrough is anticipated at $5,000 per year. The recommended inspections for the subcomponents at the facility are provided in Table 3.3 (attached).

4. Referenced information

The key relevant documentation reviewed/referenced for the development of this memorandum is listed below in Table 4.1.

Table 4.1 Referenced information

No.	Document title
1.	Bioenergy Consumption
2.	OpManual_2018
3.	Property map with circle
4.	Drawing 03 012 11 G5RD
5.	Drawing 03 012 11 G7RD
6.	Drawing 03 012 11 M1RD
7.	Drawing 03 012 11 S1RD
8.	Drawing 03 012 11 G2RD
9.	Township of Georgian Bluffs Strategic Plan 2020 2024
10.	Basic Treatment Units Flow Diagram
11.	MECP Amended ECA No. 2206 8KSQZV August 23, 2011
12.	OPA Contract Notification
13.	OPA Contract Termination Excerpt
14.	ESA for Genset
15.	TSSA Approval for Boiler
16.	TSSA Inspection Report
17.	O&M Manuals
18.	O&M Manuals

5. Attachments

Attachment 1: Genivar record drawing "Process Flow and Instrumentation Diagram for the Septage Biogas Project" dated 06/05/2011

Attachment 2: Supporting tables

Table 2.1 Specific recommendations – Decommissioning and recommissioning requirements

– Septage Receiving System Components
– Dewatering System Components
– BioGRID Feed System Components
– BioGRID Digester and Digestate Storage Tanks

– Biogas Handling and Utilization Systems
– Odour Control System
– Building Hot and Cold-Water Supply Systems

Table 3.1 Probable costs – Decommissioning Tasks

– Including same overall components/system as per above.

Table 3.2 Probable costs – Recommissioning Tasks

– Including same overall components/system as per above.

Table 3.3 Recommended Inspections and Maintenance

Regards,

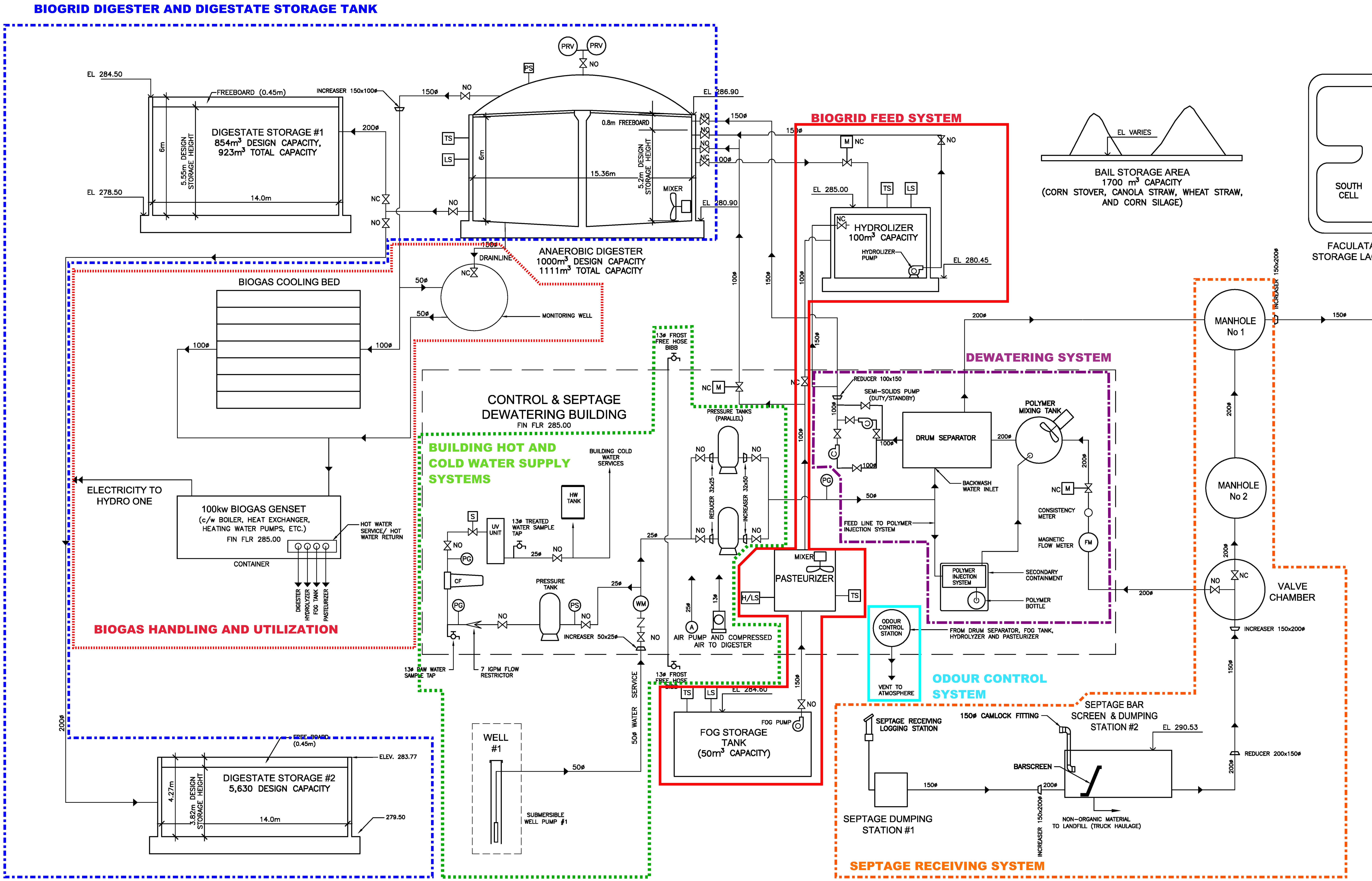
Ben Samuell
Senior Project Manager

CM/mc/TM01

Attachments

Attachment 1

Genivar record drawing “Process flow and instrumentation diagram for the septage biogas project” dated 06/05/2011



LEGEND:

- H/LS HIGH/LOW LEVEL SWITCH
- TS TEMPURATURE SENSOR
- PS PRESSURE SENSOR
- M AUTMATIC CONTROL VALVUE
- LS LEVER SWITCH
- NC ISOLATION VALVUE
- PG PRESSURE GAUGE
- PS PRESSURE SWITCH

RECORD DRAWING

06/05/2011	RECORD DRAWING
05/02/2010	POST TENDER – CONSTRUCTION DRAWING
07/10/2009	ISSUE FOR TENDER
DATE	DESCRIPTION
	REVISION / ISSUE

Seal not valid unless signed and dated

GENIVAR
945 Third Ave E, Suite 212, Owen Sound, ON, N4K 2K8
Telephone: (519) 376-7612 / Fax: (519) 376-8008
Toll Free: 1-888-376-7612

Title:
PROCESS FLOW AND INSTRUMENTATION DIAGRAM
SEPTAGE BIOGAS PROJECT

Client: TOWNSHIP OF GEORGIAN BLUFFS/TOWNSHIP OF CHATSWORTH

Design:	MRS/CSW	Scale:	N T S
Drawn:	E K	Approved:	
Checked:	M R S		
Date:	DEC 2009		Design Engineer
DRAWING No.	03-012-11-G2RD		

G:\2003\100\103012\DRAW\Record Drawings 2011\03-021-11-G2RD.dwg Jan 10, 2012 – 3:56pm PLOTTED Tuesday, January 10, 2012 3:56:45 PM

Attachment 2

Supporting tables

Attachment 2 - Supporting Tables

GHD Project No: 11223233
Dated: 14-Jun-21

BioGRID System Decommissioning and Recommissioning Plan
Derby WWTW Asset Evaluation – Technical Memorandum #1

Table 2.1 - Specific Recommendations – Decommissioning and Recommissioning Requirements

Septage Receiving System Components

Component/Subsystem	Description	Decommissioning Requirements	Recommissioning Requirements
Septage Receiving Logging Station	Septage receiving logging station is an above ground component, operated by electricity. Septage customer proceeds to drop of their load after logging in at the station. There is no weighting station or flowmeter to record the volume of the load. Logging station topically registers which customer and when their truck arrived.	The logging station can be left power on with onboard heat to prevent condensation within the panel and reduce potential for corrosion.	No specific requirement.
Dumping Station No. 1	150 mm diameter influent sewer from the septage receiving tank to the aerated sewage lagoon.	In the event, the site is not receiving any septage or sewerage load then dumping station no. 1 should be emptied out, flushed & power washed. Locked/Secured from entry.	No specific requirement.
Dumping Station No. 2 & Bar Screen	Manual bar screen with 9mm spacing, with rated capacity of 57.5 m3/day.	In the event, the site is not receiving any septage or sewerage load then dumping station no. 1 should be emptied out & power washed. Locked/Secured from entry. If possible based on condition, screen should be pivoted/raised up to avoid ice formation around bars with any water accumulation at the base of the chamber.	If raised, lower screen back into operable position.
Valve Chamber	Valve chamber is consisting of two valves; one controls the flow towards the Aerated lagoon and other flow goes to the polymer mixing tank.	Emptied out, cleaned & power washed.	No specific requirement.
MH No. 1 & 2 (to the Aeration Lagoon)	MH No. 1 receives flow from the drum screen and MH No1.	In the event, the site is not receiving any septage or sewerage load then both the manholes need to be cleaned and flushed, power washed of accumulated material. Secured from entry/tampering.	No specific requirement.

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GHD Project No: 11223233
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BioGRID System Decommissioning and Recommissioning Plan
Derby WWTW Asset Evaluation – Technical Memorandum #1

Table 2.1 - Specific Recommendations – Decommissioning and Recommissioning Requirements

Dewatering System Components

Component/Subsystem	Description	Decommissioning Requirements	Recommissioning Requirements
Magnetic Flow Meter	Magnetic Flow Meter is located on a 200 mm diameter pipe which conveys sewerage/septage going from the valve chamber to the polymer mixing tank.	The pipeline feeding the flowmeter should be flushed with water, then purged with diluted caustic water, then flush with water again. Drain and blow out pipe to remove moisture from pipe and meter. Flow meter can be powered down or left on.	Power up and calibration.
Polymer Injection System	Facility utilizes a formula CP 9310 emulsion polymer. Polymer chemical pump, diluted polymer feed pump, tubing/piping to mixing tank are all part of this system.	Polymer injection system should be well flushed with water (~1 hour). Rinse with diluted caustic water to deactivate any residual polymer, then flush with diluted chlorine water, then rinsed with clean water again. On conclusion, the system should be drained an blown out with compressed air to remove residual water.	Flooding with polymer, re-test of dilution water flow, recalibration of system.
Polymer Mixing Tank	Polymer mixing tank is a stainless-steel tank equipped with a mixer and a level sensor at the top.	Emptied out, cleaned & power washed. Level sensor can be left in place.	No specific requirement for tank. Level sensor will require calibration check.

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BioGRID System Decommissioning and Recommissioning Plan
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Table 2.1 - Specific Recommendations – Decommissioning and Recommissioning Requirements

BioGRID Feed System Components

Component/Subsystem	Description	Decommissioning Requirements	Recommissioning Requirements
FOG Storage Tank,	Fats Oils and Greases (FOG) are received in the FOG tank, volume of the tank is 50 m3.	Emptied out, cleaned & power washed.	No specific requirements
FOG Tank Temperature Sensor	The temperature of FOG in the tank is measured using an immersed temperature sensor, GOG is maintained at 20 degrees C via the FOG tank heating control.	Ensure tank cleaning also cleans insertion portion of temperature sensor.	Calibration check.
Chopper Pump	There is chopper pump in the FOG tank, which agitates and transfers FOG to the pasteurizer.	Recommend that the chopper pump inside the FOG be flushed with chorine water, cleaned, dried then stored on blocks in dry, secure location.	Recommend pump test on restart to confirm operation.
Pasteurizer Tank	FOG is pumped from FOG tank into the pasteurizer in batch mode. FOG is pasteurized at 70 deg C in a 2m3 pasteurizer. Pasteurized FOG is delivered to BioGRID or Hydrolyzer via gravity drainage, controlled by the motorized valve cV9. C	Emptied out, cleaned & power washed.	No specific requirements
Pasteurizer Mixer	There is a mixer to agitate FOG, level switch, pasteurizer heat control valve associated with the pasteurizer. As supplied by Waler Engineered Products	Ensure tank cleaning also cleans mixer of any accumulated material.	No specific requirements
Hydrolyzer Tank	Pasteurized FOG and dewatered/thickened septage is conveyed to the hydrolyzer prior to the BioGRID. Hydrolyzer tank is 6.775 m dia x 2.8 m SWD, 100 m3, in-ground covered hydrolyzer tank for conditioning of waste prior to anaerobic digestion. Dry substrate loading chute with cover.	Emptied out, cleaned & power washed.	No specific requirements
Hydrolyzer Temperature Sensor	The temperature of FOG in the tank is measured using an immersed temperature sensor, GOG is maintained at 20 degrees C via the FOG tank heating control.	Ensure tank cleaning also cleans insertion portion of temperature sensor.	Calibration check.
Hydrolzyer pH Meter	pH sensor is part of the hydrolyzer package.	pH sensor component will not last for duration of storage. Remove sensor module.	Purchase and install replacement pH sensor module.
Hydrolyzer Heat Control Valve	Heating system control valve.	No specific requirements, will be flushed as part of pipe flushing.	No specific requirements
Hydrolyzer Chopper Pump	Chopper pump is submersible, located within the hydrolyzer tank.	The chopper pump inside the hydrolyzer needs to be flushed with chorine water and cleaned and dried then stored at a secured place.	Recommend pump test on restart to confirm operation.

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BioGRID System Decommissioning and Recommissioning Plan
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Table 2.1 - Specific Recommendations – Decommissioning and Recommissioning Requirements

BioGRID Digester and Digestate Storage Tanks

Component/Subsystem	Description	Decommissioning Requirements	Recommissioning Requirements
BioGRID Digester	BioGRID digester is 1000m3, maintained at an internal temperature of around 25-40 degrees C via the hot water heating system. Covered with a flexible membrane to allow gas storage in the freeboard space, held in place with a compressed-air filled securement system.	Digester decommissioning procedure should be completed. Clean out is recommended to prevent settling and solidification of grit and solids within the digester.	Suggest structural inspection prior to refill. Recommissioning will require water fill/leak test, reinstallation of the membrane, and pressure testing. TSSA notification and witness of pressure testing will be required on restart.
Air Compressor and Air Pump	Located in the BioGRID control room, the air compressor supplies air to the membrane securement system and to the feed for desulphurization.	Drain moisture traps. Disconnect from the local disconnect.	No specific requirements
Digester Pressure Relief Valve	PRV is located on top of the BioGRID, it prevents over pressurization of digester freeboard.	Purge piping of any residual biogas. Would recommend removal and storage within clean, dry, secure space.	No specific requirements
Digestate Storage Tank	There are two digestate storage tanks, with storage capacity of 854m3 and 5,630m3 respectively.	Tanks to be emptied and power washed.	Inspection prior to restart, and check for leaks.

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BioGRID System Decommissioning and Recommissioning Plan
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Table 2.1 - Specific Recommendations – Decommissioning and Recommissioning Requirements

Biogas Handling and Utilization Systems

Component/Subsystem	Description	Decommissioning Requirements	Recommissioning Requirements
Biogas Cooling Field	The biogas cooling field is a 6.1 mix 15.2 m grid of HDPE piping designed to provide passive gas cooling and moisture removal. Biogas is collected from BioGRID and piped to the Biogas Cooling Field. It is at a 4% incline and the condensate is trapped in the monitoring well.	After the biogas flow has been stopped, piping should be purged of biogas. All the condensate water needs to be allowed to be drained. Condensation needs to allow either to percolate through the digester footing drainage or can be pumped to the valve chamber to send to the Aeration lagoon.	Pressure test prior to restart is recommended.
Boiler	The biogas boiler serves to facilitate system start-up and can act an alternative consumer of biogas. The Biogas boiler receives biogas after it has passed through the biogas cooling filed. Thermal energy produced by the boiler is used to heat the HOT Water Supply system. Low temperature hot water boiler (1.2 MMBtu, model number Raytherm 1223).	The gas line of the boiler should be purged with nitrogen. The hot water system should be flooded with propylene glycol to prevent freezing and pipe damage. Power can be shut off at local disconnect.	Full inspection of boiler by licensed technician is prior to restart is recommended. Inspection of fuel train is required prior to restart.
Biogas generator/ CHP unit	100 Kw Co-generation unit uses biogas as a fuel for combustion and production of thermal and electrical energy. The co-generation unit is primary method of biogas combustion. Thermal energy is captured from the exhaust and engine jacket and then supplied to the Hot Water Supply and Return system. Electrical energy is exported to the public through the Hydro One Inc. and power purchase agreement with the Ontario Power Authority.	Isolate the biogas line and purge with nitrogen, including headspace of engine. Batteries need to be disconnected and stored in a cool, dry, secure area and charger should be turned off. Put new oil and filters in engine before storage. Check the freeze level of the antifreeze in the engine loop. Temperature of the storage room should be between 15 deg C to 35 deg C with relative humidity 60%.	Full inspection and servicing of engine by licensed technician prior to restart is recommended. Inspection of fuel train is required prior to restart.

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BioGRID System Decommissioning and Recommissioning Plan
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Table 2.1 - Specific Recommendations – Decommissioning and Recommissioning Requirements

Odour Control System

Component/Subsystem	Description	Decommissioning Requirements	Recommissioning Requirements
Odour Control System	Odour control system consists of a carbon drum filter within the control and dewatering building. Purafill is the manufacturer of the OCS. The drum separator, FOG tank, hydrolyzer, and the pasteurizer are connected to the odour control station.	Turn off suction fan at local disconnect. The media in the OCS can be left in filter as it is or stored in a dry storage.	No specific requirements.

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BioGRID System Decommissioning and Recommissioning Plan
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Table 2.1 - Specific Recommendations – Decommissioning and Recommissioning Requirements

Building Hot and Cold Water Supply Systems

Component/Subsystem	Description	Decommissioning Requirements	Recommissioning Requirements
Hot water supply system	Hot water Supply and Return system consists of a series of PEX tubing. Insulated twin PEX tubing distributes hot water throughout the Site while PEX tubing is embedded in the walls of the BioGRID, below the FOG storage tank, in the walls and floor of the Hydrolyzer and Pasteurizer to provide heating.	Water in the piping loop should be drained of water. Because the system is difficult to drain completely, recommendation is that the piping loop should be flushed and filled with propylene glycol to prevent freezing.	System to be drained of polypropelene glycol and refilled with water, unless assessed to determine whether system will operate with appropriate heat transfer using polypropelene glycol.
Cold water supply system		Water in the piping loop, pressure tank, UV system, filter, and building cold water services should be drained and blown out.	Recommend draining the cold water line and frost-free hydrants and blowing clear with compressed air. The well pump system should be turned off at local disconnect.

