Options Assessment Report for the High Solids Anaerobic Digestion Facility

City of Edmonton

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Executive Summary

Overview and Purpose

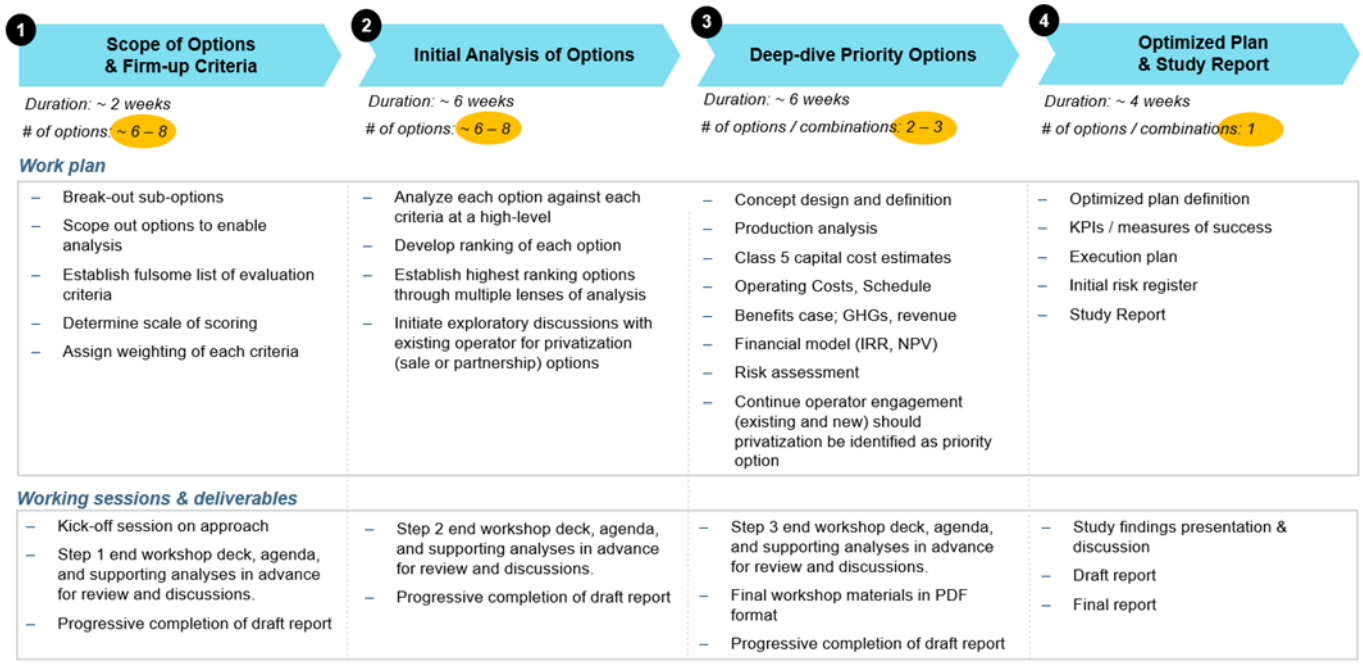
GHD Limited (GHD) was hired by the City of Edmonton (City) to assess options for the City's High Solids Anaerobic Digestor Facility (HSADF). The HSADF is not functioning as intended and has gone through a series of prolonged commissioning phases. A combination of technical challenges has limited feedstock throughput and led to difficulties with regulatory compliance, operating costs, and accelerated degradation of facility infrastructure due to off-spec biogas. GHD was asked to assess the viability of various organics management and processing options to determine the optimal role of the HSADF moving forward.

Methodology

The methodology to complete this assignment was based on the following vision and problem statements developed with the City during a Visioning Workshop held in November 2023:

- **Vision Statement:** Process 120,000 tonnes per year of organics by 2027, in a way that is cost effective, operationally resilient and meets environmental goals
- **Problem Statement:** What is the optimal role of the existing HSADF in meeting the City's overall organics management goals?

Following the Workshop, GHD proposed a four-step approach to answer the Problem Statement, summarized in the Figure below.



Following completion of Step 2, it was agreed that additional analysis of the options was not necessary.

Options

Six initial options were developed during the Visioning Workshop which were then later refined to ten options in Step 1. Following a Working Session during Step 2, a total of 14 options were developed and agreed upon. The

purpose of the additional options was to capture a holistic view of the options the City has to manage the tonnage that was originally planned to be processed at the HSDAF. The fourteen options are summarized in the following table:

Options			Definition
1	Capital Improvements		City makes capital improvements to the HSADF.
2	Privatize		City owns the HSADF, but a third-party contractor makes upgrades and operates the HSADF.
3	Decom.	Repurpose - New Facility	HSADF is decommissioned and the building is repurposed. A new facility is constructed to manage organic waste.
4		Repurpose - Third-Party Processing	HSADF is decommissioned and the building is repurposed. Organic waste is hauled to third-party processing facilities.
5		Repurpose - New Facility/Third-Party Processing	50/50 combination of Options 3 and 4.
6		Full Decommission - New Facility	HSADF is decommissioned and a new facility is constructed to manage organic waste.
7		Full Decommission - Third-Party Processing	HSADF is decommissioned and organic waste is hauled to third-party processing facilities.
8		Full Decommission - New Facility/Third-Party Processing	50/50 combination of Options 6 and 7.
9	Run to Failure	Repurpose – New Facility	The HSADF runs to failure and is then decommissioned (building is repurposed). A new facility is constructed to manage organic waste.
10		Repurpose – Third Party Processing	The HSADF runs to failure and then is decommissioned (building is repurposed). Organic waste is hauled to third-party processing facilities.
11		Repurpose – New Facility/Third-Party Processing	50/50 combination of Options 9 and 10.
12		Full Decommission – New Facility	The HSADF runs to failure and is then decommissioned. A new facility is constructed to manage organic waste.
13		Full Decommission – Third-Party Processing	The HSADF runs to failure and is then decommissioned. Organic waste is hauled to third-party processing facilities.
14		Full Decommission – New Facility/Third-Party Processing	50/50 combination of Options 12 and 13.

Assessment and Results

The fourteen options were assessed against several qualitative and quantitative criteria. Following an initial analysis of the fourteen options, three were consistently shortlisted through non-weighted, weighted, and scatter plot assessments. The three preferred options are summarized in the table below.

Option ID	Option	Definition	Rank
Option 5	Decom-Repurpose-New facility/Third party	The Facility is fully decommissioned and removed from site except for the shell and foundations of the facility. The shell is repurposed (as a bay for receiving, storage, mixing and transfer) and the City builds a new organics processing facility to manage 50% of organic waste. The City hauls the remaining 50% of organic waste to third-party processing facilities.	Non-weighted scoring model: 1 50/50 Weighted scoring model: 1 Scatter Plot Ranking: 1 or 2
Option 7	Decom - Third party	The Facility is fully decommissioned and removed from site. The City hauls all organic waste to third-party processing facilities.	Non-weighted scoring model: 3 50/50 Weighted scoring model: 3 Scatter Plot Ranking: 3

Option ID	Option	Definition	Rank
Option 8	Decom-New facility/Third-party	The Facility is fully decommissioned. The City builds a new organics processing facility. The City processes ~50% (23,000 tonnes) of material at the new facility and hauls the remaining 50% of organic waste to third-party processing facilities.	Non-weighted scoring model: 2 50/50 Weighted scoring model: 2 Scatter Plot Ranking: 1 or 2

Option 5 (Repurpose – New Facility and Third-Party Processing) produced the highest score and was the most preferred option, for unweighted and weighted models. The scatter plot, which is used to show the relationship between the financial criteria (capital and operational costs) and qualitative criteria, also resulted in Option 5 as one of the preferred options. In addition to being one of the most cost-effective solutions, the high score was also driven by satisfying the qualitative criteria including timeframe, strategic objectives, ease of implementation, and ability to accommodate program changes.

Option 8 (Full Decommission – New Facility and Third-Party Processing) was the second-best choice in all three models. Like Option 5, both quantitative and qualitative criteria received high scores, with the second-place ranking attributed to higher capital and operation and maintenance costs.

The scatter plot illustrated that Options 4, 5, 6, 7 and 8 are all viable options for the City. Options 5 and 8 best satisfy the qualitative criteria while being cost competitive compared to the remaining options.

A sensitivity analysis was conducted to understand if changing the evaluation criteria and project lifecycle would impact the rankings. The results of these analyses confirmed that Options 5, 7, and 8 were the top-ranking options.

Conclusions

It was determined that the results of Step 2 were conclusive and conducting a "deep dive analysis" in Step 3 would not alter the outcome of the Study. The results of the Study can be summarized as follows:

– Options 5, 7 and 8 are the most viable options
– Repurposing the shell of the HSADF provides the City with operational flexibility
– Third-party processors may not guarantee the required capacity to meet City overall tonnage needs.
– Long-term outdoor processing of organics at the quantities generated by the City can lead to increased odour and land capacity limitations.
– The City’s objective of processing 120,000 tpy of organic waste by Q1 2027 may not be attainable.
– At the time of the report, there is insufficient information available to draw substantial conclusions regarding the viability of privatization. This option should be reviewed as additional information is made available to the City.

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1. Introduction

GHD Limited (GHD) was retained by the City of Edmonton (the 'City') to prepare an options assessment (Study) of the High Solids Anaerobic Digestor Facility (HSADF) located in the North-East area of the City of Edmonton, at the Edmonton Waste Management Centre (EWMC), 250 Aurum Road NE, Site 500, Edmonton, Alberta.

The HSADF is not functioning as intended and has gone through a series of prolonged commissioning phases. A combination of technical challenges has limited feedstock throughput and led to difficulties with regulatory compliance, operating costs, and accelerated degradation of facility infrastructure due to off-spec biogas. As such, the City has asked for an options assessment to provide a path forward for the HSADF, intended to support the goals and objectives of the City's Organics Management Program (Program). The HSADF was designed to handle 40,000 tonnes of material annually.

1.1 Project Background

On November 16, 2023, a Visioning Workshop was held for internal engagement with Waste Services and IIS (Integrated Infrastructure Services) of the City to establish evaluation criteria and a shortlist of options for the HSADF. Based on input provided during the workshop, the following statement was proposed as a vision statement to articulate how success is defined with respect to the overall organics management program:

– **Draft vision statement:** Process 120,000 tonnes per year (tpy) of organics by 2027, in a way that is cost effective, operationally resilient and meets environmental goals.

