Finance and Performance Committee
SUPPLEMENTARY AGENDA

Notice of Meeting:

An ordinary meeting of the Finance & Performance Committee will be held on:

Date: **Thursday 28 April 2022**
Time: **9.30am**
Venue: **Council Chambers, Civic Offices, 53 Hereford Street, Christchurch**

Membership

Chairperson	Deputy Mayor Andrew Turner
Deputy Chairperson	Councillor Sam MacDonald
Members	Mayor Lianne Dalziel
	Councillor Jimmy Chen
	Councillor Catherine Chu
	Councillor Melanie Coker
	Councillor Pauline Cotter
	Councillor Mike Davidson
	Councillor Celeste Donovan
	Councillor Anne Galloway
	Councillor James Gough
	Councillor Yani Johanson
	Councillor Aaron Keown
	Councillor Phil Mauger
	Councillor Jake McLellan
	Councillor Tim Scandrett
	Councillor Sara Templeton

26 April 2022

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Part A **Matters Requiring a Council Decision**
Part B **Reports for Information**
Part C **Decisions Under Delegation**

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26. Resolution to Include Supplementary Reports

1. Background

1.1 Approval is sought to submit the following report to the Finance and Performance Committee meeting on 28 April 2022:

22. Organics Processing Options

1.2 The reason, in terms of section 46A(7) of the Local Government Official Information and Meetings Act 1987, why the report was not included on the main agenda is that it was not available at the time the agenda was prepared.

1.3 It is appropriate that the Finance and Performance Committee receive the report at the current meeting.

2. Recommendation

2.1 That the report be received and considered at the Finance and Performance Committee meeting on 28 April 2022.

22. Organics Processing Options

22. Organics Processing Options

Reference Te Tohutoro:	22/100196
Report of Te Pou Matua:	Ross Trotter – Resource Recovery Manager
General Manager Pouwhakarae:	Jane Davis – General Manager for Infrastructure, Planning and Regulatory Services

1. Purpose of the Report Te Pūtake Pūrongo

1.1 This report responds to two resolutions.

1.2 The first was by Council on 9 September 2021, (CNCL/2021/00001), that:

Request staff investigate building a new organics processing facility. The investigation should include:

a. A detailed assessment of processing technology options;

b. A detailed assessment of potential locations for a new facility and planning, consenting and cost requirements;

c. An assessment of the impacts of each option on greenhouse gas emissions; and

d. A review of partnership models, including the options of:

(i) a jointly funded and co-designed facility in collaboration with the Council's partners in the Greater Christchurch Partnership;

(ii) procurement of the new building under a design-build-operate or build-operate contract with a contractor; and

(iii) investment from the private sector to provide organic waste processing services to the Council.

1.3 The second resolution was by the Finance & Performance Committee Resolution on 24 March 2022 (FPCO/2022/00017), that thanks Dr McLellan for the petition presentation and refers the petition to staff; and requests that staff respond to the matters raised in the petition, in the report that is scheduled to come to the Committee in April 2022.

1.4 The third purpose is to inform about a recent letter from Environment Canterbury in which they said that they are investigating whether the Council's current management of the Metro Place site is causing a chronic odour which is offensive and objectionable.

1.5 This report provides Council with the findings of an assessment of the options for processing organics including: technology; potential locations for a new facility; statutory planning considerations and costs; an assessment of the impacts of each option on greenhouse gas emissions; and a review of partnership models.

1.6 As a result, staff advise that:

a. there are feasible and viable alternatives to the current location that warrant further investigation and a further approach to the market; and

b. given the sensitivity of the current location, relocating the plant to an alternative site is preferred, subject to the outcome of a procurement process.

c. following that process staff will bring a further report to the Committee on the options, seeking a resolution to either continue with the redevelopment of the current site or to pursue a specific alternative; and

d. Redevelopment of the current site should remain on hold while options are more fully investigated; and

e. The Council should continue to operate Metro Place with the current process controls until either redevelopment or relocation is complete.

1.7 The decision in this report is of low significance in relation to the Christchurch City Council's Significance and Engagement Policy. The level of significance was determined by:

1.7.1 Noting that the decision to upgrade the Organics Processing Plant has already been made by the Council on 9 December 2020. This was included in the Long Term Plan 2021-2031;

1.7.2 The recommended resolution is that staff further investigate options for a new organics processing facility. Budget decisions will be made following this investigation.

1.7.3 In terms of gauging the views and preferences of interested and affected persons, the Council regularly engages with residents that live near the Organics Processing Plant through quarterly community meetings and regular newsletters. After Council have considered this report an update will be provided about this report and the decision being considered by the elected Council.

2. Officer Recommendations Ngā Tūtohu

That the Finance and Performance Committee resolves to:

1. Agree in principle the relocation of the Organics Processing Facility to an alternative site

2. Request staff to:

   (a) approach the market for options for location, partnerships, joint ventures, commercial opportunities, and

   (b) report to Council on short listed relocation options with a comparison to redevelopment of the current site by end February 2023.

3. Support the continued operation at the Metro Place site with the current process controls to manage and mitigate odour until an alternative facility, or redevelopment of the current site, is operational.

4. Agree that, should it be necessary to meet the interim capex needs of the existing facility, staff are able to utilise part of the current capital budget for the new facility. Any capital expenditure will be confined to meeting compliance requirements and any decision to use the capex will be made by GM Infrastructure Planning & Regulatory Services in consultation with the Chair and Deputy Chair of the Finance & Performance Committee.

5. Agree that the redacted information can be released when the Chief Executive is satisfied that there are no longer grounds under LGOMIA for withholding the information.

3. Reason for Report Recommendations Ngā Take mō te Whakatau

3.1 Council commissioned the attached report by Jacobs for the purpose of investigating the feasibility of relocation having regard to each of the factors specified in Council resolution CNCL/2021/00001 and other relevant factors.

3.2 We here summarise that report's findings, together with our analysis of those findings.

3.3 The Jacobs report is a high level assessment due to the limited potential sites available for assessment – based mainly at this stage in Council-owned land, and two other options. Staff

consider that there may be many other options in the market and the Council should continue to investigate that possibility.

A detailed assessment of processing technology options

3.4 Staff agree with the Jacobs report recommendation that there are two technology options for a relocated plant: Aerated Static Pile (ASP) and In-tunnel composting. The inclusion of Anaerobic Digestion is also noted for consideration, based on the potential benefits associated with this complimentary process.

3.5 Part of the reason for that is that there is going to be much more organic waste ("feedstock") for processing. Central Government has signalled that direction in both the draft Emersions Reduction Plan and recent "Transforming Recycling" document, which includes the potential for mandates in relation to the diversion of organics.

3.6 This will create additional demand for organics processing capacity. It might also increase the potential for odour because of increased putrescible materials (that currently go to landfill).

3.7 As a city, Christchurch is likely to require a facility that can accept Commercial and Household organic waste streams (or multiple facilities).

3.8 The generation and release of odour from a composting facility is one of the principal risks to be mitigated to ensure reliable long-term operations. The composting technology must be capable of processing the future feedstocks identified and achieving compost compliance with NZ and Australian standards. ASP and In-tunnel composting technologies both have the capability to achieve this.

3.9 ASP technology has lower energy consumption and lower GHG emissions compared with In-tunnel composting but has constant low-level odour discharge that requires more separation than in-tunnel composting from sensitive receivers to mitigate against chronic sensitivity or offensive and objectionable effects.

3.10 In-tunnel, fully enclosed composting is the most effective process for controlling odour at source and managing odour risks resulting from process upset or highly putrescible feedstocks, it is therefore able to be sited at closer proximity to population centres and sources of waste. However, this technology also has higher energy consumption and therefore greater GHG emissions compared with Aerated Static Pile. Energy consumption and GHG emissions can be reduced by attaching Anaerobic Digestion to an in-tunnel process, with the two technologies complementing each other including the potential for the site to be a net generator of electricity or piped renewable natural gas.

3.11 The suggested site area required for In-tunnel composting is 9 Ha and 12 Ha for ASP (excluding separation distance), to provide for future growth.

3.12 ASP is less well suited to processing putrescible organic waste streams such as pre consumer food waste and feedstock selection may need to be carefully considered if selected as the preferred technology.

Potential locations for a new facility

3.13 Identifying a specific site is not practical at this stage for this feasibility study as not all feasible options have been considered and other decisions e.g. the service – incoming stock and outgoing product, methodology, technology, to move and/or build a new facility on a different site need to be considered and made. Those decisions will identify in detail attributes such as transportation, zoning, services, location, environmental factors, reverse sensitivity issues etc. to support a thorough and detailed site analysis and investigation.

3.14 With those decisions made a more defined and tighter brief could be developed, thereby opening up the option of buying land, albeit likely that option would inevitably prove to be

more difficult to achieve, take longer and be more expensive hence making it less feasible. Without those strategic decisions it is not tenable to establish where a relocated/new facility would be best located.

3.15 The Jacobs report short-listed these options against minimum criteria including land area, vulnerability to sea level rise and avoidance of open space land zoning. This resulted in 6 possible relocation options plus the existing Bromley location in potential consideration. Some of these sites are reserve land. The appropriateness of seeking a change to that status has not yet been assessed.

3.16 Evaluation of the remaining 6 site locations against a multi assessment criteria identified that none of the sites were clearly preferable, with all sites having actual or potential constraints. More detailed assessment of suitability is needed. In addition to the reserve status of some of the options, the primary matter requiring assessment is the number and location of sensitive receptors relative to each of the sites based upon the potential future layout and technology of the facility, hence as stated earlier these decisions need to be made before a site is chosen.

Planning and consenting context

3.17 The Jacobs report has identified no insurmountable barriers to consenting at alternative sites if odour and other effects are managed appropriately. Air discharge consent from Environment Canterbury is needed for all alternatives, just as it is for the current site. For land use approvals, the RMA process of designation for a public work is preferable to reliance on seeking land use consents.

Request for Information

3.18 In November 2021 a Request for Information (RFI) was offered to the market to inform the Jacobs assessment of options (feasibility study).

3.19 The intent was that information received from the market, be considered and referenced in the Feasibility Study to inform the Council staff report back to Council on options for:

1. Building a new organics processing facility, or
2. Upgrading the existing Organics Processing Plant.

3.20 The remaining responses either provide a partial solution, are unproven at the required scale or are emerging technologies untried in New Zealand, so have not considered as options at this time.

3.21 More information is required to evaluate the feasibility, cost, consenting risk and commercial arrangements for these and any other alternative site.

Partnership models

3.22 If Council chooses to investigate options for organics processing at an alternative site, it is recommended that Council approach the market for a solution, based on a functional brief which does not limit technology options.

Cost

3.23 The capital and life-cycle cost assessment performed by Jacobs provides comparison between the options on a Total Cost basis (the sum of initial capital construction costs, capital replacement/renewals and annual operating expenditure). Broad outcomes from the cost assessment include:

- Total Cost is considered the best metric to demonstrate the most cost-effective location / technology combination over a 25-year horizon.

- Aerated Static Pile as a technology has lower capital, operating, NPV and total costs than In-tunnel.
- Upgrading the In-tunnel technology at Bromley has a cheaper Capital Cost than implementing In-tunnel composting at a new site, due to the existing residual facility value, no land purchase costs and limited bulk infrastructure costs however the Total Cost over 25-years is similar due to the increased cost of transportation of compost to market from the Bromley location relative to others.
- Anaerobic Digestion yields modest income benefits however has relatively high initial capital and capital renewals costs.

Timeline

3.24 Staff estimate that once a preferred site is identified, investigating, consenting, procuring and constructing a new facility would take a **minimum of three years**. This timeframe is uncertain with many variables falling outside of the Council's control. The timeframe could realistically extend to four or five years.

4. Alternative Options Considered Ētahi atu Kōwhiringa

4.1 The attached consultant report assesses some options for location, technology and regulatory planning pathways. The pros and cons along with limitations are discussed in depth in this report.

4.2 The options are to either continue with fuller investigation of relocation options, or to cease those investigations and redevelop the current site. Staff consider that the feasibility study shows that there may be feasible options and that the Council should more fully investigate those options before making a final decision on whether to continue with redevelopment of the current site.

5. Detail Te Whakamahuki

5.1 To address ongoing concerns relating to operation of the Council owned Organics Processing Plant (OPP), a number of operational changes have been made while options for upgrading (or developing a new facility) are investigated. Key changes implemented prior to the abatement notice deadline have included shifting from an effective mixed model for organics processing (in-tunnel composting and outdoor windrowing) to an all enclosed process. These significant changes have resulted in reduced odour from the facility.

5.2 Staff and its contractor, Living Earth, have developed and implemented a transitional plan for the maintaining operation at the Organics Processing Plant, including the continued processing of Council's kerbside green bin service.

5.3 The operating plan, developed with Living Earth in June 2021, outlines interim measures to reduce potential sources of offensive odour and include:

- Stop receiving pre-consumer food organics.
- Minimising onsite storage of finished compost by prioritising screening and removal of finished product from the site.
- Maintain effective treatment of processing air, including maintenance of the bio filter.
- Investigate additional buffering, including boundary plantings, along the southern site boundary.
- Maximise stability of compost onsite.

5.4 Since the implementation of the plan, key changes include;

- Removed all maturing compost, previously stored on-site in windrows, from the site.
- Completed on the biofilter to improve backpressure and sustain airflow rates, in order to maintain effective treatment of processing air.
- Monitored temperature and back pressure on the biofilter.
- Installed a new roof cover on the screening shed.
- Included the addition of a probiotic to the compost to accelerate the composting process.
- Additional buffering through boundary planting along the southern site boundary could be considered.

5.5 These changes have resulted in reduction of odour. This improvement has been reflected in the drop in complaints received by CCC about objectionable odour from the Organics Processing Plant and was acknowledged by Dr Tracey McLellan in the deputation to F&P on 24 March 2022.

5.6 Data extracted from the CCC customer services team shows a dramatic decline in the number of odour complaints received since the implementation of the transitional plan. Of the fifty complaints recorded in the period 2020 – 2022, there were thirty six in 2020, thirteen in 2021 and one in 2022.

5.7 Independent air quality experts have carried out a site assessment and concluded that a number of potential odour sources from the site have been eliminated, therefore reducing the likelihood of offensive or objectionable odour beyond the boundary.

5.8 Dr Tracey McLellan - MP for Banks Peninsula presented a petition of 316 signatures from the Bromley community at the Finance & Performance meeting on 24 March 2022;

Petition request: The Bromley community calls on the Christchurch City Council to move the Living Earth compost plant.

Reason: The plant has been emitting offensive odours for a long time, significantly and negatively impacting the lives of nearby residents. The local community has expressed concern that proposals to redevelop the facility would not succeed in eliminating the odours. Relocating the plant to a non-residential area is the only solution that would ensure the odour problem is resolved for long suffering Bromley residents.

5.9 If the Council is to consider the view of local residents, who wish to see the existing Organics Processing Plant relocated away from the Metro place site, then the Council would resolve to continue to investigate alternatives.

5.10 The location of the Organics Processing Plant at Metro place positions it in the heavy industrial zone. The Organics Processing Plant is not the only source of odour in this area and there is a real risk that even if the Organics Processing Plant is relocated to a new site that an odour issue may remain.

5.11 A condition in the resource consent for discharge to air from the facility states "*The discharges to air shall not cause odour or dust which is offensive or objectionable beyond the boundary of the site on which this consent is exercised*". Environment Canterbury issued an Abatement Notice to the Council that requires the cessation of offensive and objectionable odour travelling beyond the boundary of the facility by 31 January 2022.

5.12 Despite the operational changes made by the Council and Living Earth, and the assessment by the Council's air quality consultant that there is not offensive and objectionable odour beyond

the boundary of the site, a recent letter from Environment Canterbury to the Council states that Environment Canterbury are investigating whether ongoing "chronic" odour from the site amounts to an offensive and objectionable odour.

5.13 If the existing plant is forced to cease operation in the absence of an alternative, the organics waste would be directed to landfill. This would have a direct impact on rates with a cost in the order of $8M. This action would be contrary to Council's own Climate Change and Waste Minimisation policies.

5.14 Council can undertake further engagement with the community before reporting back seeking a resolution on a preferred option.

5.15 The decision affects the entire district, as changes to the organics processing process will have an impact on rates.

5.16 The Waikura Linwood-Central-Heathcote ward is closest in proximity to the existing organics processing site and would be directly impacted by this decision.

6. Policy Framework Implications Ngā Hīraunga ā- Kaupapa here

Strategic Alignment Te Rautaki Tīaroaro

6.1 The decision to upgrade or explore building a new organics processing facility aligns with the Council's strategic priority to 'meet the challenge of climate through every means available'. Sending organic waste to landfill emits the potent greenhouse gas methane. Our regional landfill, Kate Valley, has a process to capture methane and utilise this to generate energy. However, no landfill gas capture system is fully effective and the most sustainable solution is to process organic waste through a bespoke system, such as composting or anaerobic digestion.

6.2 This decision to upgrade or advance a new organics process also promotes the community outcome we strive to achieve, 'sustainable use of resources and minimising waste'.

This report supports the Councils Long Term Plan (2021 – 2031):

Activity: Solid Waste and Resource Recovery

Level of Service: 8.2.7 Organic materials collected by Kerbside Collection and received for processing at the Organics Processing Plant (OPP) - 130kg +40%/-10% organic materials / person / year collected by Kerbside Collection

Policy Consistency Te Whai Kaupapa here

6.3 The recommended decision is consistent with Council's Plans and Policies, including the Waste Minimisation and Management Plan 2020.

6.4 The decision to upgrade or explore the establishment of a new organics processing pathway is consistent with Council's Plans and Policies. The decision aligns with Council's target of being net carbon neutral for its operations by 2030 and our commitments under the Waste Management and Minimisation Plan 2020.

6.5 Once Council has resolved to provide direction on Council's preferred option(s) for organics processing, the preferred option(s) will be procured in accordance with Council's Procurement Policy and Framework.

Impact on Mana Whenua Ngā Whai Take Mana Whenua

6.6 The decision does not involve a significant decision in relation to ancestral land or a body of water or other elements of intrinsic value, therefore this decision does not specifically impact Mana Whenua, their culture and traditions.

6.7 Should the Council decide to redevelop the current site, operations at the existing facility will not be amended significantly. The primary change is bringing more elements of the process into an enclosed environment.

6.8 If the Council agrees to advance investigations of a new organics processing site, the impacts on Mana Whenua will need to be considered in detail.

Climate Change Impact Considerations Ngā Whai Whakaaro mā te Āhuarangi

6.9 The Council is committed to achieving net zero emissions by 2030. Programme 9 of the Ōtautahi Christchurch Climate Resilience Strategy commits the Council to work towards zero waste and includes as a focus area work to maximise the diversion of organic material.

6.10 Processing organic waste from the kerbside green bins rather than sending this material to landfill reduces greenhouse gas emissions. This is achieved by the reduction in methane produced and emitted into the atmosphere from the landfilling of organic waste as well as through the carbon sequestration properties of compost when applied to land.

6.11 Sustainability was a consideration when assessing the preliminary options for a new Organics Processing Plant and in relation to upgrading the existing facility.

6.12 Building a new facility at a different location may impact greenhouse gas emissions due to changes in transportation requirements. This will be investigated further for specific sites should the Council choose to proceed with this option.

6.13 Assessments by the Asset Management Team have calculated the current site of the Organics Processing Plant as having a low level of exposure to climate change, this increases slightly to low-medium by 2050. The vulnerability of the site is low, rising to medium in 2050. It was noted that the Organics Processing Plant is close to the coast but set relatively high. Rising groundwater might be an issue but due to most processing happening indoors, exposure is low.

Accessibility Considerations Ngā Whai Whakaaro mā te Hunga Hauā

6.14 We want to ensure our infrastructure is accessible both to staff and visitors of the sites. Noting the waste facilities welcome educational school groups on a regular basis through the Learning Through Action programme.

6.15 The current Metro Place organics processing facility is not particularly accessible and the main office and educational areas have no wheelchair access. This is something that should be addressed by the project if the Council elects to upgrade the existing facility.

6.16 Should the decision be made to establish a new facility, staff investigations will include consideration of how the site and all educational areas are fully accessible.

7. Resource Implications Ngā Hīraunga Rauemi

Capex/Opex Ngā Utu Whakahaere

7.1 Jacobs have advised the key drivers of this increase include updated cost assumptions in design, consenting, council costs, construction management/administration, escalation and contingency.

7.2 However, operationally (in terms of both operational costs and ongoing asset replacements and renewals) the projections of the various options suggest savings are likely to be realised by Council. This is driven by efficiencies such as reduced loader movements.

7.3 Jacobs have emphasised in their report the high-level nature of their projections (in light of significant variables that will only be refined as detail is developed for Council's preferred

option). Consequently, staff recommend deferring revising Council budgets etc. until options are progressed further.

7.4 For the interim period (between now and the completion of a new facility) it is projected that operating costs can be met through the existing Council budgets noted above, if the current operation can continue. Should it be necessary to meet the interim compliance requirements of the existing facility through capex, staff request approval from Council to be able to draw down on the capital budget for the new facility.

8. Legal Implications Ngā Hīraunga ā-Ture

Statutory power to undertake proposals in the report Te Manatū Whakahaere Kaupapa

8.1 The Council has the statutory power to either continue with the redevelopment of the existing site or investigate a new site.

8.2 The Council has the legal ability to enter into contracts for the procurement of services, however to do so it needs to act in accordance with Section 14 of the Local Government Act 2002 (LGA) 2002. The LGA 2002 (Section 14) details the principles relating to local authorities. The principles most relevant to the Council's procurement activity are:

i. In performing its role, a local authority must act in accordance with the following principles:

1. a local authority should-

- conduct its business in an open, transparent, and democratically accountable manner; and;
- give effect to its identified priorities and desired outcomes in an efficient and effective manner and;
- undertake any commercial transactions in accordance with sound business practices and;
- ensure prudent stewardship and the efficient and effective use of its resources in the interests of its district or region, including by planning effectively for the future management of its assets; and
- in taking a sustainable development approach, a local authority should take into account-
    - the social, economic, and cultural interests of people and communities; and
    - the need to maintain and enhance the quality of the environment; and
    - the reasonably foreseeable needs of future development.

Other Legal Implications Ētahi atu Hīraunga-ā-Ture

8.3 The Council must also comply with its Procurement Policy, which aligns with the Local Government Act 2002 and the Controller and Auditor-General - Procurement Guidance for Public Entities.

8.4 None of the options presented under this paper has undergone a procurement in accordance with Councils Procurement Policy that would allow Council to enter into direct negotiations or award of contract.

8.5 There will be a need to ascertain the views and preferences of the community when staff report back following further investigation of options. That may involve engagement with the community.

8.6 The key legal considerations have been described in this report and the attached Jacobs report and are summarised here.

8.7 First, the operation of the current site is subject to a resource consent condition that the discharges to air shall not cause odour or dust which is offensive or objectionable beyond the boundary of the site on which this consent is exercised. Environment Canterbury has served an abatement notice on the Council stating that the Council is in breach of that condition and requiring compliance with the condition by 31 January 2022. Environment Canterbury issued the abatement notice with that compliance date after the 9 December 2020 Three Waters and Waste Infrastructure and EnvironmentCommittee resolution TWIA/2020/00033 supporting the upgrade of the composting technology at the facility and the construction of a new building so that all processing and screening of material is enclosed. .Recent correspondence from Environment Canterbury states that they are investigating whether ongoing chronic odour amounts to a breach of the resource consent condition that there shall not be offensive and objectionable odour beyond the boundary. This does not change the officer recommendations made in this report.

8.8 The Council intends to comply with the operational requirements of current resource consents when undertaking interim odour mitigation measures for current activity at the Bromley site.

8.9 If Council decides to redevelop the current site there might be delays and costs arising from variations to existing resource consents.

8.10 The principal consenting issue for alternative sites is likely to focus on management of odour and proximity of residential neighbours. The Jacobs assessment has not identified any insurmountable barriers. For land use approvals, designation for a public work will probably be a more efficient process than seeking a resource consent.

8.11 Assessment of alternative relocation options is likely to include community engagement.

8.12 The current central government programme for reform of the RMA intends to have new legislation in place before the end of 2023. It will be difficult to provide estimates of consenting timeframes for alternative sites until we know the provisions of the new legislation. We expect that there will be streamlined consenting options available for important infrastructure. It is also possible that there will be regulatory or legislative change arising from central government's "Transforming Recycling" programme.

8.13 This report has been reviewed and approved by the Legal Services Unit.

9. Risk Management Implications Ngā Hīraunga Tūraru

9.1 Options to establish a new organics processing site for Christchurch involve a significant degree of uncertainty and therefore risk. Given the likely changes signalled in the current Central Governmentt consultation document '*Te panoni to haungarua - Transforming Recycling'*.

9.2 Further financial modelling based on the outcomes of the current Central government work program on waste, including the current consultation document '*Te panoni to haungarua - Transforming Recycling'* will provide more information about the potential market for (Food) organics processing. This information should be considered as part of any due diligence process before advancing contractual arrangements prior to the confirmation of future mandates and the completion of the government work stream.

9.3 The Council needs to consider a number of risks when considering this report. Of particular note are: financial, legal and reputational.

Financial risks include:

- Current cost projections of either upgrading the current facility, or pursuing an alternative processing option, being exceeded. This would lead to a negative impact on rates;
- Ongoing operational costs of maintaining interim measures to meet the Abatement Notice compliance date (unfunded);
- Increases in the upgrade proposal costs with inflation; and
- The income Council receives in the form of a waste levy from the Ministry for the Environment could be impacted if organics diversion targets are not met because organics are directed to landfill.

Legal risks include:

- Potential non-compliance with the air discharge consent condition and abatement notice at the existing facility whilst interim measures are in place;
- Potential difficulty extending the current or being granted a new consent for the existing site following its expiry in 2033; or
- Potential difficulty in obtaining approvals for organics processing at an alternative site

Reputational risks include:

- Ongoing concern from Bromley community about delayed decision making and odour concerns. This can be mitigated through regular communications and engagement throughout the process; and
- Concern from the wider Christchurch community regarding costs of building a new facility and potential locations; and
- Concern from the adjacent property owners and residents about the use of CCC land for a new industrial process.

Property Risks includes:

- Moving to a new/different site could shift the issues and problems at Bromley to another area and group of residents/citizens. Unfortunately any site within the city boundaries is likely to have neighbours even in the rural fringes e.g. lifestyle blocks.
- Purchasing private property can extremely difficult if there are not willing vendors and compulsory acquisition under the Public Works Act can be extremely costly and time consuming.
- Aggregation of privately owned sites may not be practically possible and costly.
- Using some council owned sites may require processes that require consultation, hearings panels and rights of appeal/challenge, therefore achievability may not be entirely within the council's control.

Attachments Ngā Tāpirihanga

No.	Title	Page
A ⇩	IA237000 - Future of Organics - FINAL - 13APR22 (Redacted)	17
B	IA237000 - Future of Organics - FINAL - 13APR22 (Public Excluded) *(Under Separate Cover)* - **CONFIDENTIAL**	
C	20220411_Memo OPP Property Options (Public Excluded) *(Under Separate Cover)* - **CONFIDENTIAL**	
D ⇩	PDP Memo_C04012800L003_Final	258
E	ORGANICS PROCESSING OPTIONS : PX Redactions from the Officer Report to Council 28 April 2022 *(Under Separate Cover)* - **CONFIDENTIAL**	

Additional background information may be noted in the below table:

Document Name	Location / File Link
Te panoni to haungarua -Transforming Recycling	https://environment.govt.nz/publications/transforming-recycling-consultation-document/

Confirmation of Statutory Compliance Te Whakatūturutanga ā-Ture

Compliance with Statutory Decision-making Requirements (ss 76 - 81 Local Government Act 2002).

(a) This report contains:
  (i) sufficient information about all reasonably practicable options identified and assessed in terms of their advantages and disadvantages; and
  (ii) adequate consideration of the views and preferences of affected and interested persons bearing in mind any proposed or previous community engagement.

(b) The information reflects the level of significance of the matters covered by the report, as determined in accordance with the Council's significance and engagement policy.

Signatories Ngā Kaiwaitohu

Authors	Ross Trotter - Manager Resource Recovery Lynne Armitage - Project Manager Kent Summerfield - Senior Project Manager Michael Down - Finance Business Partner Jo van den Heever - Head of Procurement & Contracts Rowan Latham - Contract & Project Lead Angus Smith - Manager Property Consultancy
Approved By	Lynette Ellis - Head of Transport & Waste Management Jane Davis - General Manager Infrastructure, Planning & Regulatory Services

Jacobs

The Future of Organics

Processing Technology and Location Options Assessment

IA253700-GN-RPT-0001 | 0

13 April 2022

Christchurch City Council

Future of Organics

Project No:	IA253700
Document Title:	Processing Technology and Location Options Assessment
Document No.:	IA253700-GN-RPT-0001
Revision:	0
Document Status:	Final
Date:	13 April 2022
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Overview

The Bromley Organics Processing Plant has had ongoing odour complaints from the surrounding community, resulting in the Canterbury Regional Council issuing an abatement notice with a deadline of January 2022.

[redacted]

Via Resolution CNCL/2021/00001, Council requested that staff cancel the current tender process and undertake further investigation that should include:

- A detailed assessment of processing technology options
- A detailed assessment of potential locations for a new facility and planning, consenting and cost requirements
- An assessment of the impacts of each option on greenhouse gas emissions; and
- A review of partnership models, including the options.

This report summarises the assessments undertaken and presents a short-list of potentially viable site locations and composting technologies for further assessment and consideration by Council.

Matters of Relevance

After identifying relevant National and Regional legislative and regulatory requirements and establishing project objectives and performance criteria, the *Future of Organics* study considered a range of matters relevant to the *Future of Organics* for Christchurch. The following key outcomes were identified:

- ***Future feedstocks***

  National legislative focus on removing organics from landfills will likely see an increase in organics volumes, with an increase in food waste having significance regarding odour risk and an increase in green waste having significance regarding capacity.

- ***Technology options***

  In-tunnel and Aerated Static Pile (ASP) composting technologies have been identified as being potentially suitable, depending upon the site location and separation distance to sensitive receptors. In-tunnel is more expensive but has better process control and less odour risk than Aerated Static Pile.

  Anaerobic digestion is identified as a viable sustainable energy process that is complementary with composting, as it utilises the energy-dense fraction of the organics waste stream to produce biogas and benefits the composting process by reducing the odour potential and composting duration of the anaerobically digested organics. The economics of anaerobic digestion do not appear favourable if biogas is used for electricity production however may improve if utilized for direct heating or if GHG emissions offsets are monetised. Anaerobic digestion can be added to a composting facility at any time subject to provision of adequate land.

- ***Process Greenhouse Gas Emissions***

  Composting of organics is the key step to remove GHG emissions, thereafter there are minor differences between composting technologies.

  Anaerobic digestion has good GHG emission performance due to the production of renewable biogas.

- ***Transportation Greenhouse Gas Emissions***

  All new site locations close to Christchurch result in a minor increase in transportation costs and GHG emissions while sites remote from Christchurch have a more significant increase in transportation costs and GHG emissions relative to the existing Bromley location.

  Further consideration is required on the best way to mitigate increased GHG emissions, particularly if a site location remote to Christchurch is considered.

- ***Consenting and approvals***

  Statutory approvals under the Resource Management Act 1991 (RMA) are required for a composting facility and there are a range of pathways available.

  Adverse effects from odour are the primary matter of consideration for all sites and remains the primary barrier to obtaining approval from the regional authority. The suitability of the activity for the location in relation to zoning is another important consideration for obtaining statutory approvals from the territorial authority.