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.1 - Probable Costs – Decommissioning Tasks

Septage Receiving System Components

Component/Subsystem	Decommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions (as applicable)
Septage Receiving Logging Station	The logging station can be left power on with onboard heat to prevent condensation within the panel and reduce potential for corrosion.	$ -	
Dumping Station No. 1	In the event, the site is not receiving any septage or sewerage load then dumping station no. 1 should be emptied out, flushed & power washed. Locked/Secured from entry.	$ 3,000.00	1 base day of contractor work for septage receiving area
Dumping Station No. 2 & Bar Screen	In the event, the site is not receiving any septage or sewerage load then dumping station no. 1 should be emptied out & power washed. Locked/Secured from entry. If possible based on condition, screen should be pivoted/raised up to avoid ice formation around bars with any water accumulation at the base of the chamber.	incl. above	
Valve Chamber	Emptied out, cleaned & power washed.	incl. above	
MH No. 1 & 2 (to the Aeration Lagoon)	In the event, the site is not receiving any septage or sewerage load then both the manholes need to be cleaned and flushed, power washed of accumulated material. Secured from entry/tampering.	incl. above	

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.1 - Probable Costs – Decommissioning Tasks

Dewatering System Components

Component/Subsystem	Decommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions (as applicable)
Magnetic Flow Meter	The pipeline feeding the flowmeter should be flushed with water, then purged with diluted caustic water, then flush with water again. Drain and blow out pipe to remove moisture from pipe and meter. Flow meter can be powered down or left on.	$ 1,500.00	
Polymer Injection System	Polymer injection system should be well flushed with water (~1 hour). Rinse with diluted caustic water to deactivate any residual polymer, then flush with diluted chlorine water, then rinsed with clean water again. On conclusion, the system should be drained an blown out with compressed air to remove residual water.	$ 750.00	
Polymer Mixing Tank	Emptied out, cleaned & power washed. Level sensor can be left in place.	$ 870.00	

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.1 - Probable Costs – Decommissioning Tasks

BioGRID Feed System Components

Component/Subsystem	Decommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions (as applicable)
FOG Storage Tank,	Emptied out, cleaned & power washed.	$ 12,133.80	50m^3 – 50,000 Litres -Rectangular Concrete Tank 10feet deep, 16" x16" access, confined space, approximately 2 feet sludge in bottom to vacuum out and offload into on site dumping station. BUDGET $19,500.00 Power Wash down walls and floor and vacuum out wash water and residue, confined Space , and offload into on site dumping station BUDGET $32,350.00
FOG Tank Temperature Sensor	Ensure tank cleaning also cleans insertion portion of temperature sensor.	incl. above	
Chopper Pump	Recommend that the chopper pump inside the FOG be flushed with chorine water, cleaned, dried then stored on blocks in dry, secure location.	$ 750.00	
Pasteurizer Tank	Emptied out, cleaned & power washed.	$ -	2m^3- 2000 Litres – small stainless steel tank to be empty prior to our power washing and vacuum out wash water and residue, confined space, and offload into on site dumping station
Pasteurizer Mixer	Ensure tank cleaning also cleans mixer of any accumulated material.	incl. above	
Hydrolyzer Tank	Emptied out, cleaned & power washed.	$ 8,053.08	1 Day, vac truck, wash truck, material transferred to on-site dumping station, as quoted by Accuworkx Inc.
Hydrolyzer Temperature Sensor	Ensure tank cleaning also cleans insertion portion of temperature sensor.	incl. above	
Hydrolzyer pH Meter	pH sensor component will not last for duration of storage. Remove sensor module.	incl. above	
Hydrolyzer Heat Control Valve	No specific requirements, will be flushed as part of pipe flushing.	incl. above	
Hydrolyzer Chopper Pump	The chopper pump inside the hydrolyzer needs to be flushed with chorine water and cleaned and dried then stored at a secured place.	$ 750.00	

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.1 - Probable Costs – Decommissioning Tasks

BioGRID Digester and Digestate Storage Tank Components

Component/Subsystem	Decommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions (as applicable)
BioGRID Digester	Digester decommissioning procedure should be completed. Clean out is recommended to prevent settling and solidification of grit and solids within the digester.	$ 307,200.93	Pressure washing and cleaning of tank only, not disposal of residual solids was quoted by Accuwork Inc. at cost of $36,745, estimated at 6.5 days effort Removal of solids is estimated based on 1m depth evenly distributed over the base of the 16m diameter tank, for a total of 200m3 of material. Removal crew for solids is based on 2 months of work (assuming productivity rate from recent GHD project at Humber), and assuming transport at $2,410.00 per load, 10m3 load as slurry, disposed of at Townships landfill with no additional tipping fee to Townships)
Air Compressor and Air Pump	Drain moisture traps. Disconnect from the local disconnect.	$ 750.00	
Digester Pressure Relief Valve	Purge piping of any residual biogas. Would recommend removal and storage within clean, dry, secure space.	$ 1,500.00	
Digestate Storage Tank	Tanks to be emptied and power washed.	$ 41,971.56	7 Day, vac truck, wash truck, material transferred to on-site dumping station, as quoted by Accuworkx Inc. On-site disposal of washing residuals.
Digestate Storage Tank	Tanks to be emptied and power washed.	$ 23,771.40	3 Day, vac truck, wash truck, material transferred to on-site dumping station, as quoted by Accuworkx Inc. On-site disposal of washing residuals.

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.1 - Probable Costs – Decommissioning Tasks

Biogas Handling and Utilization Units

Component/Subsystem	Decommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions (as applicable)
Biogas Cooling Field	After the biogas flow has been stopped, piping should be purged of biogas. All the condensate water needs to be allowed to be drained. Condensation needs to allow either to percolate through the digester footing drainage or can be pumped to the valve chamber to send to the Aeration lagoon.	$ 750.00	
Boiler	The gas line of the boiler should be purged with nitrogen. The hot water system should be flooded with propylene glycol to prevent freezing and pipe damage. Power can be shut off at local disconnect.	$ 8,000.00	Technician on site for single day servicing, including flooding of hot water system with polypropylene glycol and nitrogen purging of fuel lines
Biogas generator/ CHP unit	Isolate the biogas line and purge with nitrogen, including headspace of engine. Batteries need to be disconnected and stored in a cool, dry, secure area and charger should be turned off. Put new oil and filters in engine before storage. Check the freeze level of the antifreeze in the engine loop. Temperature of the storage room should be between 15 deg C to 35 deg C with relative humidity 60%.	incl. above	

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.1 - Probable Costs – Decommissioning Tasks

Odour Control System

Component/Subsystem	Decommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions (as applicable)
Odour Control System	Turn off suction fan at local disconnect. The media in the OCS can be left in filter as it is or stored in a dry storage.	$ 750.00	

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.1 - Probable Costs – Decommissioning Tasks

Building Hot and Cold Water Supply Systems

Component/Subsystem	Decommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions (as applicable)
Hot water supply system	Water in the piping loop should be drained of water. Because the system is difficult to drain completely, recommendation is that the piping loop should be flushed and filled with propylene glycol to prevent freezing.	$ 3,250.00	
Cold water supply system	Water in the piping loop, pressure tank, UV system, filter, and building cold water services should be drained and blown out.	$ 1,500.00	

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.2 - Probable Costs – Recommissioning Tasks

Septage Receiving System Components

Component/Subsystem	Recommissioning Requirements	Recommissioning Cost	Recommissioning Cost Assumptions
Septage Receiving Logging Station	The logging station can be left power on with onboard heat to prevent condensation within the panel and reduce potential for corrosion.	$ 7,200.00	
Dumping Station No. 1	In the event, the site is not receiving any septage or sewerage load then dumping station no. 1 should be emptied out, flushed & power washed. Locked/Secured from entry.	incl. above	
Dumping Station No. 2 & Bar Screen	In the event, the site is not receiving any septage or sewerage load then dumping station no. 1 should be emptied out & power washed. Locked/Secured from entry. If possible based on condition, screen should be pivoted/raised up to avoid ice formation around bars with any water accumulation at the base of the chamber.	incl. above	
Valve Chamber	Emptied out, cleaned & power washed.	incl. above	
MH No. 1 & 2 (to the Aeration Lagoon)	In the event, the site is not receiving any septage or sewerage load then both the manholes need to be cleaned and flushed, power washed of accumulated material. Secured from entry/tampering.	incl. above	

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.2 - Probable Costs – Recommissioning Tasks

Dewatering System Components

Component/Subsystem	Recommissioning Requirements	Recommissioning Cost	Recommissioning Cost Assumptions
Magnetic Flow Meter	The pipeline feeding the flowmeter should be flushed with water, then purged with diluted caustic water, then flush with water again. Drain and blow out pipe to remove moisture from pipe and meter. Flow meter can be powered down or left on.	$ 3,500.00	
Polymer Injection System	Polymer injection system should be well flushed with water (~1 hour). Rinse with diluted caustic water to deactivate any residual polymer, then flush with diluted chlorine water, then rinsed with clean water again. On conclusion, the system should be drained an blown out with compressed air to remove residual water.	$ 1,500.00	
Polymer Mixing Tank	Emptied out, cleaned & power washed. Level sensor can be left in place.	incl. above	

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.2 - Probable Costs – Recommissioning Tasks

BioGRID Feed System Components

Component/Subsystem	Recommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions
FOG Storage Tank,	Emptied out, cleaned & power washed.	$ 3,500.00	Fill tanks and leak test of system. Assume use of temporary transfer pumps for re-use of lagoon water for pressure testing. 1 days cumulative effort to complete the filling and inspection.
FOG Tank Temperature Sensor	Ensure tank cleaning also cleans insertion portion of temperature sensor.	incl. with dewatering system Flow Meter line item	
Chopper Pump	Recommend that the chopper pump inside the FOG be flushed with chorine water, cleaned, dried then stored on blocks in dry, secure location.	$ 750.00	
Pasteurizer Tank	Emptied out, cleaned & power washed.	incl. above	0
Pasteurizer Mixer	Ensure tank cleaning also cleans mixer of any accumulated material.	$ 750.00	
Hydrolyzer Tank	Emptied out, cleaned & power washed.	incl. above	0
Hydrolyzer Temperature Sensor	Ensure tank cleaning also cleans insertion portion of temperature sensor.	incl. with dewatering system Flow Meter line item	
Hydrolzyer pH Meter	pH sensor component will not last for duration of storage. Remove sensor module.	incl. with dewatering system Flow Meter line item	
Hydrolyzer Heat Control Valve	No specific requirements, will be flushed as part of pipe flushing.	incl. above	
Hydrolyzer Chopper Pump	The chopper pump inside the hydrolyzer needs to be flushed with chorine water and cleaned and dried then stored at a secured place.	incl. above	

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Table 3.2 - Probable Costs – Recommissioning Tasks

BioGRID Digester and Digestate Storage Tank Components

Component/Subsystem	Recommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions
BioGRID Digester	Digester decommissioning procedure should be completed. Clean out is recommended to prevent settling and solidification of grit and solids within the digester.	$ 39,000.00	Filling and leakage testing using lagoon water. Mobilization cost for crane/scaffold for roof re-installation. Pressure testing per TSSA Witness / Permit by TSSA
Air Compressor and Air Pump	Drain moisture traps. Disconnect from the local disconnect.	$ 750.00	
Digester Pressure Relief Valve	Purge piping of any residual biogas. Would recommend removal and storage within clean, dry, secure space.	$ 750.00	
Digestate Storage Tank	Tanks to be emptied and power washed.	$ 9,000.00	Transfer of liquid from digester to digestate storage, and top up with lagoon water as needed. Pump out back to lagoons at completion of testing.
Digestate Storage Tank	Tanks to be emptied and power washed.	incl. above	0

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.2 - Probable Costs – Recommissioning Tasks

Biogas Handling and Utilization Units

Component/Subsystem	Recommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions
Biogas Cooling Field	After the biogas flow has been stopped, piping should be purged of biogas. All the condensate water needs to be allowed to be drained. Condensation needs to allow either to percolate through the digester footing drainage or can be pumped to the valve chamber to send to the Aeration lagoon.	$ 3,000.00	
Boiler	The gas line of the boiler should be purged with nitrogen. The hot water system should be flooded with propylene glycol to prevent freezing and pipe damage. Power can be shut off at local disconnect.	$ 5,000.00	Checkout by licensed technician prior to restart.
Biogas generator/ CHP unit	Isolate the biogas line and purge with nitrogen, including headspace of engine. Batteries need to be disconnected and stored in a cool, dry, secure area and charger should be turned off. Put new oil and filters in engine before storage. Check the freeze level of the antifreeze in the engine loop. Temperature of the storage room should be between 15 deg C to 35 deg C with relative humidity 60%.	incl. above	

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.2 - Probable Costs – Recommissioning Tasks

Odour Control System

Component/Subsystem	Recommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions
Odour Control System	Turn off suction fan at local disconnect. The media in the OCS can be left in filter as it is or stored in a dry storage.	$ 750.00	

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.2 - Probable Costs – Recommissioning Tasks

Building Hot and Cold Water Supply Systems

Component/Subsystem	Recommissioning Requirements	Decommissioning Cost	Decommissioning Cost Assumptions
Hot water supply system	Water in the piping loop should be drained of water. Because the system is difficult to drain completely, recommendation is that the piping loop should be flushed and filled with propylene glycol to prevent freezing.	$ 3,750.00	
Cold water supply system	Water in the piping loop, pressure tank, UV system, filter, and building cold water services should be drained and blown out.	incl. above	

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BioGRID System Decommissioning and Recommissioning Plan
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Table 3.3 - Recommended Inspections and Maintenance

Septage Receiving System Components

Component/Subsystem	Description		Monthly	Bi-Monthly	Semi-Annually	Annually
Septage Receiving Logging Station	Septage receiving logging station is an above ground component, operated by electricity. Septage customer proceeds to drop of their load after logging in at the station. There is no weighting station or flowmeter to record the volume of the load. Logging station topically registers which customer and when their truck arrived.		None	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.	Power down and open panel to visually inspect for corrosion or degredation.
Dumping Station No. 1	150 mm diameter influent sewer from the septage receiving tank to the aerated sewage lagoon.		None	Inspection for water/ice accumulation in chamber.	Inspection for water/ice accumulation in chamber.	Inspection for water/ice accumulation in chamber.
Dumping Station No. 2 & Bar Screen	Manual bar screen with 9mm spacing, with rated capacity of 57.5 m3/day.		Inspection for water/ice accumulation in chamber.	Inspection for water/ice accumulation in chamber.	Inspection for water/ice accumulation in chamber.	Inspection for water/ice accumulation in chamber.
Valve Chamber	Valve chamber is consisting of two valves; one controls the flow towards the Aerated lagoon and other flow goes to the polymer mixing tank.		None	Exercise of valves, 1/4 turn in either direction to confirm free movement.	Exercise of valves, 1/4 turn in either direction to confirm free movement.	Exercise of valves, 1/4 turn in either direction to confirm free movement.
MH No. 1 & 2 (to the Aeration Lagoon)	MH No. 1 receives flow from the drum screen and MH No1.		None	Inspection for water/ice accumulation in chamber.	Inspection for water/ice accumulation in chamber.	Inspection for water/ice accumulation in chamber.

Attachment 2 - Supporting Tables

GHD Project No: 11223233
Dated: 14-Jun-21

BioGRID System Decommissioning and Recommissioning Plan
Derby WWTW Asset Evaluation – Technical Memorandum #1

Table 3.3 - Recommended Inspections and Maintenance

Dewatering System Components

Component/Subsystem	Description		Monthly	Bi-Monthly	Semi-Annually	Annually
Magnetic Flow Meter	Magnetic Flow Meter is located on a 200 mm diameter pipe which conveys sewerage/septage going from the valve chamber to the polymer mixing tank.		Visually inspect for signs of corrosion or degredation, or moisture accumulation around display screen/readout.	Visually inspect for signs of corrosion or degredation, or moisture accumulation around display screen/readout.	Visually inspect for signs of corrosion or degredation, or moisture accumulation around display screen/readout.	Visually inspect for signs of corrosion or degredation, or moisture accumulation around display screen/readout.
Polymer Injection System	Facility utilizes a formula CP 9310 emulsion polymer. Polymer chemical pump, diluted polymer feed pump, tubing/piping to mixing tank are all part of this system.		None	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.
Polymer Mixing Tank	Polymer mixing tank is a stainless-steel tank equipped with a mixer and a level sensor at the top.		None	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.

Table 3.3 - Recommended Inspections and Maintenance

BioGRID Feed System Components

Component/Subsystem	Description		Monthly	Bi-Monthly	Semi-Annually	Annually
FOG Storage Tank,	Fats Oils and Greases (FOG) are received in the FOG tank, volume of the tank is 50 m3.		None	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.
FOG Tank Temperature Sensor	The temperature of FOG in the tank is measured using an immersed temperature sensor, GOG is maintained at 20 degrees C via the FOG tank heating control.		None	None	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.
Chopper Pump	There is chopper pump in the FOG tank, which agitates and transfers FOG to the pasteurizer.		None	Rotate pump shaft (on shelf) to reduce potential for seizing due to long term storage.	Rotate pump shaft (on shelf) to reduce potential for seizing due to long term storage.	Rotate pump shaft (on shelf) to reduce potential for seizing due to long term storage.
Pasteurizer Tank	FOG is pumped from FOG tank into the pasteurizer in batch mode. FOG is pasteurized at 70 deg C in a 2m3 pasteurizer. Pasteurized FOG is delivered to BioGRID or Hydrolyzer via gravity drainage, controlled by the motorized valve cV9. C		None	Exercise valve to reduce potential for seizing.	Exercise valve to reduce potential for seizing.	Exercise valve to reduce potential for seizing.
Pasteurizer Mixer	There is a mixer to agitate FOG, level switch, pasteurizer heat control valve associated with the pasteurizer. As supplied by Waler Engineered Products		None	Rotate mixer shaft to reduce potential for seizing due to long term storage	Rotate mixer shaft to reduce potential for seizing due to long term storage	Rotate mixer shaft to reduce potential for seizing due to long term storage
Hydrolyzer Tank	Pasteurized FOG and dewatered/thickened septage is conveyed to the hydrolyzer prior to the BioGRID. Hydrolyzer tank is 6.775 m dia x 2.8 m SWD, 100 m3, in-ground covered hydrolyzer tank for conditioning of waste prior to anaerobic digestion. Dry substrate loading chute with cover.		None	None	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.
Hydrolyzer Temperature Sensor	The temperature of FOG in the tank is measured using an immersed temperature sensor, GOG is maintained at 20 degrees C via the FOG tank heating control.		None	None	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.
Hydrolzyer pH Meter	pH sensor is part of the hydrolyzer package.					
Hydrolyzer Heat Control Valve	Heating system control valve.		None	Exercise valve to reduce potential for seizing.	Exercise valve to reduce potential for seizing.	Exercise valve to reduce potential for seizing.
Hydrolyzer Chopper Pump	Chopper pump is submersible, located within the hydrolyzer tank.		None	Rotate pump shaft (on shelf) to reduce potential for seizing due to long term storage.	Rotate pump shaft (on shelf) to reduce potential for seizing due to long term storage.	Rotate pump shaft (on shelf) to reduce potential for seizing due to long term storage.