GHD developed the following draft problem/opportunity statement to articulate the challenge that needs to be addressed by the City within the context of the overall organics management program:

– **Draft problem/opportunity statement:** What is the optimal role of the existing HSADF in meeting the City's overall organics management goals?

It was understood that the options assessment for the HSADF must be considered in the context of supporting the Program goals and objectives. For the purpose of this Study, the total capacity considered is 40,000 tpy. At the completion of the workshop, a total of six (6) options for the HSADF and corresponding evaluation criteria were agreed upon.

1.2 Methodology

Following the Visioning Workshop, GHD proposed a structured framework and methodology, as per Figure 1.1, to align with the City's draft vision and problem/opportunity statements and to provide the City with a path forward for the HSADF. The structured framework was designed to provide the City with an initial analysis of the options and quickly eliminate non-feasible options, followed by a deep-dive analysis of priority or viable options and a progressively clearer path forward.

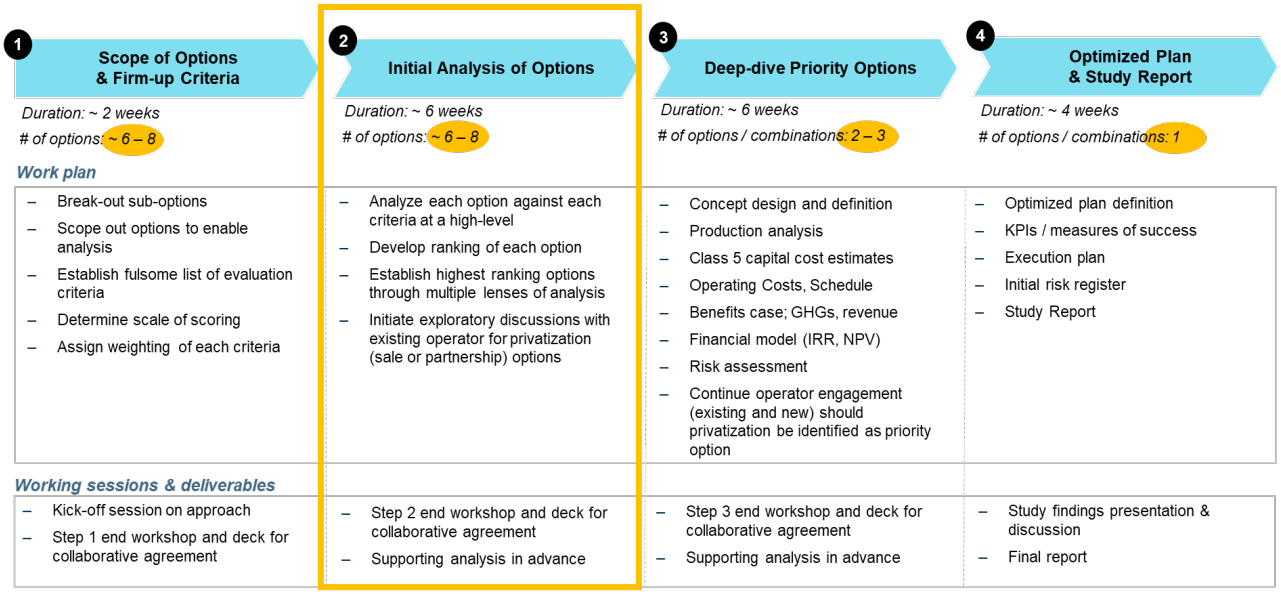

Figure 1.1 Structured Framework and Methodology and Current Stage of Study

Step 1: Scope of Options & Firm up Criteria

The objective of Step 1 of the structured framework and methodology was to break out sub-options, if any, and firm up the definitions of the options and evaluation criteria to inform the remainder of this Study. During Step 1, it was determined that there are a total of 10 complete options that provide a holistic understanding of potential pathways for the HSADF in lieu of the initial 6 options that were agreed upon. The 10 options proposed were based off two primary paths: a) keep the facility or b) remove the facility. These primary paths were further broken down into clear sub-options as discussed in Section 2.1.

Step 2: Initial Analysis of Options – *Current Stage*

Following completion of Step 1, the options and evaluation criteria considered in this Study were further refined in Step 2 where a quantitative and qualitative analysis was conducted based on the available information. Each option was then analyzed against the evaluation criteria using a combination of scoring and weighting models and a sensitivity analysis, resulting in an immediate elimination of “unattractive” or non-feasible options and a clear demonstration of options that are most viable for the City, based on currently available information.

The Study as presented herein, is reflective of the analysis completed to date. Following the Step 2 Working Session, it was determined that the options analysis conducted in Step 2 was essentially a “deep dive” of the information available. It was agreed that proceeding with Step 3 – Deep-dive Priority Options would not add significant insight to the City that was not already determined in Step 2.

The following sections are included in this Study to provide further context

– Summary of results from Step 2 and rationale for not proceeding with Step 3: Deep-dive Priority Options
– Risks associated with the each of the top-ranking options
– Potential next steps for the City including considerations for repurposing the HSADF area

1.3 Purpose of this Report

The overall objective of this Study is to evaluate options using the established criteria and produce a final report that provides the City with a roadmap forward for the HSADF in supporting the Program goals.

1.4 Scope and Limitations

The scope of this Study comprises a multiphase approach to define and evaluate options for the HSADF and to provide a possible path forward. A high-level review of existing data and studies was completed to develop a detailed understanding of the options proposed for the HSADF. The initial review considered the following attributes:

- Capital (CAPEX) and operation and maintenance (OPEX) costs
- Processing throughput and waste redirection to third party processors is limited to a 40,000 tpy throughput for the purpose of this study
- Reputation and technical risk
- Ease of implementation
- Timeframe
- Accommodation to program changes
- Regulatory compliance
- Greenhouse Gas Emissions
- Alignment with strategic objectives

This report has been prepared by GHD for the City of Edmonton and may only be used and relied on by the City of Edmonton for the purpose agreed between GHD and the City of Edmonton as set out in section 1.3 of this report. GHD otherwise disclaims responsibility to any person other than the City of Edmonton arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible. The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

2. Options & Criteria Evaluation

2.1 Description of Options

The initial analysis included documenting the inclusions and exclusions that would be considered in the next stages of the analysis.

The 10 options were then further refined and developed following the Step 2 Working Session held with the City, to include a total of 14 options that would support the City's overall program. Additional options were included to reflect the City's preference to process 50% of organic waste on site and haul the remaining 50% to third-party processors. The 14 options and corresponding pathways are described in Table 2.1 below.

In addition to generating a list of strategic options, the following considerations were identified and agreed upon with the City during the Visioning Workshop:

- Options should align with the City's overall objectives, including replacing the processing capacity of the HSADF (40,000 tpy);
- Options must be cost effective, operationally resilient, and meet environmental goals, including but not limited to compliance with regulatory requirements for emissions.
- Options must ensure that the technology matches the feedstock and must consider how the feedstock changes;
- Options should consider the City's aim to process 50% of organics on-site vs. off-site
- Options should ensure value for money as a key consideration; and
- Each option should consider the current policy direction and plan for potential changes to regulatory direction.

Table 2.1 Summary of Options and Definitions

Option ID	Options		Definition
1	Capital Improvements		The City completes capital improvements necessary for the HSADF to function as intended. Capital improvements are limited to the ammonia scrubber, H2S scrubber, biofilter and/or percolate lines.
2	Privatize		HSADF remains under City ownership but a third-party makes the necessary capital upgrades. In this option the City would provide long-term tonnage commitment at an agreed rate.
3	Decommission	Repurpose – New Facility	The HSADF is decommissioned but the shell is repurposed. The City builds a new facility in place to manage organic waste.
4		Repurpose – Third-Party Processing	The HSADF is decommissioned but the shell is repurposed. The City hauls organic waste to third-party processing facilities.
5		Repurpose – New Facility and Third-Party Processing	The HSADF is decommissioned but the shell is repurposed. The City builds a new facility to manage 50% of organic waste. The City hauls the remaining 50% of organic waste to third-party processing facilities.
6		Full Decommission – New Facility	The HSADF is decommissioned and is removed from site. The City builds a new facility to manage 40,000 tonnes of City organic waste.
7		Full Decommission – Third Party Processing	The HSADF is fully decommissioned and removed from site. The City hauls all organic waste to third-party processing facilities.
8		Full Decommission – New Facility and Third-Party Processing	The HSADF is fully decommissioned and removed from site. The City builds a new facility to manage 50% of organic waste. The City hauls the remaining 50% of organic waste to third-party processing facilities.
9	Run to Failure	Repurpose – New Facility	The HSADF runs to failure until it is non-functioning, and no major upgrades are during this time. Following failure, the HSADF is decommissioned but the shell is repurposed. The City builds a new organics processing facility to manage 40,000 tonnes of City organic waste.
10		Repurpose – Third Party Processing	The HSADF runs to failure until it is non-functioning, and no major upgrades are made during this time. Following failure, the HSADF is decommissioned but the shell is repurposed. The City hauls organic waste to third-party processing facilities.
11		Repurpose – New Facility and Third-Party Processing	The HSADF runs to failure until it is non-functioning, and no major upgrades are during this time. Following failure, the HSADF is decommissioned but the shell is repurposed. The City builds a new organics processing facility to manage 50% of organic waste. The City hauls the remaining 50% of organic waste to third-party processing facilities
12		Full Decommission – New Facility	The HSADF runs to failure until it is non-functioning. No major upgrades are made during this time. Following failure, the HSADF is decommissioned and removed from site. The City builds a new organics processing facility to manage 40,000 tonnes of City organic waste.
13		Full Decommission – Third Party Processing	The HSADF runs to failure until it is non-functioning, and no major upgrades are during this time. Following failure, the HSADF is decommissioned and removed from site. The City hauls all organic waste to third-party processing facilities.
14		Full Decommission – New Facility and Third-Party Processing	The HSADF runs to failure until it is non-functioning. No major upgrades are made during this time. Following failure, the HSADF is decommissioned and removed from site. The City builds a new organics processing facility to manage 50% of organic waste. The City hauls the remaining 50% of organic waste to third-party processing facilities.

2.2 Detailed Options Development

Each option is defined below. There are two primary paths that the City can pursue with the HSADF:

– Keep the HSADF; or
– Remove the HSADF.

Both of these paths have several options. Each one of these options assumes that the HSADF would operate “as-is” with a contractor primarily operating the HSADF until an alternative option is implemented in 2027.