  A successful application to the regional authority will depend on the efficacy of on-site management of odour. Odour effects are also influenced by meteorology, topography and location of the site, as well as the location, density and nature of sensitive receptors, and these are matters that will influence the management approach. Preliminary air modelling is recommended for short-listed sites to gain an early understanding of potential effects of odour dispersal.

  [redacted]

- ***Private Sector participation***

  [redacted]

- ***Evaluation of Site Location and Technology Options***

  A list of 26 sites provided by Council plus 2 sites identified through the RFI process were evaluated against minimum criteria including land area, vulnerability to sea level rise and avoidance of open space land zoning, resulting in the short-listing of 6 new locations plus the existing Bromley location.

  Evaluation of the remaining 6 site locations against the MCA criteria identified that none of the sites were clearly preferable, with all sites having actual or potential constraints. This identified that development of concept outline master plans is required for the remaining sites to enable more detailed assessment of

suitability. The primary matters requiring assessment are the number and location of sensitive receptors relative to each of the sites based upon the potential future layout and technology of the facility and the meteorology, topography and location of the site.

- ***Costs***

[redacted]

[redacted]

Risks and Opportunities

The assessment work completed has identified a number of risks and uncertainties that require resolution so Council can make an informed decision on a preferred location and composting technology option. The identified risks are generally reflective of the high-level nature of the development of site location and technology options but provide guidance on the matters requiring advancement.

Outcome

The assessment has identified suitable composting technologies and established their operational characteristics and risks which has informed the requirements for a site location and enabled short-listing of sites provided by Council and identified the key matters requiring resolution to establish and consent a facility that provides for future growth and adaptability with minimum operational constraints.

Recommendations are made within the report on further work required to develop a short-list of site location and technology options, potentially including other sites that have not yet been assessed, so the risks and uncertainties can be more accurately assessed and clear guidance provided to Council on the risks, benefits and costs of the remaining locations and technology options.

Definitions

Biogas	A mixture of gases, primarily consisting of methane and carbon dioxide, produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste.
Greenhouse Gas	Any gas that has the property of absorbing infrared radiation (net heat energy) emitted from Earth's surface and reradiating it back to Earth's surface, thereby contributing to the greenhouse effect. Carbon dioxide, methane, and water vapour are the most important greenhouse gases. To a lesser extent, surface-level ozone, nitrous oxides, and fluorinated gases also trap infrared radiation.
Landfill gas capture	LFG is a by-product of decomposing organic waste in landfills. It is mainly composed of methane and carbon dioxide. LFG capture captures the methane to produce energy or flared. The process converts the methane to carbon dioxide
Organic Waste	Waste that contains degradable organic carbon e.g., recoverable materials such as food and green waste, paper, cardboard, and timber.
Sensitive receivers *Source: CCC District Plan*	• residential activities • care facilities • education activities and preschools • guest accommodation • health care facilities which include accommodation for overnight care • hospitals • custodial and/or supervised living accommodation where the residents are detained on the site
Separation distance	The space between the composting facility (the activity boundary) and sensitive land uses. The terms 'buffer' and 'separation distance' may be used interchangeably

1. Introduction

1.1 Purpose of Report

[redacted]

Due to this significant increase in cost, Council via Resolution CNCL/2021/00001 requested staff cancel the current tender process and undertake further investigation that should include:

- A detailed assessment of processing technology options
- A detailed assessment of potential locations for a new facility and planning, consenting and cost requirements
- An assessment of the impacts of each option on greenhouse gas emissions; and
- A review of partnership models, including the options.

This report assesses and evaluates potential technologies and site options for the redevelopment of the existing Bromley Organics Processing Plant or the development of a new organics processing plant for Christchurch and the wider region, to assist Christchurch City Council (Council) with its investment decision making for organics processing for Christchurch.

1.2 Study Approach

Effective management of organics processing in the region is influenced by a number of technical, social, legislative and economic factors. The Councils decision making will also need to consider national, regional, and local objectives for waste management and climate change.

Development of this study therefore adopted the following approach:

- Establish project objectives and performance criteria – Section 3
- Assess contributing factors – Section 4
- Assess outcomes of Council RFI process – Section 5
- Short-list technology and sites –Section 6
- Assess feasible technology and sites against the agreed project objectives and performance criteria – Section 7
- Outline key findings – Section 8
- Risk assessment and conclusions –Section 9 and Section 10

1.3 Report Structure

The report is structured in the same manner as the study approach to allow the reader to develop an understanding of the contributing matters that lead to the conclusions.

The contributing factors assessments have been reported on individually, with the respective memoranda attached in the Appendices and key outcomes presented in Section 4 for discussion.

The shortlisting of feasible technologies and sites in Section 6 provides the rationale for identifying potentially suitable options.

The assessment of feasible technologies and sites in Section 7 use a multi-criteria assessment methodology to assess the relative performance of options against the objectives and performance criteria as discussed in Section3.

For each of the technology options discussed in Section 4.3, a general description of the process, physical infrastructure, inputs and outputs was considered along with a qualitative assessment to compare each option against the minimum standards. Key findings from the relevant contributing memo then informed an overall strategic assessment of technology and site options and MCA.

1.4 Limitations and Assumptions

This study provides a high-level assessment of technology options, costs, planning risk and site considerations within the project timeframe and available information.

This report is limited to the assessment of technology and location options for the *Future of Organics* study.

Consideration of options for management of odour at the existing Bromley facility is outside of the scope of this assessment and is being undertaken in parallel by Council staff in conjunction with Living Earth. The outcome of those odour management initiatives is of relevance to the *Future of Organics* study, as the degree of success will influence the extent to which there is continued adverse effects on the community from the existing facility, and therefore time pressure to resolve this issue.

The review of technology options is limited to four technologies with low technology and complexity risk to Council and informed by good practice as outlined in Section 4.3. Other technologies that were identified through Council's RFI process but discounted after preliminary assessment are discussed in Section 5.

The status of development of each of the technology options is to conceptual level and the performance assessment is comparatively high-level, however this is considered appropriate for purpose of screening of technology options.

This report provides a high-level assessment of site options including the existing location, other potential locations, a location assessment report completed by Council and information received via a Market Assessment undertaken by the Council. More detailed assessment, which should include development of concept designs and detailed costing, planning and technical assessments, is required to verify the feasibility of establishing an organics processing operation on a preferred site.

Indicative sizing of technology is based upon design feedback agreed with the Council along with project feedstock types and volumes as outlined in this report. A recommendation has been made within this report to update the 2021 Design Feedstock report for the new or upgraded compost facility that results from this process.

2. Background

2.1 History of Organics Processing at Bromley

Christchurch organics are currently processed at 40 Metro Place, Bromley. A composting facility has operated at the site since 1994 and food organics and garden waste has been processed there since 2009, when the current In-tunnel composting facility was constructed.

The existing organics processing plant is a Council owned composting facility that processes organic waste from the kerbside green bins, commercial food waste, green waste and riverweed. [redacted]

The existing composting facility is consented to process up to 90,000 tonnes of organic material per year but typically processes around 70,000 tonnes per year and produces around 40,000 tonnes of compost per year.

The compost produced is of high quality, complying with the New Zealand (NZS 4454:2005) and Australian (AS 4454:2012) composting standards and achieving organic certification.

The original hybrid compost process design basis uses In-tunnel composting for primary composting and open windrows for secondary composting and maturation. The system does not have sufficient capacity or process control to fully mitigate the generation of odours. An upgrade is being pursued to address these issues.

Environment Canterbury imposed an abatement notice on the Council to cease objectionable odours from the site by 31 January 2022.[2] Council is undertaking activities to comply with the abatement notice, including removal of windrows and all outdoor storage of compost and implementing formal odour assessments and these activities and outcomes are outside of the scope of this report.

The key steps and dates of activity preceding the *Future of Organics* study shown schematically in Figure 2-1.

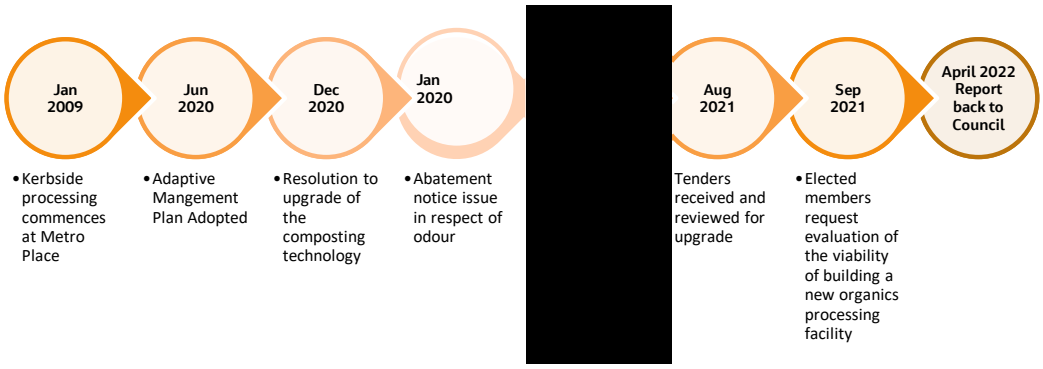


Figure 2-1 Process to date

[1] [redacted]

[3] This Act amends the Climate Change Response Act 2002 (the principal Act).

2.2 Central Government Direction and Context

The Central Government policy framework sets out expectations and broader outcomes for waste management and climate change mitigation in New Zealand.

The *Climate Change Response (Zero Carbon) Amendment Act 2019*[3] provides the broad framework by which New Zealand can develop and implement clear and stable climate change policies. As waste is a key contributor to GHG emissions the advice to Government from the Climate Change Commission (established under the Act) emphasises the need to addresses emissions from waste.

New Zealand's Emissions Reduction Plan will be published in May 2022 and will established an emissions budget. The plan requires collective action and focuses on key sectors. Draft strategies and policies were released in October 2021; for waste the focus is on

- reducing organic waste material,
- reducing organic waste disposal to land fill
- reducing emissions from organic waste.

The Government's *waste reduction work programme* sets out proposed changes to the national waste management framework and is being led by the Ministry for the Environment (MfE). It is anticipated that new waste management legislation will be introduced in 2023 with significant emphasis on climate change mitigation and focus on specific waste streams including organic waste. Proposed changes to the *Waste Minimisation Act* will include a national licensing system to improve waste data and to help track progress towards a circular economy.

The Climate Change Commission recommends reducing waste biogenic methane emissions to at least 40 % below 2017 levels by 2035. This advice has been reflected in MfE' s waste reduction programme and *Te hau mārohi ki anamata Transitioning to a low-emissions and climate-resilient future – discussion document.* MfE' s waste reduction programme and *Te hau mārohi ki anamata Transitioning to a low-emissions and climate-resilient future – discussion document* proposes a staged approach to reducing GHG emissions from waste as follows:

- Landfill Gas capture at all Class 1 municipal landfills by 2026.
- All organic material disposal be banned from Class 2–5 by 2030.[4]
- Key organic materials such as food, green, and paper waste banned from Class 1 landfills by 2030.

Council's primarily inorganic waste (red bins) currently goes to a Class 1 landfill with landfill gas capture and therefore does not require to be diverted from landfill, however it is expected that the broader emphasis within Christchurch will be to reduce the volume of organics to landfill.

Achieving this vision involves reducing the reliance on landfill and diversifying organic waste processing. The detailed action plan outlines key activities towards achieving the objectives *of Te mahere whakahaerenga para, 2020 Waste Management and Minimisation Plan.*

This context establishes the need and timeline for Councils to remove organics from landfill the requirement to manage waste in a separate and sustainable manner.

[3] This Act amends the Climate Change Response Act 2002 (the principal Act).
[4] Emphasis added

2.3 Council Policy Framework

The Council's strategies and plans are consistent with the current national waste management framework and direction on climate change and waste sector.

The Council has developed an action plan with short-term actions – these are adaptive approaches and will provide a foundation for long term outcomes. The actions are grouped into five themes of which the following have direct relevance:

- Theme 1 is maximizing composting of organics. The actions include diversifying and expanding organics collection and processing.
- Theme 4 focuses on leadership and innovation which is supported by 11 keys actions. Embracing new technology for a better resource recovery system and promote and addressing climate change emissions targets are relevant to this report.

The Council have already made significant progress in this area by implementing a mixed Food and Garden Organics collection which diverts a significant volume of organics from landfill.

3. Project Objectives and Evaluation Framework

The initial study task was to agree project objectives and evaluation framework, to provide focus for ensuing assessments against which technology and location options could be assessed. Legislative and Council operational requirements were considered when establishing objectives and performance assessment criteria that reflected these requirements. The resulting ***Project Objectives and Evaluation Framework*** memorandum is attached in Appendix A. The project objectives established are set out in Figure 3-1.

Project objectives	Supporting Criteria
• Long term outcomes that benefit Christchurch residents • Reducing emissions and supporting climate change objectives • Minimising waste in line with central government direction and Council's Waste Management and Minimisation Plan • Support wider resource efficiency objectives	• Need to cater for growth and diversity of future organic feedstocks • Need to meet operational requirements and objectives • Must deliver on strategic outcomes • Acceptability of any alternative sites

Figure 3-1 Project objectives and supporting criteria.

Critical minimum standards were developed for matters considered fundamental to the project. The minimum requirements agreed with the Council are presented in Figure 3-2.

	Minimum Requirement
Technology	**FOGO collection –** must be able to receive and process feedstock from current FOGO collection **Scalability -** must be scaleable and upgradeable **Processing emissions -** must not result in increases in GHG emissions, relative to the current processing technology and based upon common feedstock tonnages
Location	**Land area –** must have the minimum land area considered necessary for future upgrading and diversification, for the proposed technology option **Transport emissions** - must not result in increases in GHG emissions, relative to the current transportation needs and based upon common feedstock tonnages

Figure 3-2 Minimum Standards for Assessments and Analysis of Options

A multi-criteria assessment (MCA) process was identified as an appropriate evaluation framework to assess the relative performance of technology and location options. A non-weighted MCA was considered appropriate, as this enabled all criteria to be considered equally and priority applied by those responsible for decision making.

The agreed objectives and performance assessment criteria and related evaluation ratings guidance are presented for the technology assessment in Table 3-1 and for the location assessment in Table 3-2.

The MCA process was then undertaken for the shortlisted technologies and locations and discussed in Section 7, including any limitations with criteria applied.

[5] This criterion was bundled with the technology assessment and removed from site assessment MCA.

4. Assessment of Contributing Factors

4.1 Contributing Factors

The contributing factors identified as being of primary relevance when considering the future management of organics processing in the city are presented in Figure 4-1.

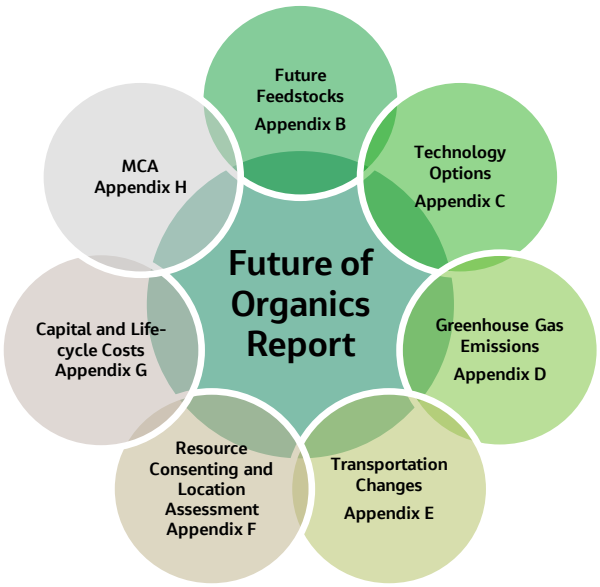


Figure 4-1 Contributing Assessments

The assessment of these contributing factors is summarised in the following sections and the detailed assessment memorandums are attached in the Appendices for reference.

4.2 Future Feedstocks

The purpose of this assessment is to ensure that the technology option selected is capable of accepting and processing the feedstocks likely in the future. Feedstocks are the raw ingredients for composting. Feedstocks will determine the character of compost including nutrients, moisture and value.

This assessment of ***Future Feedstocks*** includes and expands upon the evaluation of feedstocks undertaken [redacted] Additional feedstocks are considered, which may eventuate over time as a result of improved composting technology and changes in market drivers, such as the requirement to remove organics from the landfill waste stream.

The resulting ***Project Objectives and Evaluation Framework*** memorandum is attached in Appendix B. This contains detailed assessment of the likely additional feedstocks and their implication for the ***Future of Organics*** study [redacted]

Key outcomes of this assessment are:

- Increased growth of Food Organics variety and volume is likely to occur for pre-consumer and post-consumer food waste as the Central government's waste minimisation focus and levies take effect. These increases will require updating of the Design Feedstock developed through the 2021 Feedstock assessment and are likely to require an increase in high Carbon (C) and low-density amendments to maintain target Carbon: Nitrogen (C:N) ratios and bulk density.
- Food Organics are more putrescible than garden waste. So an increase in the food organics fraction will increase the risk of odour generation and therefore place increased importance on the suitability of the processing technology, maintaining a good composting recipe (C:N ratios, bulk density, moisture content) and greater process control (maintenance of aerobic conditions) to avoid generation of strong odours that result from development of anaerobic conditions.
- Increased growth will occur from Garden Waste by taking from [redacted] from household collections if larger bins are introduced, which requires updating of the Design Feedstock developed through the 2021 Feedstock assessment.
- Additional Garden Waste with associated increase in C will assist with increasing C:N rations and reducing bulk density, reducing the need for additional high C and low-density supplements.
- Composting or anaerobic digestion **of biosolids** may be considered in future and should be accommodated by the selected technology or future upgrade pathway.
- There is potential for other feedstocks e.g., vineyard waste and paper that could be accepted so technology options should ideally accommodate these, or allow for future adaptability to meet changes in the incoming feedstock

Overall, the **2021 Feedstock Assessment** [redacted] remains relevant, as it provides for general growth and diversity of feedstocks within the 85,000 t/annum **Design Feedstock**. The 2021 Design Feedstock should however be updated to include the additional garden waste and food organics fractions identified through this assessment, prior to design development for a preferred facility, to ensure the organics' processing facility is designed to accommodate these foreseeable changes.

4.3 Technology Options

The purpose of the technology options assessment is to ensure that the technology option selected is capable of accepting and processing the feedstocks likely in the future and meets project strategic objectives such as GHG emissions profiles and costs.

Technology options considered included In-tunnel composting, Aerated Static Pile composting, Windrow Composting and Anaerobic Digestion, as these are commonly used internationally and are low technology and complexity risk to Council.

Technology options identified through Councils RFI process that were not considered at this stage include vermiculture, pyrolysis and wet anaerobic digestion. The reasoning for not considering these technologies at this stage are outlined in Section 5.

Anaerobic digestion is a symbiotic sustainable renewable energy process that can offset energy requirements, so has been evaluated to further understand the merits and need for consideration of anaerobic digestion. It is not a composting technology.

A ***Technology Options Assessment*** memorandum that summarises the assessment is attached in Appendix C. This provides an overview of the process, design, assets, ability to expand, process inputs and outputs, consenting requirements, location considerations and land requirements. Costs and revenues are presented in the ***Cost and Revenues*** Memorandum presented in Appendix G.

Key outcomes of the technology options assessment include:

- Odour and dust emissions are key considerations for technology assessment. The intensity of odour emissions depends on the waste being treated, the scale and method of treatment and management and mitigation measures implemented. Feedstock type and variability influence odour risk daily and seasonally.
- The potential for odour generation and management varies with different technologies, with an overview provided in Table 4-1. For enclosed options, the majority of odorous activities on site can be undertaken indoors within a processing building

Table 4-1 Composting Process and Odour Potential (Contextual Only)

Process Type	Potential for odour generation
Open, static pile/windrow	Highest
Open, turned windrow	
Open, aerated, static pile/windrow, capable of continuous aeration	
Vermiculture without pre-composting	
Covered, aerated, static pile/windrow, capable of continuous aeration and moisture control, open-air maturation	
Vermiculture with pre-composting	
Housed/indoor composting with odour-control equipment and open-air maturation	
Covered process for active and maturation phase with odour-control equipment	
In-vessel[6] (tunnel or drum) aerobic composting with odour-control equipment and open-air maturation	
Fully enclosed facility with enclosed receipts and enclosed maturation phase with best-practice odour-control technology*	Lowest

* Best-practice odour-control technology based on the proposal, may include biofiltration, activated carbon or others.
Source: EPA (2012)

It is noted that the existing Bromley facility is technically "*In-vessel aerobic composting with odour control equipment and open-air maturation*" and therefore theoretically at the more effective end of the odour

[redacted]

[6] TURN INTO ASTERIX of current for reader

[redacted]

For composting facilities the management of objectionable or offensive odour discharge is best achieved by:

- Maintaining good compost recipe including correct C:N, bulk density and moisture content requirements, utilising amendments as required
- Providing adequate peak processing capacity and process control, including provision for use of amendments
- Using a composting technology that enables forced aeration to maintain aerobic conditions, in this case either Aerated Static Pile or In-tunnel composting
- Enclosing critical odour release locations such as receivals hall and screenings area provides good mitigation of the main odour discharges
- Enclosing all compost processing and handling and provision of air collection and treatment provides the greatest control of odour at source

Anaerobic digestion is an all-enclosed technology so the odour generated is collected and treated in the same manner as In-tunnel composting.

The performance of the technology options considered are summarised below:

- In-tunnel composting with full building enclosure and treatment of collected air is the most controlled process. It presents the lowest odour emission risk however it still has potential odour discharge from biofilters and there can be a risk of fugitive odour emissions from open doors or during process upset. Automated process control can significantly mitigate this risk.

  This technology is most suited where Council wishes to implement the highest level of odour control achievable. In-tunnel composting has the highest capital cost due to the scale of buildings and air handling and highest operating costs due to the significant electricity consumption in the process required to control composting process temperatures.

- Aerated static pile composting utilising an enclosed receivals hall and screening area and Gore-Tex covers on aerated static piles to repel rain and control moisture is the next most controlled process. It utilises aeration to maintain aerobic conditions however requires considerably less aeration capacity compared to In-tunnel composting, as the composting process is allowed to run "hotter" and slower with the tradeoff being a need for a greater processing area footprint.

  The receivals processing, compost screening and contamination removal areas are the areas of greatest odour potential so would be enclosed in a building with air collected and treated, in the same manner as In-tunnel composting. The covers on the aerated static piles provide some odour mitigation by condensation and dissolving of odourous compounds however there is an ongoing emission of low-strength odour during normal operation with period of greater odour release when turning piles. Aerated Static Pile operation has less aeration capacity and therefore less process control than In-tunnel composting and is also not enclosed to capture and treat odour, and accordingly the putrescible organic content of the feedstock may need to be limited. Aerated Static Pile is also less forgiving of poor site

operations than In-tunnel composting, requiring correct placement of covers and maintaining a tidy site to avoid odour emissions from uncovered compost. While these odours are generally not likely to be objectionable or offensive, there is potential for long term chronic sensitivity if the composting facility is located close to sensitive receptors. Provision of an appropriate separation distance from sensitive receptors is therefore an important mitigation of the potential adverse effects from odour discharges.

Aerated Static Pile composting has considerably lower capital cost than In-tunnel due to significantly reduced building and air handling infrastructure and lower operating costs due to reduced electricity consumption required for compost aeration.

- Windrow composting is the least controlled process, utilising natural aeration and mechanical windrow turning. Windrows are exposed to rainfall with a resulting increased risk of anaerobic conditions forming, has moderate odour emissions during normal operation and risk of greater odour emissions during turning of piles, particularly if anaerobic conditions develop. It has lowest capital cost but higher operating costs due to increased mechanical effort and labour.

- Windrow curing of compost could be considered for both In-tunnel and Aerated Static Pile composting if an appropriate level of maturation is achieved in the composting process and sufficient a separation distance is provided to mitigate the low-level odour discharges that occur. This would assist to reduce initial capital costs.

- Anaerobic digestion is a sustainable energy production technology that uses the energy dense fraction of the feedstock and requires composting to process outputs. Sizing can be optimised to meet energy requirements for an In-tunnel composting plant.

Overall, the following conclusions are made:

- In-tunnel and aerated static pile composting options are considered appropriate technologies due to their ability to accommodate the expected scale and diversity of future feedstocks, have sufficient process control to manage odour risks and be upgradeable. Correct operation and management are critical to ensuring effective composting.

- In-tunnel composting has greater process control, odour capture and treatment than aerated static pile, so is preferable over Aerated Static Pile where additional mitigation through adequate separation distances to sensitive receivers cannot be provided or where Council wishes to provide a higher level of odour control.

- In-tunnel composting has better ability than Aerated Static Pile to mitigate the effects of process upset due to poor composting recipe or putrescible feedstocks if there is enclosure of all components of the process and sufficient air handling and treatment to capture and treat odorous air.

- Due to the identified limitations on odour control, provision of an appropriate separation distance to sensitive receptors is an important mitigation for Aerated Static Pile composting.

- Windrow composting is considered to have too high a risk of uncontrolled odour generation so is not considered appropriate for a FOGO waste stream. Windrow curing is however considered appropriate for garden waste or where pre-composted material is sufficiently matured and adequate separation distance to sensitive receivers is provided.

- Anaerobic digestion is a good option as a renewable energy source or alternative source of bio-methane production as [redacted] Landfill gas diminishes. GHG benefits include the avoidance of fossil-fuel power production emissions or the avoidance of use of fossil fuel derived natural gas. Implementation of anaerobic digestion as a pre-process to In-tunnel or Aerated Static Pile composting can have a number of benefits including a reduction in secondary processing volume, reduction in the putrescible nature of the composting feedstocks and generation of composting electricity needs, with associated reduction in operational costs and offset of electricity generation GHG emissions. Other potentially valuable byproducts include organic liquid fertilizer and carbon dioxide gas when combusted. Affordability is dependent on scale of Anaerobic Digestion facility, with the payback period potentially being in in excess of 25-years.

It is noted that a using a combination of technologies is possible and relatively common, such as open windrow curing following Aerated Static Pile or In-tunnel composting, subject to the appropriate odour mitigation including adequate separation distance to sensitive receivers.

For the purposes of this assessment, consideration has been focused on a consolidated long-term solution. Once a preferred location and technology is agreed, [redacted]

4.4 Greenhouse Gas Emissions

The greenhouse gas emissions assessment identifies the greenhouse gas emissions for the composting technology and location options and therefore, the significance of greenhouse emissions in the decision of preferred technology and location options. A ***Greenhouse Gas Emissions*** memorandum that summarises the assessment is attached in Appendix D.

Key outcomes of the greenhouse gas emissions assessment are:

- The primary greenhouse gas emission reduction benefit is derived from reducing organic waste being disposed in landfill. Current estimates are that 39.6 per cent of total material going to landfill from our facilities could be diverted; 9.7 % could be diverted to organic collection and treatment.
- The productive recovery of soil amendments through composting supports broader circular economy outcomes. Reducing waste further and increasing the diversity of organic waste processed will further support these outcomes.
- The difference in GHG emissions between technology options are relatively minor, with Anaerobic Digestion capturing Greenhouse Gases for the production of Energy and windrow composting having the highest GHG emissions profile. A summary of technology and GHG emission are shown in Table 4-2.

Table 4-2 GHG emissions of technology and co-benefits

Technology	GHG Direct Impact	Co-benefits for climate change mitigation and circular economy
Anaerobic digestion (AD)*	Lowest emissions 0.02 t CO_2e / t waste	• Electricity generation or renewable natural gas production • Offset of electricity production GHG emissions

Technology	GHG Direct Impact	Co-benefits for climate change mitigation and circular economy
		• organic liquid fertilizer
Gasification/pyrolysis	Low emissions 0.04 t CO_2e / t waste	• Electricity generation • Offset of electricity production GHG emissions • Soil amendment product
Composting	Highest emissions 0.172 t CO_2e / t waste	• Soil amendment product

***Not a composting technology**

- There are relatively minor increases in GHG emissions from transport for new locations that are close to Christchurch and quite significant increases for remote locations such as [redacted] Council would need to mitigate these increases, potentially by replacing the fleet to low emission technologies (EV, Hydrogen), in order to comply with Council's GHG emission strategies and targets.
- Anaerobic digestion is a sustainable renewable energy source of bio-methane, with valuable by products of CO2 and heat when combusted for heating or electricity production, further supporting circular economy outcomes. Anaerobic digestion also provides a compost plant upgrade pathway by reducing the compost process demand of the solid digestate fraction.

4.5 Transportation Changes

The transportation assessment aims to identify changes in travel time, cost and Greenhouse gas emissions for the various location options considered and to understand the significance of transportation in the decision of a preferred location. The ***Transportation*** memorandum is attached in Appendix D.

For the transportation assessment the Christchurch transport model was used to determine the travel times from the centroid of organics collection catchment areas to which annual trips and trip costs were applied and then the difference in costs between those locations [redacted] was determined. This assessment therefore considered the change (increase or decrease) in transportation costs [redacted]

Key outcomes of the transportation assessment are:

- The annual transportation cost differences between new location options in the vicinity of Christchurch [redacted]
- Transporting organics to a more remote site [redacted] requires local consolidation, pre-processing then transport by road and significantly more costly [redacted]
- [redacted] if the collection trucks could dispose kerbside organics at the local transfer stations for consolidated transportation to the organics processing location, not including capital costs for the required facilities. Likely upgrade requirements at each site

would include an additional commercial FOGO receival area for collection trucks, aggregation equipment such as shredder or compactor, and a load-out area for trans-shipping via larger truck and trailer units.

Increased greenhouse gas emissions relative to the increased travel distance are discussed in Section 4.4.

4.6 Location Assessment and Planning Assessment

The location assessment provides an initial assessment of sites suitability to inform the MCA and assess options against the project objectives. It then considers planning pathways for the current and new sites. A ***Planning and Location Assessment*** memorandum that summarises the assessment is attached at Appendix D.

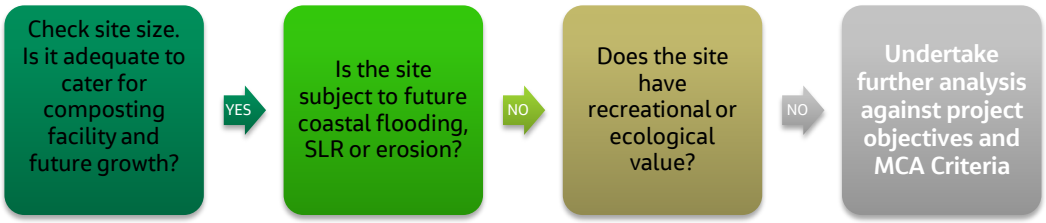
4.6.1 Sites Assessed

The list of sites was provided by the Council. In total, 28 sites (some comprising multiple lots) were provided by Council including those identified through the RFI process. The sites are shown in Figure 4-2. Some are grouped for ease of reference.

4.6.2 Initial filtering of Sites

The first step in assessing the sites was to assess whether minimum critical criteria could be met with regard to size, risk of SLR impacts and recreational or ecological value as shown in figure 4.3. Remaining sites would then be assessed against the MCA Criteria.

Figure 4-3 Location Assessment Process – initial filtering



This 'first cut' of site suitability considered the following:

- **Size** - All new sites smaller than 9 Ha were omitted from further consideration, as the Technology Assessment (Appendix C) concludes that 9 Ha was required to establish the smallest footprint technology, In-tunnel composting, and to provide adequate provision for growth and diversity of future composting technology or incorporation of Anaerobic Digestion. It is acknowledged that an In-tunnel composting facility could be established on a smaller site if required however this might constrain future operational flexibility or adaptability.

- **Risk of SLR Impacts** - Sites were reviewed against Christchurch coastal hazards online portal and hazard maps[7] to assess risk of coastal flooding due to sea level rise (SLR). Sites within areas projected to be prone to flooding by 2040[8] from SLR were considered high risk and discounted.