Attachment 2 - Supporting Tables

GHD Project No: 11223233
Dated: 14-Jun-21

BioGRID System Decommissioning and Recommissioning Plan
Derby WWTW Asset Evaluation – Technical Memorandum #1

Table 3.3 - Recommended Inspections and Maintenance

BioGRID Digester and Digestate Storage Tank Components

Component/Subsystem	Description		Monthly	Bi-Monthly	Semi-Annually	Annually
BioGRID Digester	BioGRID digester is 1000m3, maintained at an internal temperature of around 25-40 degrees C via the hot water heating system. Covered with a flexible membrane to allow gas storage in the freeboard space, held in place with a compressed-air filled securement system.		None	Periodic inspection for deterioration or rainwater ingress	Periodic inspection for deterioration or rainwater ingress	Periodic inspection for deterioration or rainwater ingress
Air Compressor and Air Pump	Located in the BioGRID control room, the air compressor supplies air to the membrane securement system and to the feed for desulphurization.		None	None	Exercise to charge and discharge the system.	Exercise to charge and discharge the system.
Digester Pressure Relief Valve	PRV is located on top of the BioGRID, it prevents over pressurization of digester freeboard.		None	None	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.
Digestate Storage Tank	There are two digestate storage tanks, with storage capacity of 854m3 and 5,630m3 respectively.		None	None	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.

Attachment 2 - Supporting Tables

GHD Project No: 11223233
Dated: 14-Jun-21

BioGRID System Decommissioning and Recommissioning Plan
Derby WWTW Asset Evaluation – Technical Memorandum #1

Table 3.3 - Recommended Inspections and Maintenance

Biogas Handling and Utilization Units

Component/Subsystem	Description		Monthly	Bi-Monthly	Semi-Annually	Annually
Biogas Cooling Field	The biogas cooling field is a 6.1 mix 15.2 m grid of HDPE piping designed to provide passive gas cooling and moisture removal. Biogas is collected from BioGRID and piped to the Biogas Cooling Field. It is at a 4% incline and the condensate is trapped in the monitoring well.		None	None	None	None
Boiler	The biogas boiler serves to facilitate system start-up and can act an alternative consumer of biogas. The Biogas boiler receives biogas after it has passed through the biogas cooling filed. Thermal energy produced by the boiler is used to heat the HOT Water Supply system. Low temperature hot water boiler (1.2 MMBtu, model number Raytherm 1223).		Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.	Inspection by licensed technician
Biogas generator/ CHP unit	100 Kw Co-generation unit uses biogas as a fuel for combustion and production of thermal and electrical energy. The co-generation unit is primary method of biogas combustion. Thermal energy is captured from the exhaust and engine jacket and then supplied to the Hot Water Supply and Return system. Electrical energy is exported to the public through the Hydro One Inc. and power purchase agreement with the Ontario Power Authority.		Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.	Inspection by licensed technician

Attachment 2 - Supporting Tables

GHD Project No: 11223233
Dated: 14-Jun-21

BioGRID System Decommissioning and Recommissioning Plan
Derby WWTW Asset Evaluation – Technical Memorandum #1

Table 3.3 - Recommended Inspections and Maintenance

Odour Control System

Component/Subsystem	Description		Monthly	Bi-Monthly	Semi-Annually	Annually
Odour Control System	Odour control system consists of a carbon drum filter within the control and dewatering building. Purafill is the manufacturer of the OCS. The drum separator, FOG tank, hydrolyzer, and the pasteurizer are connected to the odour control station.		Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.	Visual inspection for corrosion or degredation.

Attachment 2 - Supporting Tables

GHD Project No: 11223233
Dated: 14-Jun-21

BioGRID System Decommissioning and Recommissioning Plan
Derby WWTW Asset Evaluation – Technical Memorandum #1

Table 3.3 - Recommended Inspections and Maintenance

Building Hot and Cold Water Supply Systems

Component/Subsystem	Description		Monthly	Bi-Monthly	Semi-Annually	Annually
Hot water supply system	Hot water Supply and Return system consists of a series of PEX tubing. Insulated twin PEX tubing distributes hot water throughout the Site while PEX tubing is embedded in the walls of the BioGRID, below the FOG storage tank, in the walls and floor of the Hydrolyzer and Pasteurizer to provide heating.		Inspection for leaks. Running circulation pump.	Inspection for leaks. Running circulation pump.	Inspection for leaks. Running circulation pump.	Inspection for leaks. Running circulation pump.
Cold water supply system			Visual inspection for leaks, corrosion, or degradation.	Visual inspection for leaks, corrosion, or degradation.	Visual inspection for leaks, corrosion, or degradation.	Visual inspection for leaks, corrosion, or degradation.

Technical Memorandum

June 14, 2021

To	Patty Sinnamon	**Tel**	519 794-3232 x 124
Copy to	Étienne Bordeleau	**Email**	psinnamon@chatsworth.ca
From	Ben Samuell	**Ref. no.**	11223233
Subject	**Valuation of Sewage Lagoons System** **Derby WWTW Asset Evaluation – Technical Memorandum #2**		

1. Introduction

GHD Limited (GHD) has been retained by the Township of Chatsworth, in collaboration with Ontario Clean Water Agency (OCWA), to provide a valuation of the sewage lagoons system located at the Derby Wastewater Treatment Works (WWTW or Site).

1.1 Purpose

The purpose of this memorandum is to provide a conceptual level valuation for the sewage lagoons system as a standalone treatment process, not including the on-Site BioGRID system.

1.2 Site and evaluation context

The BioGRID system (Bio Green Renewable Industrial Digester) is owned and managed by the BioGRID Joint Board of Management (Joint Board), comprising the Township of Georgian Bluffs (Georgian Bluffs) and the Township of Chatsworth (Chatsworth). Collectively, Georgian Bluffs and Chatsworth are referred to herein as 'Townships'. The Site is approved under Ontario Ministry of Environment, Conservation and Parks (MECP) Environmental Compliance Approval (ECA) No. 2206-8KSQZV, issued on August 23, 2011.

The WWTW sewage lagoons were implemented in 1975, and the BioGRID system was implemented in 2011. The sewage lagoons receive liquid sewage directly from input to the WWTW Dumping Station #1 and are interconnected with the BioGRID system via a drum screen (i.e., the screened liquid portion of materials input to the BioGRID system process are conveyed to the sewage lagoons). The BioGRID system has faced operational and financial challenges relating to securing organic waste feedstocks, approaches for setting organic waste feedstock tipping fees, capacity, and bottlenecks of the existing anaerobic digestion (AD) process, material receiving station and other associated infrastructure, renewable energy generation, as well as process/operations of the sewage lagoons. With the challenges faced and previously evaluated at the facility, this evaluation looks to the requirements around BioGRID system mothballing and separated sewage lagoons operations.

This memorandum is to provide a conceptual level valuation of the sewage lagoons' infrastructure and equipment.

1.3 Organization

This memorandum is organized in the following sections:

- **Section 1 Introduction |** Provides the evaluation purpose, context with decision-making intent, and organization of this memorandum.
- **Section 2 Valuation of infrastructure |** Details the sewage lagoons infrastructure and equipment with estimated valuation, alongside BioGRID system estimates.
- **Section 3 Estimated annual operating costs |** Details the estimated annual costs for operating the sewage lagoons as a standalone treatment system, not including the BioGRID system.
- **Section 4 Referenced information |** Lists the key relevant documentation reviewed/referenced for the development of this memorandum.
- **Section 5 Attachments |** Lists the enclosed documentation.

2. Valuation of infrastructure

2.1 Approach, assumptions, and limitations

The valuation detailed herein was developed by establishing a conceptual level replacement cost for the key components of the sewage lagoons system, reflecting the extent and/or limitations of available information. Additional valuation information for the separate BioGRID system is also provided below as identified in a concurrent study evaluating various feasibility scenarios for the future operations of the BioGRID system (GHD, June 2011) and as asset data identified during the project meeting held May 13, 2021, between the Joint Board, OCWA, and GHD.

The replacement cost estimates are based on either conversation with manufacturers and vendors, or else unit-price costs combined with information from resources such as RS Means construction estimating data. Replacement costs noted do not include costs for engineering or contract administration, though they do include allowances where applicable for the installation of equipment.

A site visit was not undertaken given the health and safety considerations required due to the COVID-19 pandemic. Accordingly, the current condition of the equipment was not visually assessed. For the purpose of this valuation, input gained from operations staff was used to generate an assumed depreciation of the equipment to pro-rate the replacement cost valuation.

2.2 Valuation summary table

GHD has prepared an estimated valuation for the sewage lagoons as detailed in Attachment 1 and summarized below in Table 2.1. The detailed valuation for the sewage lagoons considers current value replacement cost, with pro-rating for the age of equipment compared to the anticipated asset life, with calculated depreciation value via a straight-line calculation. Also included below are estimates for the BioGRID system, the land value, and the existing Site ECA.

Table 2.1 Overall estimated valuation of the sewage lagoons system and BioGRID system

Component	Overall estimated valuation	Source / Reference
Sewage lagoons system	$ 1,180,000	Attachment 1 – Valuation Estimate
Site ECA update	$ 40,000	Estimate to amend current ECA for standalone operation of the existing sewage lagoons system
BioGRID System	$ 2,400,000	Concurrent study (GHD, June 2011)

Component	Overall estimated valuation	Source / Reference
		- Based on straight-line depreciation with facility at year 11 of 30-year life expectancy, depreciated from $3.8M initial construction cost with residual value of $125,000 at end of life.
Land value	$ 200,000	Project meeting held May 13, 2021, with OCWA and Joint Board representatives - Based on Joint Board financial statement tangible capital asset data(1)
Existing site ECA	$ 150,000	Concurrent study (GHD, June 2011) - Based on inherent value of ECA resulting from MECP facility approval following approximate 24 months permitting planning, design, and review process (i.e., engineering and approval), with risks on applicants.

Note:

(1) Asset data provided by Joint Board also included values for overall Site buildings and accessories (at $1.6M), overall vehicles and equipment (at $1.2M), and others (at $0.1M). Including land value, the Joint Board asset data totals $3.1M. There is a relatively small discrepancy between this value and the total for the above-listed sewage lagoons system, BioGRID system, and land value (at $3.78M). Further evaluation of this discrepancy could not be made as details on how the asset data were derived were not available to GHD.

3. Estimated annual operating costs

The operating costs for the sewage lagoons system have been estimated as summarized below in Table 3.1. Included with the estimated operating costs are the related assumptions made, which are based on GHD's understanding of current operating costs provided by the Township, estimates based on GHD experience, and/or supplier quotations, as noted.

Table 3.1 Estimated annual operating costs of the sewage lagoons system

Item	Estimated annual operating cost	Assumptions
General staffing	$ 78,000	Assumption of 1.5 days/wk, 52 wks/yr for operating staff, at a carrying rate of $1000/day.
Lab testing and reporting	$ 52,000	Assumption of 52 samples/yr, at a rate of $1000 per sample including collection, analysis, and reporting.
Bar screen material disposal	$ 18,000	Assumption of 12 bins pickup per year, at a rate of $1500 per pickup.
Lagoons' aeration system	$ 3,400	3.8 kW unit, operating 24 hrs/day, 7 days/wk, 52 wks/yr, with electrical cost of 0.1 $/kWh.
Spray system annual activation and winterization	$ 4,000	Assumption of 2 days of activity, 2 times per year by operators, at a rate of $1000/day.
Sewage effluent pump	$ 2,340	7.5 kW unit, operating 24 hrs/day, 5 days/week, 26 weeks/yr, with electrical cost of 0.1 $/kWh.
Total	**$ 157,740**	

4. Referenced information

The key relevant documentation reviewed/referenced for the development of this memorandum is listed below in Table 4.1.

Table 4.1 Referenced Information

No.	Document title
1.	MECP amended ECA No. 2206-8KSQZV August 23, 2011
2.	OpManual_2018
3.	Property map with a circle
4.	Concurrent study (GHD, June 2011)
5.	Project meeting held May 13, 2021 (Joint Board, OCWA, and GHD)

5. Attachments

Attachment 1 - Valuation Estimate

Regards,

Ben Samuell
Senior Project Manager

CM/mc/TM02

Attachment 1

Valuation estimate

Attachment 1 - Valuation Estimate

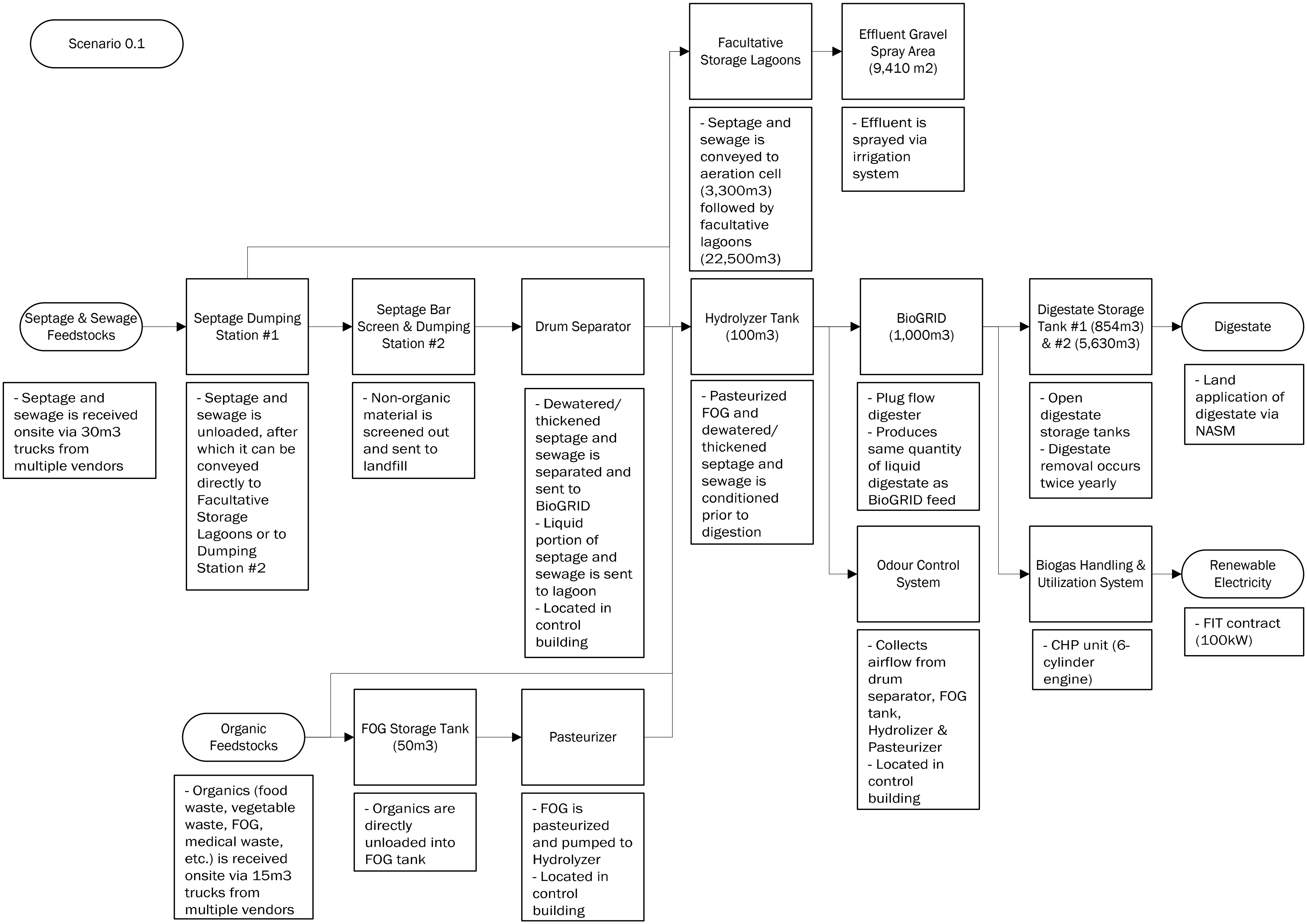
GHD Project No: 11223233
Dated: 14-Jun-21

Valuation of Sewage Lagoons System
Derby WWTW Asset Evaluation – Technical Memorandum #2

Item	Description and Assumptions for Valuation	Replacement Value (Installed cost opinion)	Installed Date	Anticipated Useful Life	FIN-020-08 Category / Notes	Calculated Life Remaining	GHD Estimated Depreciated Value (% Residual Remaining)	Residual Valuation with Assumed Depreciation	Source / Reference
Septage Receiving Tank	2x2x6m concrete tank, assumed logging station was not included.	$ 37,700.00	2011	50	Building/Structure	80%	80%	$ 30,160.00	RS Means and Conceptual Quantity Take-off
Bar Screen	Sewage Dumping Station, including 9mm spacing, manual bar screen, rake, drain pan, safety rail	$ 18,000.00	2011	50	Building/Structure	80%	80%	$ 14,400.00	Rough installed pro-rated estimate based on previous installations
Dumping Station Piping	Assumed 150 mm diameter influent sewer from tank to aeration cell of lagoon	$ 53,000.00	1975	80	Equipment	43%	80%	$ 42,400.00	RS Means and Conceptual Quantity Take-off
Septage Receiving Station	Sewage Logging Station	$ 45,000.00	2011	20	Equipment	50%	60%	$ 27,000.00	Similar project budget pricing
Blower & Effluent Pump Building	2640x3250mm concrete block building	$ 35,000.00	1975	50	Building/Structure	8%	20%	$ 7,000.00	RS Means and Conceptual Quantity Take-off
Aeration Cell, Facultative Cells, and Spray Irrigation Area	Clearing and grubbing, topsoil stripping, and excavation for approximate aeration cell dimensions (34 m x 59 m x 2.6 m depth with freeboard); approximate facultative cells dimensions (77 m x 118 m x 2.6 m depth with freeboard; and 60m x 75 m x 2.6 m depth with freeboard); and approximate spray irrigation dimensions (75 m x 126 m x 0.3 m depth for clear stone). Including 1 m granular fill for facultative cells. Including 2 m wide perimeter berm for aeration cell and facultative cells. Including perimeter ditch for aeration cell, facultative cells, and spray irrigation area. Including topsoil and seeding for perimeter berm, perimeter ditch, and for internal side slopes of sewage lagoons. Including 20% contingency.	$ 1,726,000.00	1975	80	Assumed similar to watermain as installed Civil infrastructure	43%	60%	$ 1,035,600.00	GHD costing and conceptual quantity take-off
Aeration Cell Weir Structure	Precast structure, equivalent cost to a 1.2m diameter MH.	$ 4,860.00	1975	50	Building/Structure	8%	60%	$ 2,916.00	Forterra for quote, plus 80% installation cost
Lagoon Aeration System	Fine bubble diffusers, floating laterals new air header and 2x5hp blowers. The total air flow would be 35 SCFM at 5 psi. Lagoon area based on overhead views, assumed 1.5m average depth.	$ 87,100.00	1984	20	Equipment	0%	20%	$ 17,420.00	Nexom / EDI Replacement Quote plus 30% for installation costs.
Air Blower (Duty)	included in Aeration system quote								
Air Blower (Standby)	included in Aeration system quote								
Air Intake filter	included in Aeration system quote								
Air Silencer	included in Aeration system quote								
Sewage Effluent Pump	10HP, 575V, self-priming centrifugal pump, assumption is a generic 10HP centrifugal sewage/sanitary pump based on O&M description.	$ 3,200.00	1984	20	Equipment	0%	20%	$ 640.00	Acklands/Grainger for base cost plus 30% for installation.
Spray Irrigation Piping	New irrigation pipe (PVC), six spray nozzles with same basic layout. No freeze protection (assumed blown out in winter months)	$ 10,000.00	1975	20	Equipment	0%	20%	$ 2,000.00	Telephone conversation with Dubois Agrinovation.
	Calculated Subtotal	***$ 2,019,860.00***					**Calculated Subtotal**	***$ 1,179,536.00***	
	Rounded Value	***$ 2,020,000.00***					**Rounded Value**	***$ 1,180,000.00***	