2.2.1 Keep the HSADF

In this case the City chooses to keep the HSADF and therefore decommissioning is not considered.

Figure 2.1 provides a graphic overview of these options, with inclusions and exclusions clearly defined for each option.

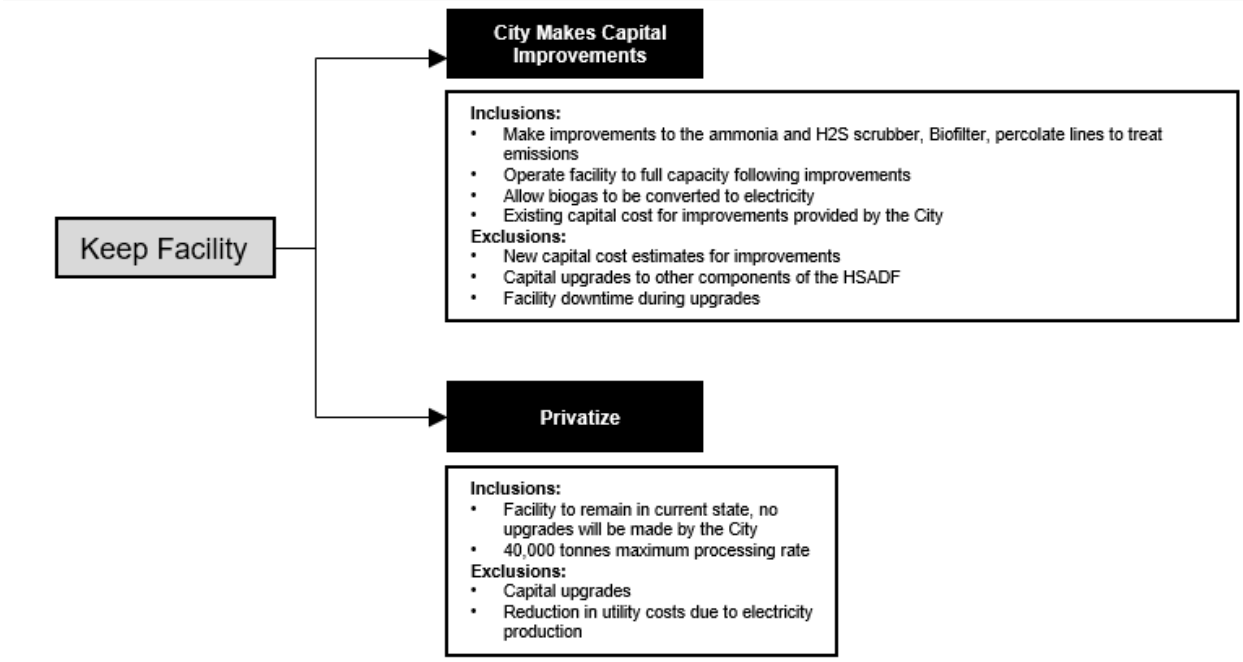

Figure 2.1 Keep HSADF Pathways

2.2.1.1 Option 1: Capital Improvements

In this first option, the HSADF would operate in its current state until the City makes capital improvements. The capital improvements will allow the HSADF to operate as intended at a design capacity of 40,000 tpy of organic waste. For the purpose of this Study, HSADF upgrades are limited to addressing the major issues currently experienced by the HSADF and previously discussed with the City. This includes replacing the ammonia and H2S scrubber, biofilter, and percolate lines to address the regulatory non-compliance which currently limits throughput to approximately 11,000 tpy. The capital improvements will allow the HSADF to convert the biogas produced to electricity to support operations on Site, a process which is currently limited due to the off-spec biogas produced.

It is expected that the capital improvements will allow the HSADF to operate at design capacity for up to 10-years, assuming that other components of the HSADF not receiving improvements will “fail” and reach the end of their lifecycle, resulting in a non-functioning HSADF. At this time the City would pursue third-party processing until other options are implemented.

2.2.1.2 Option 2: Privatize the HSADF

In Option 2, privatizing the HSADF would allow the City to maintain ownership of the HSADF while retaining a private third-party company to take control of the HSADF. The third-party would manage operations and maintenance, as well as make capital upgrades, as needed, to operate the HSADF at a design capacity of 40,000 tpy. Since the third-party company would take on all risks associated with the HSADF, any profit or environmental attributes generated through carbon credits and greenhouse gas emissions reductions would belong to the third-party company. This option assumes that the City would enter into a contract with the third-party operator and mutually agree on a tipping fee per tonne that takes into account operations, costs associated with capital improvements, profit, and risk assumed by the third-party.

Option 2 was evaluated based on the information provided to GHD at the time of this report. However, it should be noted that if the City receives additional commercial information, the viability of this option may change.

2.2.2 Remove the HSADF

If the City chooses to remove the HSADF, they can either decommission the HSADF now or allow the HSADF to operate “as-is” until it runs to failure.

Figures 2.2 and 2.3 provide a graphic overview of the options for this pathway, with inclusions and exclusions clearly defined for each option.