- **Recreational or Ecological Value** - Sites zoned Open Space, Ecological Value or earmarked for future use were also omitted from further consideration. Open Space Zones and /or reserve status recognise and protect the amenity, recreational or natural values associated with them. The District Plan framework includes several Open Space zones and seeks to avoid activities that do not have a practical or functional need to be located within open space. The Council could seek to revoke this status of sites that have Reserve Status or choose to pursue these activities via a resource consent application. However Jacobs does not consider industrial activities compatible with Open Space functions and has excluded them from further assessment.

As a result of this initial filtering, several potential sites were determined to be unsuitable. Those discounted, respective sizes and reasoning for being discounted are listed in Table 4-3.

[redacted]

[8] Frequency and risk are project increase each decade.

4.7 Planning Pathways for a New Site

There are several pathways for obtaining planning approval at a new site. The key options considered are resource consent applications under the relevant district and regional plans, or a designation as described in the following sections.

4.7.1 Regional Authority Requirements

Regional Plans apply to the discharge of contaminants to land, air and water. Resource consents would be required under the *Canterbury Air Regional Plan* and the *Canterbury Land and Water Regional Plan* for discharges from a composting facility at a new site.

A preliminary review of the statutory framework and Jacobs' experience with similar projects shows that the regional planning framework for all new sites will be the biggest consenting challenge.

The discharge of contaminants to air or water is permitted where certain conditions are met. Given the scale of operation, and based on the existing activity, it is anticipated that resource consent would be required as a discretionary activity under the *Canterbury Land and Water Regional Plan* and a non-complying activity under the *Canterbury Air Regional Plan*. A resource consent can be granted for a *non-complying activity*, but first it must be established that the adverse effects of the activity on the environment will be minor or that the activity will not be contrary to the objectives of the relevant planning plans or proposed plan, known as the 'threshold test'.[9]

Table 4-4 Consent Requirements under Canterbury Regional Plans

Plan	Rule #	Likely Activity Status
Canterbury Land and Water Regional Plan	5.6 – Use of land for the stockpiling of decaying organic matter (including compost) that does not meet the condition of Rule 5.40, as it will not be subject to a Farm Environment Plan.	**Discretionary**

[9] This test is imposed by section 104D of the Resource Management Act 1991.

Plan	Rule #	Likely Activity Status
Canterbury Air Regional Plan	The discharge of contaminants into air that does not comply with condition 1 of Rules 7.47, 7.48, 7.49, 7.50 7.51, 7.55, 7.59 and 7.62 is a non-complying activity.	**Non-complying**

The decision of granting or declining a consent is likely to be decided predominantly on odour and potential effects on sensitive receivers.

Any new site would require resource consent as a non-complying activity under the Canterbury Air Regional Plan. A resource consent application would have to demonstrate that the actual and potential effects of the activity would be no more than minor, or otherwise establish that it will meet the objectives and policies of the relevant planning instruments.

The path to obtaining approvals will depend on the efficacy of on-site management for odour, the meteorology, topography and location of the site, as well as the location, density and nature of sensitive receivers.[10]

To resolve the residual subjectivity about whether a resource consent at any new location is likely to be successful it is recommended that a technical air quality assessment is undertaken for any short-listed sites.

[redacted]

[10] Noting that the location of sensitive receivers for each site is traversed extensively in the corresponding locations assessment and provides one of the crucial elements for settling on shortlisted options that are contained in the main report.
[11] Refer to **Appendix A**.

[redacted]

[redacted]

4.7.3 Alternative Pathways

There are alternative approvals pathways for land use approval from the Council as the territorial authority including designation or plan change. A designation or a plan change provide an alternative pathway for enabling the proposal for sites outside of the Industrial Heavy Zone.[13] Either approach could be subject to the same level of assessments, time frames and public submissions as for a resource consent. The pathways for either a designation or plan change are discussed in the following section.

4.7.3.1 Designation

A designation is a method used to authorise works and activities undertaken by a requiring authority (i.e. a Minister of the Crown, a local authority or a network utility operator) within a particular area, without the need for a land use consent. Designations can apply to both privately-owned land and land owned by the requiring authority.

A designation is a form of 'spot zoning' over a site, area or route identified in a district plan, and is essentially an overlay on top of the zoning. The designation authorises the requiring authority's work and activity on the site, area or route without the need for land use consent from the relevant territorial authority. In effect, land use consents under section 9(3) RMA are not required on designated land (i.e. rules in the Christchurch District Plan would not ordinarily apply) if the activity is in accordance with the designated purpose. Otherwise, compliance with the rules of the underlying Zone is required to be a permitted activity, or resource consent is needed.

Designations are still subject to any restrictions on land use under s.9(1), as well as in relation to air and water. This has a similar effect to a plan change establishing a permitted activity as it:

- identifies (spatially and legally) the land affected in the district plan
- enables a requiring authority to undertake the works within the designated area without the need for a land use consent
- sets the parameters within which the activity must occur.

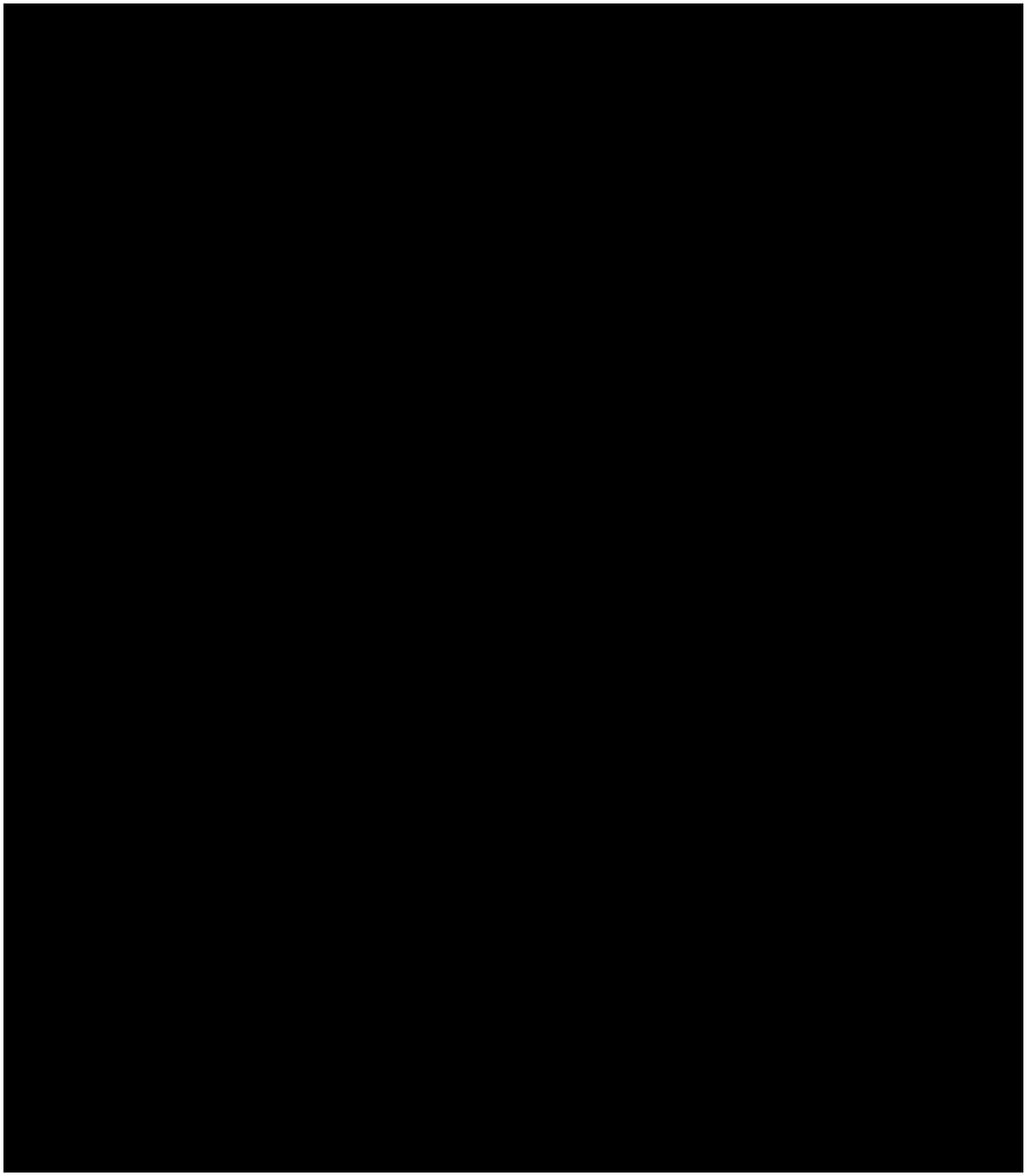
4.7.3.2 Plan Change

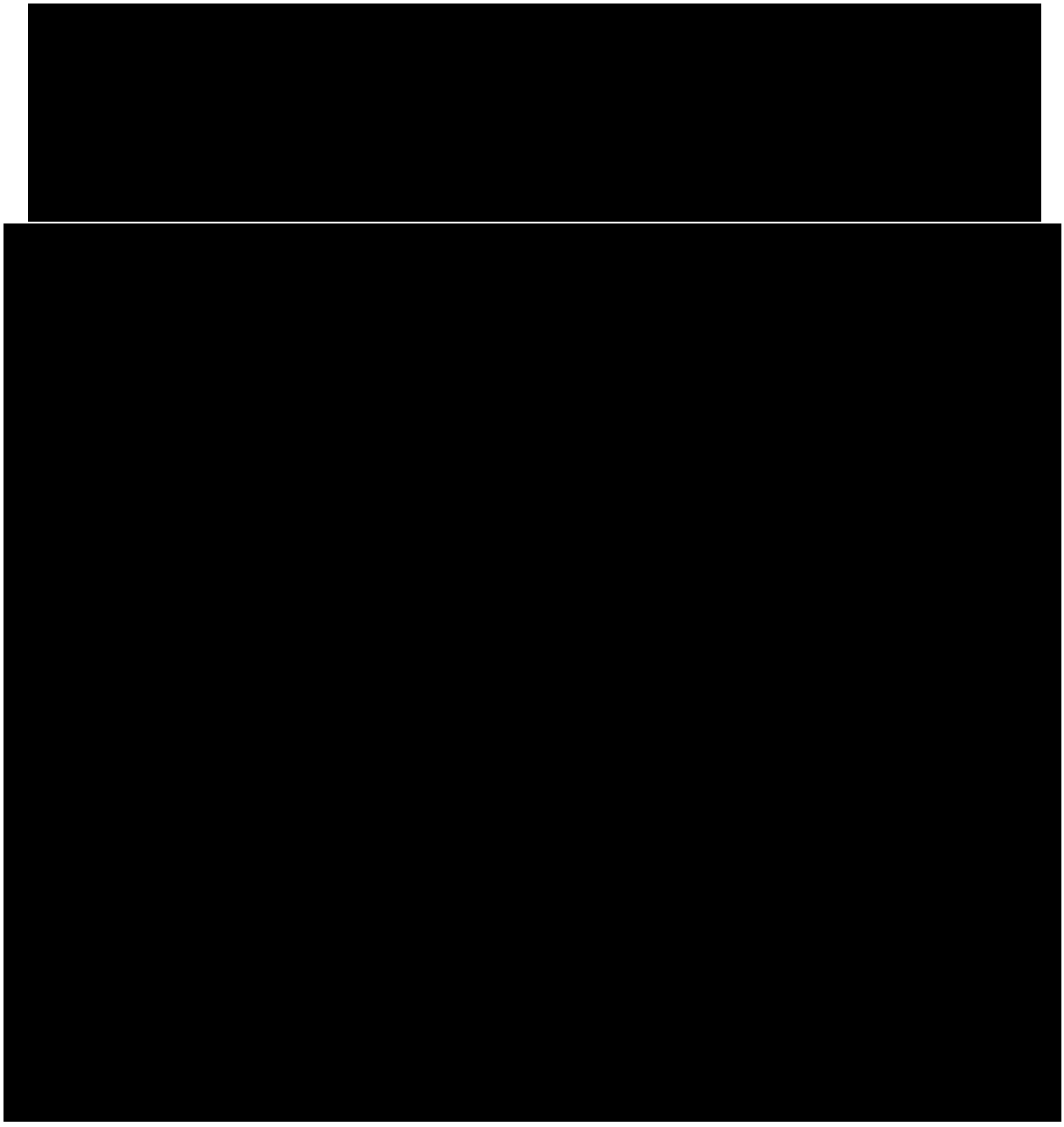
A plan change is the process to make changes to a District or Regional Plan. This may include changing the zoning of a particular area, and/or the deletion, alteration or insertion of rules, policies and objectives. The standard process for a plan change is laid out in Schedule 1 of the RMA. The advantages and disadvantages of various approvals pathways are summarised in Table 4-5.

[13] Noting there may be practical limitations of designation outside of the Christchurch City Council boundary placing limits on efficacy of this approach for the sites proposed at [redacted]

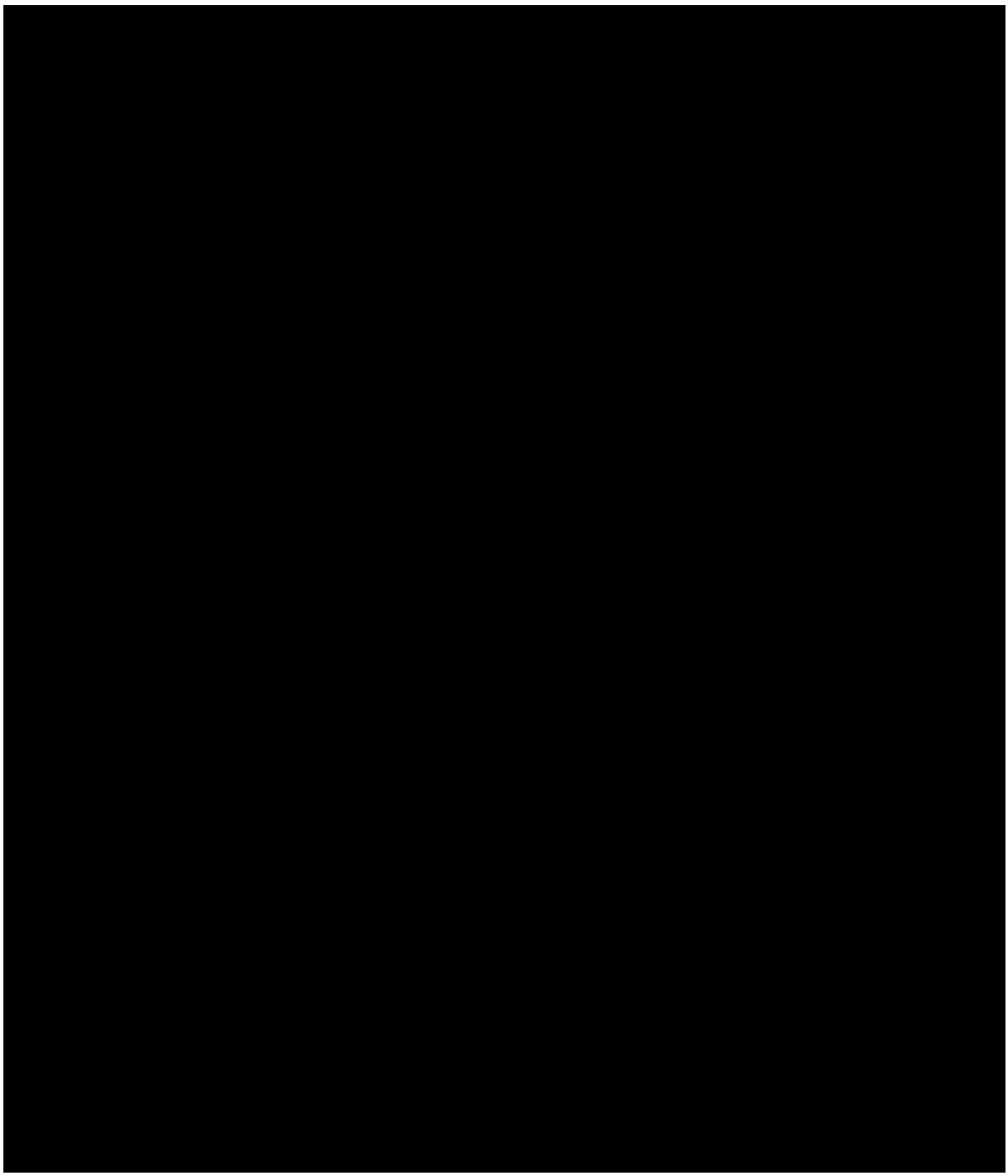
Table 4-5 Comparison of Approvals Pathway Options for Section 9(3) RMA requirements under Christchurch District Plan

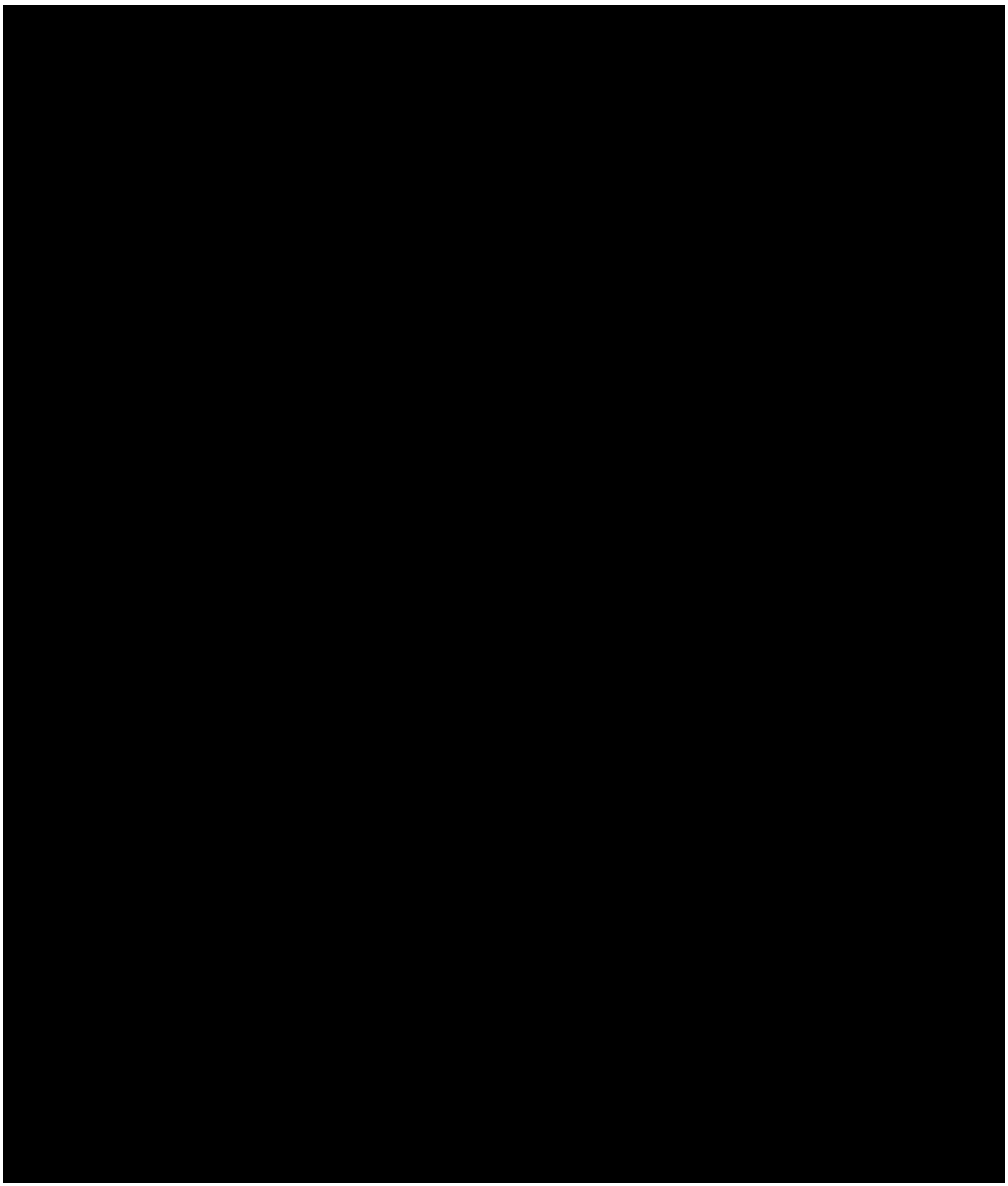
Option	Advantages	Disadvantages
Land use consent under s 9(3) of the RMA	▪ Process is well understood by the public ▪ Allows bundling of consents ▪ Flexibility in following the traditional council pathway or the option remains for direct referral to the Environment Court.	▪ Will have to prove that effects are no more than minor under first limb of s104D, or not be inconsistent with policy framework for non-compliant activities [redacted] ▪ Does not future proof the site
Designation	▪ Removes the requirement for any land use consent normally required under s.9(3) RMA. Not subject to the non-complying test that the majority of sites are for resource consent although underlying land use zoning remains relevant for activities outside the purpose of designation. ▪ Able to be bundled with resource consent applications for a joint hearing when compared to the plan change process ▪ Generally provide for longer-term and more flexible protection compared with a resource consent or plan change ▪ Compared to a plan change cannot be altered by anyone else (other than the requiring authority) ▪ The territorial authority is only able to make a recommendation to the requiring authority compared to a decision made to grant or decline a resource consent ▪ The final decision to accept the territorial recommendation is made by the requiring authority.	▪ May be seen by the community as circumventing the plan change process to which they are more accustomed
Schedule 1 Plan Change	▪ Process is well-understood by the public ▪ Multiple opportunities for the community and stakeholders to provide input	▪ Time – can take up to 2 years ▪ Can subsequently be appealed to the Environment Court (if not directly referred)
Streamlined Plan Change	▪ Time – has proved to be faster than Schedule 1	▪ Limited appeal rights

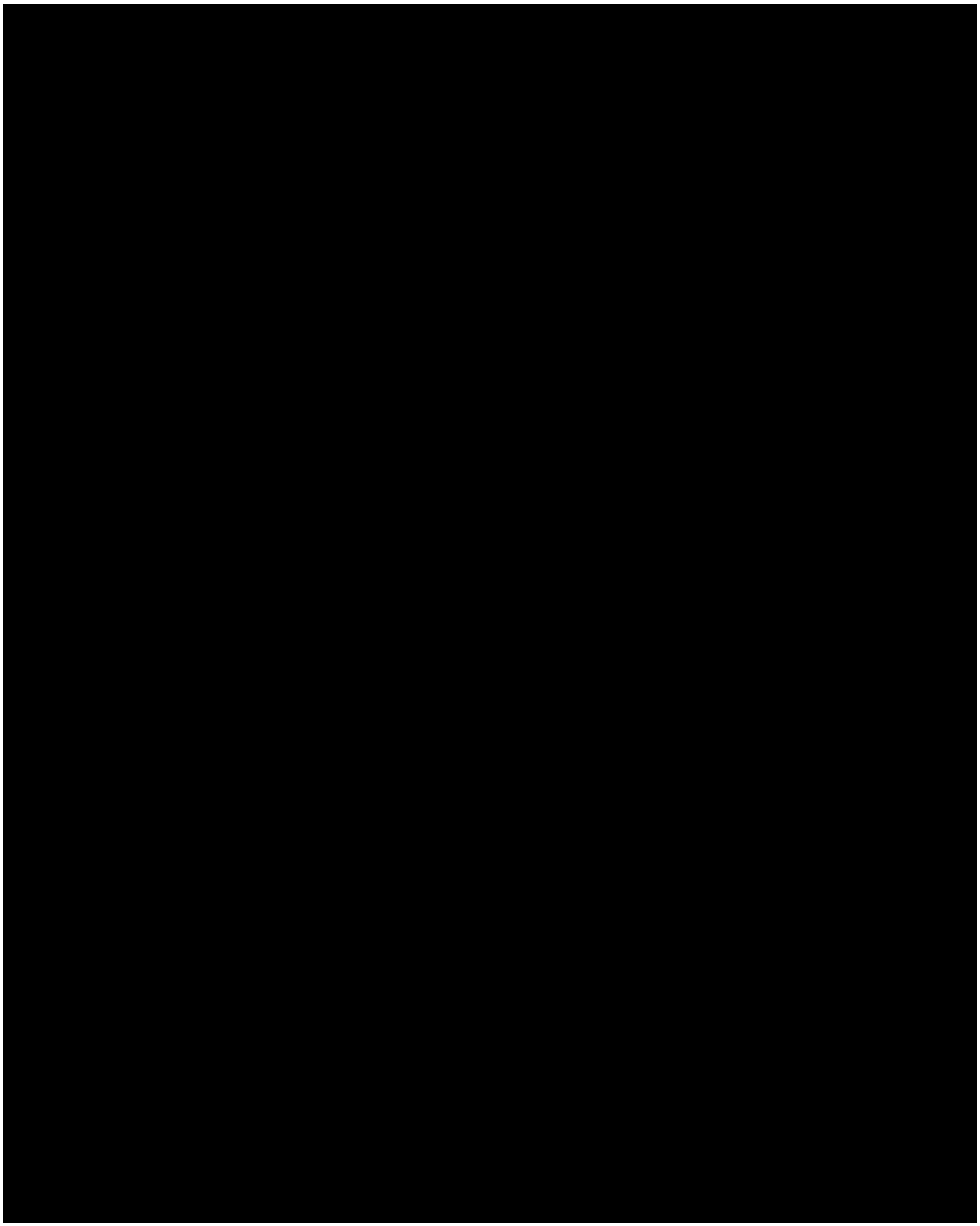


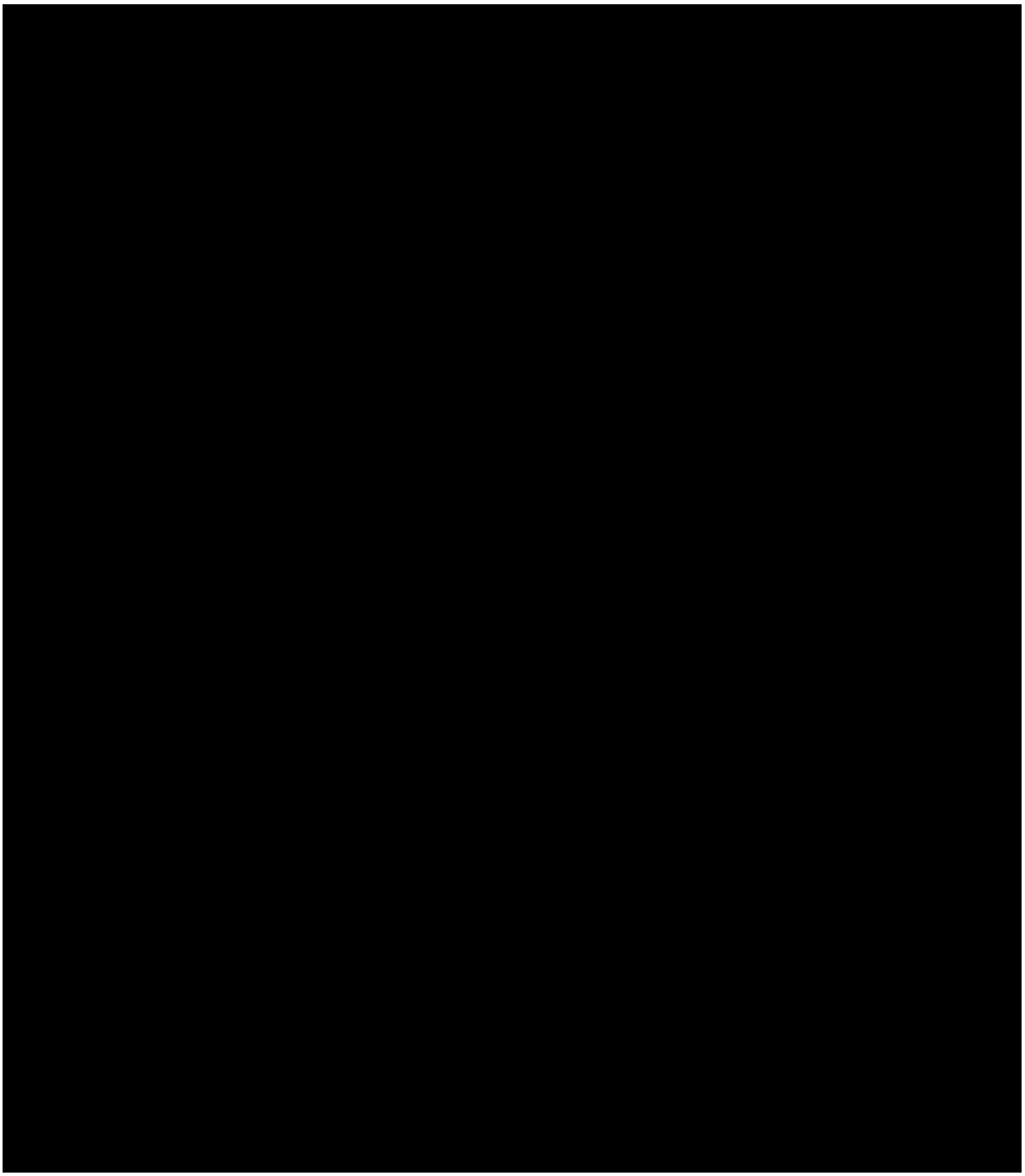


[14] Refer to Section 4.1.1 and Table 6 of the Ministry for the Environment Good Practice Guide for Assessing and Managing Odour (2016) or Section 4.2.1 and Table 8 of the Ministry for Environment Good Practice Guide for Assessing Dust (2016).









4.10 Capital and Life-cycle Cost Assessment

The purpose of the Capital and Life-cycle Cost assessment is to identify the expected costs to build and operate the various technology options at various locations, so that life-cycle costs can be considered when deciding on a preferred technology and location.

A ***Capital and Life-cycle Cost assessment*** memorandum that summarises the assessment is attached in Appendix G.