Appendix D

Detailed Scenario Specific Process Flow Diagrams


Scenario 0.1
Septage & Sewage Feedstocks
- Septage and sewage is received onsite via 30m3 trucks from multiple vendors
Septage Dumping Station #1
- Septage and sewage is unloaded, after which it can be conveyed directly to Facultative Storage Lagoons or to Dumping Station #2
Septage Bar Screen & Dumping Station #2
- Non-organic material is screened out and sent to landfill
Drum Separator
- Dewatered/ thickened septage and sewage is separated and sent to BioGRID
- Liquid portion of septage and sewage is sent to lagoon
- Located in control building
Facultative Storage Lagoons
- Septage and sewage is conveyed to aeration cell (3,300m3) followed by facultative lagoons (22,500m3)
Effluent Gravel Spray Area (9,410 m2)
- Effluent is sprayed via irrigation system
Hydrolyzer Tank (100m3)
- Pasteurized FOG and dewatered/ thickened septage and sewage is conditioned prior to digestion
BioGRID (1,000m3)
- Plug flow digester
- Produces same quantity of liquid digestate as BioGRID feed
Odour Control System
- Collects airflow from drum separator, FOG tank, Hydrolizer & Pasteurizer
- Located in control building
Digestate Storage Tank #1 (854m3) & #2 (5,630m3)
- Open digestate storage tanks
- Digestate removal occurs twice yearly
Biogas Handling & Utilization System
- CHP unit (6-cylinder engine)
Digestate
- Land application of digestate via NASM
Renewable Electricity
- FIT contract (100kW)
Organic Feedstocks
- Organics (food waste, vegetable waste, FOG, medical waste, etc.) is received onsite via 15m3 trucks from multiple vendors
FOG Storage Tank (50m3)
- Organics are directly unloaded into FOG tank
Pasteurizer
- FOG is pasteurized and pumped to Hydrolyzer
- Located in control building

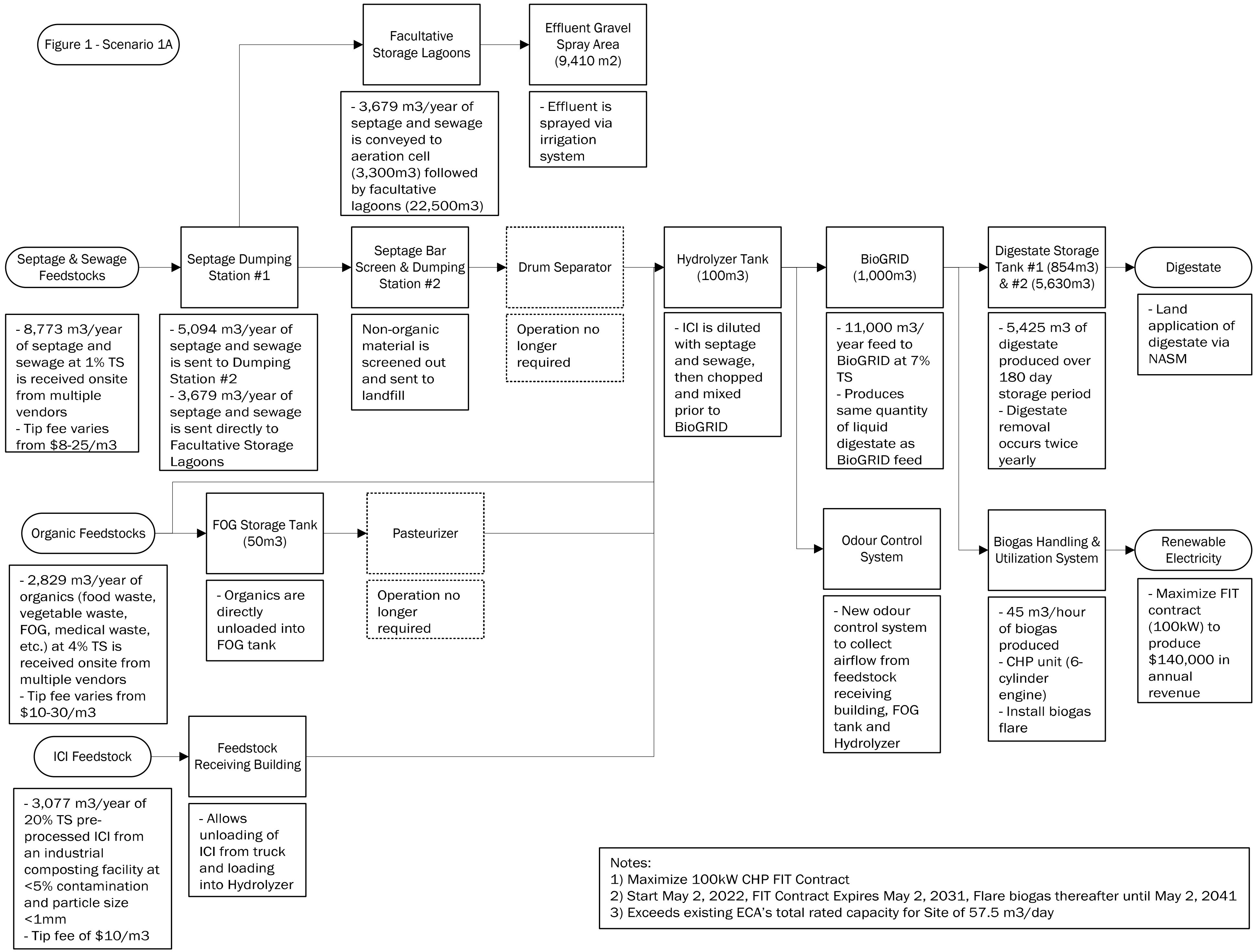


Figure 1 - Scenario 1A
Septage & Sewage Feedstocks
- 8,773 m3/year of septage and sewage at 1% TS is received onsite from multiple vendors
- Tip fee varies from $8-25/m3
Septage Dumping Station #1
- 5,094 m3/year of septage and sewage is sent to Dumping Station #2
- 3,679 m3/year of septage and sewage is sent directly to Facultative Storage Lagoons
Facultative Storage Lagoons
- 3,679 m3/year of septage and sewage is conveyed to aeration cell (3,300m3) followed by facultative lagoons (22,500m3)
Effluent Gravel Spray Area (9,410 m2)
- Effluent is sprayed via irrigation system
Septage Bar Screen & Dumping Station #2
Non-organic material is screened out and sent to landfill
Drum Separator
Operation no longer required
Hydrolyzer Tank (100m3)
- ICI is diluted with septage and sewage, then chopped and mixed prior to BioGRID
BioGRID (1,000m3)
- 11,000 m3/year feed to BioGRID at 7% TS
- Produces same quantity of liquid digestate as BioGRID feed
Digestate Storage Tank #1 (854m3) & #2 (5,630m3)
- 5,425 m3 of digestate produced over 180 day storage period
- Digestate removal occurs twice yearly
Digestate
- Land application of digestate via NASM
Organic Feedstocks
- 2,829 m3/year of organics (food waste, vegetable waste, FOG, medical waste, etc.) at 4% TS is received onsite from multiple vendors
- Tip fee varies from $10-30/m3
FOG Storage Tank (50m3)
- Organics are directly unloaded into FOG tank
Pasteurizer
Operation no longer required
Odour Control System
- New odour control system to collect airflow from feedstock receiving building, FOG tank and Hydrolyzer
Biogas Handling & Utilization System
- 45 m3/hour of biogas produced
- CHP unit (6-cylinder engine)
- Install biogas flare
Renewable Electricity
- Maximize FIT contract (100kW) to produce $140,000 in annual revenue
ICI Feedstock
- 3,077 m3/year of 20% TS pre-processed ICI from an industrial composting facility at <5% contamination and particle size <1mm
- Tip fee of $10/m3
Feedstock Receiving Building
- Allows unloading of ICI from truck and loading into Hydrolyzer
Notes:
1) Maximize 100kW CHP FIT Contract
2) Start May 2, 2022, FIT Contract Expires May 2, 2031, Flare biogas thereafter until May 2, 2041
3) Exceeds existing ECA's total rated capacity for Site of 57.5 m3/day

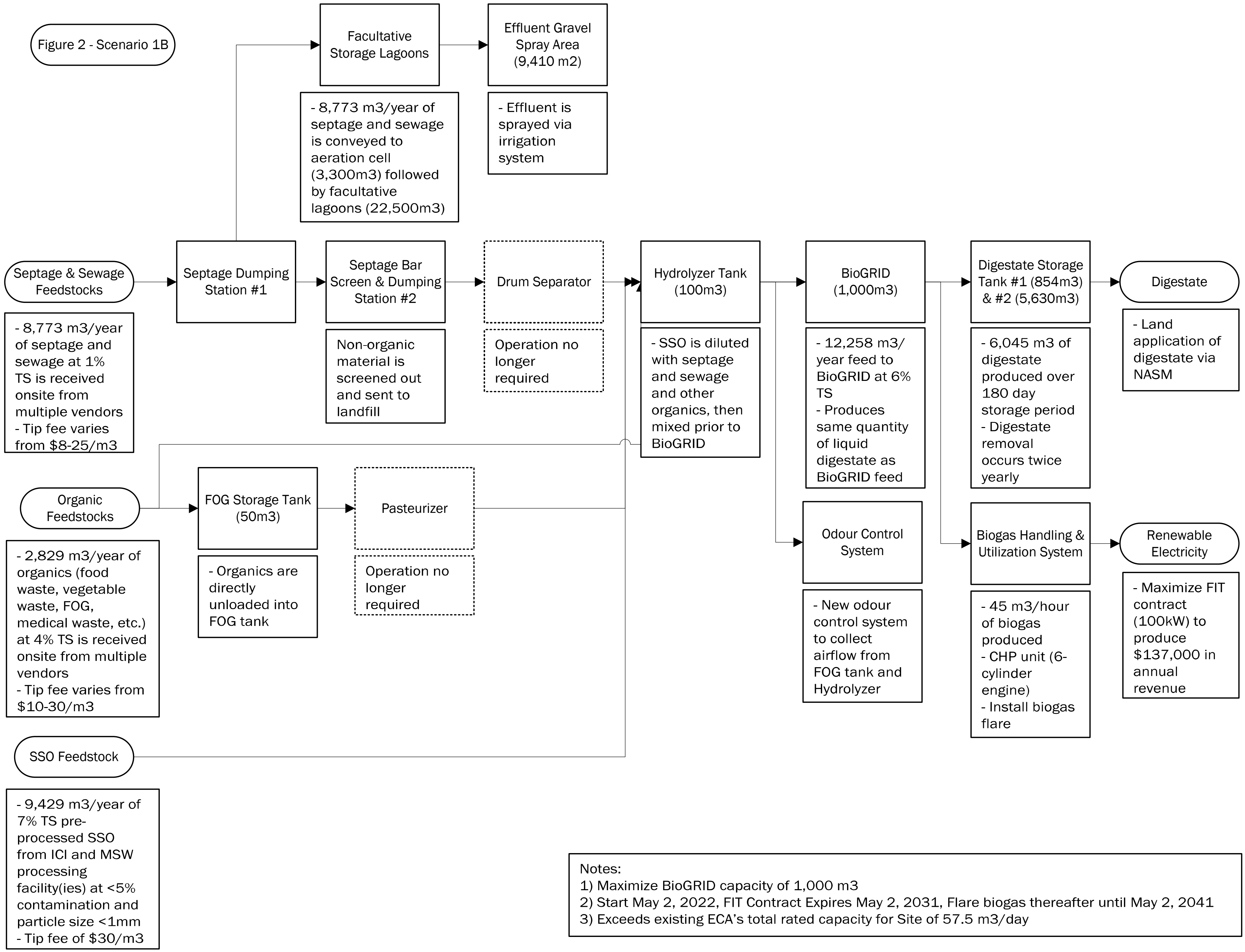


Figure 2 - Scenario 1B
Facultative Storage Lagoons
- 8,773 m3/year of septage and sewage is conveyed to aeration cell (3,300m3) followed by facultative lagoons (22,500m3)
Effluent Gravel Spray Area (9,410 m2)
- Effluent is sprayed via irrigation system
Septage & Sewage Feedstocks
- 8,773 m3/year of septage and sewage at 1% TS is received onsite from multiple vendors
- Tip fee varies from $8-25/m3
Septage Dumping Station #1
Septage Bar Screen & Dumping Station #2
Non-organic material is screened out and sent to landfill
Drum Separator
Operation no longer required
Hydrolyzer Tank (100m3)
- SSO is diluted with septage and sewage and other organics, then mixed prior to BioGRID
BioGRID (1,000m3)
- 12,258 m3/year feed to BioGRID at 6% TS
- Produces same quantity of liquid digestate as BioGRID feed
Digestate Storage Tank #1 (854m3) & #2 (5,630m3)
- 6,045 m3 of digestate produced over 180 day storage period
- Digestate removal occurs twice yearly
Digestate
- Land application of digestate via NASM
Organic Feedstocks
- 2,829 m3/year of organics (food waste, vegetable waste, FOG, medical waste, etc.) at 4% TS is received onsite from multiple vendors
- Tip fee varies from $10-30/m3
FOG Storage Tank (50m3)
- Organics are directly unloaded into FOG tank
Pasteurizer
Operation no longer required
Odour Control System
- New odour control system to collect airflow from FOG tank and Hydrolyzer
Biogas Handling & Utilization System
- 45 m3/hour of biogas produced
- CHP unit (6-cylinder engine)
- Install biogas flare
Renewable Electricity
- Maximize FIT contract (100kW) to produce $137,000 in annual revenue
SSO Feedstock
- 9,429 m3/year of 7% TS pre-processed SSO from ICI and MSW processing facility(ies) at <5% contamination and particle size <1mm
- Tip fee of $30/m3
Notes:
1) Maximize BioGRID capacity of 1,000 m3
2) Start May 2, 2022, FIT Contract Expires May 2, 2031, Flare biogas thereafter until May 2, 2041
3) Exceeds existing ECA's total rated capacity for Site of 57.5 m3/day