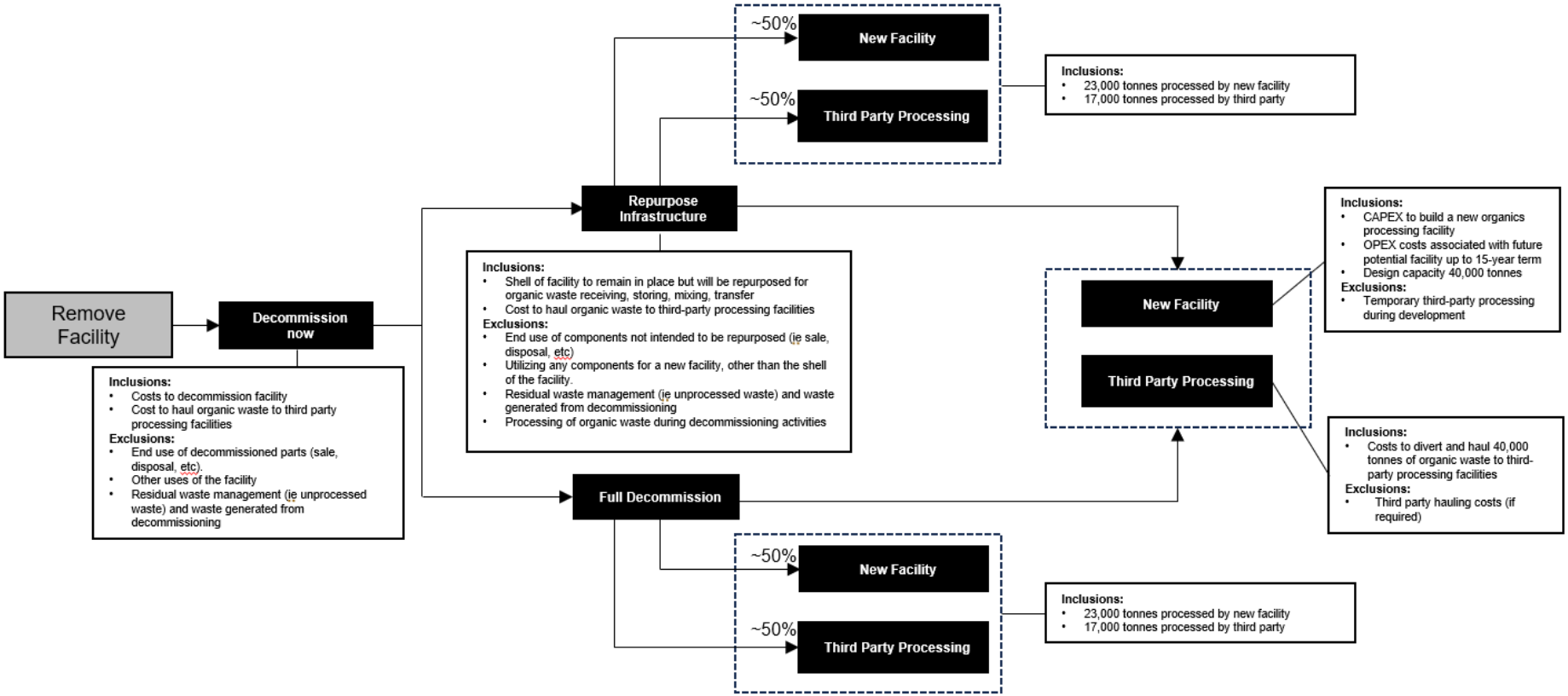

Figure 2.2 HSADF Removal Pathways – Decommission Now

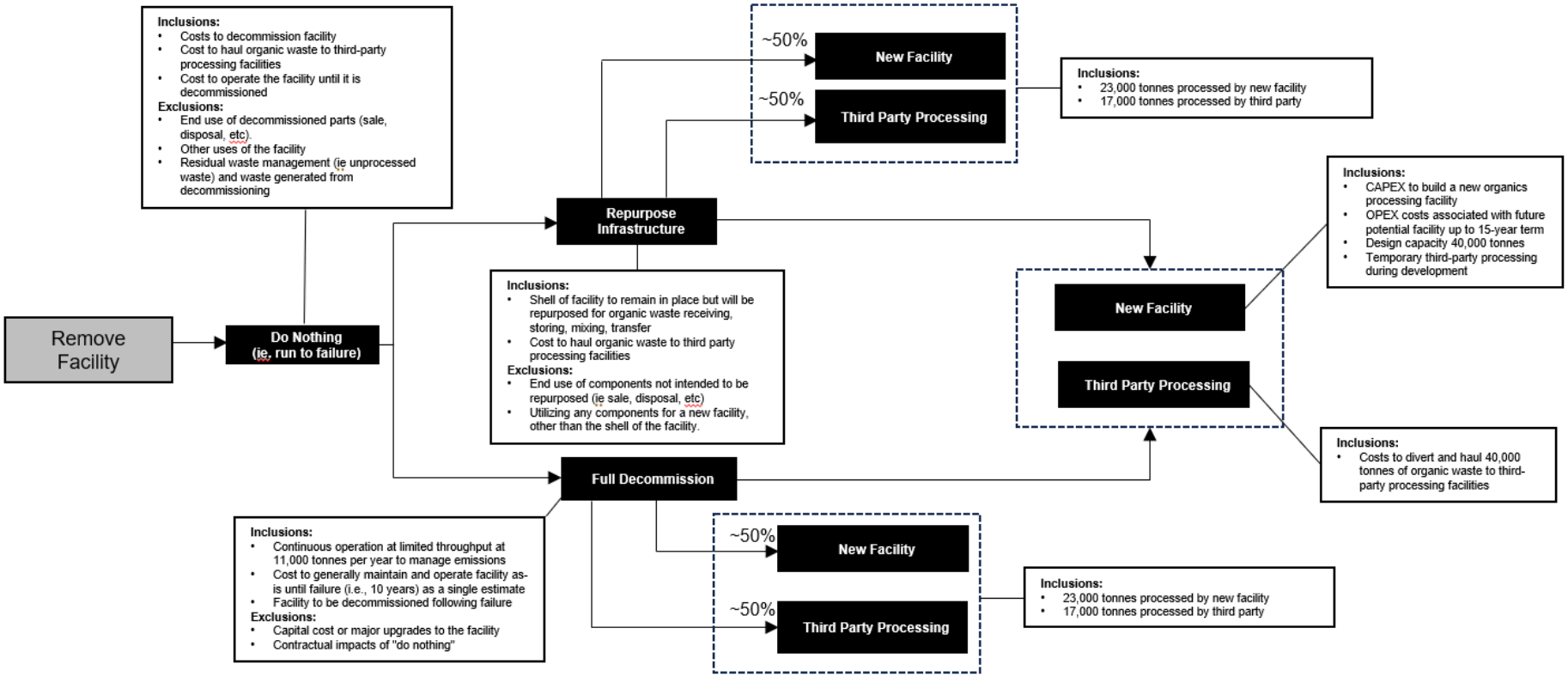

Figure 2.3 HSADF Removal Pathways – Run to Failure

2.2.2.1 Option 3: Full Decommission – Repurpose – New Facility

Under this option, the HSADF would be decommissioned almost immediately. All infrastructure and equipment associated with the HSADF, except for the shell, would be removed from the site. The remaining shell would be retrofitted for use as a receiving or storage and mixing bay, or as a transfer station. The City will build a new organics processing facility, using an aerated static pile (ASP) system to manage 40,000 tonnes of the 120,000 tonnes of organic waste expected to be collected from single-family and multi-family homes through the curbside collection program. As part of this option, the City would purchase waste separation equipment, such as a de-packager, along with supporting infrastructure for storage and operation. The de-packager will enable the City to efficiently separate organic material from non-organic material, facilitating an efficient composting process. It is assumed that no third-party processing will be required at any time during the 15-year lifecycle of this option.

2.2.2.2 Option 4: Full Decommission – Repurpose – Third-Party Processing

Similar to Option 3, this option assumes the HSADF will be decommissioned, with all infrastructure and equipment removed from the site, except for the shell. The shell may be repurposed for use as a receiving, storage, mixing bay, or transfer station. Organic waste collected through the curbside bin program will continue to be sorted at the EWMC but will be hauled to third-party processors as needed to manage the increasing volume of waste. It is assumed that approximately 40,000 tpy will be hauled to these third-party processors. This option does not account for additional haul trucks required for transporting waste to third-party processors and assumes that the City will handle the hauling internally, as discussed with the City.

2.2.2.3 Option 5: Full Decommission – Repurpose – New Facility and Third-Party Processing

Option 5 combines elements of Options 3 and 4. The HSADF will be decommissioned, with all infrastructure and equipment removed, except for the shell, which may be repurposed for other uses. The City will then build a new organics processing facility utilizing an ASP system to manage 23,000 tpy of organic waste. The remaining 17,000 tpy of organic waste will be hauled to third-party processors. This option does not account for additional haul trucks needed for transporting waste to third-party processors, assuming that the City will handle the hauling internally.

2.2.2.4 Option 6: Full Decommission – New Facility

In this option, the HSADF would be decommissioned, with all associated infrastructure and equipment removed from the site. The area previously occupied by the HSADF would be repurposed for a new organics processing facility, similar to the one described in Option 3. The new facility is assumed to have a design capacity of 40,000 tpy of organic waste for the purposes of this study. Additionally, the City would invest in constructing a new building to house an appropriately sized de-packager system, which will effectively separate organic waste from plastic waste. This building would serve as a receiving bay, as well as for storage, mixing, or transfer purposes.

2.2.2.5 Option 7: Full Decommission – Third-Party Processing

Similar to Option 6, this option assumes that the City will decommission and remove the HSADF from the site almost immediately. However, instead of constructing new on-site facilities to manage the City’s organic waste, the City will redirect the organic waste collected from the curbside collection program to third-party processors. It is assumed that 40,000 tpy of organic waste will be redirected to external waste management facilities. The City will pay tipping fees to these third-party processors and will handle the transportation of the organic waste using City trucks.

2.2.2.6 Option 8: Full Decommission – New Facility and Third-Party Processing

Option 8 combines elements of Options 6 and 7. The City will decommission and remove the HSADF from the site almost immediately. Following this, the City will construct a new organics processing facility utilizing an ASP system to manage 23,000 tpy of organic waste. The remaining 17,000 tpy of organic waste will be hauled to third-party

processors. This option does not account for additional haul trucks needed for transporting waste to third-party processors, assuming that the City will handle the hauling internally.

2.2.2.7 Option 9: Run to Failure – Repurpose – New Facility

In this option, the City will allow the HSADF to operate until it fails before decommissioning. It is assumed that the HSADF can continue operating in its current state until the end of 2034, after which the City will implement a new facility. During this period, the HSADF is expected to process only 11,000 tpy to maintain regulatory compliance. Consequently, the remaining 29,000 tpy of waste will need to be redirected to third-party processors until the new facility is in place. Once the HSADF reaches the end of its operational life, all infrastructure and equipment, except for the shell, will be decommissioned and removed from the site. The City will then construct a new organics processing facility, designed to handle 40,000 tpy, to manage the increasing volume of waste, similar to the approach described in Option 3.

2.2.2.8 Option 10: Run to Failure – Repurpose – Third-Party Processing

Similar to Option 9, this plan involves allowing the HSADF to operate until failure over a 10-year period, after which all components except for the shell will be decommissioned. During this time, the HSADF will process up to 11,000 tpy of waste, with the remaining 29,000 tpy redirected to third-party processors. Following the HSADF's failure, the City will redirect 40,000 tpy of organic waste to third-party processors. However, this option does not consider the need for additional haul trucks required to transport waste to third-party processors, assuming that the City will handle the hauling internally.

2.2.2.9 Option 11: Run to Failure – Repurpose – New Facility and Third-Party Processing

This option combines elements of Options 9 and 10. Like both options, the HSADF will operate until failure, with the exception of the shell, which will remain intact. After the HSADF fails, the City will proceed to construct a new organics processing facility similar to the one described in Option 3. This facility will handle 23,000 tpy of organic waste. The remaining 17,000 tpy of organic waste will be redirected to third-party processors. Additional haul trucks needed to transport waste to third-party processors is not considered, assuming that the City will handle the hauling internally.

2.2.2.10 Option 12: Run to Failure – Full Decommission – New Facility

Option 12 closely resembles Option 9, except that the HSADF will be entirely decommissioned, and all associated infrastructure and equipment will be removed from the site. Following this, the City will proceed to construct a new organics processing facility capable of handling 40,000 tpy of waste, similar to the facility described in Option 3.

2.2.2.11 Option 13: Run to Failure – Full Decommission – Third-Party Processing

This option entails the HSADF operating for a 10-year period until it inevitably reaches failure, upon which the entire facility will be decommissioned. After its failure, the City will redirect the entire 40,000 tpy of waste to third-party processors. However, this plan does not consider the need for additional haul trucks required for waste transportation to third-party processors, assuming that the City will handle the hauling internally.

2.2.2.12 Option 14: Run to Failure – Full Decommission – New Facility and Third-Party Processing

Option 14 combines elements from Options 12 and 13. Initially, the City will operate the HSADF until it reaches failure, after which the facility will be fully decommissioned. Subsequently, the City will construct a new facility capable of managing 23,000 tpy of organics, which is approximately 50% of the original design throughput for the HSADF, mirroring the approach outlined in Option 3. The remaining 17,000 tpy will be redirected to third-party processors. However, this option does not consider the need for additional haul trucks required for waste transportation to third-party processors, assuming that the City will handle the hauling internally.

2.3 Evaluation Criteria

During the Visioning Workshop, GHD and the City established an initial set of evaluation criteria. These criteria were then reviewed and further refined to include the following evaluation criteria as discussed with the City. Table 2.2 below summarizes the definition of each evaluation criteria.

Table 2.2 Evaluation Criteria Definitions

Criteria ID	Evaluation Criteria	Definition
1	Capital Cost	Capital costs are fixed, one-time expenses incurred on the purchase of land, buildings, construction, and/or equipment.
2	Operation & Maintenance Cost	Annual operation and maintenance (O&M) costs are composed of labor, material, and consumable costs and are often considered variable costs.
3	Timeframe	2027 – Expected timeframe to complete and initiate each option proposed.
4	Greenhouse Gas Emissions	Greenhouse gas emissions reductions in tonnes CO2e.
5	Ease of Implementation	Ease of integrating option and delivering solution
6	Technical Risk	Technology functionality, complexity, design, and manufacturing
7	Regulatory Risk	Ability to meet and maintain regulatory compliance
8	Reputation Risk	Public and stakeholder acceptance, i.e., odor, noise, social acceptance
9	Accommodate Program Changes	Ability for options to accommodate to changes in the program
10	Alignment to Strategic Objectives	Alignment with the City's objective of processing all organics collected with City infrastructure and/or third-party processors. **It should be noted that this Study considers a maximum throughput of 40,000 tpy for all options based on the design capacity of the HSADF.**

2.3.1 Evaluation Criteria Definitions

The evaluation criteria were categorized into two main groups: qualitative and quantitative. Qualitative criteria predominantly consider associated risk factors and an option's adaptability to accommodate future program changes, aligning with the City's strategic objectives. Quantitative criteria primarily examine the financial aspects of the options, encompassing capital costs and operation and maintenance costs.

It's assumed that the 14 options put forward provide comparable waste processing or composting capacity. Therefore, "throughput" wasn't listed as a separate quantitative evaluation criterion, despite being a key priority identified by the City. Instead, throughput and capacity are integrated into the "strategic objective" criterion.

Ease of Implementation

Incorporating new technologies into an existing process can pose various challenges, including retrofitting equipment, coordinating with third parties, navigating complex construction methods, and addressing commercial considerations. To align with the City's waste strategy objectives by Q1 2027, it's crucial that the chosen option seamlessly integrates into the current processes at the EWMC.