The Capital and Life-cycle Cost assessment considered a range of contributing costs including:

- Capital construction cost
- Project implementation costs including escalation, consenting, design and management, Council costs and a nominal contingency
- Capital replacement for plant and equipment based upon expected service life
- Operating costs including power, labour, maintenance and compost movement within the process

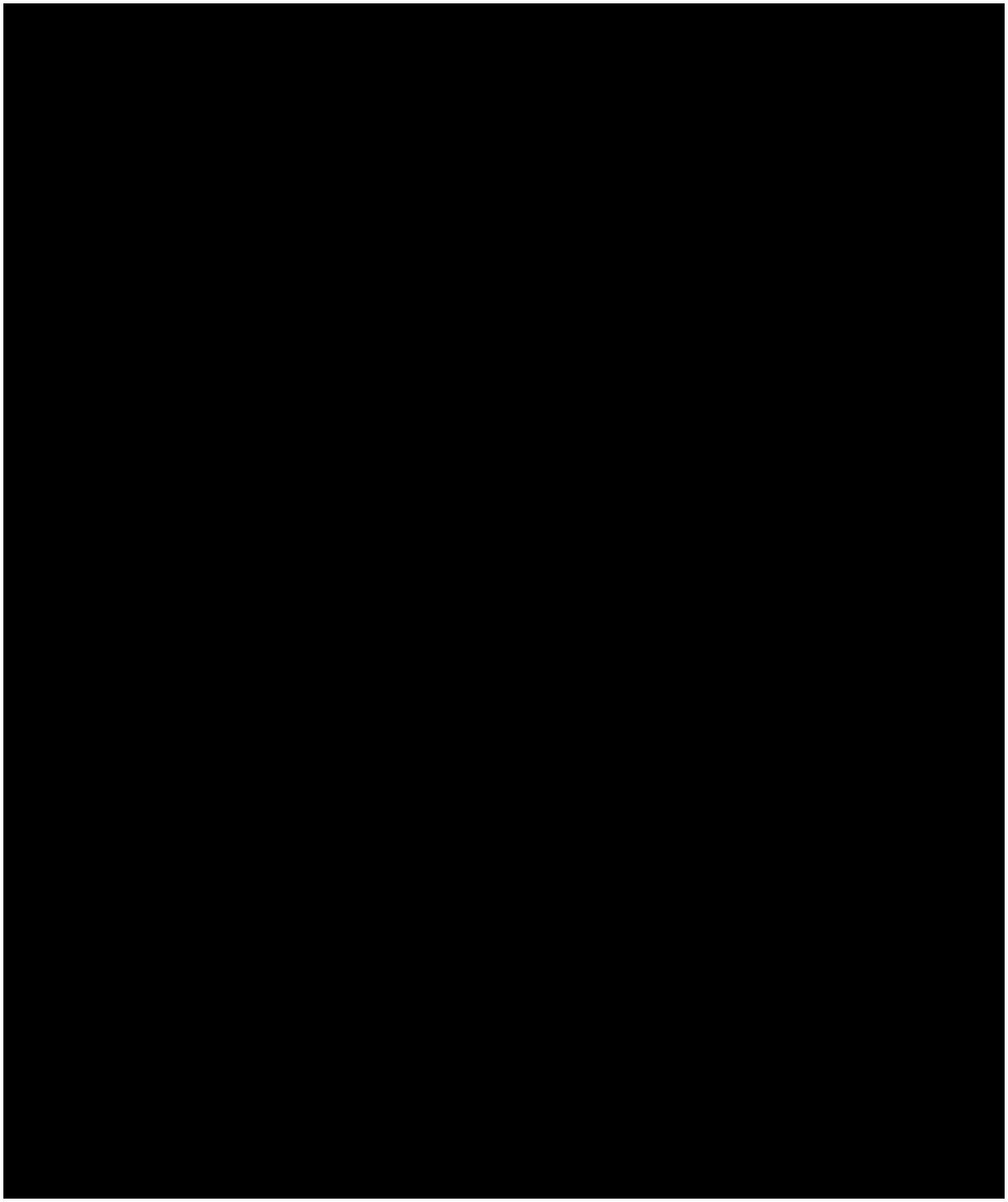
[redacted]

The allowances made for these items are detailed in the Cost Memorandum and summarised below. The cost estimate is expected to have an accuracy aligned with the Class 4 level based on the American Association of Cost Estimating (AACE) guidelines as outlined in the memo in Appendix G.

[redacted]

Project Implementation costs include:

[redacted]



[redacted]

Some broad outcomes from the cost assessment include:

- Total Cost is considered the best metric to demonstrate the most cost-effective location / technology combination over a 25-year horizon.
- Aerated Static Pile as a technology has lower capital, operating, NPV and total costs than In-tunnel.
- [redacted]
- [redacted]
- [redacted]

[redacted]

Once preferred sites are identified and concept designs developed, a more detailed assessment of consenting pathways and risks can be undertaken and the cost differences between options based upon expected start date.

5. Council RFI Process

As part of the *Future of Organics* study, Council sought requests for information from the market to assist in understanding what interest there may be from the private sector to participate in the *Future of Organics*, to see how this knowledge may be of relevance to the *Future of Organics* study. The Council RFI process is summarised in the ***Council RFI Process*** memorandum attached in Appendix H.

A total of 9 responses were received that were evaluated and key outcomes of the RFI process relevant to the ***Future of Organics*** study include:

6. Shortlisting of technologies and locations

6.1 Technology Shortlisting

As discussed in Section 4.3, In-tunnel and aerated static pile composting technologies are both considered appropriate, due to their ability to receive expected scale and diversity of future feedstocks, have sufficient process control to manage odour risks and be upgradeable.

Windrow composting was considered to have too great an odour discharge risk and was therefore not considered as a main composting process. Windrows do remain potentially suitable for maturation of compost, subject to provision of an adequate separation distance to sensitive receptors.

In-tunnel composting is the most effective technology for controlling odour at source so is an appropriate choice where the Council wishes to apply the best technology or where there are sensitive receivers within close proximity.

Aerated Static Pile may be appropriate if sufficient separation distance can be provided to mitigate the effects of odour discharges.

The need for and benefit of providing a separation distance for these preferred technologies is discussed in Section 4.9.1.

6.2 Location Shortlisting

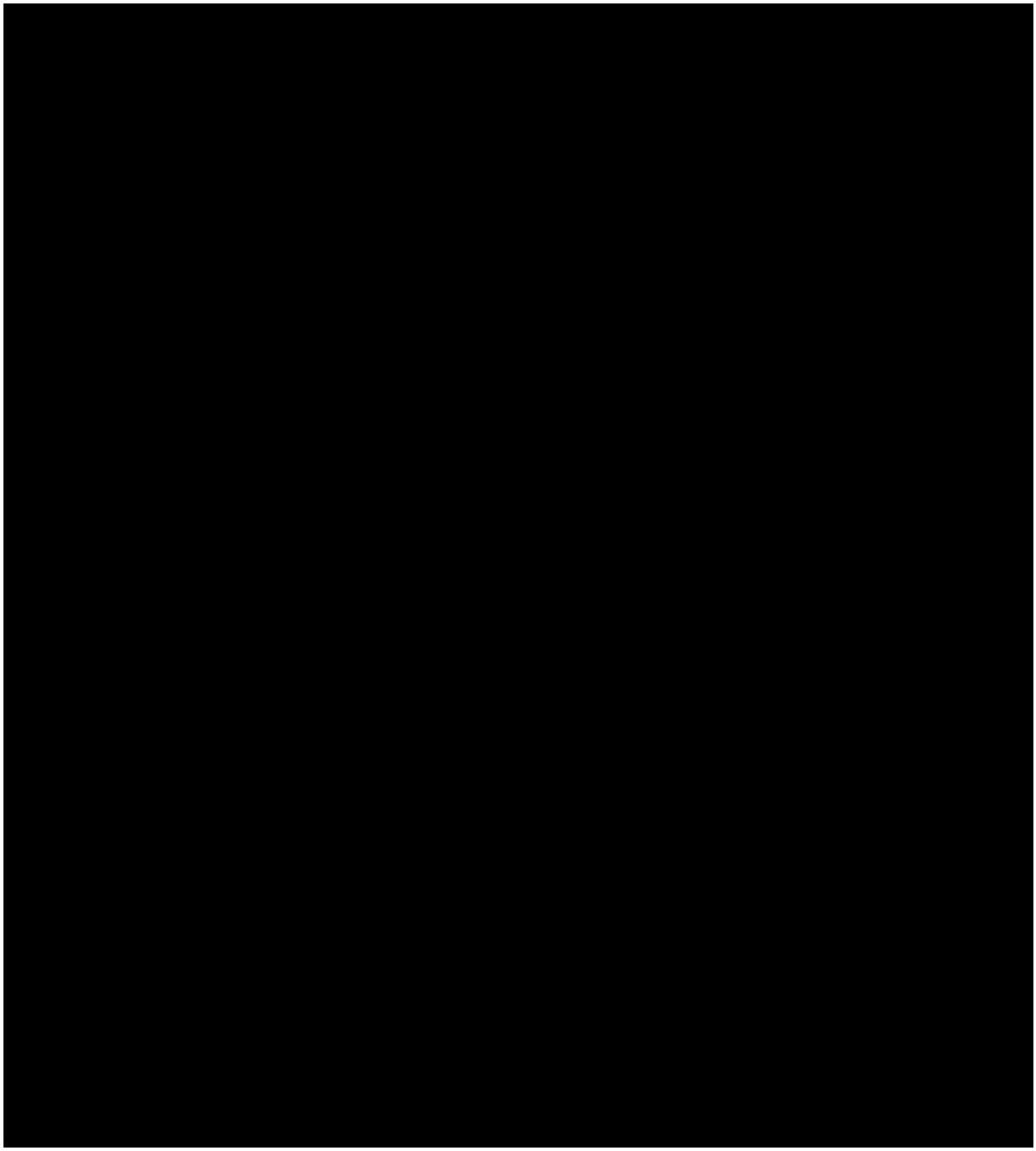
Choosing the location of a composting facility is a significant decision in terms of the sustainability of a composting facility and identifying a site that has all of the required components for a successful operation is complex.

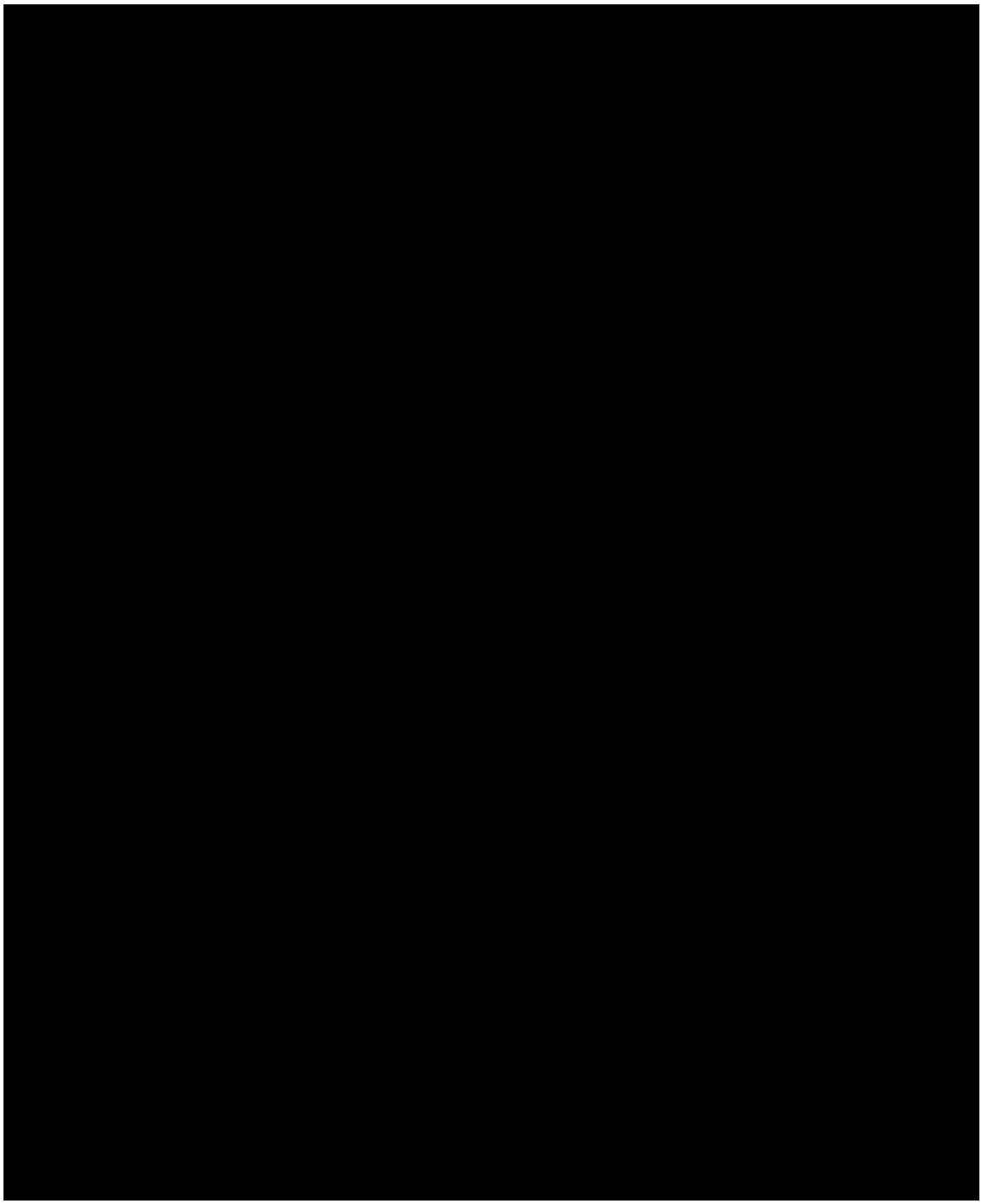
As discussed in Section 4.6.2, an initial review of sites was undertaken to identify those that meet minimum requirements. This review resulted in many sites being considered unsuitable based upon insufficient size, exposure to the impacts of sea level rise or having open space zoning or ecological significance.

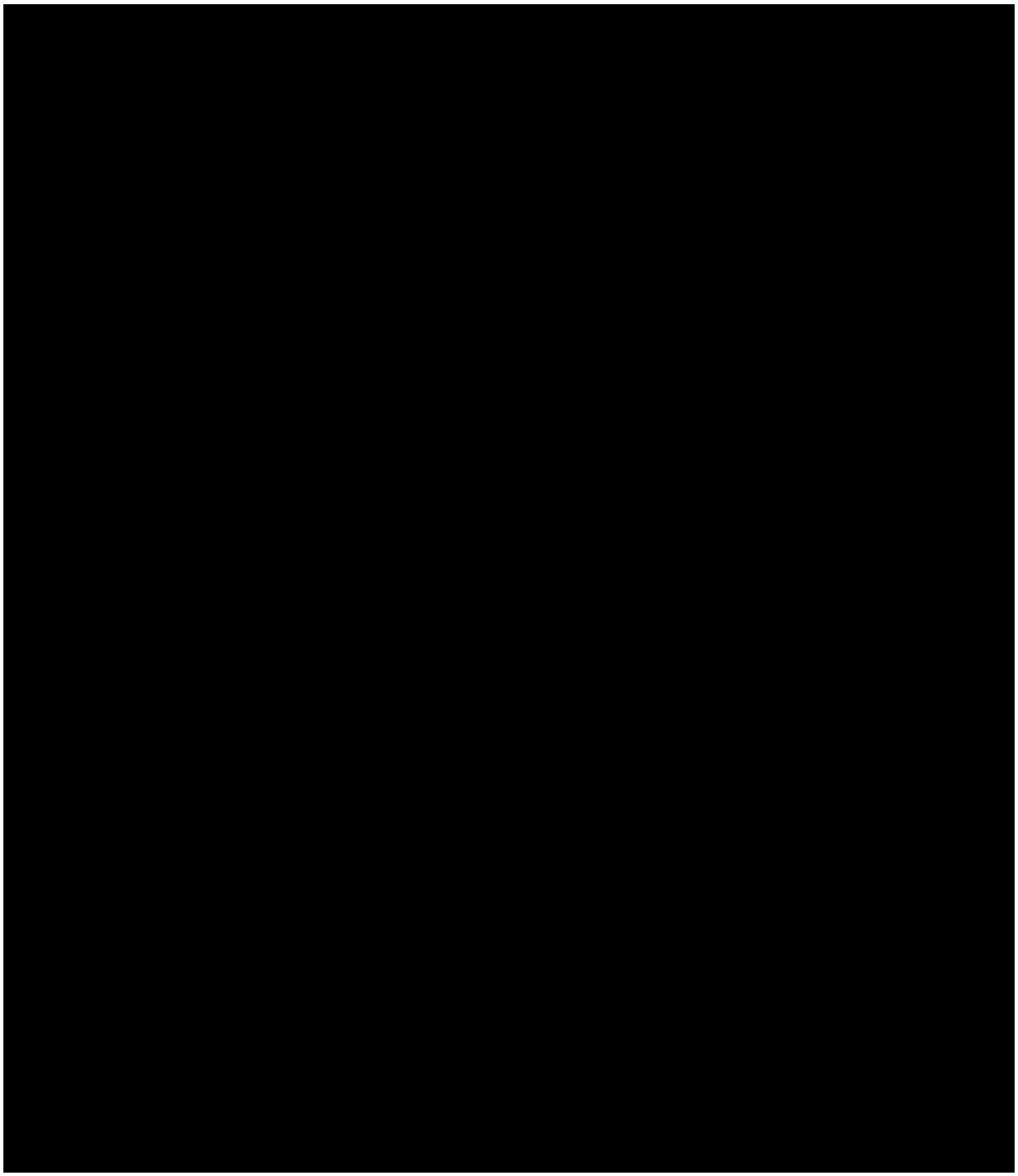
Following this review, the following sites remained in consideration as potential sites for further investigation:

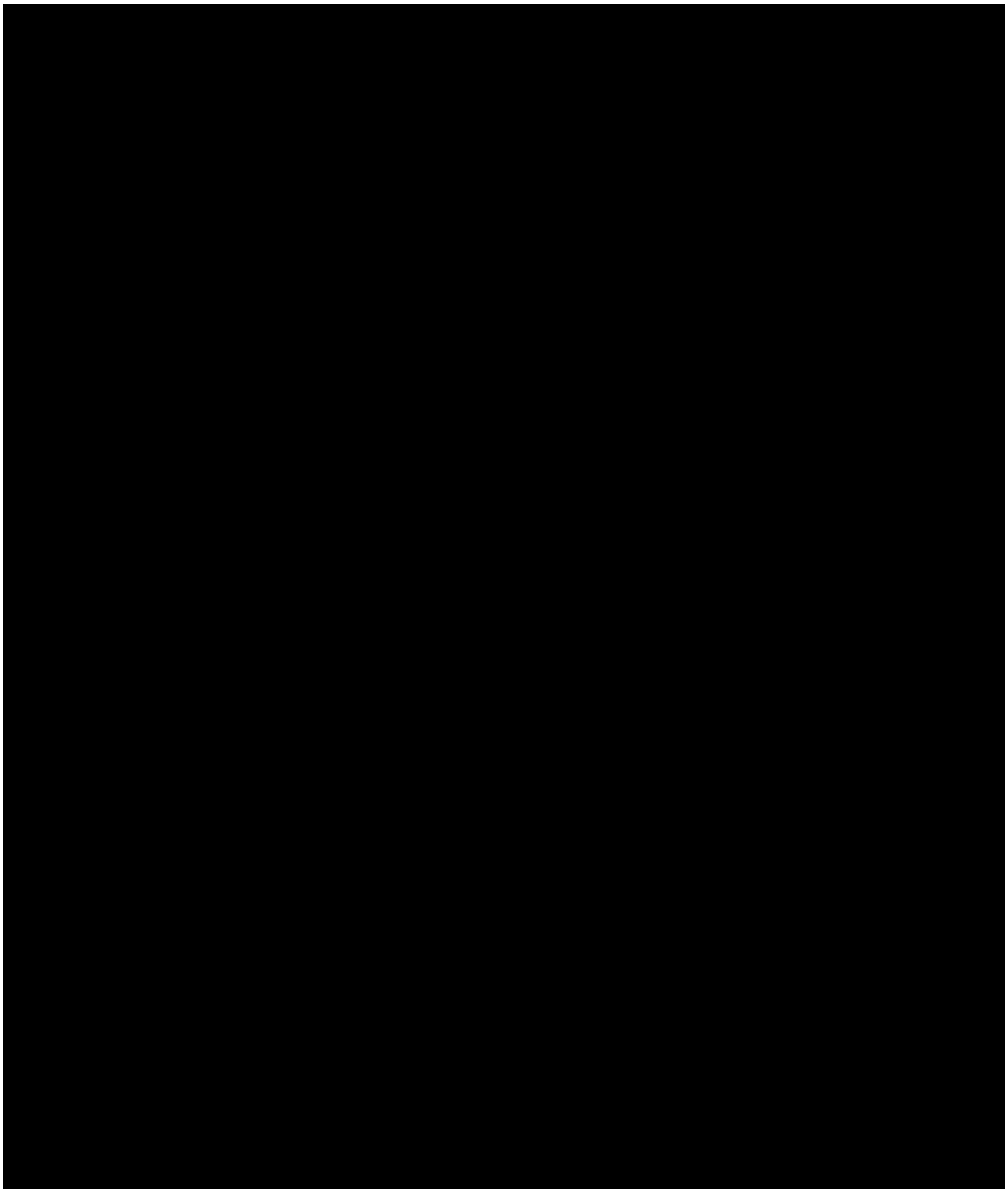
[redacted]

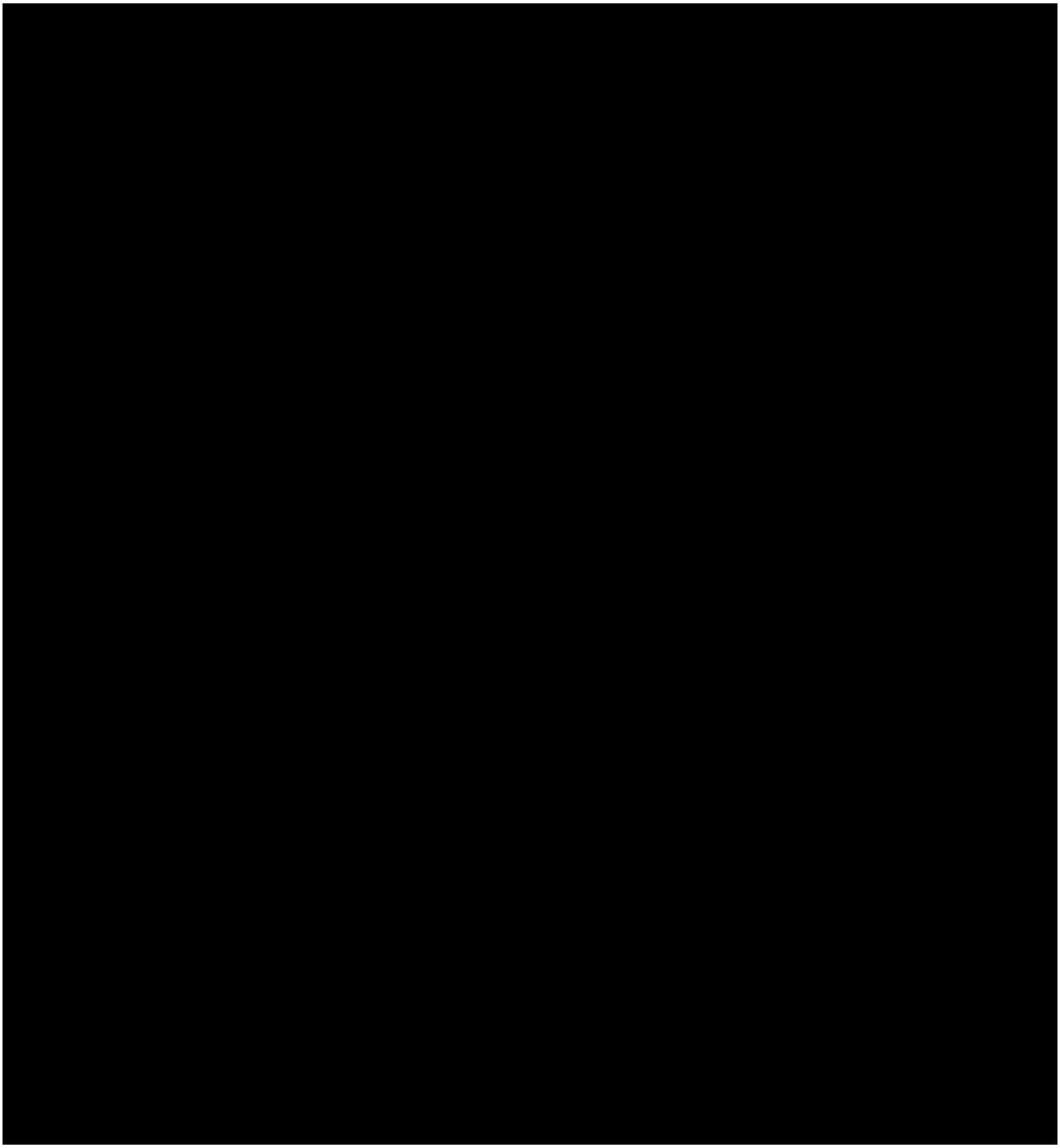
7. MCA Assessment

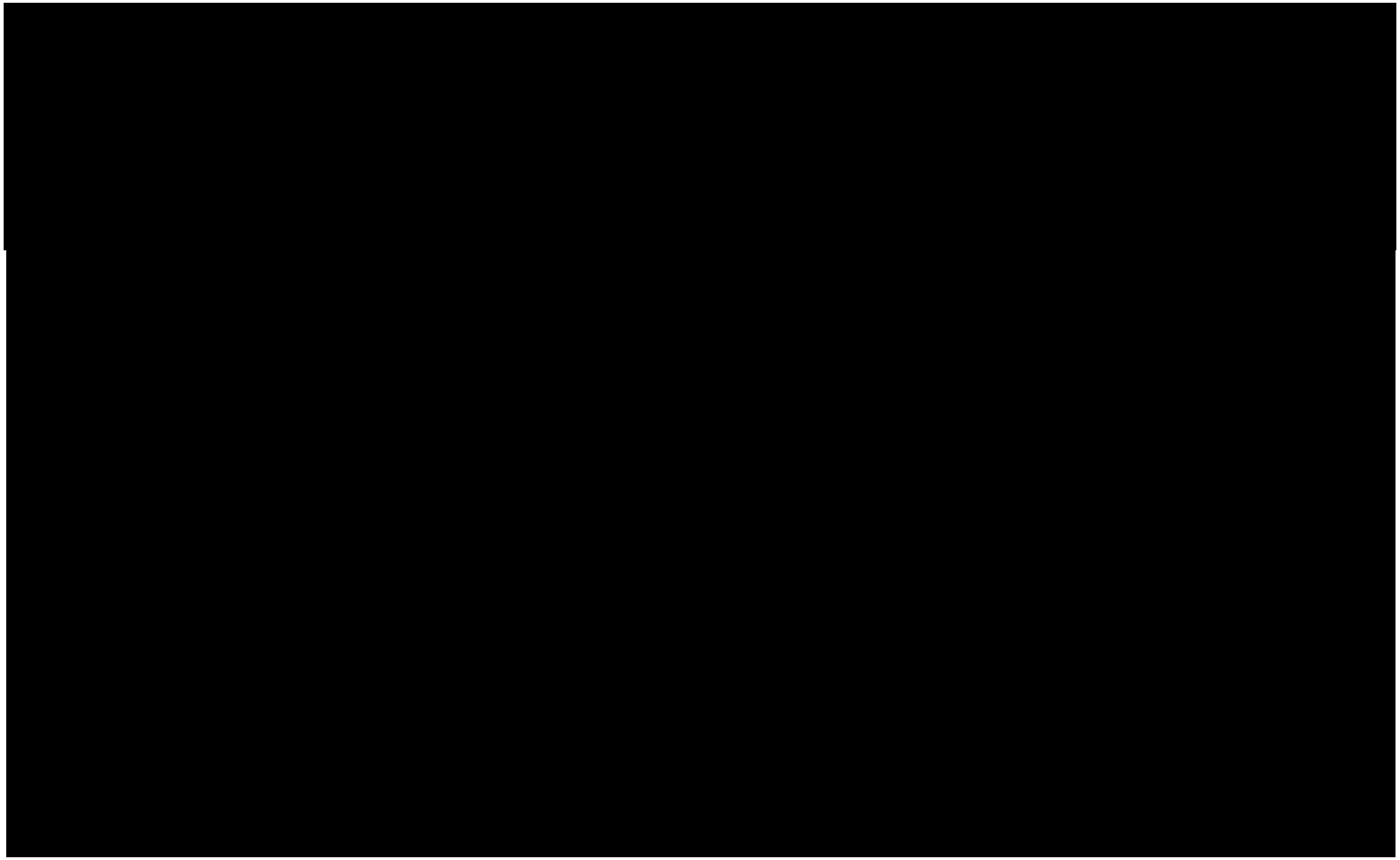


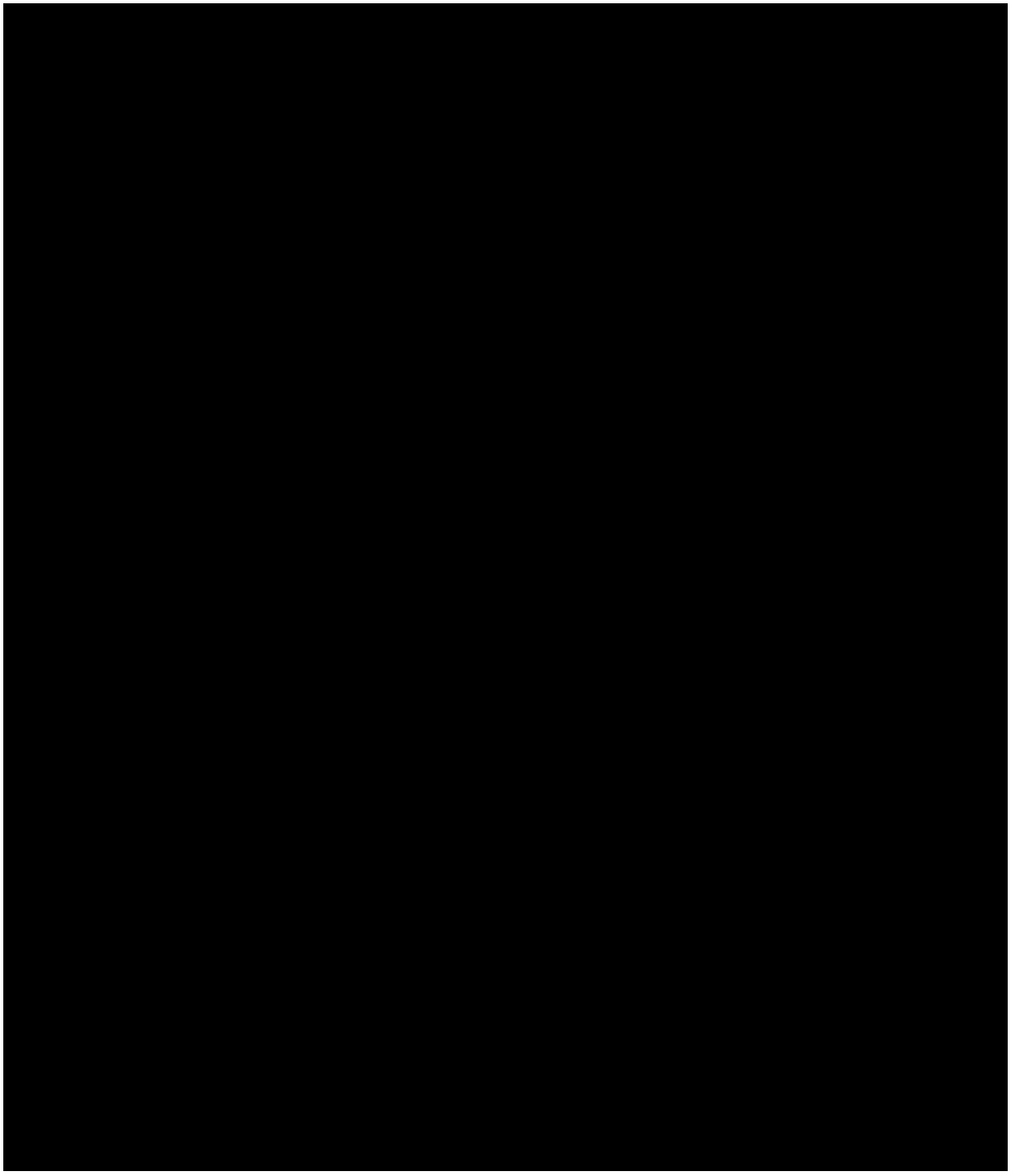


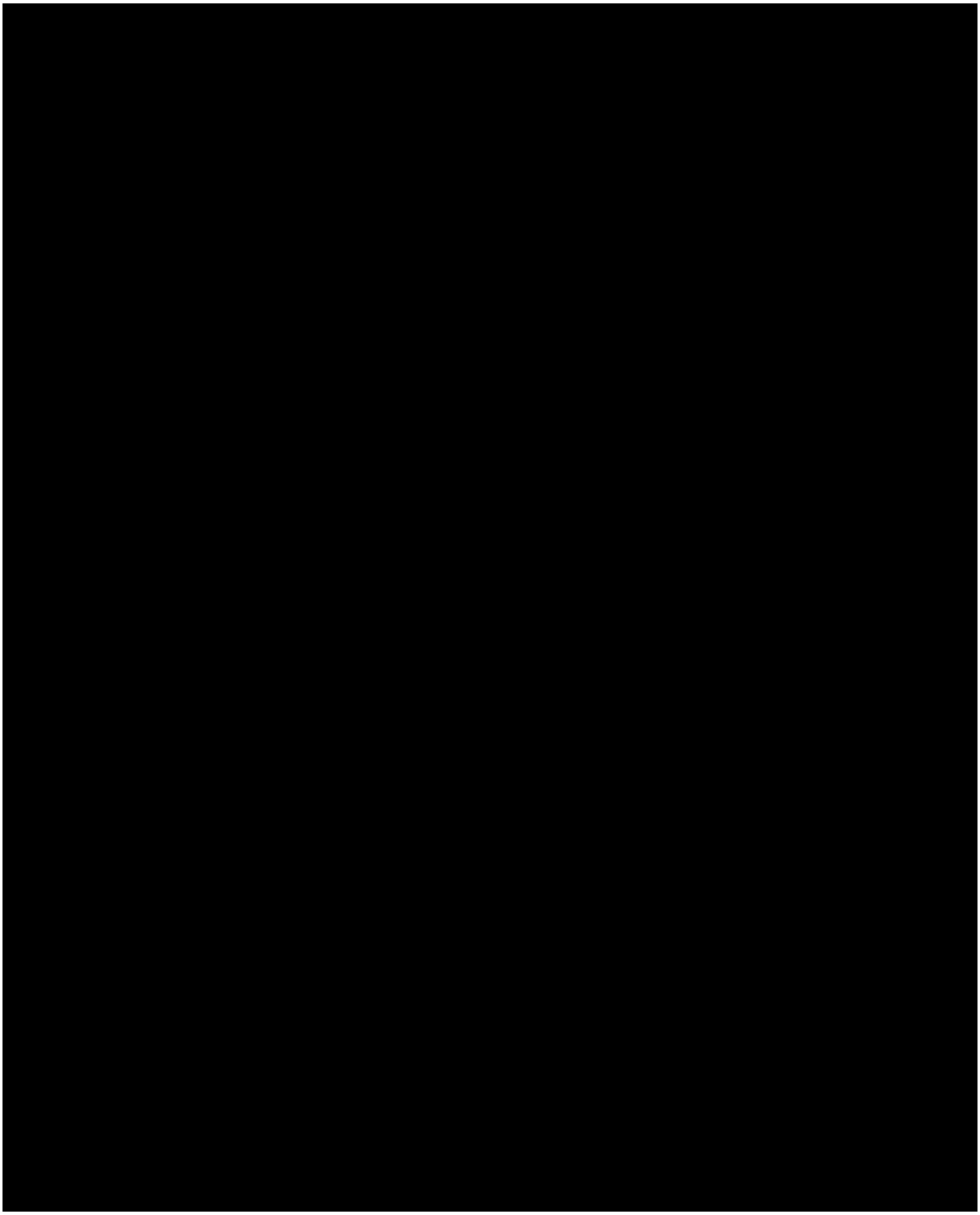












9. Summary of Identified Risks and Opportunities

There are risks and opportunities associated with the remaining location and technology options that require resolution for Council to make an informed decision on a preferred location and composting technology option.