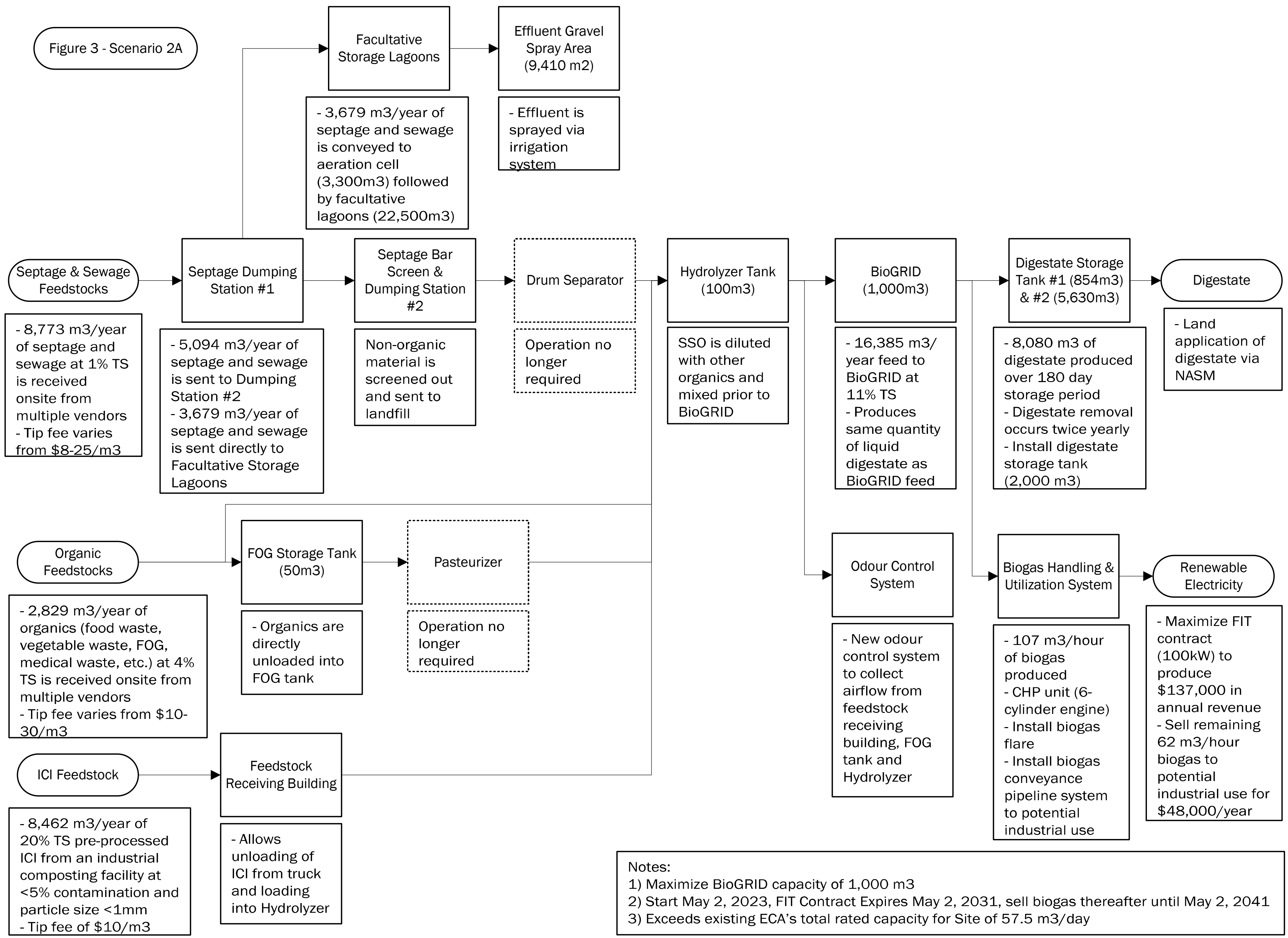


Figure 3 - Scenario 2A
Facultative Storage Lagoons
- 3,679 m3/year of septage and sewage is conveyed to aeration cell (3,300m3) followed by facultative lagoons (22,500m3)
Effluent Gravel Spray Area (9,410 m2)
- Effluent is sprayed via irrigation system
Septage & Sewage Feedstocks
- 8,773 m3/year of septage and sewage at 1% TS is received onsite from multiple vendors
- Tip fee varies from $8-25/m3
Septage Dumping Station #1
- 5,094 m3/year of septage and sewage is sent to Dumping Station #2
- 3,679 m3/year of septage and sewage is sent directly to Facultative Storage Lagoons
Septage Bar Screen & Dumping Station #2
Non-organic material is screened out and sent to landfill
Drum Separator
Operation no longer required
Hydrolyzer Tank (100m3)
SSO is diluted with other organics and mixed prior to BioGRID
BioGRID (1,000m3)
- 16,385 m3/year feed to BioGRID at 11% TS
- Produces same quantity of liquid digestate as BioGRID feed
Digestate Storage Tank #1 (854m3) & #2 (5,630m3)
- 8,080 m3 of digestate produced over 180 day storage period
- Digestate removal occurs twice yearly
- Install digestate storage tank (2,000 m3)
Digestate
- Land application of digestate via NASM
Organic Feedstocks
- 2,829 m3/year of organics (food waste, vegetable waste, FOG, medical waste, etc.) at 4% TS is received onsite from multiple vendors
- Tip fee varies from $10-30/m3
FOG Storage Tank (50m3)
- Organics are directly unloaded into FOG tank
Pasteurizer
Operation no longer required
Odour Control System
- New odour control system to collect airflow from feedstock receiving building, FOG tank and Hydrolyzer
Biogas Handling & Utilization System
- 107 m3/hour of biogas produced
- CHP unit (6-cylinder engine)
- Install biogas flare
- Install biogas conveyance pipeline system to potential industrial use
Renewable Electricity
- Maximize FIT contract (100kW) to produce $137,000 in annual revenue
- Sell remaining 62 m3/hour biogas to potential industrial use for $48,000/year
ICI Feedstock
- 8,462 m3/year of 20% TS pre-processed ICI from an industrial composting facility at <5% contamination and particle size <1mm
- Tip fee of $10/m3
Feedstock Receiving Building
- Allows unloading of ICI from truck and loading into Hydrolyzer
Notes:
1) Maximize BioGRID capacity of 1,000 m3
2) Start May 2, 2023, FIT Contract Expires May 2, 2031, sell biogas thereafter until May 2, 2041
3) Exceeds existing ECA's total rated capacity for Site of 57.5 m3/day

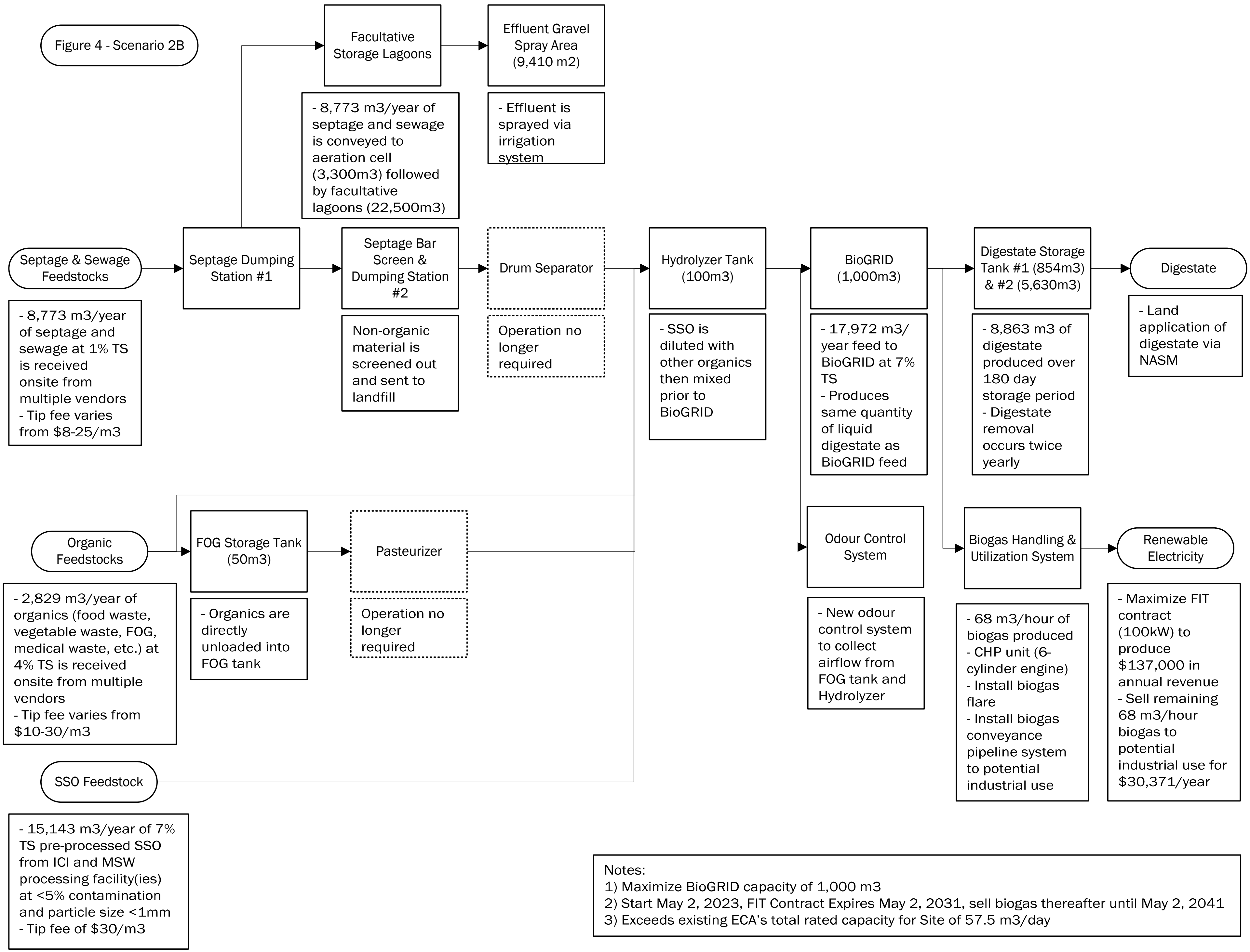


Figure 4 - Scenario 2B
Septage & Sewage Feedstocks
- 8,773 m3/year of septage and sewage at 1% TS is received onsite from multiple vendors
- Tip fee varies from $8-25/m3
Septage Dumping Station #1
Facultative Storage Lagoons
- 8,773 m3/year of septage and sewage is conveyed to aeration cell (3,300m3) followed by facultative lagoons (22,500m3)
Effluent Gravel Spray Area (9,410 m2)
- Effluent is sprayed via irrigation system
Septage Bar Screen & Dumping Station #2
Non-organic material is screened out and sent to landfill
Drum Separator
Operation no longer required
Hydrolyzer Tank (100m3)
- SSO is diluted with other organics then mixed prior to BioGRID
BioGRID (1,000m3)
- 17,972 m3/year feed to BioGRID at 7% TS
- Produces same quantity of liquid digestate as BioGRID feed
Digestate Storage Tank #1 (854m3) & #2 (5,630m3)
- 8,863 m3 of digestate produced over 180 day storage period
- Digestate removal occurs twice yearly
Digestate
- Land application of digestate via NASM
Organic Feedstocks
- 2,829 m3/year of organics (food waste, vegetable waste, FOG, medical waste, etc.) at 4% TS is received onsite from multiple vendors
- Tip fee varies from $10-30/m3
FOG Storage Tank (50m3)
- Organics are directly unloaded into FOG tank
Pasteurizer
Operation no longer required
Odour Control System
- New odour control system to collect airflow from FOG tank and Hydrolyzer
Biogas Handling & Utilization System
- 68 m3/hour of biogas produced
- CHP unit (6-cylinder engine)
- Install biogas flare
- Install biogas conveyance pipeline system to potential industrial use
Renewable Electricity
- Maximize FIT contract (100kW) to produce $137,000 in annual revenue
- Sell remaining 68 m3/hour biogas to potential industrial use for $30,371/year
SSO Feedstock
- 15,143 m3/year of 7% TS pre-processed SSO from ICI and MSW processing facility(ies) at <5% contamination and particle size <1mm
- Tip fee of $30/m3
Notes:
1) Maximize BioGRID capacity of 1,000 m3
2) Start May 2, 2023, FIT Contract Expires May 2, 2031, sell biogas thereafter until May 2, 2041
3) Exceeds existing ECA's total rated capacity for Site of 57.5 m3/day

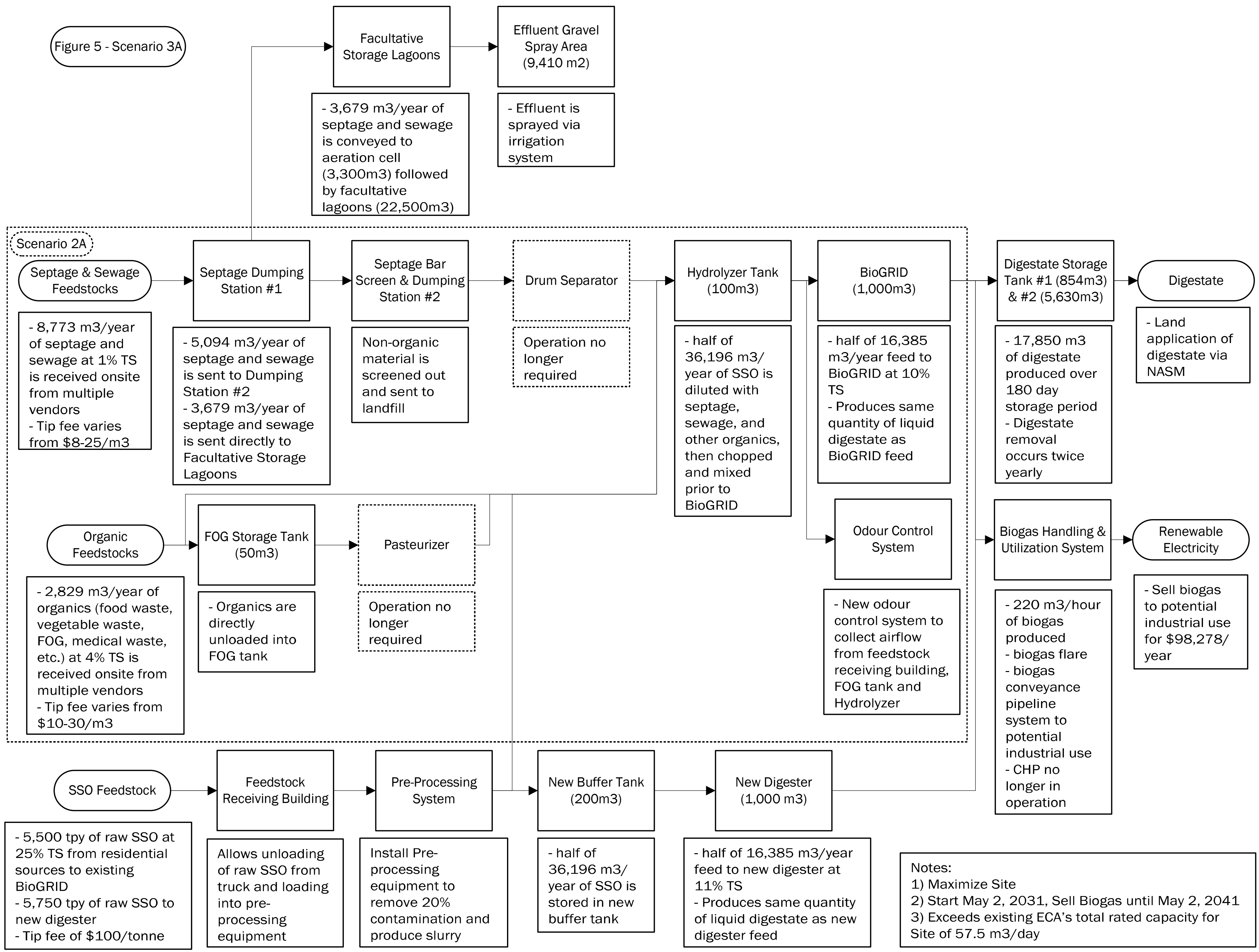


Figure 5 - Scenario 3A

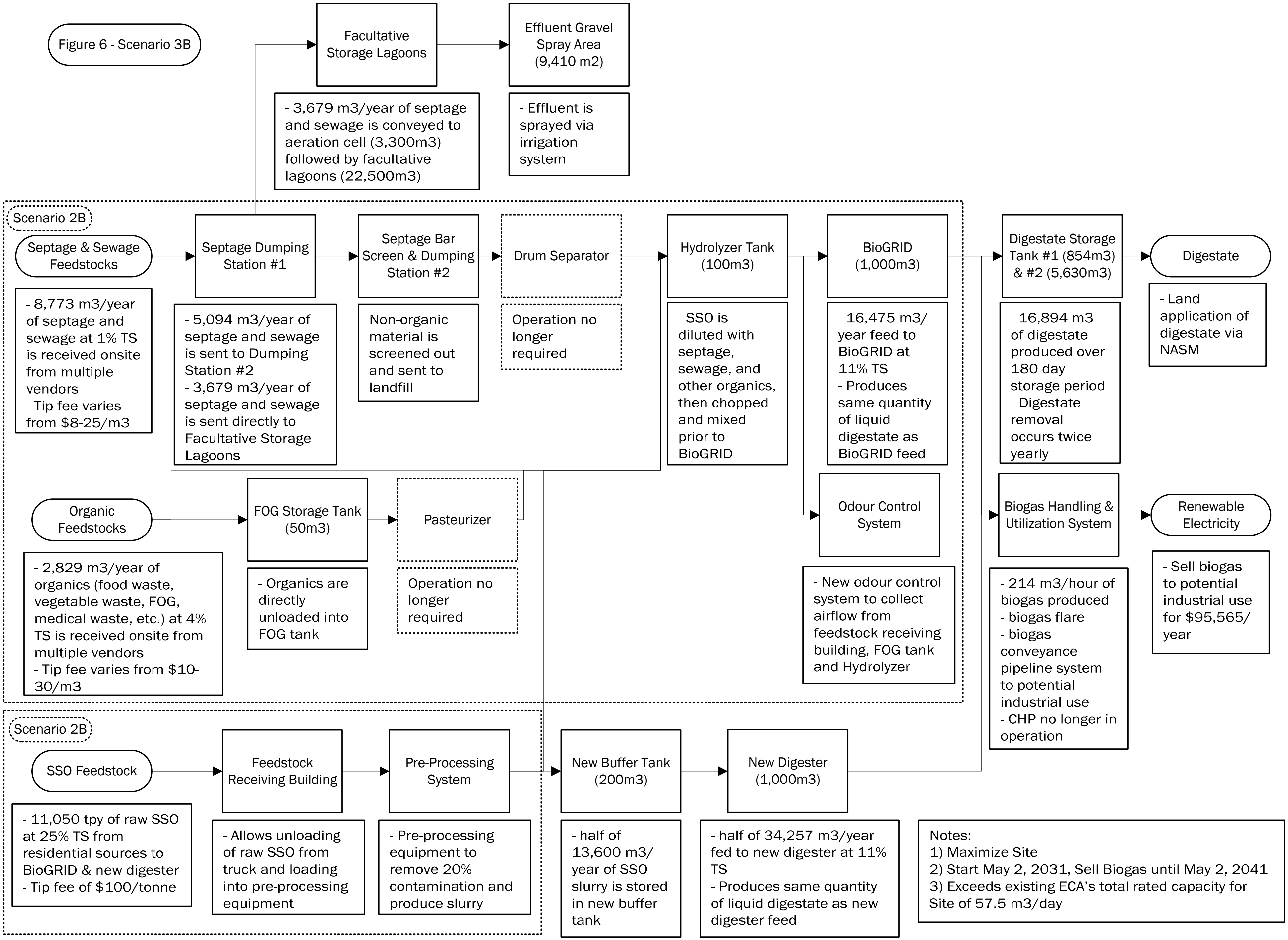


Figure 6 - Scenario 3B
Facultative Storage Lagoons
Effluent Gravel Spray Area (9,410 m2)
- 3,679 m3/year of septage and sewage is conveyed to aeration cell (3,300m3) followed by facultative lagoons (22,500m3)
- Effluent is sprayed via irrigation system
Scenario 2B
Septage & Sewage Feedstocks
Septage Dumping Station #1
Septage Bar Screen & Dumping Station #2
Drum Separator
Hydrolyzer Tank (100m3)
BioGRID (1,000m3)
Digestate Storage Tank #1 (854m3) & #2 (5,630m3)
Digestate
- 8,773 m3/year of septage and sewage at 1% TS is received onsite from multiple vendors
- Tip fee varies from $8-25/m3
- 5,094 m3/year of septage and sewage is sent to Dumping Station #2
- 3,679 m3/year of septage and sewage is sent directly to Facultative Storage Lagoons
Non-organic material is screened out and sent to landfill
Operation no longer required
- SSO is diluted with septage, sewage, and other organics, then chopped and mixed prior to BioGRID
- 16,475 m3/ year feed to BioGRID at 11% TS
- Produces same quantity of liquid digestate as BioGRID feed
- 16,894 m3 of digestate produced over 180 day storage period
- Digestate removal occurs twice yearly
- Land application of digestate via NASM
Organic Feedstocks
FOG Storage Tank (50m3)
Pasteurizer
Odour Control System
Biogas Handling & Utilization System
Renewable Electricity
- 2,829 m3/year of organics (food waste, vegetable waste, FOG, medical waste, etc.) at 4% TS is received onsite from multiple vendors
- Tip fee varies from $10-30/m3
- Organics are directly unloaded into FOG tank
Operation no longer required
- New odour control system to collect airflow from feedstock receiving building, FOG tank and Hydrolyzer
- 214 m3/hour of biogas produced
- biogas flare
- biogas conveyance pipeline system to potential industrial use
- CHP no longer in operation
- Sell biogas to potential industrial use for $95,565/ year
Scenario 2B
SSO Feedstock
Feedstock Receiving Building
Pre-Processing System
New Buffer Tank (200m3)
New Digester (1,000m3)
- 11,050 tpy of raw SSO at 25% TS from residential sources to BioGRID & new digester
- Tip fee of $100/tonne
- Allows unloading of raw SSO from truck and loading into pre-processing equipment
- Pre-processing equipment to remove 20% contamination and produce slurry
- half of 13,600 m3/ year of SSO slurry is stored in new buffer tank
- half of 34,257 m3/year fed to new digester at 11% TS
- Produces same quantity of liquid digestate as new digester feed
Notes:
1) Maximize Site
2) Start May 2, 2031, Sell Biogas until May 2, 2041
3) Exceeds existing ECA's total rated capacity for Site of 57.5 m3/day