Technical Risk

Numerous technologies exist for processing organic waste, each with their own operational complexities and inherent risks. To effectively meet the City's requirements, the chosen technology should have a proven track record both commercially and operationally in North America, ideally at a scale of 40,000 tpy. While anaerobic digestion is a well-established technology, its successful operation depends on several factors, such as consistent feedstock quality and type. Furthermore, the City should consider the willingness of third-party processors to engage in agreements for organic waste processing. The nature and quality of the organics, including the level of contamination, may influence

third-party interest. Given the technical challenges encountered by the HSADF thus far and the potential for future risks, careful consideration of these factors is essential.

Regulatory Risk

Currently, the HSADF is not operating at its design capacity of 40,000 tpy to avoid negative environmental impacts and ensure compliance with regulations, particularly regarding ammonia and H2S scrubbers. The solution selected should minimize regulatory risks for the City.

Reputation Risk

Public and stakeholder acceptance of the pathway chosen are important factors that should be considered. Each option and pathway outlined here may elicit varying levels of response and acceptance. Factors such as alignment with green initiatives and the potential for odors, which could be a nuisance to the public, need to be considered. These factors can influence the success of a new facility. Moreover, public and stakeholder opinions will likely be shaped by past experiences, including the City's successes or failures. For instance, if the City previously faced challenges in implementing the HSADF, stakeholders may scrutinize the construction of a new facility differently.

Accommodate Program Changes

Organics programs are continuously evolving with new technologies, methods, feedstocks, and contractual agreements. It is important that the technology implemented has the ability to accommodate these changes in the future, with limited impact on the existing infrastructure, capital and operational costs.

Capital Costs

Organics processing infrastructure demands a significant capital investment from the City. Despite considerable capital already invested in the HSADF as designed, which currently isn't functioning as intended, the City will aim to optimize the return on future capital investments. This ensures that the proposed organics facility meets identified requirements and operates as intended, thereby minimizing setbacks in other developments and changes to the overall City budgets.

Operation and Maintenance Costs

The operation and maintenance costs to process organics is considered variable and depends highly on the type of technology implemented. A variable cost introduces risk to the City and should be closely evaluated with each option.

Timeframe

The City’s 25-year Waste Strategy has the objective of processing 120,000 tonnes per year of organics by 2027. In order to meet this objective, the City is heavily constrained by time and therefore timeframe will play a significant role in the options analysis. It should be noted that the although the City’s goal is to process 120,000 tonnes, the options analysis and evaluation criteria have been limited to 40,000 tpy design capacity of the HSADF and any assessment will assume an upper limit of processing 40,000 tonnes.

GHG Emissions

Reduction of GHG emissions is in alignment with the City’s 25-year Waste Strategy as well as the corporate goal to be GHG neutral by 2040. It is assumed the primary focus of the City with regards to GHG emissions is reduction and not necessarily potential revenue due to generating offset credits. The options considered do not generate a significant amount of GHG emissions compared to the alternative of landfilling and therefore is not considered a main driver for the City.

Alignment to Strategic Objectives

On March 4, 2024 the City published a report titled “Organics Processing Program Path Forward”, outlining four options for implementation into the organics processing program to meet future demand which is projected to be

120,000 tonnes by 2027. This projection stems from the rollout of organic waste collection across all residential properties in accordance with the 25-year Waste Strategy. With the closure of the Edmonton Composting Facility (ECF) and the operational issues reducing throughput at the HSADF, there is no one facility which currently meets the City's current processing needs or the future program needs. For the purposes of this Study, the options presented are limited to processing 40,000 tonnes (upper limit), in line with the design capacity of the HSADF. Additionally, the City aims to process 50% of their organic waste (approximately 23,000 tonnes assumed for this Study) using City infrastructure and operations (i.e., not using third-party processers). Alignment with the 25-year Waste Strategy and its objectives of organic waste collection and processing is key for the City and Waste Services.

3. Initial Analysis of Options

An initial, high-level analysis was completed to rank each option based on qualitative and quantitative categories. The analysis was completed using the following models:

1. Unweighted Scoring Model
2. 50/50 Weighted Scoring Model
3. Scatter Plot – Financial Ranking ($/tonne) vs. Average Qualitative Ranking

Each option was vetted against all criteria with a score from 1 to 5, with 1 having a very low impact on the program and 5 having a very high impact, and then ranked accordingly from lowest to highest (1 through 14). The 'economic' criterion (i.e., capital costs, O&M costs, GHG revenue) was evaluated quantitatively, a standardization process was used to convert the calculated net present cost to a score between 1 to 5, whereas the rest of the criteria were evaluated qualitatively.

3.1 Scoring Models

3.1.1 Unweighted Scoring Model

In this unweighted scoring model, weight percentages were not applied to the evaluation criteria, therefore each criterion was "weighed" evenly which assumes that all the qualifying criteria hold the same importance.

Table 3.1 *Unweighted Scoring Model*

		Capital	O&M	GHG Emissions	Timeframe	Strategic Objectives	Ease of Implementation	Technical Risk	Regulatory Risk	Reputation Risk	Accommodate to Program Changes	Non-weighted Total	Rank
Options		**Quant**	**Quant**	**Qual.**	**Qual.**	**Qual.**	**Qual.**	**Qual.**	**Qual.**	**Qual.**	**Qual.**	**Out of 50**	
Option 1	Capital Improvements	2.8	3.2	4	3	4	1	2	3	1	1	25.0	8
Option 2	Privatize	5.0	1.7	4	3	4	1	4	3	2	1	28.7	7
Option 3	Decom-Repurpose-New Facility	1.6	4.3	4	3	5	4	4	4	3	3	35.9	6
Option 4	Decom-Repurpose-Third Party	4.1	4.1	3	5	2	5	3	4	3	3	36.2	5
Option 5	Decom-Repurpose-New Facility/Third-Party	2.5	4.4	4	5	5	5	4	4	3	5	41.9	1
Option 6	Decom-New Facility	1.5	5.0	4	3	5	4	4	4	3	3	36.5	4
Option 7	Decom-Third Party	4.0	4.8	3	5	2	5	3	4	3	3	36.8	3
Option 8	Decom-New Facility/Third Party	2.4	4.3	4	5	5	5	4	4	3	5	41.7	2
Option 9	Run to Failure-Repurpose-New Facility	1.0	1.1	2	2	2	2	2	2	2	2	18.1	13
Option 10	Run to Failure-Repurpose-Third Party	4.1	1.0	1	2	1	3	1	1	2	2	18.1	13
Option 11	Run to Failure-Repurpose-New Facility/Third Party	2.1	3.2	2	2	2	3	2	2	2	3	23.3	9
Option 12	Run to Failure-Decom-New Facility	2.0	1.4	2	2	2	2	2	2	2	2	19.4	11
Option 13	Run to Failure-Decom-Third Party	4.0	1.3	1	2	1	3	1	1	2	2	18.3	12
Option 14	Run to Failure-Decom-New Facility/Third Party	2.0	1.1	2	2	2	3	2	2	2	3	21.1	10

1	Very low impact
2	Low impact
3	Neutral
4	High impact
5	Very high impact

3.1.2 Weighted Scoring Model

3.1.2.1 Evaluation Criteria Weighting

Figure 3.1 below represents an initial weighting of each evaluation criteria with higher weighted criteria indicative of most important to the City and lower weighted criteria indicative of being the least important.

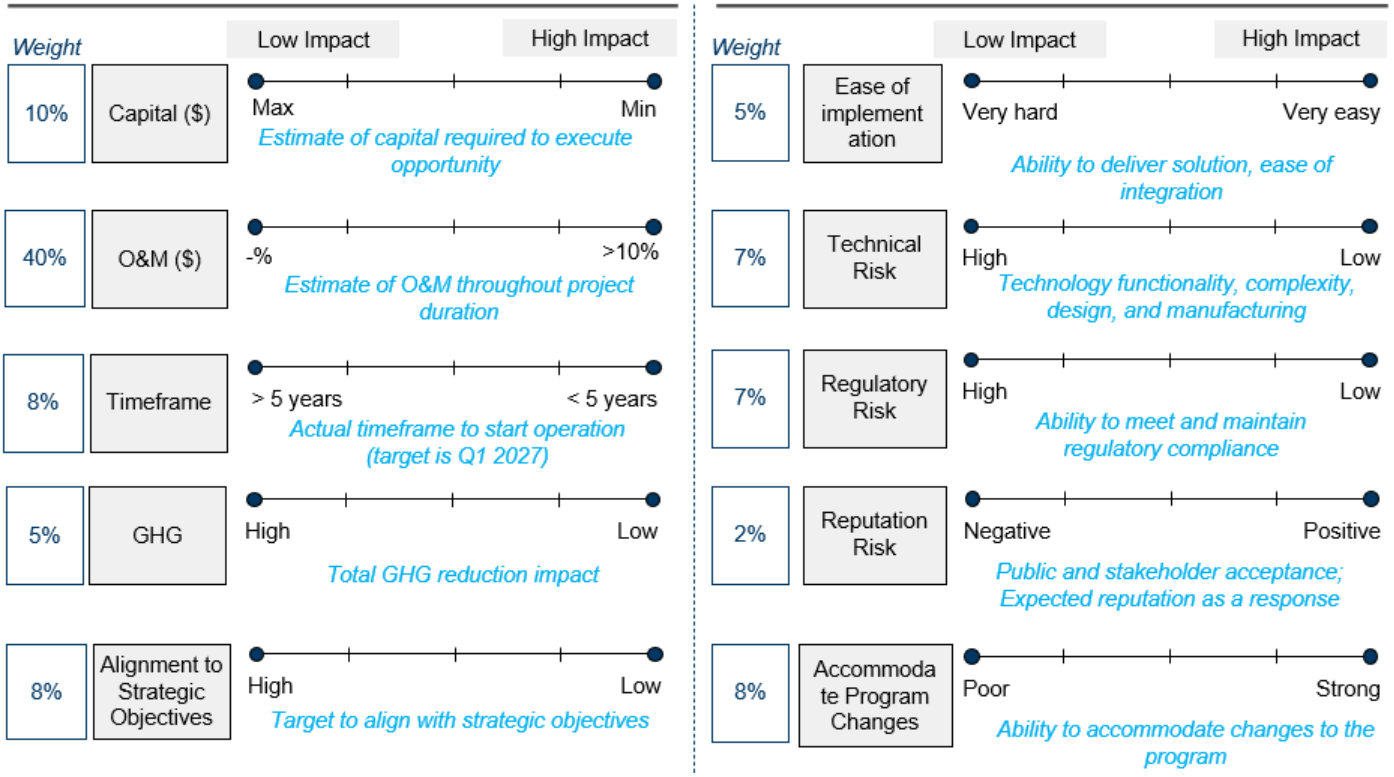

Figure 3.1 Evaluation Criteria Weighting

The criteria used to assess the options are:

– Financial including capital and operation and maintenance costs. Weight 50%
– Timeframe, alignment to strategic objectives, and accommodation to program changes. Weight 24%
– Ease of implementation and risks. Weight 26%, criteria of lesser importance were weighed lower.