An assessment of foreseeable risks, their potential impact and potential mitigations is outlined in Table 9-1.

Table 9-1 Foreseeable Project Risks

Risk	Potential Impact	Potential Mitigation
Planning and approvals risks applicable to all sites		
Site suitability assessment at this stage is high level due to limited detail of location + technology options and proximity to sensitive receivers and upon greater scrutiny, some of the remaining location options may be discounted	Reduced selection of feasible sites which could be more costly or less favourable options Adequacy of the options assessment process is undermined by limited viable options	Develop outline master plans for all sites, considering current and future development. Undertake more detailed assessment of short-listed sites and re-assess suitability Review final list of viable site + technology options for adequacy of consideration of alternatives Review final list of viable site + technology options for acceptability from Councils economic and sustainability perspective
Challenges to adequacy of the number and appropriateness of locations and the process of short-listing, in light of LGA requirements	Process is challenged or subject to judicial review resulting in delays and potentially decline of approvals sought	Review final list of viable site + technology options for adequacy of consideration of alternatives
Proposed mitigation of effects is considered ineffective and the impacts of the activity are considered more than minor and land use or regional resource consent applications are declined	Revisit site selection and/or upgrade quality of technology Delay to gaining consents with associated risk of cost escalation Increased construction costs if change in technology required (ASP to In-tunnel)	Develop a detailed consenting strategy Ensure robust assessment of environmental effects Engage with affected parties Develop appropriate mitigations
A successful Resource consent decision is appealed to the Environment Court	Additional costs and delay	Develop a detailed consenting strategy Ensure technical assessments are robust Ensure effective mitigation and community engagement. Seek referral direct to the Environment Court.

Risk	Potential Impact	Potential Mitigation
Implementation and operational risks applicable to all sites		
Tendering for design and construction yields limited or poor responses	[redacted]	[redacted] Undertake market EOI once a procurement approach is agreed
Construction cost estimates are inaccurate	Insufficient budget or too conservative a budget	Use of recent tender costs as basis and application o [redacted] contingency and escalation in current cost estimates Re-assess cost estimates at completion of next stage of project
Reduced availability and increased cost of materials	Increase in construction costs	Use of recent tender costs as basis and application of [redacted] contingency and escalation in current cost estimates Re-assess risks at completion of next stage of the project and increase budget contingency I considered appropriate
Market is busy or specialist skills cannot reliably come to NZ	Increase in construction costs	Application of [redacted] contingency in current cost estimates Re-assess risks at completion of next stage of the project and increase budget contingency I considered appropriate
[redacted]		

Risk	Potential Impact	Potential Mitigation
Risks applicable to a new Council owned site		
[redacted]		
Risks applicable to a facility operated by a Private Sector Partner		
[redacted]		

Risk	Potential Impact	Potential Mitigation
[redacted]		

An initial assessment of potential opportunities is provided in Table 9-2.

Table 9-2 Potential Project Opportunities

Nature of Opportunity	Potential Benefit	Proposed Assessment
[redacted]		

10. Conclusions

The assessment presented in this report has identified suitable composting technologies and established their operational characteristics and risks, which has informed the requirements for a facility location and enabled short-listing of sites from the initial list of sites provided by Council.

[redacted]

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Appendix A. Project Objectives and Evaluation Framework

Jacobs

Memorandum

Project Objectives and Evaluation Framework

Subject	**Project Objectives and Evaluation Framework**	**Project Name**	Future of Organics
Attention	Kent Summerfield	**Project No.**	IA253700-NP_MEM-0001
From	Rochelle Hardy and Matthew Sheppard		
Revision History	FINAL		
Date	December 14 2021		
Copies to	**Kent Summerfield (to circulate to relevant CCC staff)**		

1. Purpose

The memorandum sets out project objectives, a Multi Criteria Assessment (MCA) framework and evaluation criteria to inform the assessment of future organic waste processing technologies and locations for Christchurch City Council (the Council).

The objectives represent the Councils strategic and functional needs, and the evaluation criteria enable measurement and comparison of the performance of technology and locations against the objectives.

The draft version of this memorandum was workshopped with Council staff on 02 November 2021 and Council feedback has been received and incorporated into this version (Revision B) of the *Project Objectives and Evaluation Framework* memorandum.

The objectives, evaluation framework and criteria within this memorandum will be used to inform the assessment and evaluation of technology and location options. It is anticipated that following initial review of technology and location options, there may be a need to revisit some of the objectives, evaluation framework and criteria to more accurately reflect the fundamental requirements learned through the assessment and evaluation process.

2. Background

[redacted] As part of Council resolution CNCL/2021/00001, Council requested (among other matters):

- A detailed assessment of processing technology options
- A detailed assessment of potential locations for a new facility and planning, consenting and cost requirements
- An assessment of the impacts of each option on greenhouse gas emissions.

Jacobs

Memorandum

Project Objectives and Evaluation Framework

The first stage in providing this information is to develop specific 'project objectives' based on desired long- term outcomes for organics waste management locally and nationally. This will the ensure the assessment of potential technologies and locations are focused on long term outcomes and are robust and sufficiently detailed to inform advice to Council in March 2022.

The original upgrade objectives of odour management and capacity increase remain relevant and are reflected in the proposed objectives below.

[redacted]

3. Project Objectives

3.1 Factors Influencing Project Objectives

The first stage of the *Future of Organics Study* is to agree specific project objectives to inform the technology and location assessments.

The guiding factors influencing the specific project objectives are varied, however the strategic direction is strongly focused on reducing emissions, minimising waste and supporting wider resource efficiency objectives.

The requirements and expectations considered appropriate to the *Future of Organics* study are presented below, along with discussion of their relevance and resulting specific project objectives.

3.1.1 Strategic Requirements and Expectations

3.1.1.1 National Policy Framework

The Central Government policy framework sets out expectations and broader outcomes for waste management and climate change mitigation in New Zealand via:

- Waste Minimisation Act, 2008
- New Zealand Waste Strategy, 2010
- Climate Change Response Act 2002
- Climate Change Response (Zero Carbon) Amendment Act 2019
- Te hau mārohi ki anamata | Transitioning to a low-emissions and climate-resilient future: Have your say, 2021.

This framework has a strong focus on waste minimisation and provides direction to local authorities on reducing the effects of waste and improving resource efficiency. Central government has agreed that the framework needs updating to achieve a step change in waste management in New Zealand. Continual increases in waste volumes and associated climate change impacts are key drivers for the review. Climate change mitigation is adding more impetus to waste minimisation objectives due to the emissions

generated by current patterns of extraction, production, consumption, transport and disposal. Organic waste and solid waste disposal currently contribute to 81 % of GHG emissions from waste.

The Government's *waste reduction work programme* sets out proposed changes to the national waste management framework and is being led by the Ministry for the Environment (MfE). It is anticipated that new waste management legislation will be introduced in 2023 with significant emphasis on climate change mitigation and focus on specific waste streams including organic waste. Proposed changes to the *Waste Minimisation Act* will include a national licensing system to improve waste data and to help track progress towards a circular economy.

The *Climate Change Response Act 2002* establishes a system of emissions budgets and emissions reduction plans. New Zealand first emissions reduction plan (ERP) will be published in May 2022. This plan will set out the policies and strategies to meet the first emissions budget and set the direction for climate action for the next 15 years. The ERP and will require action across a range of areas, including waste. As such, the ERP is central to the transformation of the waste sector and contributing to achieving a circular economy by 2050.

The *Climate Change Response (Zero Carbon) Amendment Act 2019* provides the broad framework by which New Zealand can develop and implement clear and stable climate change policies. As waste is a key contributor to GHG emissions the advice to Government from the Climate Change Commission (established under the Act) emphasises the need to addresses emissions from waste. The Climate Change Commission recommends reducing waste biogenic methane emissions to at least 40 % below 2017 levels by 2035. This advice has been reflected in MfE' s waste reduction programme and *Te hau mārohi ki anamata Transitioning to a low-emissions and climate-resilient future – discussion document.*

The discussion document proposes a staged approach to reducing GHG emissions from waste as follows:

- Landfill Gas capture at all Class 1 municipal landfills by 2026.
- **All organic material disposal be banned from Class 2–5 by 2030.**
- Key organic materials such as food, green, and paper waste banned from Class 1 landfills by 2030.

Organic material captured under the ban could potentially include food and green waste, fibre (paper and cardboard), wood waste for municipal landfills, and all organic materials to landfills without landfill gas collection, typically smaller or non-municipal landfills[1]. This is consistent with Climate Change Commission's advice to focus on waste reduction and increase recycling systems to divert organic waste from landfill and back into a circular economy.

3.1.1.2 Council Policy Framework

The Council's strategies and plans are consistent with the current national waste management framework and direction, address the important aspects of the over-arching central government direction and are

[1] This would be subject to further assessment and consultation.

considered appropriate to form the basis of strategic requirements and expectations for the *Future of Organics* study.

The key relevant documents are:

- *Otautahi Christchurch Climate Resilience Strategy, 2021*
- *Waste Management and Minimisation Plan, 2020*
- *Christchurch City Sustainability Policy, 2008*

The *Climate Resilience Strategy* and *Waste Management and Minimisation Plan* have been reviewed to inform development of the project objectives of the *Future of Organics* study. The relevant goals and objectives from these documents are listed and assessed for relevance in Appendix A and the resulting proposed project strategic objectives discussed in Section 3.2 and presented in Table 4-2 and Table 4-3.

The *2008 Christchurch City Sustainability Policy* has essentially been succeeded by the *Climate Resilience Strategy* and the *Waste Management and Minimisation Plan* and it has therefore not been assessed in this memorandum.

3.1.2 Operational Requirements and Expectations

In addition to the strategic framework, the Council has a range of operational requirements and expectations that are relevant to the *Future of Organics* study. These are listed and assessed for relevance in Appendix B and the resulting proposed operational project objectives discussed in Section 3.2 and presented in Table 4-2 and Table 4-3.

3.2 Specific Project Objectives

Review of the strategic and operational assessments presented in Appendix A and Appendix B generally identifies that:

- the strategic project objectives generally apply to both technology selection and location selection, with each affecting the strategic project objective differently
- the operational project objectives apply to both technology selection and location selection

The specific project objectives identified in the strategic and operational assessments have therefore been consolidated into ***technology selection objectives*** and ***location selection objectives*** as presented in Table 4-2 and Table 4-3.

4. Options Evaluation

4.1 Minimum Standards

Minimum standards will be applied to the technology and location options assessment to ensure baseline requirements are achieved, as summarised in Table 4-1.

Table 4-1 Minimum Standards for Options Evaluation

Technology	Location
Current FOGO collection – must be able to work reliably and efficiently with feedstock received from current FOGO collection **Scalability** – must be scaleable and upgradeable **GHG emissions -** must not result in increases in GHG emissions, relative to the current processing technology and based upon common feedstock tonnages	**Land area –** must have the minimum land area considered necessary for future upgrading and diversification, for the proposed technology option

4.2 Evaluation Framework

The purpose of the evaluation framework is to assess the performance of individual technologies and locations against evaluation criteria and to compare the performance of individual technologies or locations against one another.

The technology options to be considered include:

- In-vessel aerobic composting
- Static pile aerobic composting
- Dry anaerobic digestion
- Wet anaerobic digestion
- Organics only pyrolysis
- Gasification.

The status of development of each of the technology options is to conceptual level only, and performance assessment is comparatively high-level, however the outcomes are considered appropriate for screening of technology options.

The assessment of locations is limited to sites that have been selected by Council staff and summarised in their *Site Options Investigation for Composting Facility* memorandum.

A non-weighted multi criteria assessment (MCA) approach with broad performance bands is proposed for the evaluation framework, due to its suitability for screening assessments of this nature, however it is recognised that the strategic objectives underpinned by Government policy have a greater importance than operational objectives.

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Project Objectives and Evaluation Framework

The evaluation framework includes specific criteria that can be tested against the project objectives.

4.3 Performance Assessment

For each of the project objectives, evaluation ratings are proposed along with key criteria to be considered when assessing the performance against an objective.

The technology selection is critical to achieving the waste minimization and climate change adaption objectives and for this reason should be undertaken initially and technologies short-listed that are worthy of further consideration. ***Technology Selection Objectives and Performance Assessment Criteria*** are presented in Table 4-2.

Location selection is then critical to identifying a site where the activity can be established and operated in a manner that mitigates adverse impacts on the environment and the community and reduces exposure to climate change and natural hazards. These do not include options to address any restrictions on sites, for example a Plan Change or land acquisition under the Public Works Act. Such matters would be generally discussed as broader project outcomes following the assessment. *Location Selection Objectives and Performance Assessment Criteria* are presented in Table 4.3.

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Project Objectives and Evaluation Framework

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Project Objectives and Evaluation Framework

[redacted]

[redacted]

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Project Objectives and Evaluation Framework

4.4 Application of MCA

The objectives and evaluation criteria agreed with Council will initially provide focus for the assessment of technology and location options. Once completed, the technology and location options will be evaluated by the Jacobs study team using the MCA method and criteria outlined above and provided in draft to the Council project team. This will be followed by a consensus workshop to amend and agree on the MCA assessment.

There are a number of assumptions that will be applied to these assessments including:

- High level order of equivalent carbon emissions (CO_2e) will be used to assess greenhouse gas emissions and carbon footprint assessment (T/annum). Offset costs will be excluded from cost evaluation at this stage. Similarly, we will limit our assessment to comparative emissions between options and will not evaluate the overall impact of CO_2 on the Council or Canterbury Region.
- All facilities can be designed to be operated safely, and health and safety is therefore not seen as a technology differentiator.
- All costs will be based on an agreed design annual waste tonnage and used for the purposes of comparative assessment only.
- Any technology or location options that do not meet key objectives may be eliminated from further consideration.
- Location assessments will initially focus on key criteria, however if a new site is to be sought, more detailed site assessments will be required. Additional considerations potentially include:
    - Availability – council owner, willing seller, compulsory acquisition
    - Infrastructure requirements - power, water, wastewater and local roading
    - Visual impact
    - Stakeholder interest.
- Following an initial assessment of technologies and locations and the lessons learned from this, it may be necessary to undertake a further and more detailed assessment for shortlisted technologies at shortlisted sites.

4.5 Outcomes of MCA

The outcomes of the MCA assessment will be identification of preferred technologies and the identification of a range of location options potentially suitable for the preferred technology options, with associated relative performance evaluation against the project objectives.

The non-weighted MCA approach leaves the weighting of objectives to Council staff and / or decision makers.

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Project Objectives and Evaluation Framework

Appendix A – Evaluation of Christchurch City Council Policies and Plans

Table 4-4 Strategic Objectives and Relevance Future of Organics project objectives

Strategic goal or objective	Specific project objective	Relevance to Organic Composting							
		Different composting technologies have differing GHG emission profiles and/or effects	Different locations have differing transportation requirements and therefore differing GHG emission profiles.	Different locations are exposed to differing impacts from climate change	Different composting technologies have differing resource utilisation profiles.	Different composting technologies have differing energy utilisation and embodied carbon profiles	Different composting technologies have differing potential to expand feedstock type or volume	Different locations have differing cultural, social and environmental sensitivity.	Composting technologies have differing potential to support regional collaboration to advance zero waste and circular economy objectives.
Otautahi Christchurch Climate Resilience Strategy, 2021									
▪ Zero net greenhouse gas emissions (GHG) by 2045 ▪ Halve the 2016 net GHG emissions by 2030 ▪ 50% reduction in in methane by 2045 and a 25% reduction in methane by 2030	Reduce GHG profile through technology selection Reduce GHG profile through location selection	✓	✓						
▪ Council's operations to be net carbon neutral by 2030	Reduce carbon footprint through technology selection Reduce carbon footprint through location selection		✓						

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Project Objectives and Evaluation Framework

Strategic goal or objective	Specific project objective	Relevance to Organic Composting							
		Different composting technologies have differing GHG emission profiles and/or effects	Different locations have differing transportation requirements and therefore differing GHG emission profiles.	Different locations are exposed to differing impacts from climate change	Different composting technologies have differing resource utilisation profiles.	Different composting technologies have differing energy utilisation and embodied carbon profiles	Different composting technologies have differing potential to expand feedstock type or volume	Different locations have differing cultural, social and environmental sensitivity.	Composting technologies have differing potential to support regional collaboration to advance zero waste and circular economy objectives.
▪ Planned infrastructure account for the impacts of climate change (adaptive, risk awareness and avoidance	Avoid or mitigate the impacts of climate change through location selection and infrastructure design			✓					
▪ Transition away from resource intense industries	Reduce resource usage through technology selection				✓				
▪ Greening of infrastructure with new infrastructure to utilise low-energy solutions and minimising embodied carbon	Reduce energy usage and reduce embodied carbon through technology selection					✓			
▪ Reduce transport emissions	Reduce transportation requirements through location selection		✓						
▪ Maximise composting or organics	Maximise potential feedstock type or volume						✓		

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Project Objectives and Evaluation Framework

Strategic goal or objective	Specific project objective	Relevance to Organic Composting							
		Different composting technologies have differing GHG emission profiles and/or effects	Different locations have differing transportation requirements and therefore differing GHG emission profiles.	Different locations are exposed to differing impacts from climate change	Different composting technologies have differing resource utilisation profiles.	Different composting technologies have differing energy utilisation and embodied carbon profiles	Different composting technologies have differing potential to expand feedstock type or volume	Different locations have differing cultural, social and environmental sensitivity.	Composting technologies have differing potential to support regional collaboration to advance zero waste and circular economy objectives.
	through technology selection								
Waste Management and Minimisation Plan, 2020									
▪ Waste Management and Minimisation Plan, 2020									
▪ Improve organics processing plant to accept more products, increase capacity and address odour	Maximise potential feedstock type or volume through technology selection						✓		
▪ Make sure the organics facilities support climate change emissions targets	Reduce GHG profile through technology selection Reduce GHG profile through location selection	✓	✓						
▪ Make sure our waste management facilities and services avoid adverse effects to	Avoid or mitigate adverse effects to people and the environment through	✓						✓	

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Project Objectives and Evaluation Framework

Strategic goal or objective	Specific project objective	Relevance to Organic Composting							
		Different composting technologies have differing GHG emission profiles and/or effects	Different locations have differing transportation requirements and therefore differing GHG emission profiles.	Different locations are exposed to differing impacts from climate change	Different composting technologies have differing resource utilisation profiles.	Different composting technologies have differing energy utilisation and embodied carbon profiles	Different composting technologies have differing potential to expand feedstock type or volume	Different locations have differing cultural, social and environmental sensitivity.	Composting technologies have differing potential to support regional collaboration to advance zero waste and circular economy objectives.
people and the environment	technology and location selection								
▪ Collaborate with industry operators and Central Government, to support a regional and national transition to zero waste and a circular economy	Create opportunities for regional collaboration that advance zero waste and circular economy objectives.								

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Project Objectives and Eval

Appendix B – Evaluation of Christchurch City Council Operational Objectives and Requirements

Operational goal or objective	Relevance	Specific project objective
Maintain current levels of service w.r.t. frequency and form of current FOGO collection system	Composting technology must work for current FOGO collection system	▪ Composting technology must work for current FOGO collection system
Divert additional organic waste from red bins	Increase in feedstock volume	▪ Allow for increase in FOGO collection volumes in design feedstock due to diversion from landfill
Increase pre-consumer food waste collection	Increase food waste component of feedstock	▪ Allow for increase in food waste component in design feedstock
Provide for additional capacity growth and/or future technology change	Increased feedstock volumes will require room for expansion. Changes in technology may require room for expansion.	▪ Provide for expansion of facilities in location selection.
Obtain and operate facilities in accordance with Resource Consent conditions, to mitigate adverse effects on the social, cultural and natural environment	The activity must be established and operated lawfully and in compliance with all Resource Consents	▪ Seek to minimise the risk of gaining and operating in accordance with Resource Consents through technology and location selection
Minimise whole-of-life costs for the whole organics cycle including FOGO collection, composting and disposal, as well as the additional incurred costs of transition from the existing situation.	Different composting technologies have differing capital and operating cost profiles. Development of a new facility at a new site will have programme implications with associated costs.	▪ Seek to minimise NPV of capital, operational and transition costs using 25-year duration and 4% discount rate
Implement upgraded or new facility in a timely manner	Additional cost is being incurred to temporarily manage odour at the current facility. Delay in implementation of an upgrading or now facility project will likely result in increased costs.	▪ Seek to minimise the time required to implement an upgrade or new facility

Appendix B. Future Feedstocks

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Subject	**Additional Feedstocks Assessment** *Rev D*	**Project Name**	The Future of Organics
Attention	Kent Summerfield	**Project No.**	IA253700-ZA_MIN-0001
From	Matt Sheppard		
Date	16 February 2022		
Copies to	Jordan Norris - Jacobs		

1. Introduction

Christchurch City Council (the Council) is reviewing the future of organics processing in the city (Future of Organics study). [redacted]

As part of the Future of Organics study, the Council has requested the consideration of additional feedstocks due to growth and/or increased diversity of organics collected. Additional feedstock may influence the size of the site required to cater for increased volumes of feedstocks. Changes in feedstock also affect design and operation of composting facilities.

[redacted]

1.1 Scope

This is a high level assessment to identify types and indicative scale of feedstocks that might be available within the market. It provides a qualitative discussion of how the additional feedstock impacts the consideration of processing technologies and site area requirements.

The outcomes from the previous Feedstock Assessment are presented and adapted in this memo to reflect how potential additional feedstocks may affect the Design Feedstock for the *Future of Organics* study and commentary is provided to inform how such changes might influence the selection of organics processing technology.

1.2 Limitations

The following limitations apply to this assessment:

- No consultation has been undertaken with potential providers of additional feedstocks to validate availability or quantity.

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Additional Feedstocks

- [redacted]

1.3 Abbreviations

Abbreviation	Explanation
AD	Anaerobic digestion
C:N Ratios	Carbon : nitrogen ratio
CW	Commercial waste
FOGO	Food organics and garden organics
GW	green waste as collected at the transfer stations
KSO	Kerbside organics (FOGO)
SDC	Selwyn District Council
WDC	Waimakariri District Council
WMMP	Christchurch City Council Waste Minimisation and Management plan, 2020

2. Potential additional feedstocks

Population growth and the need to reduce green waste going to landfill are key drivers of increased volumes and diversification of waste types. Increased waste levies and restrictions on green waste in landfill are being proposed as part of the Government waste management reforms.

The Council has identified the following additional feedstocks based on the current market. No assessment of potential quantities that are available or consideration of present disposal or re-use approaches has been undertaken at this stage.:

Feedstock	Source
Council KSO growth	> increased diversion from red bin plus general growth
SDC KSO + Growth	> increased diversion from red bin plus general growth
WDC KSO + Growth	> increased diversion from red bin plus general growth
Council GW	> use of garden waste from Styx Mill and Parkhouse Road transfer stations that is presently not processed at Bromley
[redacted]	
Other commercial composting	> diversion from other processors
Pre-consumer food waste	> cost incentivisation to divert organics from landfill resulting from WMMP
Non-food waste such as paper, biosolids, grease trap collections, etc	> potential additional source, diverted from landfill

3. Impact of potential additional feedstock on processing technology selection

A change or increase in feedstock has the potential to affect the following design parameters that are relevant to the selection and operation of organics processing technologies:

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Additional Feedstocks

- Peak processing demand and seasonal variations
- Bulk density
- C:N ratio

A change in feedstock also has the potential to impact the following operational aspects:

- Energy demand / return
- Odour generation potential
- Cultural / societal acceptability of composting products.

The impacts of potential additional feedstocks on each of these factors are discussed in the following sections.

3.1 Peak Processing Demand and Seasonal Variations

The Design Annual Tonnages (tonnes/annum) derived in 2021 for the upgrade of the existing Bromley Organics Facility Upgrade project are presented in Appendix B. This forms the basis of assessment of the potential impact of additional future feedstocks.

A qualitative assessment of how potential additional feedstocks may affect the overall design annual tonnage adopted for the *Future of Organics* study is presented in Appendix A.

Based on this assessment, the potential additional feedstocks are expected to have the following impact on the 2021 Design Feedstock:

Feedstock	Anticipated Outcome
KSO	> A general increase in KSO annual tonnages will occur due to population growth > A small step increase in KSO annual tonnages is likely, possibly in the order of 10%, as diversion of FOGO from red bins is achieved resulting from increased emphasis being placed on diversion of organics from landfill and associated increased costs due to Waste Levies. This is likely to be of similar composition to existing KSO collections.
CW	> An increase in CW annual tonnages is likely in pre-consumer FO from manufacturing and service industries, possibly in the order of an additional 50% above 2021 Design Feedstock allowance, resulting from increased emphasis being placed on diversion of organics from landfill and associated increased costs due to Waste Levies.
GW	> An increase in GW annual tonnages, possibly in the order of an additional 10,000 t/annum to 15,000 t/.annum above 2021 Design Feedstock allowance, as Council has decided to take GW from all its transfer stations to a centralised organics processing facility

Peak processing demand occurs during spring due to the increase in garden waste including grass and plant materials. KSO increases are expected to be reasonably consistent across the year and will therefore not result in a change in peak season or a disproportionate increase in peak seasonal demand.

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Additional Feedstocks

Increased acceptance of FO as assumed for the increase in CW component in Appendix A will result in a minor increase in bulk density and a minor reduction in C:N ratio, both of which require the use of some additional amendments to reduce density and increase C:N ratio to a more optimum range. This will have the effect of increasing the processing capacity required and composting process control to avoid these more putrescible organics from decomposing under anaerobic conditions.

As Council starts accepting GW from all its transfer stations, this would result in a more significant increase in peak season processing demand, directly related to the volumes taken and projected growth over time.

3.2 Bulk Density

[redacted]

The existing feedstock is denser than desired during peak time and currently requires amendments to processing to reduce density to achieve good composting. Any increase in density of organics resulting from additional feedstocks will have a commensurate need for additional amendments to reduce density, with flow-on effect of increasing processing demand.

The likely impact of potential additional feedstocks summarised in Section 3.1 on bulk density include

Feedstock	Anticipated Outcome
KSO	KSO > increased KSO likely to be of similar density and seasonal characteristics therefore minor impact on design density
CW	> Increased CW likely to be mainly FO, which are denser than GO or GW, so likely to result in an increase in organics density and thereby potentially requiring additional GW or bulking agents to reduce the overall density
GW	> Increased GW is generally less dense than typical FOGO density, so may reduce overall density during the critical design season and may supplements amendments presently required to reduce density during the critical Spring period

3.3 C:N Ratio

[redacted]

Amendments include recycled screenings supplemented by sawdust with associated increased in design tonnage and cost for supplementary amendments. During the critical spring season, amendments are used at a ratio of 2 incoming KSO : 1 amendments, with associated large increase in processing demand.

Sawdust is particularly problematic as an amendment for increasing C:N ratio because it increases the bulk density of the mixed feedstocks. Amendments used to increase C:N ratio should ideally be sufficiently

bulky and lower density to prevent an increase in bulk density. An increase in GW tonnages will also help to balance the C:N ratio at optimal levels.

The likely impact of potential additional feedstocks summarised in Section 3.1 on C:N ratio include:

Feedstock	Anticipated Outcome
KSO	> increased KSO likely to be of similar characteristics to existing, so the C:N ratio and seasonal variations are unlikely to be affected
CW	> Increased CW is likely to be mainly FO, which is likely to lower C:N ratios, thereby potentially requiring additional bulky amendments to increase the C:N ratio
GW	> Increased GW is generally higher in C, so will increase the C:N ratio generally and more beneficially during the critical Spring season and supplement the use of amendments currently required

3.4 Energy demand / Return

Different organics processing technologies have different energy demands and the potential additional feedstocks may impact on these. The common organics processing technologies are presented in Table 1, along with their general energy profile and likely impact from potential additional feedstocks.