Appendix E

Evaluation Matrix

APPENDIX E: EVALUATION MATRIX

Project Name: **Georgian Bluffs Source Separated Organics availability, Digestion Technologies and beneficial use of Biogas Feasibility Study**
Project I.D.: GBluffsFeasStudy-ITAG-02-20
GHD Project No.: 11220446

Categories	Evaluation Criteria	RATING (0=WORST TO 10=BEST)			Evaluation Type		Units of Measure	Weighting (%)	Scenario 1A	Scenario 1B	Scenario 2A	Scenario 2B	Scenario 3A	Scenario 3B	Workshop Notes (Township/OCWA/GHD)
		0	5	10	Qualitative	Quantitative									
Financial	Net present value (includes CAPEX, OPEX, revenue)	Significantly less NPV than alternatives	Comparable NPV to alternatives	Significantly greater NPV than alternatives		X	2021 $	33%	($10,850,907)	($4,997,239)	($11,089,623)	($4,759,034)	($32,617,097)	($32,138,954)	Consider/connect with findings of concurrent project.
									5.0	9.0	4.0	10.0	0.0	1.0	
	Financial risk (securing organic feedstocks, increased digestate, price of product)	Significantly greater risk than alternatives	Comparable risk to alternatives	Significantly lower risk than alternatives	X		Relative score	33%	Pre-processed ICI from one source	Pre-processed SSO from multiple sources. Increased risk.	Increased pre-processed ICI from one source	Raw SSO from Georgian Bluffs, Chatsworth, and neighbouring municipalities	Raw SSO in addition to Scenario 3A (feedstock not necessarily available)	Raw SSO in addition to infrastructure from Scenario 3B (feedstock not necessarily available)	
									10.0	5.0	5.0	10.0	0.0	0.0	
	Potential for external funding	Much less than alternatives	Comparable to alternatives	Much greater than alternatives	X		Relative score	33%	Scored based on CAPEX (lower CAPEX, better score, less financing for Georgian Bluffs)	Scored based on CAPEX (lower CAPEX, better score, less financing for Georgian Bluffs)	Scored based on CAPEX (lower CAPEX, better score, less financing for Georgian Bluffs)	Low CAPEX	High CAPEX	High CAPEX	
									9.0	10.0	9.0	8.0	0.0	0.0	
							Total	**100%**	**80%**	**80%**	**60%**	**93%**	**0%**	**3%**	
Technical	Proven technology	Limited or no full-scale installations	Full-scale installations with 1 to 5 years of operating experience	Well-proven and widely used	X		Relative score	17%	flare, odour control system, no other major equipment required	receiving building, flare, odour control system, no other major equipment required	biogas pipeline, no other major equipment required	biogas pipeline, no other major equipment required	Large scale pre-processing equipment and new digester in full scale operations	Large scale pre-processing equipment and new digester in full scale operations	
									8.0	4.0	5.0	7.0	8.0	8.0	
	Anticipated changes to operations	Technically complex and difficult to operate-much training needed	Moderately difficult to operate-use existing staff with training	Easy to operate-no new training required	X		Relative score	17%	Training required for feeding of pre-processed ICI	Manage increase in pre-processed SSO contracts with multiple sources	Training required for feeding of pre-processed ICI	Manage increase in pre-processed SSO contracts with multiple sources	Training required for pre-processing facility and digester	Training required for pre-processing facility and digester	Decision on direction is important (definition of scenarios). What are organics available (feasible and maximum), what technologies are needed to manage and how does this work for the facility, what are related costs/requirements. With possible longer-list of scenarios, reduce list to short-list of three scenarios that may be feasible. Then select based on findings.
									5.0	7.0	5.0	7.0	0.0	0.0	
	Scalability	Much less than alternatives	Comparable to alternatives	Much greater than alternatives	X		Relative score	17%	Facility can be designed to manage additional organics in the future	Facility can be designed to manage additional organics in the future	Facility can be designed to manage additional organics in the future	Majority of SSO tonnage can be procured from future SSO collection program in Georgian Bluffs, Chatsworth, and neighbouring municipalities	Larger project out of the scenarios, so not scalable/no need for scaling up based on feedstock scan	Larger project out of the scenarios, so not scalable/no need for scaling up based on feedstock scan	
									8.0	8.0	8.0	7.0	0.0	0.0	
	O&M demands	Much greater than alternatives	Comparable to alternatives	Much less than alternatives	X		Relative score	17%	Higher O&M for loading equipment at industrial ICI source	Lowest O&M as no loading equipment is required at industrial ICI source	Comparable to Scenario 1A	Comparable to Scenario 1A	Greater O&M due to larger facility	Greater O&M due to larger facility	
									7.0	10.0	5.0	7.0	0.0	0.0	

APPENDIX E: EVALUATION MATRIX

Project Name: **Georgian Bluffs Source Separated Organics availability, Digestion Technologies and beneficial use of Biogas Feasibility Study**
Project I.D.: GBluffsFeasStudy-ITAG-02-20
GHD Project No.: 11220446

Categories	Evaluation Criteria	RATING (0=WORST TO 10=BEST)			Evaluation Type		Units of Measure	Weighting (%)	Scenario 1A	Scenario 1B	Scenario 2A	Scenario 2B	Scenario 3A	Scenario 3B	Workshop Notes (Township/OCWA/GHD)
		0	5	10	Qualitative	Quantitative									
Technical	Integration	Technically complex to integrate	Moderately difficult to integrate	Easy to integrate	X		Relative score	17%	Integration of feedstock receiving building and BioGRID feed upgrades may be complex	Less changes to feedstock receiving system required	Comparable to Scenario 1A	Less changes to feedstock receiving system required	More complex due to size of pre-processing facility and digester	More complex due to size of pre-processing facility and digester	Decision on direction is important (definition of scenarios). Consider access road needs (larger trucks) and a facility flare.
									5.0	8.0	5.0	8.0	0.0	0.0	
	Footprint area for required infrastructure	Much greater than alternatives	Comparable to alternatives	Much less than alternatives		X	Area	17%	Feedstock receiving building, odour control system, flare	Less changes to feedstock receiving system required	Comparable to Scenario 1A	Pre-processing facility, road adjustments, digestate storage tank	Pre-processing facility, slurry buffer tank, digester, road adjustments	Buffer tank for slurry, digester, potential road adjustments around digester	
									5.0	8.0	5.0	0.0	0.0	0.0	
							Total	**100%**	**63%**	**75%**	**55%**	**60%**	**13%**	**13%**	
Environmental	GHG emissions reductions	Much less than alternatives	Comparable to alternatives	Much greater than alternatives		X	tCO_2e (2021)	33%	66.34	26.13	1,654.00	863.31	9,488.69	9,257.08	
									0.0	0.0	2.0	5.0	10.0	9.0	
	Renewable energy generation	Much less than alternatives	Comparable to alternatives	Much greater than alternatives		X	GJ per year	33%	0.00	0.00	0.00	2.34	0.41	3.15	
									0.0	0.0	2.0	5.0	10.0	9.0	
	Feasibility and complexity of permits and approvals	Much more difficult than alternatives	Comparable to alternatives	Much less difficult than alternatives	X		Relative score	33%	Comparable to 1B and receiving building fairly easy to permit	ECA amendment required for flare, odour control system, increased flow to site (required for all scenarios)	biogas pipeline more challenging to permit	Georgian Bluff, Chatsworth, neighbouring townships SSO only	Significant additional material outside of Georgian Bluff, Chatsworth, neighbouring townships SSO	Significant additional material outside of Georgian Bluff, Chatsworth, neighbouring townships SSO	Odour is a primary concern.
									9.0	10.0	7.0	7.0	3.0	3.0	
							Total	**100%**	**30%**	**33%**	**37%**	**57%**	**77%**	**70%**	
Social	Public acceptability	Much less than alternatives	Comparable to alternatives	Much greater than alternatives	X		Relative score	25%	No new open digestate storage tank required	No new open digestate storage tank required	New open digestate storage tank required	Material within Georgian Bluffs, Chatsworth, New open digestate storage tank required	Significant additional material outside Georgian Bluffs, Chatsworth	Significant additional material outside Georgian Bluffs, Chatsworth	
									10.0	10.0	3.0	3.0	0.0	0.0	
	Potential impacts (odour)	Much greater than alternatives	Comparable to alternatives	Much less than alternatives		X	Estimated trucks per day	25%	3.93	5.27	6.37	5.79	12.25	11.72	Odour concerns given open tanks at facility.
									10.0	7.0	5.0	6.0	0.0	0.0	
	Potential impacts (traffic/noise)	Much greater than alternatives	Comparable to alternatives	Much less than alternatives		X	Estimated trucks per day	25%	3.93	5.27	6.37	5.79	12.25	11.72	
									10.0	8.0	5.0	7.0	0.0	0.0	
	Increased diversion from landfills	Much less than alternatives	Comparable to alternatives	Much greater than alternatives		X	Tonnes waste per year	25%	0.00	0.00	0.00	0.00	5,750	11,050	
									0.0	0.0	0.0	0.0	7.0	10.0	
							Total	**100%**	**75%**	**63%**	**33%**	**40%**	**18%**	**25%**	

Appendix F

Sample Calculations for Evaluation

Appendix F Sample Calculations for Evaluation

While the method of qualitative analysis is evident in the Draft Report, this does not necessarily hold true for quantitative results, thus a description of how quantities were determined and/or calculated is provided herein. Refer to Appendix G for the detailed assumptions and calculations of items listed below and used to quantitatively assess the scenarios.

Capital and Operating Costs

Capital and operating costs were determined using GHD's industry experience on similar projects and are based on a summation of key considerations for capital costs (e.g., building and equipment infrastructure requirements) and operating costs (e.g., maintenance and employee requirements). These costs are in the order of magnitude level of accuracy, suitable for a screening level feasibility Study.

GHG Emissions Reductions

Decomposition of organic waste in landfill produces methane, a greenhouse gas (GHG). Therefore, the avoidance of organic waste from landfill towards an alternative use where the biogas (methane) produced can be combusted generally results in GHG emission reductions.

A simplified calculation for GHG emissions reductions was completed that estimates the GHG emissions reductions as the GHG emissions that would not have been captured and destroyed by a typical LFG collection and utilization system. This calculation also accounts for GHG emissions reductions from offsetting electricity or natural gas use depending on the scenario but does not account for transportation or AD and does not consider fugitive emissions such as minimal gas venting or leakage as part of operations (less than 1%).

Another simplified calculation for GHG emissions reductions was completed that estimates the GHG emissions reductions from organic waste that is processed via anaerobic digestion process, which would otherwise be processed in an industrial composting facility.

This calculation only considers GHG emissions reductions that are additional to current practices.

Biosolids Quantity

Biosolids quantity was calculated using the following equation:

$$M_b = M_f \times (1 - F_r)$$

M_b = mass of biosolids produced

M_f = mass of feedstock

F_r = fraction of the feedstock that consists of residue (non-organic fraction of the feedstock that must be removed before processing)

In simpler terms, the BioGRID is a plug flow anaerobic digester, what is fed to the BioGRID is similar to the quantity of liquid digestate that is withdrawn and transferred to the digestate storage tanks.

Waste Generation

Waste generation was calculated using the following formula:

$$M_W = M_f \times (1 - F_r)$$

M_w = mass of waste generated

M_f = mass of feedstock

F_r = residue fraction of the feedstock

For AD, the residue fraction consists of inorganic material in the feedstock that must be removed before processing.

Hauling/Truck Traffic and Noise

Hauling/truck traffic and noise is calculated as the average number of additional trucks per operating day.

$$N_T = \frac{M_f}{M_T N_{OD}}$$

N_T = average number of trucks per operating day

M_f = mass of feedstock transported per year, or mass of dewatered digestate transported per year

M_T = capacity of one transportation truck

N_{OD} = number of operating days per year

Assumptions were made regarding the capacity of trucks and the number of operating days per year.

For SSO, ICI waste, digestate and residual trucks, 15 m3/truck was assumed.

Number of operating days was assumed to be 250 days per year. This allows for 5 days per week with the exception of holidays.

Waste Diversion

Where waste streams were considered to be diverted from landfill, waste diversion was calculated as the total feedstock amount less the residue fraction of the feedstock (inorganic materials removed from the feedstock).

$$M_{WD} = M_f - M_r$$

M_{WD} = mass of waste diverted

M_f = mass of feedstock

M_r = mass of residual from the feedstock

Energy Potential of Feedstock

The energy potential of the feedstock was calculated using the following formula:

$$E_f = M_f \times PB_f \times F_{CH_4} \times E_{CH_4}$$

E_f = energy potential of the feedstock (GJ/year)

M_f = mass of feedstock (tonnes/year)

PB_f = biogas potential of the feedstock (m^3/tonne)

F_{CH4} = methane fraction of the biogas

E_{CH4} = energy content of methane (GJ/m^3)

Appendix G

Estimated Financial Summary, Mass Balance, Truck Estimation, GHG Emissions Calculations

APPENDIX G: ESTIMATED FINANCIAL SUMMARY

Project Name: **Georgian Bluffs Source Separated Organics Availability, Digestion Technologies, and Beneficial Use of Biogas Feasibility Study**

Project Identification: GBluffsFeasStudy-ITAG-02-20

GHD Project Number: 11220446

Additional Feedstock	Scenario 0.1	Scenario 1A	Scenario 1B	Scenario 2A	Scenario 2B	Scenario 3A	Scenario 3B
TECHNICAL EVALUATION							
Average Total Feed to BioGRID (m3/year)	4,714	4,714	4,714	4,714	4,714	4,714	4,714
Direct Organics Feed to BioGRID (m3/year)	2,829	2,829	2,829	2,829	2,829	2,829	2,829
Solids Portion of Septage/Sewage Feed to BioGRID (m3/year)	1,885	0	0	0	0	0	0
Total Volume of Septage/Sewage Feed to BioGRID (m3/year)	5,094	5,094	0	5,094	0	17,828	17,828
Raw ICI/SSO (tonnes/year)	0	2,000	3,300	5,500	5,300	5,750	5,750
Total Raw ICI/SSO (tonnes/year)	0	2,000	3,300	5,500	5,300	11,250	11,050
Considering Contamination in ICI/SSO (tonnes/year)		2,000	2,640	5,500	4,240	10,100	8,840
Density of Received Material (kg/m3)		650	1,000	650	1,000	650	650
Considering Contamination in ICI/SSO (m3/year)		3,077	2,640	8,462	4,240	15,538	13,600
ICI/SSO Input (m3/day; for 250 operating days per year)		8.0	10.6	33.8	17.0	62.2	54.4
%TS in Raw ICI/SSO		20%	25%	20%	25%	22.6%	25%
ICI/SSO Slurry TS%		20.0%	7.0%	20%	7%	22.6%	25%
TS ICI/SSO SLURRY (m3/yr)	0	615	660	1,692	1,060	3,505	3,400
ICI/SSO Slurry Feed to BioGRID (m3year)		3,077	9,429	8,462	15,143	15,538	13,600
Total ICI/SSO Slurry Feed to BioGRID (m3year)		3,077	9,429	8,462	15,143	15,538	13,600
Septage/Sewage TS%	1%	1%	1%	1%	1%	1%	1%
TS Septage/Sewage Slurry (m3/yr)	51	51	0	51	0	178	178
BioGRID Feed TS%	3%	7%	6%	11%	7%	10%	11%
%TS in Direct Organics feed portion to BioGRID	4%	4%	4%	4%	4%	4%	4%
TS Direct Organics (m3/yr)	113	113	113	113	113	113	113
Total TS (m3/yr)	164	779	773	1,856	1,173	3,796	3,691
BioGRID Feed TS (kg/day)	450	2,136	2,118	5,086	3,214	10,401	10,114
BioGRID Feed VS (kg/day)	315	1,495	1,483	3,560	2,250	7,280	7,079
BioGRID Feed (m3/year)	4,713.95	11,000	12,258	16,385	17,972	36,196	34,257
BioGRID Feed (m3/day)	13	30	34	45	49	99	94
Total Flow to Both Digesters, where Scenario has Two (m3/day)	13	30	34	45	49	99	94
Total Flow to Site (m3/day)	46.4	58.7	84.1	80.3	107.0	108.6	100.8
Max Rated Flow Check	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Density of SSO Slurry (kg/m3)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Hydrolizer Tank Volume (m3)	100	100	100	100	100	200	200
Hydrolizer Capacity Check	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Digester Volume (m3)	1,000	1,000	1,000	1,000	1,000	2,000	2,000
SSO VS Loading (kg/m3/d)	0.3	1.5	1.5	3.6	2.2	3.6	3.5
Design Loading Rate Check	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
HRT (days)	20	20	20	20	20	20	20
Digester Volume Utilized (m3)	258	603	672	898	985	1,983	1,877
Available Volume in Digester (m3)	742	397	328	102	15	17	123
Digester Capacity Check	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Digestate Produced (m3/day)	13	30	34	45	49	99	94
Total Digestate Produced (m3/day)	13	30	34	45	49	99	94
Total Digestate Storage Volume (m3)	6,558	6,558	6,558	6,558	6,558	6,558	6,558
Digestate Storage Time (days)	180	180	180	180	180	180	180
Digestate Produced (m3/year)	2,325	5,425	6,045	8,080	8,863	17,850	16,894
Digestate Storage Capacity Check	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE
Additional Digestate Storage Tank Required (m3)	0	0	0	1,522	2,305	11,292	10,336
Total Additional Digestate Storage Tank Required (m3)	0	0	0	1,522	2,305	11,292	10,336
Methane Produced (m3/d)	284	628	623	1,495	945	3,058	2,973
Biogas Produced (m3/d)	490	1,083	1,074	2,578	1,629	5,272	5,127
Total Biogas Produced (m3/h)	20	45	45	107	68	220	214
FINANCIALS - CAPEX	**$ -**	**$ 1,325,500.00**	**$ 760,500.00**	**$ 1,308,500.00**	**$ 1,459,500.00**	**$ 17,212,600.00**	**$ 16,587,600.00**
FINANCIALS - CAPEX	**$ -**	**$ 1,325,500.00**	**$ 760,500.00**	**$ 1,308,500.00**	**$ 1,459,500.00**	**$ 17,212,600.00**	**$ 16,587,600.00**
Total CAPEX		**$ 1,325,500.00**	**$ 760,500.00**	**$ 2,634,000.00**	**$ 2,220,000.00**	**$ 19,846,600.00**	**$ 18,807,600.00**
Digestate Storage Tank	**$ -**	**$ -**	**$ -**	**$ 300,000.00**	**$ 425,000.00**	**$ 1,050,000.00**	**$ 950,000.00**
Design Build and Construct Circular Concrete Storage Tank	$ -	$ -	$ -	$ 250,000	$ 375,000	$ 1,000,000	$ 900,000
Clearing/Site Prep/Supply/Place/Compact Crushed Gravel 600mm Deep	$ -	$ -	$ -	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Value after 30 years ($)	$ -	$ -	$ -	$ 100,000.00	$ 141,666.67	$ 350,000.00	$ 316,666.67
Biogas Flare	**$ -**	**$ 100,000.00**	**$ 100,000.00**	**$ -**	**$ -**	**$ -**	**$ -**
Value after 30 years ($)	$ -	$ 33,333.33	$ 33,333.33	$ -	$ -	$ -	$ -
Odour Control System	**$ -**	**$ 150,000.00**	**$ 150,000.00**	**$ -**	**$ -**	**$ -**	**$ -**
Woodchip Media (Supply and Install)	$ -	$ 100,000	$ 100,000	$ -	$ -	$ -	$ -
Container with Ducting, Short Stack, Humidifier, etc.	$ -	$ 50,000	$ 50,000	$ -	$ -	$ -	$ -
Value after 30 years ($)	$ -	$ 50,000.00	$ 50,000.00	$ -	$ -	$ -	$ -
Design, Approvals, Permits and Construction Management	**$ -**	**$ 169,000.00**	**$ 104,000.00**	**$ 169,000.00**	**$ 195,000.00**	**$ 2,950,000.00**	**$ 2,950,000.00**
Design	$ -	$ 130,000	$ 80,000	$ 130,000	$ 150,000	$ 1,500,000	$ 1,500,000
Approvals, Permits	$ -	$ 13,000	$ 8,000	$ 13,000	$ 15,000	$ 200,000	$ 200,000
Submittals (O&M, PCN, H&S and E&R plan)	$ -	$ 13,000	$ 8,000	$ 13,000	$ 15,000	$ 550,000	$ 550,000
Construction Management	$ -	$ 13,000	$ 8,000	$ 13,000	$ 15,000	$ 700,000	$ 700,000
Site Works for New Digester	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,830,000.00**	**$ 1,830,000.00**
Mobilization, Demobilization, Temporary Site Facilities	$ -	$ -	$ -	$ -	$ -	$ 250,000	$ 250,000
Earthworks	$ -	$ -	$ -	$ -	$ -	$ 200,000	$ 200,000
Asphalt	$ -	$ -	$ -	$ -	$ -	$ 300,000	$ 300,000
Surface Water Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Secondary Containment, Pond and Liner	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Utilities (Natural Gas, Water, Sewer, Data/Telephone)	$ -	$ -	$ -	$ -	$ -	$ 480,000	$ 480,000
Electrical (Customer-Owned Transformer, Cables, Trays)	$ -	$ -	$ -	$ -	$ -	$ 600,000	$ 600,000
Building and Structures	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 4,137,600.00**	**$ 4,137,600.00**
Concrete for AD tank, Storage Tank and Building	$ -	$ -	$ -	$ -	$ -	$ 440,000	$ 440,000
Building (Structural, Cladding, HVAC, Fire Pump & Sprinkler System, Gas Detection)	$ -	$ -	$ -	$ -	$ -	$ 3,537,600	$ 3,537,600
Tip Floor (Steel Push Plates, Push Wall, Corrosion Resistant Topping)	$ -	$ -	$ -	$ -	$ -	$ 160,000	$ 160,000
Value after 30 years ($)	$ -	$ -	$ -	$ -	$ -	$ 1,379,200.00	$ 1,379,200.00