The weight associated with each criterion is based on input from the City during the Step 2 Working Session. It was determined that financial costs should account for approximately 50% of the overall weight with approximately 40% of that allocated to operation and maintenance costs and 10% allocated to capital costs. According to the City, waste management facilities have had significantly higher operation and maintenance costs than capital costs, which has been a major concern when selecting the right facility for the program. As such, operation and maintenance costs are weighed the highest and will directly impact how the City chooses to proceed.

Criteria such as reputation risks was deemed the least important while criteria associated with the City's overall vision statement and objective such as alignment to strategic objectives, ability to meet the timeframe, and accommodate to program changes have a relative degree of importance and were weighed equally at 8% per criteria. Regulatory risks and technical risks were assigned a weight of 7% considering that the City has previously experienced technical and regulatory challenges in relation to the HSADF and might be an important consideration when moving forward with the selected option.

3.1.3 Weighted Scoring Model Results

Table 3.2 below reflects the weighted model results, incorporating the criteria weighting as discussed in Section 3.1.2.1

Table 3.2 Weighted Scoring Model

		Capital	O&M	GHG	Timeframe	Strategic Objectives	Ease of Implementation	Technical Risk	Regulatory Risk	Reputation Risk	Accommodate to Program Changes	Weighted Total	Rank
		50%		50%									
		10%	40%	5%	8%	8%	5%	7%	7%	2%	8%	100%	
Options		Quant.	Quant.	Qual.	Qual.	Qual.	Qual.	Qual.	Qual.	Qual.	Qual.	Out of 5	
Option 1	Capital Improvements	2.8	3.2	4	3	4	1	2	3	1	1	2.82	7
Option 2	Privatize	5.0	1.7	4	3	4	1	4	3	2	1	2.60	9
Option 3	Decom-Repurpose-New Facility	1.6	4.3	4	3	5	4	4	4	3	3	3.78	6
Option 4	Decom-Repurpose-Third Party	4.1	4.1	3	5	2	5	3	4	3	3	3.80	5
Option 5	Decom-Repurpose-New Facility/Third-Party	2.5	4.4	4	5	5	5	4	4	3	5	4.28	1
Option 6	Decom-New Facility	1.5	5.0	4	3	5	4	4	4	3	3	4.05	4
Option 7	Decom-Third Party	4.0	4.8	3	5	2	5	3	4	3	3	4.07	3
Option 8	Decom-New Facility/Third Party	2.4	4.3	4	5	5	5	4	4	3	5	4.23	2
Option 9	Run to Failure-Repurpose-New Facility	1.0	1.1	2	2	2	2	2	2	2	2	1.54	14
Option 10	Run to Failure-Repurpose-Third Party	4.1	1.0	1	2	1	3	1	1	2	2	1.59	13
Option 11	Run to Failure-Repurpose-New Facility/Third Party	2.1	3.2	2	2	2	3	2	2	2	3	2.62	8
Option 12	Run to Failure-Decom-New Facility	2.0	1.4	2	2	2	2	2	2	2	2	1.76	11
Option 13	Run to Failure-Decom-Third Party	4.0	1.3	1	2	1	3	1	1	2	2	1.70	12
Option 14	Run to Failure-Decom-New Facility/Third Party	2.0	1.1	2	2	2	3	2	2	2	3	1.77	10

1	Very low impact
2	Low impact
3	Neutral
4	High impact
5	Very high impact

3.1.4 Scatter Plot – Financial Ranking ($/tonne) vs. Average Qualitative Ranking

In addition to the unweighted, and weighted scoring models, the total capital and operational costs on a per tonne basis for each option was assessed using the standardization process and plotted against the average of the qualitative criteria for the corresponding option. The results of this assessment are shown in Figure 3.2 below.

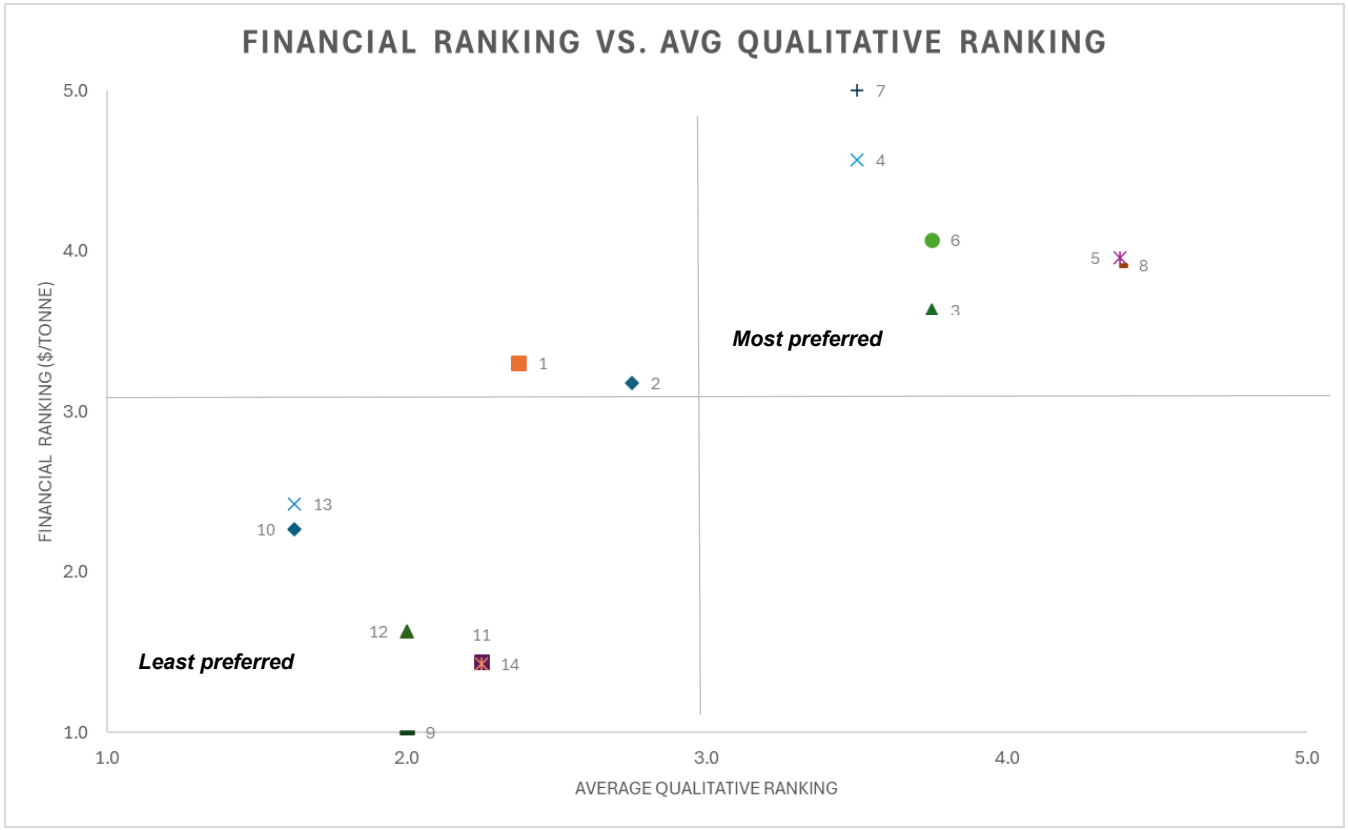

Figure 3.2 Scatter Plot – Financial vs. Qualitative

Figure 3.2 can be divided into four quadrants. The options which fall within quadrant one are considered to have the lowest financial impact and least satisfy the qualitative criteria (least preferred), options which fall within quadrant two are considered to have the highest financial impact and least satisfy the qualitative criteria, options which fall into quadrant 3 have the highest financial impact and best satisfy the qualitative criteria and options which fall within quadrant 4 are considered to have the highest financial impact and best satisfy the qualitative criteria (most preferred).

3.2 Discussion

Based on an initial review of the scoring models, Option 5 – Decommission-repurpose-new facility/third party; Option 7 – Decommission-third party; and Option 8 – Decommission-new facility/third party ranked higher than other options and are considered viable options while Options 9, 10 and 13 were amongst the lowest ranked and are likely not viable options for the City.

Rank 1: Option 5 – Decommission – Repurpose – New Facility/Third Party Processing

This option generally scored neutral to high for both quantitative and qualitative criteria and scored an overall 41.9 out of 50 (unweighted model). The major driver for yielding a positive outcome for this option is the qualitative criteria, particularly timeframe, strategic objectives, ease of implementation, and ability to accommodate to program changes. Constructing a new facility in combination with utilizing third party processors allows for program flexibility. Any changes to the program specifically to feedstock variability and volumes, and any changes to labour (i.e., civic strikes) which can otherwise negatively impact a program, can be effectively managed with the flexibility in operations that this option presents. There is also potential for the City to meet their timeline of processing increasing volumes of organic waste by 2027 by hauling organic waste to third-party processors while a new facility is being constructed. Option 5 ranked highly for the “ease of implementation” criteria considering that hauling 50% of the organic waste collected to third-party processors does not require any integration into the City’s existing waste management process and can be implemented through contractual agreements with others. Constructing an ASP process is commercially proven at this scale and can be implemented while organic waste is managed by third parties.

Operation and maintenance costs, regulatory and technical risk, and GHG emissions scored a 4 out of 5 and contributed to an overall positive outcome for this option. Hauling organic waste to third-party processors reduces technical risk for the City (i.e., third party processes may not have the infrastructure or means to process City organics); whereas the ASP process may pose some degree of technical risk if the organic waste is not maintained at optimum composting conditions, but there is a level of control. Similarly, the ASP process is not anticipated to generate high levels of GHG emissions when compared to vehicle emissions from hauling organic waste to third party processors, as such, this option scored an average of 4. The operation and maintenance costs for Option 5 were estimated to be lower when compared to other options. However, the addition of tip and haul fees to third-party processors increases the overall operation and maintenance costs.