Table 1: Organics Processing Technologies and their Energy Profile

Technology	Description	Energy Profile	Effect of Additional Feedstocks
Static pile	Static rows outdoor that are turned periodically	Mechanical energy to turn and screen windrows	Small increase in energy use proportional to increased tonnages
In-vessel aerobic composting	In-tunnel composting with forced ventilation to maintain temperature	Large electrical demand	Small increase in energy use proportional to increased tonnages Further increased energy use with increase in FO
Anaerobic digestion	In-vessel digestion with mixing and an absence of oxygen Digestate still requires composting	Small electrical demand and large energy output (Methane gas and heat of converted to electricity) Composting of digestate has large electrical demand	Small increase in energy use proportional to increased tonnages Further increased energy output with increase in FO

3.5 Odour Generation Potential

Different organics processing technologies have different odour generation potential and the potential additional feedstocks may impact on these. The common organics processing technologies are presented

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Additional Feedstocks

in Table 2, along with discussion of their general odour generation potential and likely impact from potential additional feedstocks.

Table 2: Organics Processing Technologies and their Odour Risk Profile

Technology	Description	Odour Generation Potential	Effect of Additional Feedstocks
Wind row	Static rows outdoor that are turned periodically	Aerobic piles generate low intensity odour Poor control of aeration will lead to anaerobic conditions and high intensity odour	Additional GW will slightly reduce odour potential Additional FO will increase odour potential
In-vessel aerobic composting	In-tunnel composting with forced ventilation to maintain temperature Air capture and treatment to remove offensive odours	Large volumes of low intensity odour generated requiring collection and treatment Large air handling volumes make more complex	Small increase in odour generation proportional to increased tonnages No change to odour emission risk
Anaerobic digestion	In-vessel digestion with mixing and no oxygen Air capture and treatment to remove offensive odours	Small volumes of high intensity odour requiring collection and treatment Small air handling volumes make less complex	Small increase in odour generation proportional to increased tonnages No change to odour emission risk

3.6 Cultural acceptability of composting products

The addition of wastewater biosolids has the potential to impact on the cultural acceptability of the resulting compost products, irrespective of the compliance with AS/NZ composting standards, due to incorporation of human waste.

4. Conclusions

Changing diversity and volumes of feedstocks has the following implications for the design of new composting facility for Christchurch:

Design Feedstock:

1. General growth of KSO is **accounted** for in the Design Annual Tonnages allowed for this component in the Design Feedstock derived for the Bromley Organics Facility Upgrade project.

2. Acceptance of additional FO requires an **increase** in the Design Annual Tonnages allowed for this component in the Design Feedstock [redacted]

3. Acceptance of additional GW requires an **increase** in the Design Annual Tonnages allowed for this component [redacted] plus a proportionate **decrease** in amendments required to reduce density and increase C:N ratios for aerobic composting technologies

Organics Processing Technology:

An increase in FOGO and GW design tonnage will result in:

a. minor impact on energy consumed with similar odour risks for **static pile**

b. minor impact on energy consumed with similar odour risks for in-vessel **aerobic composting**

c. minor impact on energy generated with similar odour risks for **anaerobic digestion**

An increase in FO design tonnage will result in:

d. minor impact on energy consumed with increased odour risks for **static pile**

e. minor impact on energy consumed with increased odour risks for in-vessel **aerobic composting**

f. increase in energy generated with similar odour risks for **anaerobic digestion**

Cultural Sensitivity

Inclusion of wastewater derived biosolids may have an adverse effect on cultural acceptance of the finished compost products. Further engagement with iwi would be required to consider this option, including whether non-food producing locations such as forestry or biodiversity regeneration were viewed most favourably by Iwi.

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Additional Feedstocks

Appendix A - Impact of Potential Additional Feedstocks Based on 2021 Design Feedstock

	Present tonnage (tonnes / annum)	Growth	Growth Allowance (tonnes / annum)	Design Tonnage (tonnes / annum)	Potential Additional Feedstocks	Impact on Design Annual Tonnage
Kerbside Organics KSO	51,000	Medium – 20%	10,200	61,200	Council - already received so growth proportionate to population growth. KDC - already received so growth proportionate to population growth. SDC - have invested in a new facility so unlikely to send to Council. Further diversion of Red Bin FOGO - assessed by Council to be a maximum of 10% of red bin waste volumes. Will require communications strategy to achieve.	Population growth for CCC and WDC already accounted for. Diversion of red bin FOGO will increase design annual tonnage. Increase KSO tonnage by 10%
Garden Waste GW	7,200	Low – 5%	400	7,600	Presently only receiving GW from Bromley transfer station. Could increase by up to 10,000 t/a to 15,000 t/annum if CCC decides to receive GW from Parkhouse and Styx Transfer Stations.	Need to increase garden waste annual tonnages. Increase to be confirmed with Council.
Commercial Waste CW	5,200	High – 50%	2,600	7,800	Pre-consumer FO from manufacturing, hospitality or public service could increase volumes considerably greater than current allowance. WMMP will increase likelihood and advance timeframe to occur.	Increased FO contribution is likely, so increase design annual tonnage by a further 50% to accommodate for this.
Other FOGO	4,000	High – 50%	2,000	6,000	Council, WDC and SDC KSO contributions considered above. GW considered above. FO considered above.	No further increase in design annual tonnage.
Others	3,500	Low – 5%	200	3,700	KS, GW and FO covered above. Potential for WWTP biosolids re-use.	Leave unchanged as general and specific growth allowances provide considerable buffer capacity
Overall	**70,900**	**22%**	**15,400**	**86,300**		

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Additional Feedstocks

[redacted]

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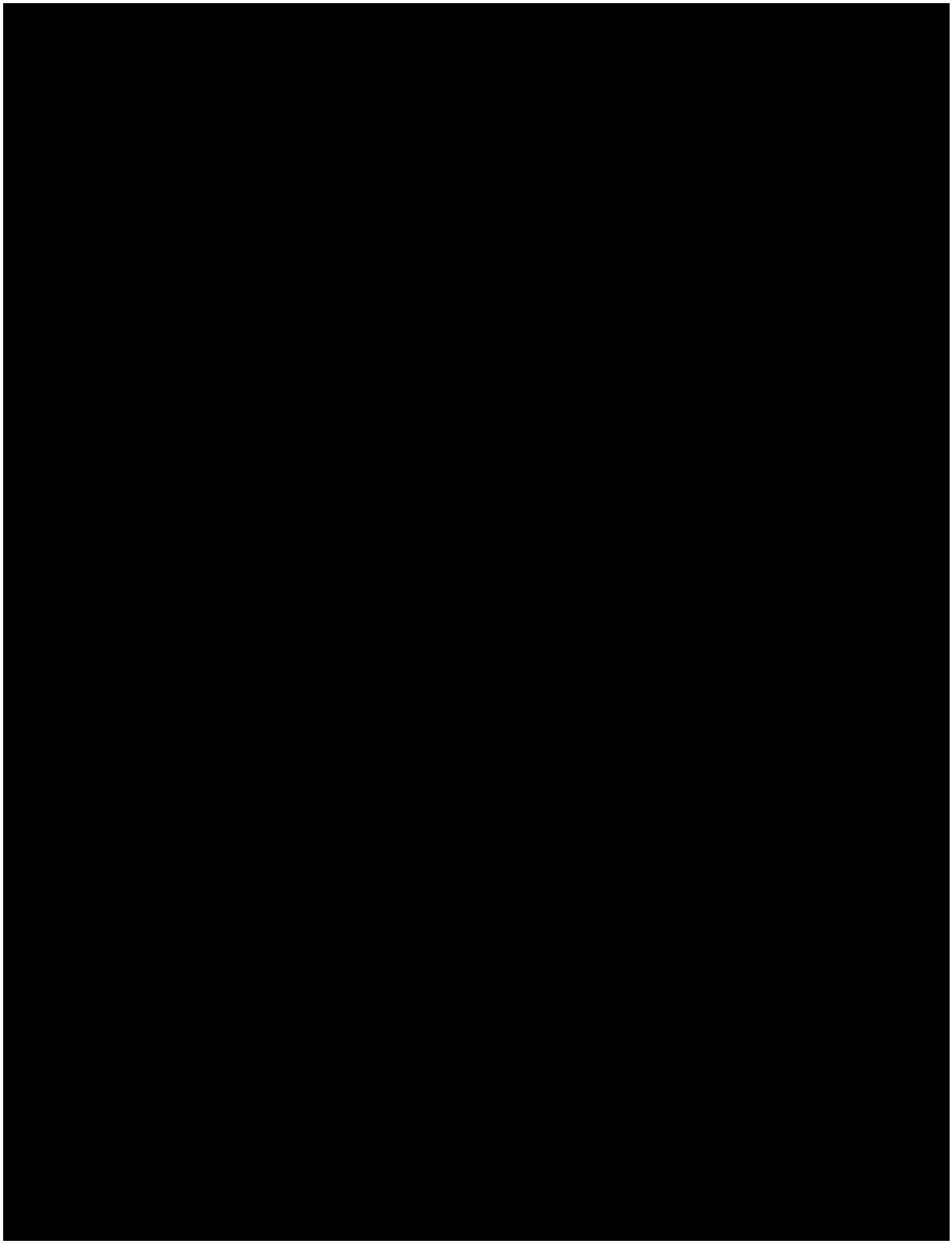

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Feedstock Assessment

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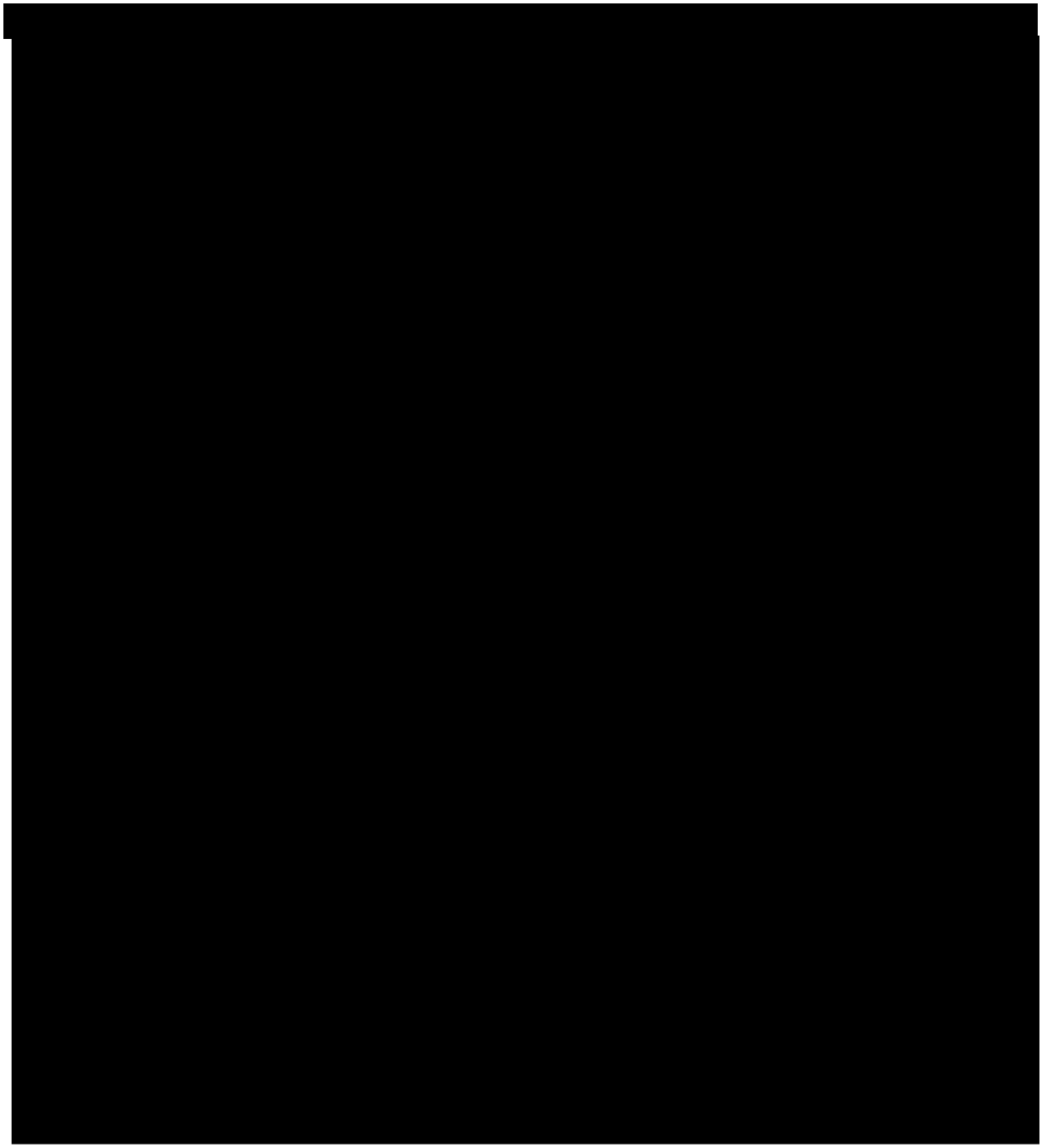
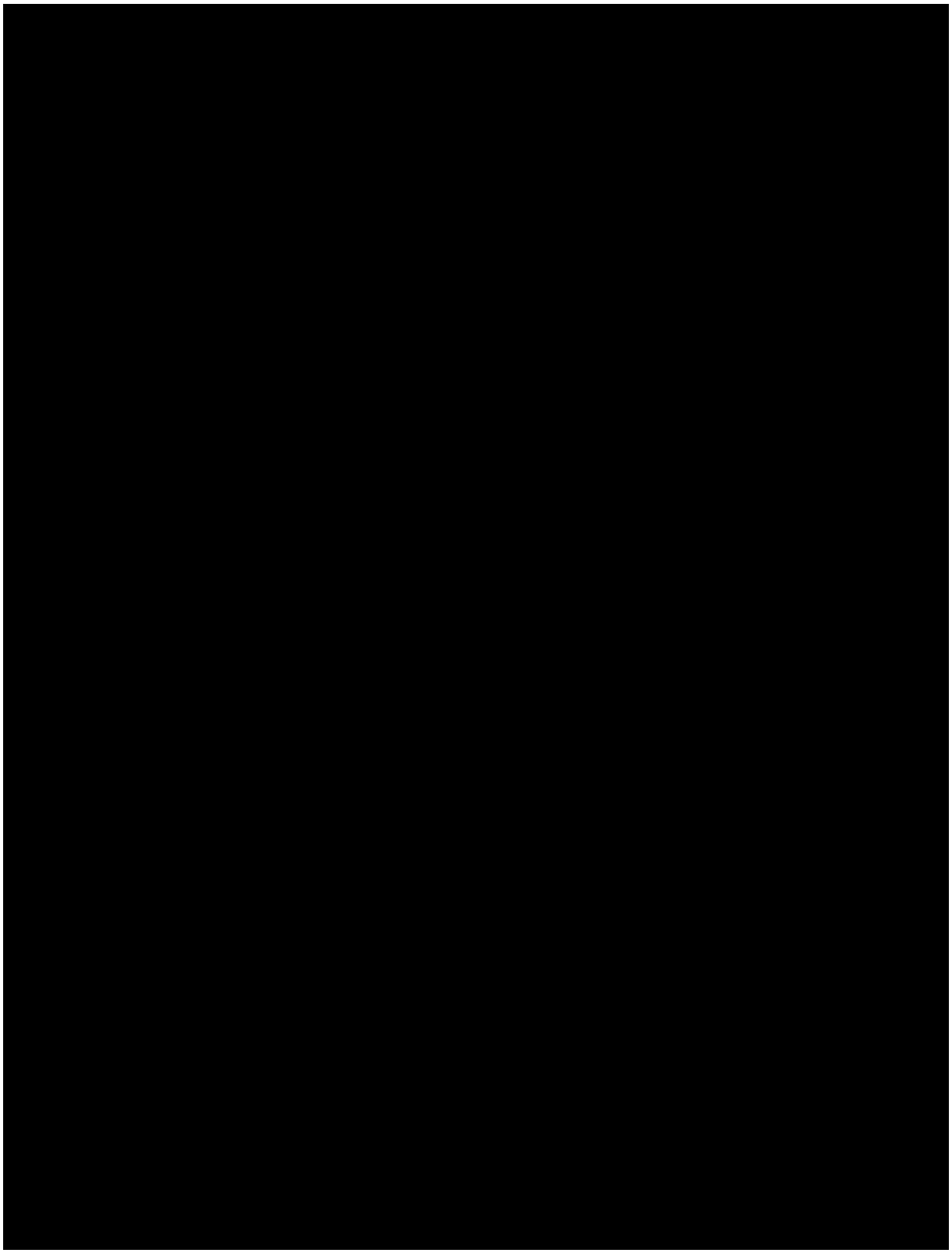
Feedstock Assessment





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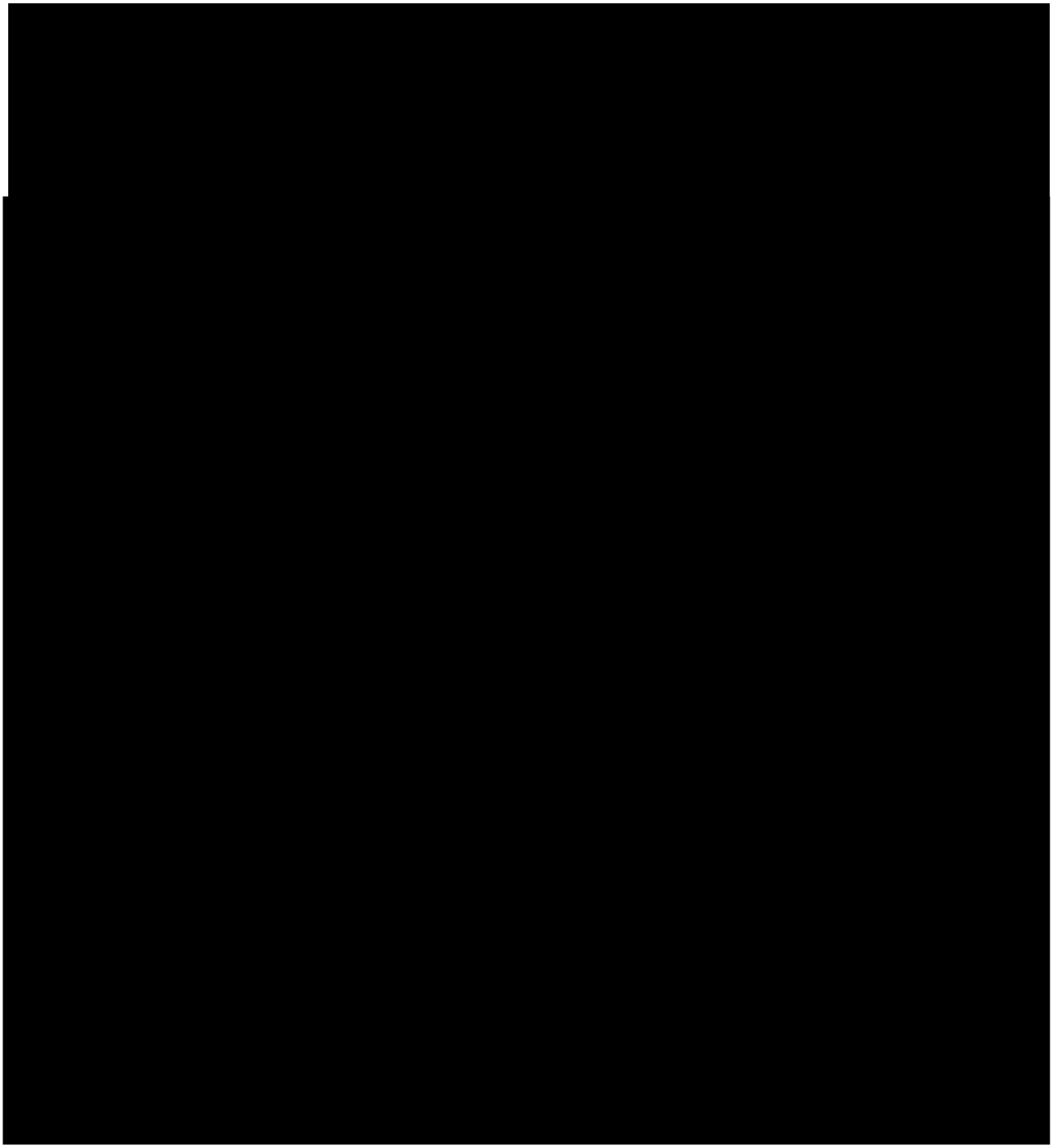
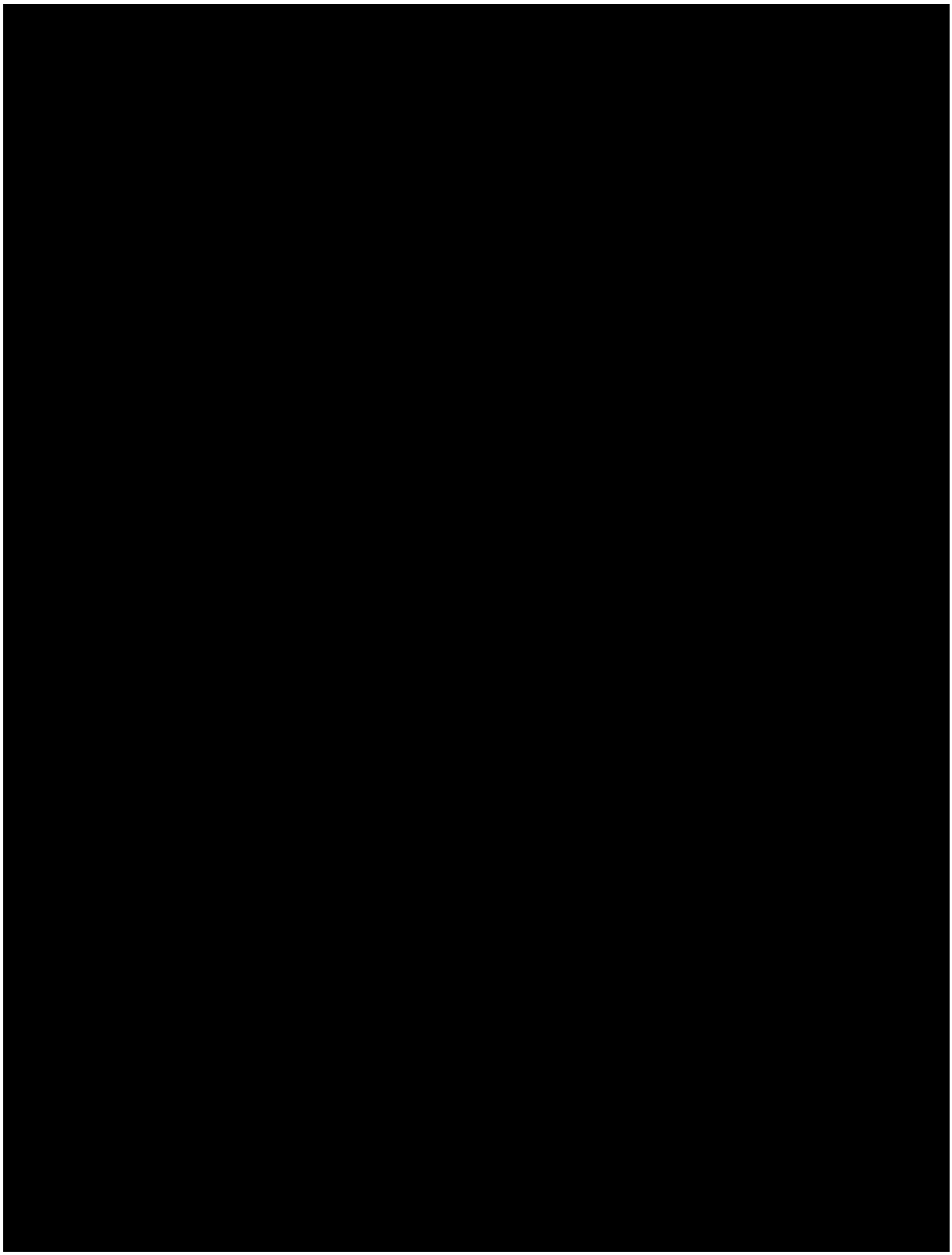
Feedstock Assessment





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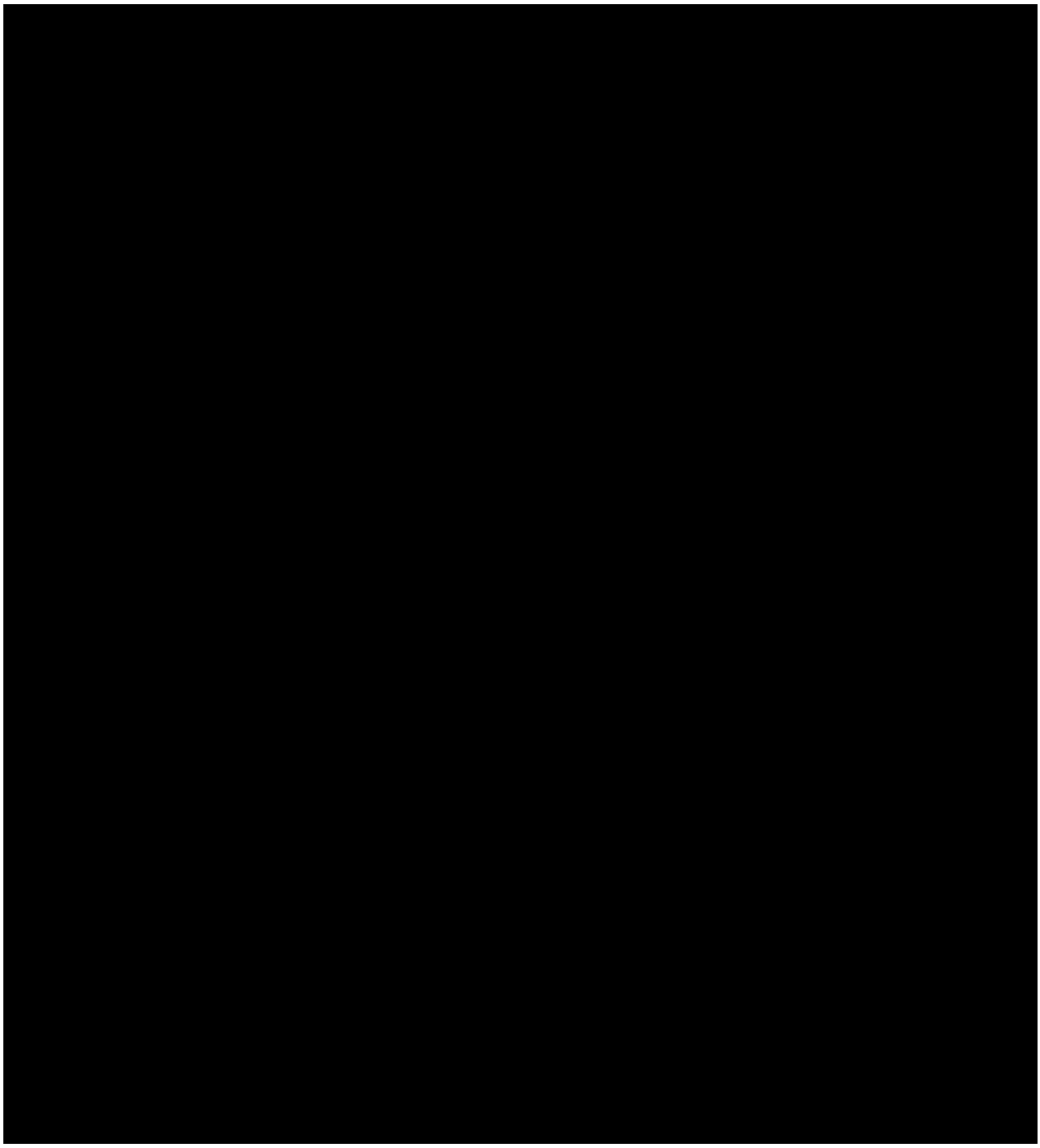
Feedstock Assessment



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Feedstock Assessment

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Feedstock Assessment

Table 7.