APPENDIX G: ESTIMATED FINANCIAL SUMMARY

Project Name: **Georgian Bluffs Source Separated Organics Availability, Digestion Technologies, and Beneficial Use of Biogas Feasibility Study**

Project Identification: GBluffsFeasStudy-ITAG-02-20

GHD Project Number: 11220446

Additional Feedstock	Scenario 0.1	Scenario 1A	Scenario 1B	Scenario 2A	Scenario 2B	Scenario 3A	Scenario 3B
Anaerobic Digestion Equipment	**$ -**	**$ 200,000.00**	**$ 200,000.00**	**$ -**	**$ -**	**$ 2,192,000.00**	**$ 2,192,000.00**
AD Tank	$ -	$ -	$ -	$ -	$ -	$ 960,000	$ 960,000
AD Mixing and Heating System	$ -	$ 90,000	$ 90,000	$ -	$ -	$ 352,000	$ 352,000
Storage/Buffer Tank	$ -	$ -	$ -	$ -	$ -	$ 480,000	$ 480,000
Misc. Mechanical (Pumps, Piping, Valves)	$ -	$ 110,000	$ 110,000	$ -		$ 400,000	$ 400,000
Value after 30 years ($)	$ -	$ 66,666.67	$ 66,666.67	$ -	$ -	$ 730,666.67	$ 730,666.67
Process Water Management System	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Dewatering	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Instrumentation and Controls	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,200,000.00**	**$ 1,200,000.00**
Value after 30 years ($)	$ -	$ -	$ -	$ -	$ -	$ 400,000.00	$ 400,000.00
Indirect Constuction Costs	**$ -**	**$ 86,500**	**$ 86,500**	**$ 96,500**	**$ 96,500**	**$ 600,000**	**$ 600,000**
Spare Parts Inventory and Tools	$ -	$ 6,500	$ 6,500	$ 6,500	$ 6,500	$ 80,000	$ 80,000
Mobile Equipment	$ -	$ -	$ -	$ -	$ -	$ 200,000	$ 200,000
Facility Start-up, Acceptance Testing; Commissioning	$ -	$ 80,000	$ 80,000	$ 90,000	$ 90,000	$ 200,000	$ 200,000
Bonding and Letters of Credit during Construction	$ -	$ -	$ -	$ -	$ -	$ 60,000	$ 60,000
Insurance During Construction	$ -	$ -	$ -	$ -	$ -	$ 60,000	$ 60,000
Pre-Processing System	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 3,253,000**	**$ 2,728,000**
Buffer Tank for Pre-Processed Slurry	$ -	$ -	$ -	$ -	$ -	$ 525,000	$ -
Wet Pre-Processing Equipment (including Grit Removal)	$ -	$ -	$ -	$ -	$ -	$ 1,728,000	$ 1,728,000
Misc. Mechanical (Pumps, Piping, Conveyors)	$ -	$ -	$ -	$ -	$ -	$ 520,000	$ 520,000
Residue Management Equipment	$ -	$ -	$ -	$ -	$ -	$ 480,000	$ 480,000
Value after 30 years ($)	$ -	$ -	$ -	$ -	$ -	$ 1,084,333.33	$ 909,333.33
Upgrades to BioGRID Feed System	**$ -**	**$ 500,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
New Receiving Building	$ -	$ 400,000	$ -	$ -	$ -	$ -	$ -
Conveyor System	$ -	$ 100,000	$ -	$ -	$ -	$ -	$ -
Feed Pumps, Piping, Valves for BioGRID	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Value after 30 years ($)	$ -	$ 166,666.67	$ -	$ -	$ -	$ -	$ -
Road Infrastructure Upgrade	**$ -**	**$ 120,000**	**$ 120,000**	**$ 43,000**	**$ 43,000**	**$ -**	**$ -**
Extend Existing Access Road near Hydrolizer Tank							
Excavation	$ -	$ 10,000	$ 10,000	$ -	$ -	$ -	$ -
Granular B	$ -	$ 19,000	$ 19,000	$ -	$ -	$ -	$ -
Granular A	$ -	$ 11,000	$ 11,000	$ -	$ -	$ -	$ -
South East Driving & Parking Area							
Excavation	$ -	$ 20,000	$ 20,000	$ -	$ -	$ -	$ -
Granular B	$ -	$ 38,000	$ 38,000	$ -	$ -	$ -	$ -
Granular A	$ -	$ 22,000	$ 22,000	$ -	$ -	$ -	$ -
Road Around New Digestate Tank							
Excavation	$ -	$ -	$ -	$ 21,000	$ 21,000	$ -	$ -
Granular B	$ -	$ -	$ -	$ 14,000	$ 14,000	$ -	$ -
Granular A	$ -	$ -	$ -	$ 8,000	$ 8,000	$ -	$ -
Biogas Conveyance System	**$ -**	**$ -**	**$ -**	**$ 700,000.00**	**$ 700,000.00**	**$ -**	**$ -**
Biogas Pipeline to Neighbour (assume 200m)	$ -	$ -	$ -	$ 600,000	$ 600,000	$ -	$ -
Blower/Compressor & Upgrades	$ -	$ -	$ -	$ 100,000	$ 100,000	$ -	$ -
Value after 30 years ($)	$ -	$ -	$ -	$ 233,333.33	$ 233,333.33	$ -	$ -
FINANCIALS - REVENUE	**$ 228,194.45**	**$ 333,064.87**	**$ 584,017.36**	**$ 414,790.73**	**$ 765,801.25**	**$ 1,040,009.44**	**$ 1,481,709.56**
Biogas to Neighbour	**$ -**	**$ -**	**$ -**	**$ 27,879.71**	**$ 10,355.32**	**$ 78,098.41**	**$ 75,549.34**
Total Biogas Produced (m3/h)				62	23	175	169
Biogas Revenue Potential ($/m3)				$ 0.103563	$ 0.103563	$ 0.103563	$ 0.103563
Annual Revenue from Biogas Produced (m3/year)				$ 27,880	$ 10,355	$ 78,098	$ 75,549
Excess Biogas Produced after FIT Contract Expires (m3/h)				107	68	220	214
Excess Biogas Produced after FIT Contract Expires (m3/h)				$ 48,059.45	$ 30,371.40	$ 98,278.15	$ 95,565.41
Biogas Usage Onsite via Existing CHP							
Electricity Consumed Yearly (kWh/year)	184,805	280,000	280,000	280,000	280,000	1,400,000	1,400,000
CHP Power Required (kW)	21	32	32	32	32	160	160
Biogas Consumed Year (m3/year)	83,162	126,000	126,000	126,000	126,000	630,000	630,000
Biogas Consumed Hourly (m3/hour)	10	14	14	14	14	72	72
Electricity FIT Contract	**$ 65,895**	**$ 139,996.64**	**$ 138,861.22**	**$ 139,996.64**	**$ 138,861.22**	**$ 139,996.64**	**$ 138,861.22**
Electricity Produced Daily (kWh/day)	1,089	2,406	2,386	2,406	2,386	2,406	2,386
FIT Contract Revenue ($/day)	$ 181	$ 399	$ 396	$ 399	$ 396	$ 399	$ 396
CHP Maintenance Downtime (days)		14	14	14	14	14	14
FIT Contract Revenue ($/year)	$ 65,895	$ 139,997	$ 138,861	$ 139,997	$ 138,861	$ 139,997	$ 138,861
Approximate CHP Power Required (kW)	45	100	100	100	100	100	100
CHP Capacity Check	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
CHP Contract Years Remaining	9	9	9	9	9	9	9
Tipping Fees	**$ 162,299.00**	**$ 193,068.23**	**$ 445,156.14**	**$ 246,914.38**	**$ 616,584.71**	**$ 821,914.38**	**$ 1,267,299.00**
Commercial Sewage Fees	$ 70,706	$ 70,706	$ 70,706	$ 70,706	$ 70,706	$ 70,706	$ 70,706
Residential Sewage Fees	$ 15,102	$ 15,102	$ 15,102	$ 15,102	$ 15,102	$ 15,102	$ 15,102
Other Tipping Fees (FOG, SSO leachate, etc.)	$ 56,419	$ 56,419	$ 56,419	$ 56,419	$ 56,419	$ 56,419	$ 56,419
Interest	$ 3,171	$ 3,171	$ 3,171	$ 3,171	$ 3,171	$ 3,171	$ 3,171
Recoveries and Other Revenue	$ 16,901	$ 16,901	$ 16,901	$ 16,901	$ 16,901	$ 16,901	$ 16,901
Pre-Processed ICI ($/tonne)	$ -	$ 10	$ -	$ 10	$ -	$ 10	$ -
Pre-Processed ICI ($/year)	$ -	$ 30,769	$ -	$ 84,615	$ -	$ 84,615	$ -
Pre-Processed SSO Slurry from General Sources ($/tonne)	$ -	$ -	$ 30	$ -	$ 30	$ -	$ -
Pre-Processed SSO Slurry from General Sources ($/year)	$ -	$ -	$ 282,857	$ -	$ 454,286	$ -	$ -
Raw SSO from Municipal Sources ($/tonne)	$ -	$ -	$ -	$ -	$ -	$ 100	$ 100
Raw SSO from Municipal Sources ($/year)	$ -	$ -	$ -	$ -	$ -	$ 575,000	$ 1,105,000

APPENDIX G: ESTIMATED FINANCIAL SUMMARY

Project Name: **Georgian Bluffs Source Separated Organics Availability, Digestion Technologies, and Beneficial Use of Biogas Feasibility Study**