Reputation risk and capital costs were scored to have a neutral impact on the program. Capital costs averaged at a score of 2.5 when compared to other options. The only capital costs considered for this option includes partial decommissioning of the HSADF and an initial investment into constructing a new facility that can manage 50% of the organic waste collected or an annual capacity of approximately 23,000 tpy. On the reputation side, the public may not be receptive to the construction of a new facility following the decommissioning of a “failed” HSADF, while the combination of a new facility and hauling organic waste to third-party processers may provide confidence of organics waste processing by other processors. Additionally, unpleasant odor generated by the ASP process may affect surrounding communities.

When considering the weighted model (refer to Section 3.1.3) which assumes a 50% focus on the financial criteria and the remaining 50% on the qualitative criteria, Option 5 remained the highest rank solution. Similarly, Option 5 fell within the “most preferred” quadrant of the scatter plot (refer to Figure 3.2), indicating it highly satisfied the qualitative criteria while still having a relatively high financial impact.

Rank 2: Option 8 – Decommission – New Facility/Third Party Processing

Option 8 scored an overall 41.7 out of 50 and ranked second of the top three options (unweighted model). Like Option 5, Option 8 scored the same across the quantitative and qualitative criterion proposed, with the exception of capital and operation and maintenance costs which were slightly higher than Option 5 but scored as having a “low impact” and “high impact”, respectively. This option assumes that the City would decommission the HSADF and construct a new building, rather than repurpose the HSADF shell, for storage, mixing, or for use as a transfer station. As such, the costs were found to be slightly higher but yielded similar scores as Option 5.

Considering the qualitative criteria scores remained the same and minor deviations in the quantitative scores compared to Option 5, Option 8 ranked second overall in the weighted model. Option 8 also landed in the “most preferred” quadrant of the scatter plot, with Figure 3.2 indicating a slightly less positive impact in terms of financial ranking.

Rank 3: Option 7 – Decommission – Third-Party

Option 7 ranked third and scored an overall 36.8 out of 50 (unweighted model). Similar to Options 5 and 8, this option scored as having a “high” and “very high” impact for qualitative categories such as regulatory risk, timeframe, ease of implementation and quantitatively for financial costs. Hauling organic waste to third-party processors poses minimal regulatory risk. Any liability or regulatory risk is passed onto the third-party processor once the waste is hauled off-site. Implementing this option into the City’s existing program requires minimal effort and can be achieved within the City’s timeframe of 2027. However, there may be technical risk with sole third-party reliance if vendors are unwilling to accept increasing volumes of organic waste due to limited capacity or varying feedstock, thus scoring a 3. Similarly, reputation risk, accommodation to program changes, and GHG emissions are assigned a score of 3 for this option. The public might expect the City to sustainably manage organic waste but by decommissioning a failed facility and solely relying on third-party processors this might lead to a lack of confidence in the City’s curbside program. Relying solely on one solution can also limit the City in terms of flexibility and ability to accommodate to future program changes. If the City chooses to increase volumes of organic waste collected from the curbside program, third-party vendors may not be willing to accept these volumes due to limited capacity which can eventually lead to higher tonnage costs, seeking processing facilities further away from the City, or alternative means to manage organic waste. When compared to other processing options, emissions generated through vehicle usage and fuel consumption can contribute to a facility’s overall GHG emissions. With the City’s hauling all organic waste to third party processors, truck traffic will significantly increase, directly burning fossil fuels as opposed to other options. Since this option does not align with the City’s objective or preference to process at least 50% of the organic waste collected, on-site, Option 7 scored a 2 for the strategic objectives criteria.

Quantitatively, Option 7 scored as having a “high” and “very high” impact for capital costs and operation and maintenance costs, respectively. The only capital costs for this option include decommissioning the HSADF, as such there are no capital costs associated with pursuing third-party processing. Since the City would rely solely on third-party processing, operation and maintenance costs primarily come from haul and tip fees paid to third-party processors.

The results of the weighted model also placed Option 7 as the third best option. With the 50% weighting on financial criteria and Option 7 ranking very high for these criteria, this was considered the main driver for the third-place rank with the weighted model compared to other options. The results of the scatter plot, similar to Option 5 and 8, resulted in Option 7 landing in the “most preferred” quadrant. As seen in Figure 3.2, it is evident that Option 7 outranks Options 5 and 8 in the financial aspect but receives the lowest qualitative score of all three options.

4. Sensitivity Analysis

A sensitivity analysis was used to understand the effect of independent variables (i.e., evaluation criteria, project lifecycle term, etc.) on dependent variables (i.e., options) under certain conditions. In this case, a sensitivity analysis was conducted on Options 1 through 14 to determine how these options rank when specific variables are altered. Two factors were identified that could affect the results based on the following unknowns:

1. “Strategic objective” Criterion
2. Project Lifecycle

4.1 Strategic Objective Criterion

As part of the sensitivity analysis, the “strategic objective” criterion was removed from the weighted scoring model to determine how this effected the ranking of the options. Based on conversations between GHD and the City, although alignment with strategic objectives is of importance to the City, it could also be considered a City preference and not a “hard stop” on any one solution. The weight allotted to the strategic objective criterion was distributed among the remaining qualitative criteria, with the results reflected in Table 4.1.

Table 4.1 Sensitivity Analysis - Strategic Objective Criterion Removed

		Capital	O&M	GHG	Timeframe	Ease of Implementation	Technical Risk	Regulatory Risk	Reputation Risk	Accommodate to Program Changes	Weighted Total	Rank
		50%		50%								
		10%	40%	6%	9%	6%	9%	8%	3%	9%	100%	
Options		Quant.	Quant.	Qual.	Qual.	Qual.	Qual.	Qual.	Qual.	Qual.	Out of 5	
Option 1	Capital Improvements	2.8	3.2	4	3	1	2	3	1	1	2.67	7
Option 2	Privatize	5.0	1.7	4	3	1	4	3	2	1	2.50	9
Option 3	Decom-Repurpose-New Facility	1.6	4.3	4	3	4	4	4	3	3	3.67	6
Option 4	Decom-Repurpose-Third Party	4.1	4.1	3	5	5	3	4	3	3	3.93	5
Option 5	Decom-Repurpose-New Facility/Third-Party	2.5	4.3	4	5	5	4	4	3	5	4.18	2
Option 6	Decom-New Facility	1.5	5.0	4	3	4	4	4	3	3	3.94	4
Option 7	Decom-Third Party	4.0	4.8	3	5	5	3	4	3	3	4.20	1
Option 8	Decom-New Facility/Third Party	2.4	4.3	4	5	5	4	4	3	5	4.17	3
Option 9	Run to Failure-Repurpose-New Facility	1.0	1.1	2	2	2	2	2	2	2	1.54	14
Option 10	Run to Failure-Repurpose-Third Party	4.1	1.0	1	2	3	1	1	2	2	1.64	13
Option 11	Run to Failure-Repurpose-New Facility/Third Party	2.1	3.2	2	2	3	2	2	2	3	2.64	8
Option 12	Run to Failure-Decom-New Facility	2.0	1.4	2	2	2	2	2	2	2	1.76	11
Option 13	Run to Failure-Decom-Third Party	4.0	1.3	1	2	3	1	1	2	2	1.75	12
Option 14	Run to Failure-Decom-New Facility/Third Party	2.0	1.1	2	2	3	2	2	2	3	1.79	10

1	Very low impact
2	Low impact
3	Neutral
4	High impact
5	Very high impact

4.2 Project Lifecycle

A sensitivity analysis was also conducted on the project lifecycle to provide the City with flexibility of the project's operating life and to demonstrate how the options rank if the City chooses to implement a short-term option, such as 10-years. A 5-year project lifecycle was not considered in this analysis as it would not provide the City with a realistic timeframe to achieve an optimum solution and a project lifecycle beyond 15-years was not considered as it is assumed that the proposed technology or facility would reach it's maximum life at the end of 15-years.

In the initial analysis of options, a 15-year term was considered, which assumes that in the first two-years (i.e., 2025 to 2027), a contractor will continue to operate the HSADF in its current state, and from years 3 through 15, the City would either continue to operate the HSADF or implement and operate the option selected (third-party processing, new facility, or a combination of third-party processing and a new facility). The potential for a reduced 10-year term was considered for the economic analysis to determine how the options ranking are directly impacted by decreasing the economic analysis term. This analysis assumes that the City would continue to operate the HSADF for a limited time (up to year 5) and implement and operate the option selected from year 6 to year 10. As this sensitivity analysis considers a reduced project lifecycle, the qualitative criteria scoring was not impacted.

The results of the reduced 10-year project lifecycle is presented in Table 4.2.