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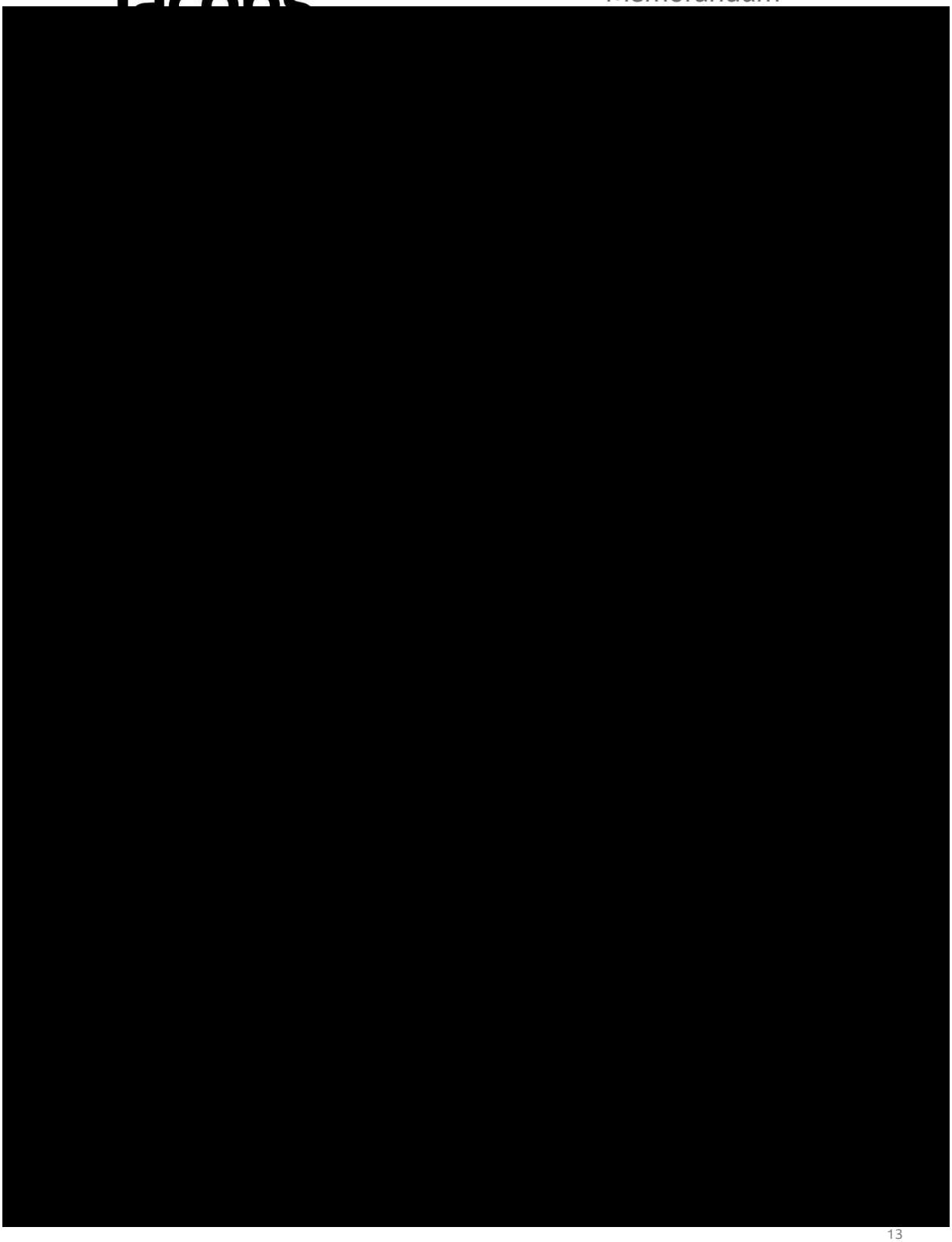

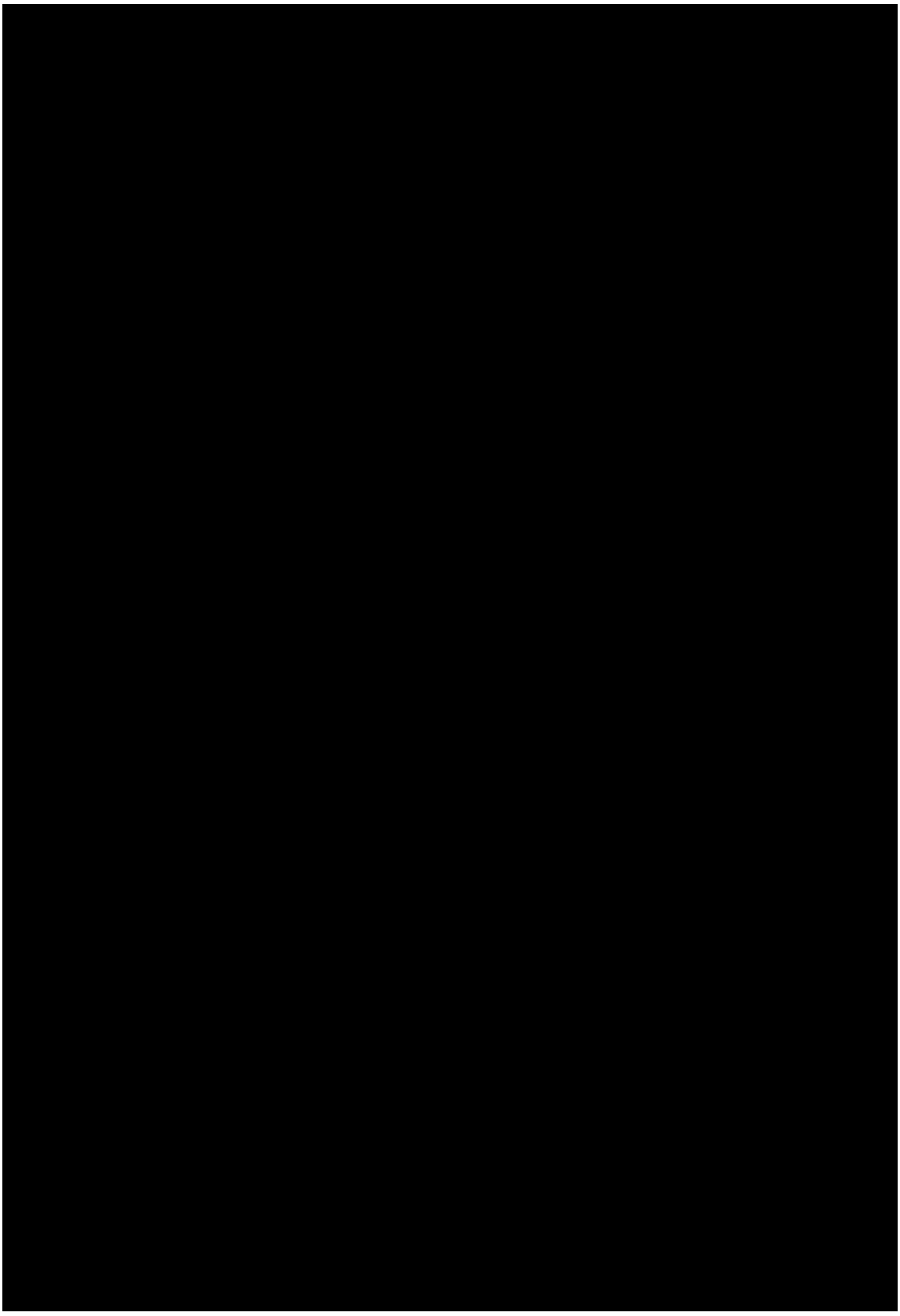

Appendix C. Technology Options

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Technology Options

Subject	**Technology Options**	**Project Name**	Future of Organics
Attention	Kent Summerfield	**Project No.**	IA253700-GN-MEM-0001
From	Matt Sheppard		
Revision History	C		
Date	16 February 2022		
Copies to	**Kent Summerfield (to circulate to relevant CCC staff)**		

1. Introduction

Christchurch City Council (the Council) is reviewing the future of organics processing in the city (*Future of Organics study*). [redacted]

The memorandum provides an assessment of potentially appropriate technology options, including the in-vessel aerobic composting [redacted] others conventionally used around the world and including those identified through Council's recent Request for Information process.

The technology options have been assessed against the project objectives and evaluation criteria established at the project outset and the additional feedstock assessment undertaken early in this study.

The outcomes of this assessment will inform the multi criteria assessment of all technology options.

This revision (C) of the memorandum combines and updates the Revision B version of technology memorandums issued to Council 21JAN22. The main changes include the deletion of options costs which have been moved to a separate memorandum.

2. Scope

This is a high level assessment aimed at identifying the fundamental performance of the organics processing technologies considered, against the identified projective objectives and evaluation criteria.

The technologies considered potentially suitable and evaluated include:

- In-vessel aerobic composting – refer Section 6
- Aerated static pile composting – refer Section 7
- Windrow composting – refer Section 8
- Dry anaerobic digestion – refer Section 9

An overview is provided for each of these technology options that summarises the treatment process, physical infrastructure, land requirements, process inputs and outputs, location considerations and consenting requirements.

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Technology Options

Additional technologies identified through Council's Future of Organics RFI process that are not assessed in this memorandum are discussed in the Future of Organics RFI memorandum.

3. Related Information

Additional memorandums provide information on related matters including:

- Project objectives and Evaluation Criteria
- Greenhouse gas emissions
- Transportation
- Location
- Planning
- Costing
- Future of organics RFI

4. Limitations

The following limitations apply to this assessment:

- The review of technology options is for the purpose of relative comparison between options
- The status of development of each of the technology options is to conceptual level only, and performance assessment is comparatively high-level, however the outcomes are considered appropriate for screening of technology options

5. Abbreviations

Abbreviation	Explanation
AD	Anaerobic digestion
ASP	Aerated Static Pile
C:N Ratios	Carbon : nitrogen ratio
CW	Commercial waste
FOGO	Food organics and garden organics
GHG	Greenhouse Gas
GW	green waste as collected at the transfer stations
KSO	Kerbside organics (FOGO)
WMMP	Christchurch City Council Waste Minimisation and Management plan, 2020

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Technology Options

6. In-vessel Composting

Overview

In-tunnel composting utilizes composting "tunnels" into which the pre-processed feedstocks are placed and forced aeration to maintain aerobic conditions.

Incoming feedstocks require pre-processing to shred and mix the feedstocks with amendments to correct density and C:N ratio and water added to achieve optimum moisture content. They are then placed into the tunnels where the material is aerated to maintain aerobic conditions and optimal temperature for composting to achieve pasteurized and stable compost. It is then decanted, screened and stockpiled until it matures prior to sale.

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Technology Options

[redacted]

Design

Assumptions

The following evaluation is for a composting system designed to handle 84,000 tonnes per year of organic solid waste feedstocks.

The feedstock composition is assumed to be as described in Jacobs 22 April 2021 Feedstock Assessment Memorandum, plus additional potential feedstocks as described in Jacobs 30 November 2021 Additional Feedstock Memorandum – V3.

It is highlighted that the design feedstock will need to be agreed to prior to advancing design of the preferred option.

General Characteristics:

The system consists of a receiving building, feedstock pre-processing, In-tunnel composting area, curing area, screening area, finished product storage and loadout areas. All these components would be housed inside buildings with all air collected and treated via a biofilter.

A preprocessing system typically involves one or all of the following: shredding, grinding, screening, contamination removal and amendment of incoming feedstocks to optimize moisture, density of C:N ratio. This is the same requirement for all composting processes.

Loading of the tunnels is achieved using front-end loaders and can be semi-automated using retracting conveyors that tip feedstocks into the tunnel, to a maximum height of 3.5m. Use of a conveyor for loading assists in achieving a constant and lower density than using a front-end loader.

Tunnels are typically constructed 8 meters wide, 40 meters long, and 8 meters tall, with a perforated floor through which air is pushed through the compost pile. The aerated floor provides optimum air distribution.

[redacted]

Air is extracted from the composting tunnels and from Receivals and Processing Halls, with all air passed through a biofilter to remove odorous compounds.

After active composting, materials are screened then moved to indoor curing and storage until it is sold.

Composting Process:

Composting is achieved via aerobic bacteria maintained at optimal temperature and moisture conditions, achieved by forced air ventilation of the pile and utilization of temperature and moisture probes placed into the piles to enable automated control of temperature and moisture content.

Tunnels are decanted after approximately 3 to 4 weeks, typically turning 4 tunnels into 3.

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Technology Options

After another 3 to 4 weeks, the tunnels are emptied, the compost screened and placed in a curing hall for another 4 to 6 weeks until matured.

Overall the process takes approximately 10 to 14 weeks to achieve mature compost.

Range of Feedstocks:

The full range of existing and future additional feedstocks anticipated can be accommodated by In-tunnel composting.

Increased Food Organics fraction would have the effect of increasing density with need for use of bulking amendments and associated increased scale of facility and increase in electricity demands to maintain aerobic conditions.

Increased Green Waste from Councils Transfer Stations would have the effect of increasing overall volume, particularly in Spring when garden spring cleaning occurs. Beneficial impacts include increased availability of carbon and reduction in bulk density, which could reduce the volume of amendments required, particularly in Spring when there is a large increase in grass.

Physical Assets

Bulk infrastructure required includes water, sewer, electricity, telecommunications and good road network access.

Other associated facilities, features, and physical assets include:

- Receiving and Processing buildings with air extraction and biofilter
- Tunnels with air extraction and biofilter
- Product screening, storage, and loading-out areas within buildings
- Amendments and screenings storage areas
- Stormwater and leachate collection, treatment and storage
- Loaders (3)
- Shredder (1)
- Screens (1)
- Tunnel loading conveyor - optional
- Office space and control rooms

Ease of Expansion

Expansion of an in-tunnel composting system can be achieved by construction of additional tunnels and associated air handling and treatment equipment, plus associated bulk infrastructure if required. It is noted that due to the scale of air handling and treatment, upgrading would typically be done in relatively large stages.

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Technology Options

Process Inputs

Energy:

In-tunnel composting requires considerable mechanical energy for shredding, screening and forced aeration of the compost tunnels and to collect air from the tunnels and buildings for treatment.

A facility of this size would be expected to have an operating electrical load of approximately 1.8 MVA.

Water:

Water input is required to maintain the optimum moisture content for composting.

Most of the process water required would come from re-use of collected roof stormwater and leachate stored in tanks onsite.

Clean water would be used for moisture conditioning of compost that has passed through pasteurization.

Process Outputs

Compost:

In-tunnel composting is capable of achieving a compost product that meets the requirements of AS4454-2012.

Odour:

Reduction of odour potential is primarily achieved through maintenance of a good compost recipe including the correct C:N rations, bulk density and moisture content. This requires access to carbonaceous and low density bulking amendments and the appropriate physical capacity to add these when required.

Reduction of odour is further managed by the maintenance of aerobic conditions achieved by the forced aeration of the compost.

All air from the tunnels and processing buildings is collected and passed through biofilters to remove odours.

As the process is enclosed, it is not affected by external weather conditions.

Management of odour relies on buildings that are well constructed and sealed, plus good maintenance of biofilters.

Due to the potential for periodic emission of low strength odour from the composting tunnels, buildings or biofilters, a buffer to sensitive receivers and to consented odour compliance boundaries would increase confidence in the ability to comply with expected odour consent compliance requirements.

Recommended buffer distances for the various composting technologies are discussed in the main report and based upon the risk of odour generation, a minimum buffer distance in the order of 0.25km would be considered appropriate.

Dust:

Creation of dust occurs to some extent within the receivals and processing halls and this is managed through maintenance of moisture content of compost and cleaning of building floors. As all activities occur indoors, dust is not emitted or generated outside of the buildings.

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Technology Options

Surface Water:

Surface water from roofs is collected and stored for re-use. Surface water from external hardstand areas is treated and discharged.

Leachate is collected, treated and stored for re-use, with any surplus treated and discharged to the wastewater network.

Consents and Approvals

Consents and approvals likely to be required for an in-tunnel composting process include:

- Air discharge of odour and dust
- Surface water discharge of treated stormwater
- Land use consent (depending on underlying zoning of land)
- Building consent for built facilities

These are generally the same for all composting and anaerobic digestion processes, however the low-strength nature of odour released from a biofilter reduces the potential for adverse effects and therefore reduces the consentin risk

[redacted]

Location Considerations

While the odour potential is relatively low and controlled, an in-tunnel compost facility would ideally be located in an area of sparse population without sensitive activities such as schools or public facilities.

Transport of feedstocks is a significant contribution to overall operational costs for organics processing so location close to the source of feedstocks is sensible.

The process is comparable to many on-farm processes and the output compost is utilized in farming and viticulture industries, so close proximity to these end users would be a benefit.

Land Requirements:

The space required for an In-tunnel composting facility with covered storage area for the assumed 84,000 tonnes / annum would be approximately 6-hectares. With allowance for growth a minimum of **9-hectares** would be recommended.

Additional land would be required to create a buffer to neighbours and sensitive receivers, with the extent dependent upon Councils risk appetite. Assuming a buffer distance of 0.25km on all sides of the facility, an additional 21 Ha of land would be required.

GHG and Carbon Footprint

The greenhouse gas emissions profile for In-Tunnel is discussed in the GHG memorandum.

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Memorandum

Technology Options

7. Aerated Static Pile Composting

Overview

ASP composting is similar to open windrow composting but has the static piles placed within concrete channels with low side walls and improved process control by using forced aeration of the compost piles to maintain aerobic conditions and reduce the risk of strong odour generation.

Incoming feedstocks require pre-processing to shred and mix the feedstocks, aerobic composting to achieve pasteurized and stable compost, screening then stockpiling of compost to mature prior to sale.

Design

Assumptions

The following evaluation is for a composting system designed to handle 84,000 tonnes per year of organic solid waste feedstocks.

The feedstock composition is assumed to be as described in Jacobs 22 April 2021 Feedstock Assessment Memorandum, plus additional potential feedstocks as described in Jacobs 30 November 2021 Additional Feedstock Memorandum – V3.

It is highlighted that the design feedstock will need to be agreed prior to advancing design of the preferred option.

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Technology Options

General Characteristics:

The system consists of a receiving building, feedstock pre-processing, active ASP composting area, curing area, screening area, finished product storage and loadout areas and leachate and stormwater retention ponds.

A preprocessing system typically involves shredding, grinding, screening, contamination removal and amendment of incoming feedstocks to optimize moisture, density of C:N ratio. This is the same requirement for all composting processes.

ASP piles would typically be approximately 9 meters wide, 60 meters long, and 3.5 meters tall, placed on concrete wind-row beds with low side walls and a central aeration system.

After active composting, materials are moved to curing where piles of similar size are built. Cured material is then screened and storage in the product storage area until it is sold.

Composting Process:

Composting is achieved via aerobic bacteria maintained through active aeration of the compost pile.

Aeration can be either positive (air pushed through the pile), negative (air pulled through the pile), or reverse (air can be pushed or pulled through the pile) aeration.

Aeration control is tied to automated monitoring systems that signal an increase or reduction of the airflow based on parameters like oxygen content and temperature. This automated control results in a more efficient process and typically better odour control, compared to open windrow composting. In-vessel aerobic composting processes similarly utilise forced aeration and the controlled conditions provide better process control but requires considerable additional capital investment and built infrastructure.

Range of Feedstocks:

The full range of existing and future additional feedstocks anticipated can be accommodated by ASP, to achieve a compost product that meets the requirements of AS4454-2012.

Increased FO fraction would have the effect of increasing density with need for use of bulking amendments and associated increased scale of facility and energy consumption.

Physical Assets

Bulk infrastructure required includes water, sewer, electricity, telecommunications and good road network access.

Other associated facilities, features, and physical assets include:

- Receiving and processing building
- Biofilters
- Product screening, storage, and loading areas
- Amendment unloading and storage areas
- Residual storage and loading areas
- Stormwater and leachate retention basin(s) and/or tanks
- Loaders (4)

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Technology Options

- Shredder (1)
- Screens (1-2)
- Water Truck (1)
- Windrow turner (1)
- Office space and control rooms

Ease of Expansion

Expansion of an ASP composting system can be achieved in a number of ways. The ASP system should be designed to handle peak incoming material volumes (usually occurring during spring) and therefore additional feedstocks may be accepted during off-peak months. Expansion can also occur by reducing the amount of time material is kept in the ASP system or by increasing the height of ASP piles (not to exceed 3.5 meters) since the width and length are typically fixed due to placement of inground piping. Changing the operating assumptions in an ASP system may lead to quality or odour issues and this method of expansion should only be employed if feedstock characteristics allow.

Expansion of ASP systems will typically require construction of additional zones which may result in significant construction activities to tie in associated infrastructure such as additional concrete or asphalt pads, aeration piping, leachate drainage, blowers or fans for aeration, ASP system automation controls. Electrical and drainage services will also require tie-in to existing services.

Process Inputs

Energy:

ASP requires considerable energy use to push large volumes of air through the static piles, comparable to in-vessel aerobic composting.

A facility of this size would be expected to have a slightly lower operating electrical load than an in-tunnel option due to removal of building air extraction and treatment, likely in the order of 1.5 MVA.

Water:

Water input is required to maintain the optimum moisture content for composting.

Most of the process water required would come from re-use of collected stormwater and leachate stored in retention basins onsite.

Clean water would be used for moisture conditioning of compost that has passed through pasteurization.

Process Outputs

Compost:

ASP composting is capable of achieving a compost product that meets the requirements of AS4454-2012.

Odour:

Reduction of odour potential is primarily achieved through maintenance of a good compost recipe including the correct C:N rations, bulk density and moisture content. This requires access to carbonaceous and low density bulking amendments and the appropriate physical capacity to add these when required.

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Technology Options

Reduction of odour potential in ASP systems is further achieved by maintaining aerobic conditions, to avoid the more strongly odourous emissions that develop in anaerobic conditions. Biodegradable or synthetic covers placed over the ASP's provide further odour reduction, however a low-strength fresh composting odour emission will be released into the atmosphere. There remains a risk of higher-strength odour emissions from anaerobic pockets within the static piles. Odour potential for ASP is therefore reduced relative to static piles because of this process control.

Odour generation at the waste receiving and processing building is managed by exhaust fans that draw air from the building and treat the air by forcing it through a biofilter, in a similar manner for pre-processing of feedstocks for all composting and anaerobic digestion processes. Odours are also minimized by carefully controlling the opening and closing of doors, using air curtains at building entrances, and conducting performance audits on the ASP aeration process to verify adequate odour control.

Due to the likelihood of emission of low strength odour from the aerated windrows, a buffer to sensitive receivers and to consented odour compliance boundaries should be provided.

Recommended buffer distances for the various composting technologies are discussed in the main report and based upon the risk of odour generation, a minimum buffer distance in the order of 0.5 km would be considered appropriate.

Dust:

Creation of dust is likely with an ASP process due to the outdoor handling of compost during pile placement, turning and screening.

Dust is primarily mitigated through watering piles, roads, and storage areas before disturbance and through use of cover materials on static piles.

Surface Water:

Surface water from all potentially contaminated areas and leachate from the ASP process would be collected and stored for re-use, with any surplus treated and discharged to the wastewater network.

Consents and Approvals

Consents and approvals likely to be required for an ASP process include:

- Air discharge of odour and dust
- Surface water discharge of treated stormwater
- Land use consent (depending on underlying zoning of land)
- Building consent for facilities

These are generally the same for all composting and anaerobic processes, however the regular discharge of low-strength odour and the potential for occasional stronger odours and dust would increase the difficulty of gaining an air discharge consent, unless a generous land buffer is available.

[redacted]

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Technology Options

Location Considerations

Ideally, an ASP facility would be located in an area of sparse population without sensitive activities such as schools or public facilities.

Transport of feedstocks is a significant contribution to overall operational costs for organics processing so location close to the source of feedstocks is sensible.

The process is comparable to many on-farm processes and the output compost is utilized in farming and viticulture industries, so close proximity to these end users would be a benefit.

Land Requirements:

The space required for an ASP composting facility with uncovered storage area for the assumed 84,000 tonnes / annum would be approximately 8 hectares. With allowance for growth 12-hectares would be recommended.

Additional land would be required to create a buffer to neighbours and sensitive receivers, with the extent dependent upon Councils risk appetite. Assuming a buffer distance of 0.5 km on all sides of the facility, an additional 60 Ha of land would be required.

GHG and Carbon Footprint

The greenhouse gas emissions profile for ASP is discussed in a separate GHG memorandum.

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Memorandum

Technology Options

8. Windrow Composting

Overview

Windrow composting utilizes static windrows placed on a hardstand area, that are turned periodically to aerate the piles.

Incoming feedstocks require pre-processing to shred and mix the feedstocks, a mix of aerobic and anaerobic composting occur to achieve pasteurized and stable compost, screening then stockpiling of compost to mature prior to sale.

[redacted]

Design

Assumptions

The following evaluation is for a windrow composting system designed to handle 84,000 tonnes per year of organic solid waste feedstocks.

The feedstock composition is assumed to be as described in Jacobs 22 April 2021 Feedstock Assessment Memorandum, plus additional potential feedstocks as described in Jacobs 30 November 2021 Additional Feedstock Memorandum – V3.

It is highlighted that the design feedstock will need to be agreed to prior to advancing design of the preferred option.

General Characteristics:

The system consists of a receiving building, feedstock pre-processing, hardstand windrow composting area, curing area, screening area, finished product storage and loadout areas and leachate and stormwater retention ponds.

A preprocessing system typically involves one or all of the following: shredding, grinding, screening, contamination removal and amendment of incoming feedstocks to optimize moisture, density and C:N ratio. This is the same requirement for all composting processes.

Windrows would typically be approximately 4.8 meters wide, 60 meters long, and 2.5 meters tall, placed on an impermeable hardstand. The windrow dimensions are smaller than that used for ASP, to enable passive aeration of the pile and to limit the heat build-up that results from composting.

The windrows are turned periodically to maintain aerobic conditions and mix the composting materials due to difference in composting rate within the windrow.

After active composting, materials are moved to curing where piles of similar size are built. Cured material is then screened and storage in the product storage area until it is sold.

Composting Process:

Composting is achieved via aerobic bacteria maintained through mechanical turning of the pile and natural air flow into the compost pile.

There is no automation of aeration and maintaining aeration requires reasonably frequent mechanical turning of the windrows.

The process takes approximately 16-weeks to achieve mature compost.

Range of Feedstocks:

The full range of existing and future additional feedstocks anticipated can be accommodated by windrow composting.

Increased FO fraction would have the effect of increasing density with need for use of bulking amendments and associated increased scale of facility and risk of strong odours associated with anaerobic conditions.

Physical Assets

Bulk infrastructure required includes water, sewer, electricity, telecommunications and good road network access.

Other associated facilities, features, and physical assets include:

- Receiving and processing building with air extraction and biofilter
- Product screening, storage, and loading areas
- Amendment unloading and storage areas
- Residual storage and loading areas
- Stormwater and leachate retention basin(s) and/or tanks
- Hardstand area

- Loaders (4)
- Windrow turners (1)
- Shredder (1)
- Screens (1-2)
- Water Truck (1)
- Office space

Ease of Expansion

Expansion of a windrow composting system can be achieved by expansion of the hardstand area and associated stormwater collection, storage and treatment systems.

Process Inputs

Energy:

Windrow composting requires considerable mechanical energy to turn the windrows frequently, but considerably less than the electrical energy required for asp or in-vessel composting.

A facility of this size would be expected to have an operating electrical load of 0.6 MVA, primarily for shredding and screening activities and general power.

Water:

Water input is required to maintain the optimum moisture content for composting.

Most of the process water required would come from re-use of collected stormwater and leachate stored in retention basins onsite.

Clean water would be used for moisture conditioning of compost that has passed through pasteurization.

Process Outputs

Compost:

Windrow composting is capable of achieving a compost product that meets the requirements of AS4454-2012.

Odour:

Reduction of odour potential is primarily achieved through maintenance of a good compost recipe including the correct C:N rations, bulk density and moisture content. This requires access to carbonaceous and low density bulking amendments and the appropriate physical capacity to add these when required.

Windrows slowly consolidate due to decomposition of the organics and exacerbated by saturation from rainfall, which lead to development of anaerobic conditions may develop, with risk of more strongly odourous emissions.

Avoidance or reduction of odourous compounds in windrow composting is primarily achieved by mechanical turning of compost to maintain aerobic conditions. This is required reasonably frequently and will release odours. If the windrows have anaerobic conditions then stronger odours are likely.

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It is possible to utilise biodegradable or synthetic covers placed over the windrows however the frequent turning of the piles increases the cost and complexity of this.

Odour generation at the waste receiving and processing building can be managed by exhaust fans that draw air from the building and treat the air by forcing it through a biofilter, in a similar manner for pre-processing of feedstocks for all composting and anaerobic digestion processes, however the due to the odour potential from the windrows, this may not reduce the overall site odour emissions meaningfully. Odours are also minimized by carefully controlling the opening and closing of doors, using air curtains at building entrances, and conducting performance audits on the windrow process to identify creation of odourous compounds.

Due to the likelihood of emission of low strength odour from the aerated windrows and occasional higher strength odour if windrows become anaerobic, a buffer to sensitive receivers and to consented odour compliance boundaries should be provided.

Recommended buffer distances for the various composting technologies are discussed in the main report and based upon the risk of odour generation, a minimum buffer distance in the order of 1.0km would be considered appropriate.

Dust:

Creation of dust is likely with a windrow composting process due to the outdoor handling of compost during pile placement, turning and screening.

Dust is primarily mitigated through watering piles, roads, and storage areas before disturbance.

Surface Water:

Surface water from all potentially contaminated areas would be collected and stored for re-use, with surplus treated and discharged to a treatment works.

Consents and Approvals

Consents and approvals likely to be required for a windrow composting process include:

- Air discharge of odour and dust
- Surface water discharge of treated stormwater
- Land use consent (depending on underlying zoning of land)
- Building consent for built facilities

These are generally the same for all composting and anaerobic processes, however the continuous discharge of low-strength odour and the reasonable potential for high-strength odour and dust would increase the difficulty of gaining an air discharge consent, unless a generous land buffer is available, likely to be significantly more than required for an ASP facility.

[redacted]

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Technology Options

Location Considerations

Due to the odour potential, a windrow compost facility would need be located in an area of sparse population without sensitive activities such as schools of public facilities.

Transport of feedstocks is a significant contribution to overall operational costs for organics processing so location close to the source of feedstocks is sensible.

The process is comparable to many on-farm processes and the output compost is utilized in farming and viticulture industries, so close proximity to these end users would be a benefit.

Land Requirements:

The space required for a windrow composting facility with uncovered storage area for the assumed 84,000 tonnes / annum would be approximately 12 hectares. With allowance for growth 18-hectares would be recommended.

Additional land would be required to create a buffer to neighbours and sensitive receivers, with the extent dependent upon Councils risk appetite. Assuming a buffer distance of 1.0km on all sides of the facility, an additional 180 Ha of land would be required.

GHG and Carbon Footprint

The greenhouse gas emissions profile for Windrow composting is discussed in a separate GHG memorandum.

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Technology Options

9. Anaerobic Digestion

Overview

Anaerobic digestion (AD) is not a composting technology, rather it is a renewable energy recovery process that is symbiotic with composting, processing some or all of the incoming organic feedstocks prior to composting the residual organic material. An AD plant is therefore typically used in conjunction with a conventional composting process.

The primary energy output is biogas, which can then be used as a direct heating source, combusted to create electricity and heat, or purified to remove carbon-dioxide, water vapour and other trace gases and used as a renewable natural gas.

The AD process is presented schematically in Figure 1.

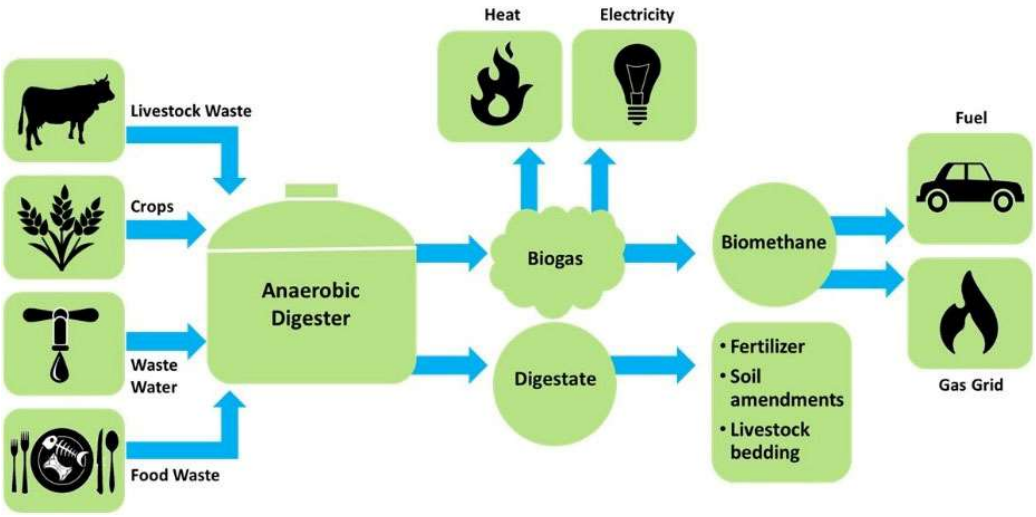

Figure 1. AD Process

AD is a naturally occurring biological process that uses microorganisms to break down organic material in the absence of oxygen. The microorganisms require zero oxygen conditions. Engineered AD systems are thus completely sealed and oxygen levels as well as other critical conditions within the digester, including moisture content, temperature, pH levels, gas pressure and gas composition, are monitored and controlled to maximize waste decomposition rates and maximize biogas generation.

Enough AD plants have been operating at full scale for enough years, treating source-separated organic (SSO) solid wastes, to demonstrate that the technology is reliable. Most plants that have been in operation for more than a decade (a hundred or so) are in Europe. Most AD systems processing SSO from combined food waste/yard waste collection programs are high-solids systems, where the solids content in the digester is maintained at 20% solids or greater. There are two basic types of high-solids digesters: stackable batch-load systems and slurry plug-flow systems.

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Stackable digesters are tunnels, similar to composting tunnels. Wastes are loaded in by front-end loaders and inoculated with digestate from a recently completed batch from a different tunnel. After sealing the tunnel, water is applied to the waste through an overhead sprinkler system inside the tunnel, and then captured by a drainage system and recirculated for a period of time until monitoring of the drainage water effluent and biogas concentration indicates sufficient digestion has occurred. The tunnel is then evacuated of biogas and the solid digestate is removed using front-end loaders. The digestate may either be used as a compost feedstock, or if from a highly uniform food waste, used directly as fertilizer where this use is approved.

Slurry plug-flow digesters are enclosed vessels in which the wastes are pre-shredded, typically to 50 mm or less, and water is added as needed to form a pumpable slurry of 40% solids or less. The slurry is moved through the digester continuously in "plug flow" either by gravity in a vertical system or using a slow speed rotor or paddles in a horizontal system. The digestate is pumped in at the head end and pumped out at the back end. The digestate is then dewatered but can often be used un-dewatered as a compost feedstock if mixed with other feedstocks that require water addition for composting.

Retention times in both types of high-solids systems are from 14 to 30 days. The batch stackable systems typically operate in the mesophilic temperature range (30 to 38o C) with retention times in the longer end of this range. Continuous plug flow systems typically are thermophilic (50 to 60o C), operating at the shorter end of the retention time range. Both types of high-solids systems produce similar amounts of biogas, as described in more detail under Utilizing Biogas below. Both types of systems produce digestate that is about 80% of the mass of the incoming feedstocks. Figure 2 is a schematic of a typical vertical plug flow high-solids SSO digester, highlighting the inputs and outputs. Figure 3 shows a similar schematic for a stackable (tunnel) digester.