Project Identification: GBluffsFeasStudy-ITAG-02-20

GHD Project Number: 11220446

Additional Feedstock	Scenario 0.1	Scenario 1A	Scenario 1B	Scenario 2A	Scenario 2B	Scenario 3A	Scenario 3B
FINANCIALS - ANNUAL OPERATING COSTS	**$ 574,593.00**	**$ 959,455**	**$ 843,663**	**$ 1,141,763**	**$ 957,541**	**$ 2,111,572**	**$ 2,452,941**
Equipment Maintenance Costs	$ 31,277	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Amortization	$ 145,306	$ 175,000	$ 175,000	$ 175,000	$ 175,000	$ 175,000	$ 175,000
Bad dept expense	$ 4,120	$ -	$ -	$ -	$ -	$ -	$ -
Commercial haulage contracts	$ 44,638	$ 44,638	$ 44,638	$ 44,638	$ 44,638	$ 44,638	$ 44,638
Digestate disposal	$ 93,942	$ 219,212	$ 244,281	$ 326,520	$ 358,158	$ 721,329	$ 682,698
Insurance	$ 13,838	$ 13,838	$ 13,838	$ 13,838	$ 13,838	$ 13,838	$ 13,838
Office expenses	$ 53	$ 53	$ 53	$ 53	$ 53	$ 53	$ 53
Operational expenses	$ 4,247	$ 4,247	$ 4,247	$ 4,247	$ 4,247	$ 4,247	$ 4,247
Other services	$ 450	$ 450	$ 450	$ 450	$ 450	$ 450	$ 450
Professional fees	$ 17,662	$ 17,662	$ 17,662	$ 17,662	$ 17,662	$ 17,662	$ 17,662
Repairs and maintenance	$ 23,937	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000
Service contracts	$ 111,009	$ 130,000	$ 130,000	$ 130,000	$ 130,000	$ 130,000	$ 130,000
Utilities	$ 51,184	$ 33,636	$ 33,636	$ 33,636	$ 33,636	$ 33,636	$ 33,636
Electricity Consumed Yearly (kWh/year)	184,805	280,000	280,000	280,000	280,000	1,400,000	1,400,000
Unit Cost of Electricity ($/kWh)	$ 0.095	$ 0.085	$ 0.085	$ 0.085	$ 0.085	$ -	$ -
Annual Electricity Cost ($/year)	$ 17,548	$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 24,000
Natural Gas Cost ($/day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Wages and Benefits	$ 32,930	$ 131,720	$ 65,860	$ 131,720	$ 65,860	$ 131,720	$ 131,720
Operating Cost for New Pre-Processing System + Digester ($/year)	$ -	$ -	$ -	$ -	$ -	$ 575,000	$ 1,105,000
Residue disposal (tonne)	0	0	0	0	0	2,250	2,210
Size of Truck (m3)	0	0	0	0	0	15	15
Number of Trucks Required per day	0	0	0	0	0	0.60	0.59
Transportion Costs ($/km)	$ -	$ -	$ -	$ -	$ -	$ 1.50	$ 1.50
Operating Costs ($/hr)	$ -	$ -	$ -	$ -	$ -	$ 60.00	$ 60.00
Roundtrip Distance from GB to Walkerton Hanover Landfill (km)	0	0	0	0	0	100	100
Roundtrip Driving Time (hours)	0	0	0	0	0	1.5	1.5
Unloading/Loading Time (hours)	0	0	0	0	0	1	1
Transportion Costs ($/day)	$ -	$ -	$ -	$ -	$ -	$ 300	$ 300
Transportion Costs ($/year)	$ -	$ -	$ -	$ -	$ -	$ 9,000	$ 8,840
Additions at ICI Location	**$ -**	**$ 75,000**	**$ -**	**$ 150,000**	**$ -**	**$ 150,000**	**$ -**
Loading Equipment	$ -	$ -	$ -	$ -	$ -	$ -	
Size of Truck (m3)	$ -	30	30	30	30	30	30
Number of Trucks Required per day	$ -	1	2	2	1	2	2
Operating Costs ($/hr)	$ -	$ 75	$ -	$ 75	$ -	$ 75	$ -
Roundtrip Distance from ICI location to BioGRID (km)	$ -	200	$ -	200	$ -	200	$ -
Roundtrip Driving Time (hours)	$ -	3	$ -	3	$ -	3	$ -
Unloading/Loading Time (hours)	$ -	1	$ -	1	$ -	1	$ -
Transportion Costs ($/day)	$ -	$ 300	$ -	$ 600	$ -	$ 600	$ -
Transportion Costs ($/year)	$ -	$ 75,000	$ -	$ 150,000	$ -	$ 150,000	$ -
FINANCIALS - NET ANNUAL COSTS							
OPERATING COSTS							
Year 1	$ (574,593.00)	$ (959,455.11)	$ (843,663.50)	$ (959,455.11)	$ (843,663.50)	$ (959,455.11)	$ (843,663.50)
Year 2	$ (574,593.00)	$ (959,455.11)	$ (843,663.50)	$ (1,141,762.52)	$ (957,540.74)	$ (1,141,762.52)	$ (957,540.74)
Year 3	$ (574,593.00)	$ (959,455.11)	$ (843,663.50)	$ (1,141,762.52)	$ (957,540.74)	$ (1,141,762.52)	$ (957,540.74)
Year 4	$ (574,593.00)	$ (959,455.11)	$ (843,663.50)	$ (1,141,762.52)	$ (957,540.74)	$ (1,141,762.52)	$ (957,540.74)
Year 5	$ (574,593.00)	$ (959,455.11)	$ (843,663.50)	$ (1,141,762.52)	$ (957,540.74)	$ (1,141,762.52)	$ (957,540.74)
Year 6	$ (574,593.00)	$ (959,455.11)	$ (843,663.50)	$ (1,141,762.52)	$ (957,540.74)	$ (1,141,762.52)	$ (957,540.74)
Year 7	$ (574,593.00)	$ (959,455.11)	$ (843,663.50)	$ (1,141,762.52)	$ (957,540.74)	$ (1,141,762.52)	$ (957,540.74)
Year 8	$ (574,593.00)	$ (959,455.11)	$ (843,663.50)	$ (1,141,762.52)	$ (957,540.74)	$ (1,141,762.52)	$ (957,540.74)
Year 9	$ (574,593.00)	$ (959,455.11)	$ (843,663.50)	$ (1,141,762.52)	$ (957,540.74)	$ (1,141,762.52)	$ (957,540.74)
Year 10	$ (519,088.50)	$ (894,455.11)	$ (778,663.50)	$ (1,076,762.52)	$ (892,540.74)	$ (2,111,571.51)	$ (2,452,940.84)
Year 11	$ (519,088.50)	$ (894,455.11)	$ (778,663.50)	$ (1,076,762.52)	$ (892,540.74)	$ (2,111,571.51)	$ (2,452,940.84)
Year 12	$ (519,088.50)	$ (894,455.11)	$ (778,663.50)	$ (1,076,762.52)	$ (892,540.74)	$ (2,111,571.51)	$ (2,452,940.84)
Year 13	$ (519,088.50)	$ (894,455.11)	$ (778,663.50)	$ (1,076,762.52)	$ (892,540.74)	$ (2,111,571.51)	$ (2,452,940.84)
Year 14	$ (519,088.50)	$ (894,455.11)	$ (778,663.50)	$ (1,076,762.52)	$ (892,540.74)	$ (2,111,571.51)	$ (2,452,940.84)
Year 15	$ (519,088.50)	$ (894,455.11)	$ (778,663.50)	$ (1,076,762.52)	$ (892,540.74)	$ (2,111,571.51)	$ (2,452,940.84)
Year 16	$ (519,088.50)	$ (894,455.11)	$ (778,663.50)	$ (1,076,762.52)	$ (892,540.74)	$ (2,111,571.51)	$ (2,452,940.84)
Year 17	$ (519,088.50)	$ (894,455.11)	$ (778,663.50)	$ (1,076,762.52)	$ (892,540.74)	$ (2,111,571.51)	$ (2,452,940.84)
Year 18	$ (519,088.50)	$ (894,455.11)	$ (778,663.50)	$ (1,076,762.52)	$ (892,540.74)	$ (2,111,571.51)	$ (2,452,940.84)
Year 19	$ (519,088.50)	$ (894,455.11)	$ (778,663.50)	$ (1,076,762.52)	$ (892,540.74)	$ (2,111,571.51)	$ (2,452,940.84)
Year 20	$ (392,421.83)	$ (577,788.45)	$ (628,663.50)	$ (743,429.19)	$ (517,540.74)	$ 1,832,628.49	$ 1,282,925.82
Total Value of Project at 20 Year Mark	**$ 126,666.67**	**$ 316,666.67**	**$ 150,000.00**	**$ 333,333.33**	**$ 375,000.00**	**$ 3,944,200.00**	**$ 3,735,866.67**
REVENUE/SAVINGS							
Year 1	$ 228,194.45	$ 333,064.87	$ 584,017.36	$ 333,064.87	$ 584,017.36	$ 333,064.87	$ 584,017.36
Year 2	$ 228,194.45	$ 333,064.87	$ 584,017.36	$ 414,790.73	$ 765,801.25	$ 386,911.02	$ 301,160.22
Year 3	$ 228,194.45	$ 333,064.87	$ 584,017.36	$ 414,790.73	$ 765,801.25	$ 386,911.02	$ 301,160.22
Year 4	$ 228,194.45	$ 333,064.87	$ 584,017.36	$ 414,790.73	$ 765,801.25	$ 386,911.02	$ 301,160.22
Year 5	$ 228,194.45	$ 333,064.87	$ 584,017.36	$ 414,790.73	$ 765,801.25	$ 386,911.02	$ 301,160.22
Year 6	$ 228,194.45	$ 333,064.87	$ 584,017.36	$ 414,790.73	$ 765,801.25	$ 386,911.02	$ 301,160.22
Year 7	$ 228,194.45	$ 333,064.87	$ 584,017.36	$ 414,790.73	$ 765,801.25	$ 386,911.02	$ 301,160.22
Year 8	$ 228,194.45	$ 333,064.87	$ 584,017.36	$ 414,790.73	$ 765,801.25	$ 386,911.02	$ 301,160.22
Year 9	$ 228,194.45	$ 333,064.87	$ 584,017.36	$ 414,790.73	$ 765,801.25	$ 386,911.02	$ 301,160.22
Year 10	$ 162,299.00	$ 193,068.23	$ 445,156.14	$ 434,970.48	$ 626,940.04	$ 900,012.80	$ 1,342,848.34
Year 11	$ 162,299.00	$ 193,068.23	$ 445,156.14	$ 434,970.48	$ 626,940.04	$ 900,012.80	$ 1,342,848.34
Year 12	$ 162,299.00	$ 193,068.23	$ 445,156.14	$ 434,970.48	$ 626,940.04	$ 900,012.80	$ 1,342,848.34
Year 13	$ 162,299.00	$ 193,068.23	$ 445,156.14	$ 434,970.48	$ 626,940.04	$ 900,012.80	$ 1,342,848.34
Year 14	$ 162,299.00	$ 193,068.23	$ 445,156.14	$ 434,970.48	$ 626,940.04	$ 900,012.80	$ 1,342,848.34
Year 15	$ 162,299.00	$ 193,068.23	$ 445,156.14	$ 434,970.48	$ 626,940.04	$ 900,012.80	$ 1,342,848.34
Year 16	$ 162,299.00	$ 193,068.23	$ 445,156.14	$ 434,970.48	$ 626,940.04	$ 900,012.80	$ 1,342,848.34
Year 17	$ 162,299.00	$ 193,068.23	$ 445,156.14	$ 434,970.48	$ 626,940.04	$ 900,012.80	$ 1,342,848.34
Year 18	$ 162,299.00	$ 193,068.23	$ 445,156.14	$ 434,970.48	$ 626,940.04	$ 900,012.80	$ 1,342,848.34
Year 19	$ 162,299.00	$ 193,068.23	$ 445,156.14	$ 434,970.48	$ 626,940.04	$ 900,012.80	$ 1,342,848.34
Year 20	$ 162,299.00	$ 193,068.23	$ 445,156.14	$ 434,970.48	$ 626,940.04	$ 900,012.80	$ 1,342,848.34

APPENDIX G: ESTIMATED FINANCIAL SUMMARY

Project Name:	**Georgian Bluffs Source Separated Organics Availability, Digestion Technologies, and Beneficial Use of Biogas Feasibility Study**
Project Identification:	GBluffsFeasStudy-ITAG-02-20
GHD Project Number:	11220446

Additional Feedstock	Scenario 0.1	Scenario 1A	Scenario 1B	Scenario 2A	Scenario 2B	Scenario 3A	Scenario 3B
NET ANNUAL COSTS							
Year 1	$ (346,398.55)	$ (626,390.24)	$ (259,646.13)	$ (626,390.24)	$ (259,646.13)	$ (626,390.24)	$ (259,646.13)
Year 2	$ (346,398.55)	$ (626,390.24)	$ (259,646.13)	$ (726,971.78)	$ (191,739.49)	$ (754,851.50)	$ (656,380.53)
Year 3	$ (346,398.55)	$ (626,390.24)	$ (259,646.13)	$ (726,971.78)	$ (191,739.49)	$ (754,851.50)	$ (656,380.53)
Year 4	$ (346,398.55)	$ (626,390.24)	$ (259,646.13)	$ (726,971.78)	$ (191,739.49)	$ (754,851.50)	$ (656,380.53)
Year 5	$ (346,398.55)	$ (626,390.24)	$ (259,646.13)	$ (726,971.78)	$ (191,739.49)	$ (754,851.50)	$ (656,380.53)
Year 6	$ (346,398.55)	$ (626,390.24)	$ (259,646.13)	$ (726,971.78)	$ (191,739.49)	$ (754,851.50)	$ (656,380.53)
Year 7	$ (346,398.55)	$ (626,390.24)	$ (259,646.13)	$ (726,971.78)	$ (191,739.49)	$ (754,851.50)	$ (656,380.53)
Year 8	$ (346,398.55)	$ (626,390.24)	$ (259,646.13)	$ (726,971.78)	$ (191,739.49)	$ (754,851.50)	$ (656,380.53)
Year 9	$ (346,398.55)	$ (626,390.24)	$ (259,646.13)	$ (726,971.78)	$ (191,739.49)	$ (754,851.50)	$ (656,380.53)
Year 10	$ (356,789.50)	$ (701,386.88)	$ (333,507.35)	$ (641,792.04)	$ (265,600.71)	$ (1,211,558.71)	$ (1,110,092.51)
Year 11	$ (356,789.50)	$ (701,386.88)	$ (333,507.35)	$ (641,792.04)	$ (265,600.71)	$ (1,211,558.71)	$ (1,110,092.51)
Year 12	$ (356,789.50)	$ (701,386.88)	$ (333,507.35)	$ (641,792.04)	$ (265,600.71)	$ (1,211,558.71)	$ (1,110,092.51)
Year 13	$ (356,789.50)	$ (701,386.88)	$ (333,507.35)	$ (641,792.04)	$ (265,600.71)	$ (1,211,558.71)	$ (1,110,092.51)
Year 14	$ (356,789.50)	$ (701,386.88)	$ (333,507.35)	$ (641,792.04)	$ (265,600.71)	$ (1,211,558.71)	$ (1,110,092.51)
Year 15	$ (356,789.50)	$ (701,386.88)	$ (333,507.35)	$ (641,792.04)	$ (265,600.71)	$ (1,211,558.71)	$ (1,110,092.51)
Year 16	$ (356,789.50)	$ (701,386.88)	$ (333,507.35)	$ (641,792.04)	$ (265,600.71)	$ (1,211,558.71)	$ (1,110,092.51)
Year 17	$ (356,789.50)	$ (701,386.88)	$ (333,507.35)	$ (641,792.04)	$ (265,600.71)	$ (1,211,558.71)	$ (1,110,092.51)
Year 18	$ (356,789.50)	$ (701,386.88)	$ (333,507.35)	$ (641,792.04)	$ (265,600.71)	$ (1,211,558.71)	$ (1,110,092.51)
Year 19	$ (356,789.50)	$ (701,386.88)	$ (333,507.35)	$ (641,792.04)	$ (265,600.71)	$ (1,211,558.71)	$ (1,110,092.51)
Year 20	$ (356,789.50)	$ (701,386.88)	$ (333,507.35)	$ (641,792.04)	$ (265,600.71)	$ (1,211,558.71)	$ (1,110,092.51)
NET PRESENT VALUE	**($5,074,972.58)**	**($10,850,907)**	**($4,997,239)**	**($11,089,623)**	**($4,759,034)**	**($30,637,711)**	**($28,335,091)**
GHG EMISSIONS CALCULATIONS	**11.92**	**66**	**26**	**1,654**	**863**	**9,489**	**9,257**
Feedstock							
LFG collection efficiency at Landfill	70%	100%	70%	70%	70%	70%	70%
GHG potential of food waste in landfill (tonnes CO2e/tonne waste)	1.93	1.93	1.93	1.93	1.93	1.93	1.93
Composting Process CH4 Generated (kg/tonne waste)	4	4	4	4	4	4	4
Composting Process CH4 Generated (kgCO2e/ tonne waste)	100	100	100	100	100	100	100
Composting Process N2O Generated (kg/tonne waste)	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Composting Process N2O Generated (kgCO2e/ tonne waste)	72	72	72	72	72	72	72
Composting Process Total Non-CO2 Emissions (kgCO2e/ tonne	172	172	172	172	172	172	172
AD Process Total Non-CO2 Emissions (kg/tonne waste)	0.8	0.8	0.8	0.8	0.8	0.8	0.8
AD Process Total Non-CO2 Emissions (kgCO2e/ tonne waste)	20	20	20	20	20	20	20
% Reduction via AD Process	88%	88%	88%	88%	88%	88%	88%
Tonnes of Waste	0	2,000	3,300	5,500	5,300	11,250	11,050
Tonnes of Residue	0	0	0	0	0	2,250	2,210
Waste Diverted	0	2,000	0	5,500	5,300	9,000	8,840
GHG Emissions Potential (if landfilled or composted)	0	344	0	946	912	17,370	17,061
Captured and Destroyed at Landfill or AD Facility	0	304	0	836	638	12,159	11,943
GHG Reduction (tonnes CO2e/yr)	0	40	0	110	273	5,211	5,118
Biogas Usage - Electrical CHP							
CHP output (m3 biogas per kWh)	0.45	0.45	0.45	0.45	0.45	0.45	0.45
1 MWh = 3,600 MJ	3,600	3,600	3,600	3,600	3,600	3,600	3,600
Electrical Consumption Intensity (gCO2e / kWh3)	30	30	30	30	30	30	30
Electrical Consumption Intensity (gCO2e / MJ)	8.33	8.33	8.33	8.33	8.33	8.33	8.33
Biogas (m3/yr)	178,848	395,122	391,918	395,122	391,918	395,122	391,918
Electrical Output (kWh)	397,439	878,049	870,928	878,049	870,928	878,049	870,928
Electrical Output (MJ)	1,430,781.7500	3,160,976.9507	3,135,340.3586	3,160,976.9507	3,135,340.3586	3,160,976.9507	3,135,340.3586
GHG Emissions Offset (t CO2e/yr)	11.9	26.3	26.1	26.3	26.1	26.3	26.1
Biogas Usage - Renewable Natural Gas to Neighbour							
Emission factor for natural gas (g CO2e/MJ energy delivered)	122.231	122.231	122.231	122.231	122.231	122.231	122.231
Biogas (m3/yr)	0	0	0	545,889	202,759	1,529,178	1,479,266
CH4 Content in Biogas	58%	58%	58%	58%	58%	58%	58%
NG Equivelant (m3/yr)	0	0	0	316,615	117,600	886,923	857,975
1GJ = 25.5 m3 NG	25.5	25.5	25.5	25.5	25.5	25.5	25.5
NG Output (MJ)	0	0	0	12,416,290	4,611,765	34,781,296	33,646,059
GHG Emissions Offset (t CO2e/yr)	0	0	0	1,518	564	4,251	4,113
Total Trucks to Site	**1.26**	**3.93**	**5.27**	**6.37**	**5.79**	**12.25**	**11.72**
Feedstock	0.00	1.00	2.00	2.00	1.00	2.00	2.00
Digestate	1.26	2.93	3.27	4.37	4.79	9.65	9.14
Residue	0.00	0.00	0.00	0.00	0.00	0.60	0.59

Appendix H

Footprint and Indicative Placement Site Plan Figures

Paper Size ANSI A

0 25 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 17N

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ONTARIO CLEAN WATER AGENCY GEORGIAN BLUFFS SOURCE SEPARATED ORGANICS AVAILABILITY, DIGESTION TECHNOLOGIES, AND BENEFICIAL USE OF BIOGAS FEASIBILITY STUDY
62111 SIDE ROAD 3 OWEN SOUND, ONTARIO

SCENARIOS 1A - ADDED INFRASTRUCTURE ESTIMATED FOOTPRINTS AND INDICATIVE PLACEMENT

Project No. **11220446**
Revision No. **-**
Date **Apr 15, 2021**

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Print date: 15 Apr 2021 - 16:55

Data source: Google Earth Imagery, Date: 06/2019

Paper Size ANSI A

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 17N

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ONTARIO CLEAN WATER AGENCY GEORGIAN BLUFFS SOURCE SEPARATED ORGANICS AVAILABILITY, DIGESTION TECHNOLOGIES, AND BENEFICIAL USE OF BIOGAS FEASIBILITY STUDY
62111 SIDE ROAD 3 OWEN SOUND, ONTARIO

SCENARIOS 1B - ADDED INFRASTRUCTURE ESTIMATED FOOTPRINTS AND INDICATIVE PLACEMENT

Project No. **11220446**
Revision No. **-**
Date **Jun 23, 2021**

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Print date: 23 Jun 2021 - 14:36

Data source: Google Earth Imagery, Date: 06/2019

Paper Size ANSI A

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 17N

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ONTARIO CLEAN WATER AGENCY GEORGIAN BLUFFS SOURCE SEPARATED ORGANICS AVAILABILITY, DIGESTION TECHNOLOGIES, AND BENEFICIAL USE OF BIOGAS FEASIBILITY STUDY
62111 SIDE ROAD 3 OWEN SOUND, ONTARIO

SCENARIOS 2A - ADDED INFRASTRUCTURE ESTIMATED FOOTPRINTS AND INDICATIVE PLACEMENT

Project No. **11220446**
Revision No. **-**
Date **Jun 23, 2021**

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Data source: Google Earth Imagery, Date: 06/2019

Paper Size ANSI A

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 17N

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ONTARIO CLEAN WATER AGENCY GEORGIAN BLUFFS SOURCE SEPARATED ORGANICS AVAILABILITY, DIGESTION TECHNOLOGIES, AND BENEFICIAL USE OF BIOGAS FEASIBILITY STUDY
62111 SIDE ROAD 3 OWEN SOUND, ONTARIO

SCENARIOS 2B - ADDED INFRASTRUCTURE ESTIMATED FOOTPRINTS AND INDICATIVE PLACEMENT

Project No. **11220446**
Revision No. **-**
Date **Jun 23, 2021**

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Data source: Google Earth Imagery, Date: 06/2019

Paper Size ANSI A

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 17N

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ONTARIO CLEAN WATER AGENCY GEORGIAN BLUFFS
SOURCE SEPARATED ORGANICS AVAILABILITY, DIGESTION TECHNOLOGIES, AND BENEFICIAL USE OF BIOGAS FEASIBILITY STUDY
62111 SIDE ROAD 3 OWEN SOUND, ONTARIO

SCENARIOS 3A - ADDED INFRASTRUCTURE ESTIMATED FOOTPRINTS AND INDICATIVE PLACEMENT

Project No. 11220446
Revision No. -
Date Jun 23, 2021

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Paper Size ANSI A

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 17N

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SOURCE SEPARATED ORGANICS AVAILABILITY, DIGESTION TECHNOLOGIES, AND BENEFICIAL USE OF BIOGAS FEASIBILITY STUDY
62111 SIDE ROAD 3 OWEN SOUND, ONTARIO

SCENARIOS 3B - ADDED INFRASTRUCTURE ESTIMATED FOOTPRINTS AND INDICATIVE PLACEMENT

Project No. **11220446**
Revision No. **-**
Date **Jun 23, 2021**

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