Table 4.2 10-Year Sensitivity Analysis

		Capital	O&M	GHG	Timeframe	Strategic Objectives	Ease of Implementation	Technical Risk	Regulatory Risk	Reputation Risk	Accommodate to Program Changes	Weighted Total	Rank
		50%		50%									
		10%	40%	5%	8%	8%	5%	7%	7%	2%	8%	100%	
Options		Quant.	Quant.	Qual.	Qual.	Qual.	Qual.	Qual.	Qual.	Qual.	Qual.	Out of 5	
Option 1	Capital Improvements	2.8	3.4	4	3	4	1	2	3	1	1	2.90	7
Option 2	Privatize	5.0	1.9	4	3	4	1	4	3	2	1	2.68	9
Option 3	Decom-Repurpose-New Facility	1.6	4.2	4	3	5	4	4	4	3	3	3.74	5
Option 4	Decom-Repurpose-Third Party	4.1	3.9	3	5	2	5	3	4	3	3	3.72	6
Option 5	Decom-Repurpose-New Facility/Third Party	2.5	4.1	4	5	5	5	4	4	3	5	4.16	1
Option 6	Decom-New Facility	1.5	5.0	4	3	5	4	4	4	3	3	4.05	3
Option 7	Decom-Third Party	4.0	4.7	3	5	2	5	3	4	3	3	4.03	4
Option 8	Decom-New Facility/Third Party	2.4	4.1	4	5	5	5	4	4	3	5	4.15	2
Option 9	Run to failure-Repurpose-New Facility	1.0	1.2	2	2	2	2	2	2	2	2	1.58	14
Option 10	Run to failure-Repurpose-Third Party	4.1	1.0	1	2	1	3	1	1	2	2	1.59	13
Option 11	Run to failure-Repurpose-New Facility/Third Party	2.1	3.4	2	2	2	3	2	2	2	3	2.70	8
Option 12	Run to failure-Decom-New Facility	2.0	1.7	2	2	2	2	2	2	2	2	1.88	10
Option 13	Run to failure-Decom-Third Party	4.0	1.5	1	2	1	3	1	1	2	2	1.78	12
Option 14	Run to failure-Decom-New Facility/Third Party	2.0	1.2	2	2	2	3	2	2	2	3	1.81	11

1	Very low impact
2	Low impact
3	Neutral
4	High impact
5	Very high impact

4.3 Discussion of Results

Following an initial review of the sensitivity analysis results, the top-ranking options were as follows:

Strategic Objective Criterion:

1. Option 7: Decom-Third Party
2. Option 5: Decom-Repurpose-New Facility/Third Party
3. Option 8: Decom-New Facility/Third Party

Project Lifecycle:

1. Option 5: Decom-Repurpose-New Facility/Third Party
2. Option 8: Decom-New Facility/Third Party
3. Option 6: Decom-New Facility

By removing the strategic objective criterion, the options were minimally impacted as the top-ranking options remained as Options 5, 7, and 8. In the initial analysis, Option 5 ranked first, however, following a sensitivity analysis of the evaluation criteria, Option 7 ranked first at 4.20 out of 5, followed closely by Options 5 (4.18) and 8 (4.17), respectively. Overall, these options ranked very close and the difference between the overall score of each option is insignificant and does not warrant a major change in the results of the initial analysis.

By reducing the project lifecycle to 10-years, Options 5, 6, and 8 were the top-ranking options. In the initial analysis, Options 5 and 8 ranked first and second, respectively, with Option 7 ranking third, followed closely by Option 6. However, following the sensitivity analysis Option 6 ranked third with Option 7 closely following. Despite the adjustment to the project lifecycle in the sensitivity analysis, the top-ranking options remained consistent, clearly delineating the leading options from the rest.

5. Risks

After completing Step 2, the highest-scoring options, also referred to as "preferred options," were identified through the initial options analysis. As these options involve either third-party processing or the construction of a new facility, risks associated with each option were examined. Outlining these risks will provide the City with additional context to assist in their decision-making regarding implementation and subsequent steps.

5.1 New Facility

– **Organic waste volume**

The proposed facility will utilize an ASP system to process organic waste. Based on information provided by the City, the intended throughput for this system is approximately 23,000 tpy, a fraction of the estimated 120,000 tpy estimated to be processed by Q1 2027. At larger throughputs, this necessitates acquiring more land and capital in order to operate the system, including dedicated areas for processing, active composting, curing, and storage. If the City does not already own land to accommodate the larger volumes, the implementation of the ASP system may be constrained. Furthermore, if the City opts to acquire additional land, there could be supplementary expenses associated with supporting operations, such as transportation between sites. Additionally, if the required land purchase extends beyond the City of Edmonton limits, it may warrant additional permitting, which is not guaranteed.

– **Organic waste composition**

With any organics composting system, the composition of the organic waste will play a major role in the quality of the output, such as finished compost. If the organic material received contains plastic and inorganic contaminants, pre-processing is necessary using separation technology like a de-packager. This step is crucial to reduce contamination to an acceptable level before initiating active composting. Furthermore, contamination can lead to additional operational challenges and associated costs. If the organic material remains heavily contaminated, it may become economically unviable and require disposal in a landfill. Moreover, if contaminated organic waste undergoes active composting, the resulting end product (compost) may not meet the required standards for distribution.

– **Odour**

Like all organics processing systems, an ASP system generates odour as the organic material breaks down. To mitigate odour, options include applying a finished layer of compost, using woodchips over the pile, or implementing a biofilter system. However, industry best practices indicate that processing large volumes (e.g., 120,000 tonnes) in an outdoor environment presents significant challenges. Odour cannot be completely eliminated and must be continuously managed, particularly when process conditions (such as moisture content, temperature, and mix composition) are not optimal. If the City decides to expand the facility beyond 23,00 tonnes, odour management will remain a concern, and proximity to residential areas should be carefully considered.

– **Operations and process control**

The new facility's components, including the retention pond, aerated static piles, and curing area, are proposed to be situated outdoors on City land. This means the composting process can be exposed to extreme winter weather with temperatures below freezing. Maintaining optimal temperature and moisture conditions during these extreme weather events can be challenging. Adverse weather may result in prolonged active composting periods, compost that does not meet distribution standards, or the need for additional bulking material, which in turn increases costs and space requirements.

5.2 Third Party Processing

– **Third party processing capacity (i.e., processers within the greater Edmonton area)**

The options presented in this Study consider an upper throughput of 40,000 tonnes of organic waste. However, with City projections indicating 120,000 tonnes by 2027, the additional waste will need processing; otherwise, it will be landfilled. It has been identified that neither the City nor the surrounding area currently has the capacity to handle this volume. Given the limited processing capacity available to the City and the future options not accounting for the total expected organic production, reliance on third-party processors will be necessary in the coming years, regardless of the option the City implements. To ensure that City organics are processed and not landfilled, it is crucial to identify and secure agreements with third-party processors in advance, thereby minimizing the risk of organic waste ending up in landfills.

– **Cost control**

With significant reliance on third-party processors to handle the City’s organic waste (beyond what is processed at the Compost Cure Site and/or a new facility), the City will have limited control over processing costs. Typically, contractual agreements are established for a fixed period, requiring negotiations to renew or extend these agreements. If the City aims to avoid the risk of sending organic waste to landfills, this dependency may introduce financial risk into the City's future cash flow and impact the assurance of "guaranteed tonnage”.

– **Guaranteed tonnage**

As part of the contract with a third-party processor, the City will be required to guarantee a certain annual tonnage of organic waste. The City will be obligated to provide the agreed-upon tonnage or pay the difference if the actual amount falls short. Alternatively, if the City generates more organic waste than anticipated and does not have agreements to handle the excess, any additional organics will likely end up in a landfill.

– **Process control**

If all organic waste is processed by a third-party, the City's involvement and oversight are limited. Without proper due diligence and depending on the contract terms, third-party processors can make changes to the processing methods, output quality (finished compost), and regulatory compliance. These changes may not align with the City's goals and could negatively impact the City's reputation.

To mitigate some of the risks outlined above, adopting a combined approach that includes both a new facility and third-party processing, such as Option 5 (Decommission – Repurpose – New Facility/Third Party Processing), allows for risk distribution between the City and the third-party processor, as demonstrated below:

– Distributing the organic waste volume between the City and a third-party allows for the City to strategically enter into agreements and ensure there is a contingency for additional tonnage. Alternatively, the City can direct organics to fulfill contractual obligations, reducing the reliance on City processing capacity.
– Reduced processing capacity for the City in future years, when organic waste is estimated to reach 120,000 tonnes, will require less land and subsequently produce less odour, thereby minimizing the potential for public backlash.
– Increased financial stability by having the ability to process a portion of the City’s organic waste.

6. Summary and Conclusions

At the conclusion of this Study, it is determined that the top-ranking options are:

1. Option 5 – Decommission – Repurpose – New Facility/Third Party Processing
2. Option 8 – Decommission – New Facility/Third Party Processing
3. Option 7 – Decommission – Third-Party

A number of scoring and weighting models were used to quickly eliminate options that were considered non-feasible, resulting in a clear selection of viable options. Additionally, a sensitivity analysis was conducted to assess the impact of changes to the evaluation criteria and project lifecycle on the proposed options. Despite minor variations in the ranking order of the top three options during the sensitivity analysis, the differences in scores were deemed negligible. Options 5, 7, and 8 remained the top-ranking options. Following completion of Step 2, it was determined that proceeding to Step 3, the "deep dive analysis," would not alter the outcome of the Study nor provide additional value to the City. The Study's results do not necessitate further evaluation to reach the same conclusions.

Based on the overarching results from Study, the following conclusions were made:

Conclusion 1: Decommission the HSADF

Decommissioning the HSADF as soon as practical in alignment with next steps, is the most viable path forward based on the analysis presented herein. Options associated with keeping the HSADF (i.e., capital upgrades and privatise) or running the HSADF to failure are deemed less viable when considering the City’s overall program goals and objectives. However, as the City obtains new commercial information, viability of privatization may change.

Conclusion 2: Repurpose the HSADF shell

Repurposing the shell of the HSADF offers the City flexibility in managing on site operations without requiring additional infrastructure for waste storage, reception, mixing, or transfer. However, repurposing also presents potential risks such as explosive hazards or exposure to hazardous gases or materials. Obtaining the required permits for reusing the shell may also be necessary and may need to be considered as part of the process.

Conclusion 3: Third-party processing risks

Relying entirely on third-party processors does not guarantee that they will have the capacity available to meet City needs and support City operations. Depending solely on third-party processors means the City has less control over waste handling, processing, and compliance with regulations, potentially impacting the City's reputation.

Conclusion 4: Limited Processing Capacity

It has been identified that neither the City nor the surrounding area currently has the capacity to handle the volume of organics generated in the City. Longer term processing capacity arrangements should be explored.

Conclusion 5: Long-term organics processing risks

Industry best practices have shown that processing large volumes (i.e., 120,000 tonnes) of material in an outdoor environment is problematic. The number one issue that typically arises at these types of facilities is odour.

Conclusion 6: Timeline risk

The City is committed to processing 120,000 tpy of organic waste by Q1 2027. The top-ranking options will require time for implementation, including activities such as FEED, technology procurement, construction, etc. potentially resulting in delays to the City's goals.

Conclusion 7: Privatizations options require further evaluation

At the time of the report, there is insufficient information available to draw substantial conclusions regarding the viability of privatization. This option should be reevaluated as additional commercial information is made available to the City.

6.1 Next Steps

Based on these conclusions, the City should:

1. Gather additional information from potential contractors to further evaluate the viability of privatization.
2. Determine the preferred option from the options identified in this Report.
3. Conduct due diligence on third-party processors to verify their current and future capacity to meet the City's 120,000 tonnes processing requirements and investigate if other third-party processors are willing to expand their capacity.

Initiate the design and procurement processes for decommissioning, repurposing, and developing new facilities to meet the capacity requirements by 2027.