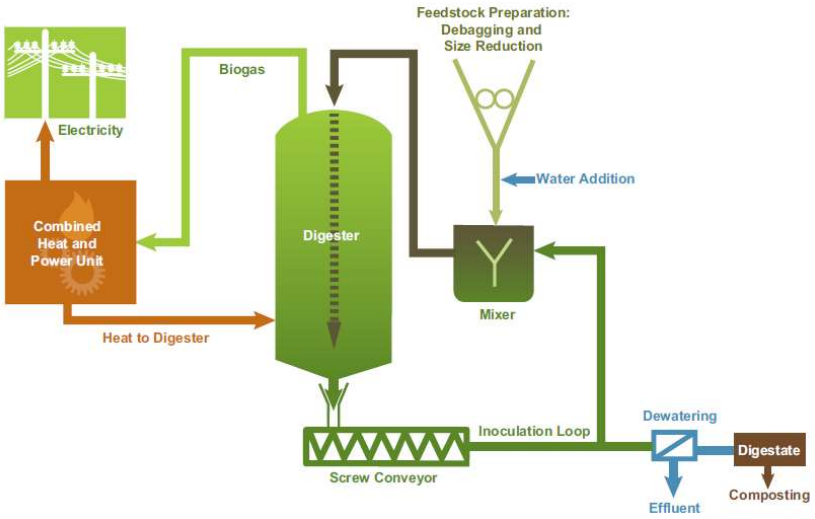

Figure 2. Plug Flow High-Solids Digester

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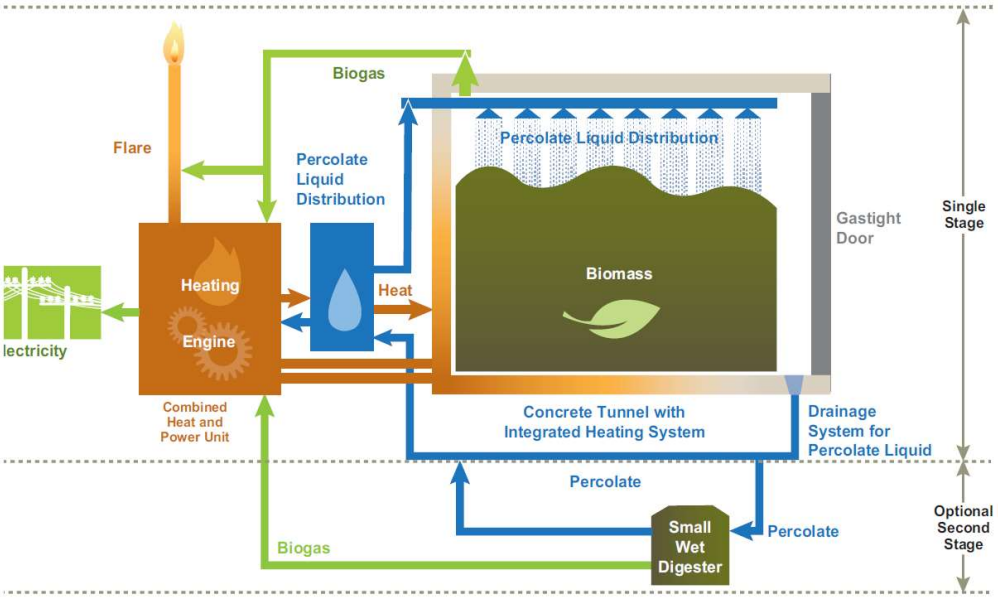

Figure 3 Stackable Tunnel High-Solids Digester

A high-level assessment of the relative advantages and disadvantages of the two systems are discussed below.

Plug-Flow High-Solids Digester	Stackable Tunnel High-Solids Digester
ADVANTAGES	ADVANTAGES
Continuous Flow – steady operation and gas production	Open tunnel allows access for inspection, cleanout.
Pumping feedstock provides uniform feed rate, less personnel exposure.	Little pre-processing required. Can process digestate for composting after digestion – easier to shred.
Uniform digestate consistency.	Requires least water addition of any digester technology.
All liquids added are pumped out with digestate. No problems with drainage.	
Typically thermophilic, with shorter retention times thus higher throughput rates and smaller footprint.	
DISADVANTAGES	DISADVANTAGES
Sealed digester difficult to access if problems occur.	Batch process – Gas evacuation after each batch. Digestion must be restarted for each batch.
Requires water addition to keep solids below 40% by weight, and may require subsequent dewatering. Heating water consumes energy.	Complicated to manage a plant of multiple tunnels to produce steady stream of digestate and consistent gas quality. Labour intensive.

Pump failure is a choke point and can shut down plant.	Batch loading and unloading requires loaders and personnel to enter digester for each batch.
	Tunnel construction subject to leakage.
	Drainage systems for percolate recycling are prone to clogging.
	Typically mesophilic, thus lower throughput and larger footprint

The reduced footprint, more uniform digestate consistency and output and reduced operation input are key factors that make the plug-flow high-solids digester preferable.

[redacted]

Integrating AD into a Composting Facility

AD is complementary with all of the composting technologies considered in the Future of Organics study and the infrastructure and land requirements discussed below would be in addition to the composting requirements.

The first consideration is how much of the existing and additional anticipated feedstocks should be fed to an AD system vs. directly to the composting system.

The most successful integrated AD and composting systems are "partial-digestion" systems, where the most energy-dense portion of SSO is digested, producing digestate that is then mixed with incoming raw feedstocks and composted together with them. In such applications, the digester is usually built to handle an expected increase in feedstocks.

Combining the AD process digestate with raw feedstocks has been found to increase the capacity of tunnel composting systems by 20% to 33%1 by speeding up the composting process. This enables a reduction of the initial composting facility capacity if AD is incorporated at the outset or achieving an effective capacity upgrade of an existing composting facility if AD is added to an existing composting facility.

Combining AD and composting has beneficial outcomes if high-energy wastes such as food waste and fats-oils-grease (FOG) waste can be separated out economically and digested, producing a higher yield of biogas and reducing the energy input otherwise required to compost this fraction.

Figure 4 shows how the inputs and outputs of a digester and composter match up to produce an integrated system.

[1] Jacobs survey of European and US integrated digestion/composting facilities, 2021.

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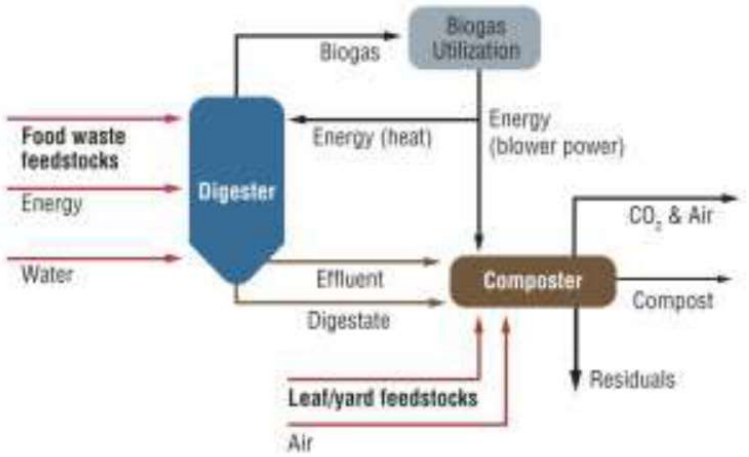

Figure 4. Integrated System Inputs and Outputs

Integration points of note:

- Liquid effluent from the digester can be used to add required moisture to the composting process or used as a liquid fertiliser.
- Energy required for composting aeration can be produced onsite using biogas-powered generators. This will typically only be a fraction of the available energy, and the rest can be sold to produce renewable energy products.
- Predigesting SSO speeds up the composting process, increasing the composting system capacity.
- Integrating AD into an existing composting system can result in zero residuals from the digester (see Figure 4).
- Pre-processing for AD often is identical with that required for composting, allowing existing pre-processing equipment to continue in use when a digester is added to an existing composting system.

Utilizing Biogas from AD to Produce Energy

Biogas is the most important byproduct of the AD process because it can be used as fuel and so provides a renewable energy source. Biogas consists primarily of methane (CH4) and carbon dioxide (CO2), and usually also contains significant concentrations of hydrogen sulfide (H2S) and trace quantities of siloxanes (which may damage gas-burning equipment) and various volatile organic compounds (VOCs). Thus the biogas must be treated before being used, and treatment systems must be selected as appropriate for the equipment that will be used to recover energy.

Mixed SSO usually produces from 100 m3 to 150 m3 of biogas per tonne of raw waste, as received. For planning purposes, 100 m3/tonne is recommended until a detailed feedstock energy assessment is undertaken. If the proportion of food waste to yard waste (or garden waste) has been determined, a slightly more refined production estimate can be made by using separate factors for food waste (144

m^3/tonne) and yard waste (41 m^3 per tonne)[2] These estimates should not be considered better than +/- 30%.

The methane content of raw biogas from anaerobic digesters is about 60% by volume, providing an energy value of roughly 22 MJ/m3. Successful biogas projects have used engine-generator sets to produce electricity. Onsite generators could be used to supply the large electricity demand of compost tunnel blowers and other onsite equipment, and there would likely be additional electricity to sell into the grid if the grid operator allows. Other successful projects have upgraded biogas to pipeline quality and injected it into gas transport and distribution systems, mixing it with natural gas. Recently, large environmental premiums have been paid in North America and Europe for biogas derived methane ("renewable natural gas" or RNG), amounting to multiples of the natural gas market price. A third major use is upgrading and pressurizing the biogas to produce compressed gas (CNG) for vehicle fuel. However, the most efficient use of biogas would be for space heating, since it requires essentially no treatment except dewatering, using part or all of the biogas, if there is a significant heating demand on-site or nearby.

Gas storage in these projects is typically one day's production or less, only for the purpose of smoothing out the flow delivered to a biogas treatment and utilization system. Low-pressure gas "bubbles" are usually used for this purpose, which may be gas bladders enclosed in plastic domes on the ground, or gas bladders on top of the digester. Some digester/biogas systems do not have separate gas storage but simply use the headspace in the digester.

By way of example of the potential gas yield, digestion of 45,000 t/a of the nominal design 84,000 t/a, including all of the high-energy food waste and "others" waste, a large fraction of the food and garden organics waste and none of the green waste received via the transfer stations, would yield an estimated 105 m3/t. Assuming biogas conversion to RNG efficiency of 95% and electrical energy conversion efficiency of 38%, the following annual energy outputs from 45,000 t/a of SSO would be achievable.

	energy/m3	annual energy produced
renewable natural gas	21 MJ/m3	99,200 GJ/year
Electricity	2.32 kWh/m3	11,000 MWh/year

Prior to determining of the design capacity and number of digesters of an AD facility, it is recommended that the efficacy and energy potential of screened FOGO plus other available food waste feedstocks is assessed, along with consideration of plant reliability, redundancy and feedstock growth opportunities and power requirements for the associated composting plant.

Design

Assumptions

The following evaluation is for a plug-flow dry-solids AD system sized to handle 25,000 t/a of the nominal design 84,000 t/a of organic solid waste feedstocks, which is combined with a composting process that

[2] All biogas/tonne factors are from Environment Canada, *Technical Document on Municipal Solid Waste Processing,* 2013. Cubic meter quantities in this memo are Nm^3 at reference conditions of 273,15K (= 0°C) and 101.325 kPa (= 1,01325 bar).

composts the solid digestate and utilizes the liquid digestate to supplement the composting water requirements.

It is noted this AD process design capacity is nominal and subject to detailed assessment of feedstock energy potential and overall plant economic assessment and optimization, however it is expected to provide sufficient energy output to meet energy inputs required for the associated aerated composting plant.

The feedstock composition is assumed to be as described in Jacobs 22 April 2021 Feedstock Assessment Memorandum, plus additional potential feedstocks as described in Jacobs 30 November 2021 Additional Feedstock Memorandum – V3.

General Characteristics:

The AD system consists of a receiving building, feedstock pre-processing, one or more digesters, dewatering, gas collection, gas treatment, combined heat and power unit and gas flaring.

If gas it to be utilized as a direct energy source then storage and additional post-treatment is required. Further assessment is required to determine the most beneficial end use of biogas produced.

Preprocessing typically involves shredding, screening to approximately 50 mm and contamination removal and would be integrated with the pre-processing for the composting processes. The digester slurry pumps can typically handle small glass, metal, stone and plastic contaminants however these remain a risk.

Loading of the digester is typically achieved using an excavator or overhead rail mounted grab bucket or hop-fed conveyor.

The digester would be one or more long steel tanks with internal rotating paddles to mix and move the contents from inlet to outlet. A portion of the liquid digestate is recycled to the inlet to inoculate the fresh feedstock with bacteria.

All these components would be housed inside a building with all air collected and treated via a biofilter and ideally, co-located with the feedstock mixing and loading area for the composting system.

Range of Feedstocks:

The full range of existing and future additional feedstocks anticipated can be accommodated by the AD process, however the low energy potential of green waste in particular will result in reduced efficiency and increased cost. Accordingly it is suggested that screening of the FOGO collection prior to shredding be used to remove the majority of the low-energy green waste component and that energy dense feedstocks such as food wastes, fats, oils and greases are not mixed with FOGO.

Further increase of the Food Organics fraction would have the effect of increasing the energy output from the digester.

Increased Green Waste from Councils Transfer Stations would bypass the AD process.

Physical Assets

Bulk infrastructure required includes water, sewer, electricity, telecommunications and good road network access. Due to the AD facility being co-located with a composting facility, it is expected that these are available.

Other associated facilities, features, and physical assets include:

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- Receiving and Processing buildings with air extraction and biofilter – shared with composting facility
- Digester (1 or 2)
- Dewatering plant
- Gas storage (1)
- Combined heat and power plant (1)
- Loaders (1) – shared with composting facility
- Screen (1) – shared with composting facility

Ease of Expansion

Expansion of an AD system requires construction of an additional digester, dewatering, gas treatment and combined heat and power plant and associated building space.

As this is expensive equipment, careful consideration is required to the sizing of the initial AD plant. Options include under sizing the initial plant and planning for a second processing line once growth in feedstocks is achieved or allowing for growth at the outset and utilizing a greater proportion of the lower energy feedstock initially.

Further detailed assessment of economics is required to inform this decision.

Process Inputs

Energy:

AD processing requires mechanical energy for mixing of the digester and heat energy to maintain temperature of the digester.

An AD facility of this size would be expected to have an operating electrical load of approximately 0.5 MVA.

Water:

Water input is required to maintain the optimum moisture content.

Most of the process water required would come from re-use of the liquid digestate and collected roof stormwater and leachate (from compost operation) stored in tanks onsite.

Process Outputs

Solid digestate:

Solid dewatered digestate would be mixed with the balance of incoming organic feedstocks and composted.

Liquid digestate:

Liquid digestate would be used within the AD digester and for moisture control in the compost process. Alternatively the liquid digestate can be used as a liquid fertilizer.

Biogas:

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Biogas has approximately 60% methane component so can be used as a direct energy source, converted to electricity or further processed into renewable natural gas.

Once combusted for heating or electricity generation, the resulting biogenic CO2 can be captured for use in glass houses or similar and resulting heat captured for re-use.

Odour:

Air from the processing building is collected and passed through biofilters to remove odours, with focused air extraction at the odour release locations including screening and digestate handling.

As the process is enclosed, it is not affected by external weather conditions.

Management of odour relies on well-constructed and sealed buildings and good maintenance of biofilters.

Odours are also minimized by carefully controlling the opening and closing of doors and using air curtains at building entrances.

Overall the odour risk for a site with AD is likely to be related to the composting technology.

To mitigate the risk of adverse effects at sensitive receivers or consent compliance boundaries resulting from odour generation during operations, a buffer should be provided.

Dust:

Creation of dust occurs to some extent within the receivals and processing hall, however is managed through maintenance of moisture content of feedstocks and by cleaning of the floors. Dust is not emitted or generated outside of the buildings.

Surface Water:

Surface water from roofs is collected and stored for re-use. Surface water from external hardstand areas is treated and discharged.

Leachate is collected, treated and stored for re-use.

Consents and Approvals

Consents and approvals likely to be required for an AD process are similar to a composting process and include:

- Air discharge of odour and dust
- Surface water discharge of treated stormwater
- Land use consent (depending on underlying zoning of land)
- Building consent for built facilities

These are generally the same for all composting processes and it is expected they would be combined with the consent for a compost plant.

Location Considerations

It is expected an AD plant would be co-located at a composting facility to gain the synergies available, however it could be located independently and digestate outputs transported for either composting or end-use of land application.

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The odour potential is relatively low and controlled, and the odour risk from a site with composting and AD is likely to be primarily related to the risk associated with the composting technology. Buffer distances as recommended for the relevant composting technology would be recommended.

Transport of feedstocks is a significant contribution to overall operational costs for organics processing so location close to the source of feedstocks is sensible.

The process is comparable to many on-farm processes and the output compost is utilized in farming and viticulture industries, so close proximity to these end users would be a benefit.

Land Requirements:

The space required for a plug-flow digester and associated dewatering and gas processing plant for the assumed 25,000 tonnes / annum would be approximately 0.2 hectares. With allowance for growth 0.4 hectares would be recommended. This assumes that room for feedstock receival and pre-processing is already allowed for in the associated composting system.

GHG and Carbon Footprint

The greenhouse gas emissions profile for AD is discussed in a separate GHG memorandum.

Appendix D. Greenhouse Gas Emissions

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Subject	**Greenhouse Gas Emissions – High Level Assessment of emissions from organic composting plants and logistics – Rev B**	**Project Name**	Christchurch City Council Future of Organics
Attention	Kent Summerfield	**Project No.**	IA253700-NP-MEM-0003
From	James Wilkinson, James Moore and Rochelle Hardy		
Date	09 February 2022		
Copies to	**Ross Trotter, Rowan Latham**		

Summary

This memo provides a high-level assessment of the potential greenhouse gas (GHG) emissions arising from composting technologies. It is part of a suite of memos being developed to help guide decision-making on potential organic composting facilities and sites for Christchurch. It focuses on three key questions to inform a Multi-Criteria Assessment and overall report, as follows:

1. Are GHG emissions materially different for the various organic waste processing technologies that could be considered in Christchurch and are they therefore a relevant factor to consider in choosing between technologies?
2. Are GHG emissions arising from transport of waste and products materially different for sites under consideration and is this a relevant factor to consider when choosing between sites?
3. Do the technologies and sites being considered contribute to or enable a change to a circular economy for organic waste and products management?

The treatment of organic waste is a significant part of Christchurch City Council's GHG footprint, with landfill and composting activities making up 6.9% of the district's GHG emissions profile. The vast majority of this is associated with landfill gas and the anaerobic decomposition of organic matter that is disposed in landfill.

When **pursuing a circular economy and addressing climate change the priority should be reducing the generation of organic waste and waste to landfill.** Reducing food waste also avoids GHG emissions throughout the entire organic life cycle, from collection, transport, processing and beyond and should be the first preference for emissions reduction. Regardless, the treatment of organic waste and diversion of organics from landfill to other processing options presents the opportunity for significant GHG emission reduction.

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Greenhouse Gas Emissions – High Level Assessment of emissions from organic composting plants and logistics – Rev B

There are some minor differences in the GHG emissions between individual anaerobic digestion (AD) or composting technologies (e.g., wet vs dry AD or static pile vs in-vessel composting). The different treatment processes for organic waste have varying levels of GHG emissions associated with them, hence GHG is a relevant factor in choosing between technologies.

For the technologies assessed in this memo, **the uncertainty range is too high to draw meaningful conclusions for decision making between the sub-options. Instead the focus should remain at the higher level, with AD having the lowest GHG emissions, followed by gasification/pyrolysis and composting having the highest impact.** As shown in the following table:

Technology	GHG Direct Impact	Co-benefits for climate change mitigation and circular economy
Anaerobic digestion (AD)	Lowest emissions 0.02 t CO_2e / t waste	• Electricity generation
Gasification/pyrolysis	Low emissions 0.04 t CO_2e / t waste	• Electricity generation • Potential soil amendment product
Composting	Highest emissions 0.172 t CO_2e / t waste	• Soil amendment product

The contribution of indirect emissions sources such as fuel and electricity use from operational activities and indirect benefits of application to land are unlikely to be a material emissions source for decision making compared to direct emissions. A more detailed view of these would be part of a full life cycle assessment of each specific technology type and not relevant to this assessment.

Transportation is a negligible contribution to the emissions of any option selected (where located within the CCC boundaries) and hence transportation distances and site selection is not a notable factor of decision making for GHG emissions if a location can be found in relatively close proximity to the city. **The influence in transportation emissions lies instead in greening of the fleet through electrification or hydrogen options, with this becoming more important if a remote location is pursued.**

The productive recovery of energy and nutrients from waste through by-products in each process supports circular economy outcomes. Where used in agricultural applications the creation of by-products such as compost or biochar have the potential to enhance soil quality. The electricity generation potential of AD and gasification/pyrolysis also has the indirect co-benefit of replacing electricity that would have been required from the grid, at a lower emissions intensity than the current average grid mix in New Zealand.

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Greenhouse Gas Emissions – High Level Assessment of emissions from organic composting plants and logistics – Rev B

1. Introduction

This memorandum provides an overview of greenhouse gas (GHG) emissions associated with existing and potential organic composting facilities and sites in Christchurch. This memo includes:

- An overview of key considerations for waste management with regard to climate change and emissions
- A high-level assessment of modelled GHG emissions from garden and food waste treatment facilities
- A discussion on the carbon footprint associated with transportation of green waste to potential sites within Christchurch.

2. Purpose

The purpose of this memorandum is to provide a high-level assessment of the GHG emissions arising from potential organic composting facilities. This assessment forms part of a suite of a package of work to consider and evaluate process technologies. The findings from this work will inform a Multi-Criteria Assessment matrix and assist with making an informed investment decision.

Key questions that this memo will inform are:

1. Are GHG emissions materially different for the various organic waste processing technologies that could be considered in Christchurch and are they therefore a relevant factor to consider in choosing between technologies?

2. Are GHG emissions arising from transport of waste and products materially different for sites under consideration and is this a relevant factor to consider when choosing between sites?

3. Do the technologies and sites being considered contribute to or enable a change to a circular economy for organic waste and products management?

3. Background

[redacted]

Climate change, waste minimisation and reducing organics in landfill are key considerations in both National and Council policy objectives and further discussed in the *Project Objectives and Evaluation Framework (IA253700-NP-MEM-0001 – FINAL).* To support these outcomes the Council seeks to reduce organics going to landfill. To support this, several technology options are being considered including:

- In-vessel aerobic composting

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Greenhouse Gas Emissions – High Level Assessment of emissions from organic composting plants and logistics – Rev B

- Static pile aerobic composting
- Dry anaerobic digestion
- Wet anaerobic digestion
- Organics only pyrolysis
- Gasification.

These options have also been included in responses to RFI 25065759 seeking market input to solutions. A vermiculture option was also included in the responses and is considered a composting option.

As a minimum requirement, the preferred option should not result in increases in GHG emissions, relative to the current processing technology and based upon common feedstock tonnages.

4. Greenhouse gas emissions from organic waste processes

4.1 GHG Emissions from Christchurch Waste

Decomposition of organic waste emits a range of different GHGs. The main GHG emissions from organic wastes are methane (CH_4), carbon dioxide (CO_2) and smaller amounts of nitrous oxide (N_2O). Open and closed landfills emit landfill gas (methane) from the breakdown of organic materials disposed of in the landfill. **Diverting organic waste from landfill to other treatment options reduces the GHG impact of the waste.**

Waste, including solid waste, is Christchurch's fourth highest GHG emitting sector producing 6.9% of Christchurch's total gross GHG emissions.[1] Approximately 0.4% of emissions from the Christchurch waste sector are from composting, as shown in Table 4-1.

Table 4-1: Christchurch District's GHG emissions from Waste (2018/2019 financial year)

GHG Emission Sector/Source	% of Total Gross GHG Emissions	% Contribution to Waste Sector GHG Emissions
Closed Landfill Sites	5.3 %	70.9 %
Open Landfill Sites	1.2 %	16.5 %
Composting	0.4 %	5.3 %

Source: AECOM (2020)

4.2 Measuring GHGs – the carbon dioxide equivalent

GHGs warm the Earth by absorbing energy which would otherwise have been reflected into space, and hence an increase in GHGs contributes to global warming through the absorption of additional energy in the atmosphere. Each GHG has a differing impact on global warming and so the *Global Warming Potential*

[1] AECOM (2020), *Christchurch Greenhouse Gas Emission Inventories for Financial Years 2018/19 and 2016/17*

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Greenhouse Gas Emissions – High Level Assessment of emissions from organic composting plants and logistics – Rev B

(GWP) provides a common unit of measure to estimate the effect of different gases. This measure simplifies the assessment of the effect of GHGs on climate and allow all GHGs to be assessed and assigned a relative impact to that of CO_2.

GWP is used to compare the ability of different GHGs to trap infra-red radiation in the atmosphere and re-emit this energy as heat. GWP also allows consideration of the effective residence time (in years) of each GHG in the atmosphere relative to that of CO_2. This combined impact of all GHGs is expressed as **"carbon dioxide equivalent", or CO_2e.**

Generally, multiplying a mass of a particular gas by its GWP gives the mass of CO_2 emissions that would produce the same warming effect over a 100-year period (CO_2e). The GWP of the GHGs relevant to organic waste treatment in this report are aligned with those used in the New Zealand organisational inventory guidance[2] and presented in Table 4-2.

Table 4-2: Global warming potentials of GHGs

GHGs	Scientific Formula	Global Warming Potential (GWP)
Nitrous Oxide	N_2O	298
Methane	CH_4	25
Carbon Dioxide	CO_2	1

Source: MfE, 2020

4.3 Biogenic vs fossil sources of carbon dioxide

When dealing with emissions from organic materials and processes it is important to distinguish between **biogenic** and **fossil sources** of GHG emissions.

All organics contain carbon, however, when they decompose aerobically or are combusted the CO_2 released is considered part of the natural cycle and not included when measuring emissions attributed to organic waste. The CO_2 produced in the treatment of organic waste is a biogenic source of emissions and it is treated differently in carbon accounting to CO_2 emissions associated with fossil sources. As plants grow, they sequester carbon from CO_2 in the air through the process of photosynthesis, which is then released at the end of its life when the organic material decays. This decay can release the carbon either in the form of CO_2 (as part of an aerobic process) or methane (as part of an anaerobic process).

Where the degradation of the material is aerobic and CO_2 is formed, the process is assumed to be carbon neutral due to the 'short cycle' of the process. For this reason, **biogenic sources of CO_2 associated with organic waste are typically not counted in carbon accounting**. This is consistent with the approach used in New Zealand.[3]

[2] Ministry for the Environment (MfE) (2020). *Measuring Emissions: A Guide for Organisations: 2020 Detailed Guide.* Wellington: Ministry for the Environment.
[3] MfE (2020). Op. cit.

Where the degradation is *anaerobic* and results in methane, the process is not assumed to be carbon neutral due to the much higher GWP of methane compared to CO_2 - which both have a single carbon atom per molecule.

This differs from the extraction and combustion of fossil sources of carbon which are stored over the long term (>1 million years), the release of which is considered a disruption to the natural cycle and hence an additional source of carbon, increasing atmospheric levels of CO_2.

In essence, methane and N_2O produced from organic waste are the main GHG emission that need to be reduced though composting and / or other technology.

The biogenic and fossil carbon cycles are illustrated in Figure 4-1. Organics that are high in nitrogen (such as food waste, manure and grass clippings) can also produce N_20 when wet or compacted. However, the generation of nitrous oxide from waste treatment does not have a corresponding drawdown within the natural cycle and hence is treated as a source of emissions regardless of biogenic or fossil origins.

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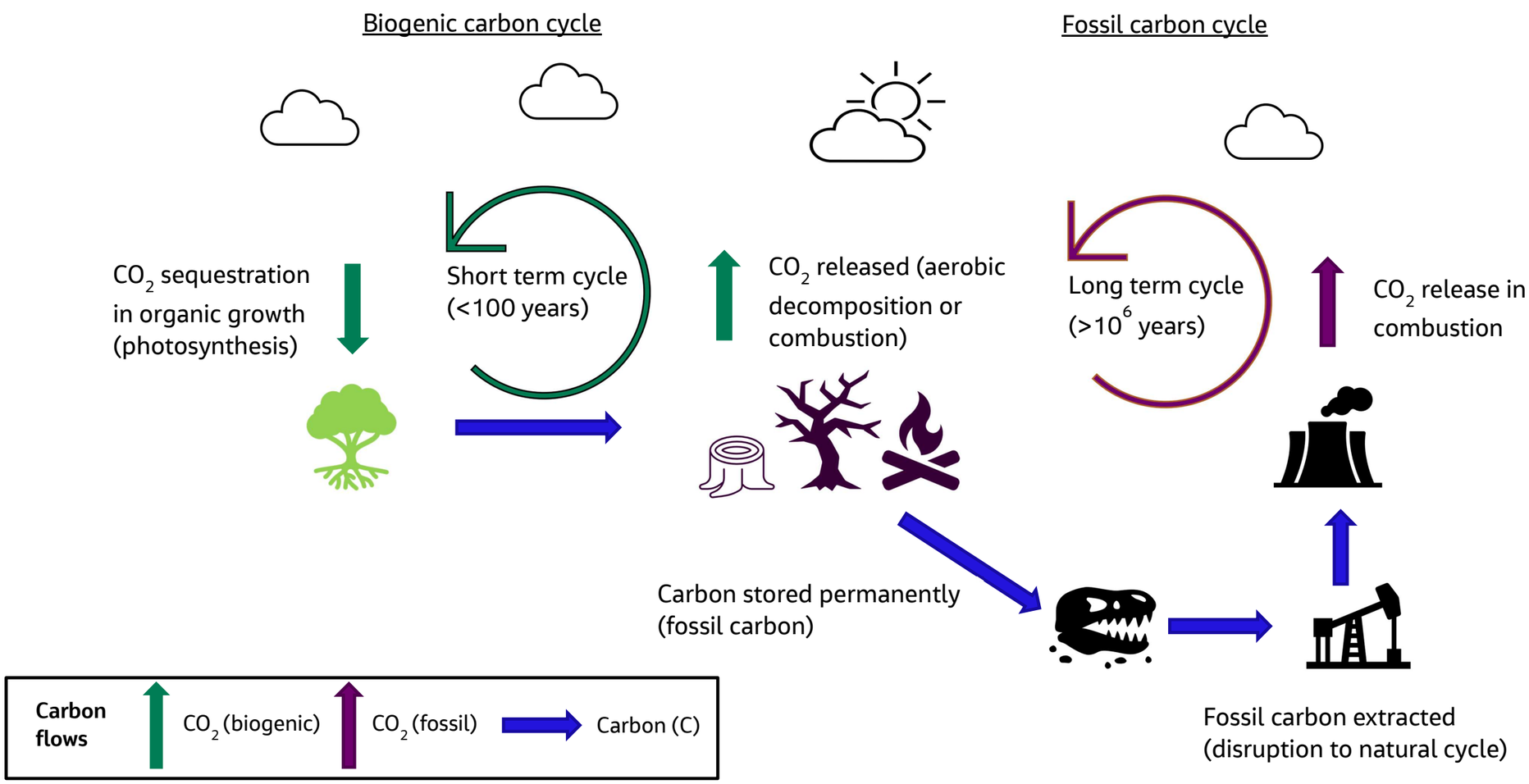

Figure 4-1: Biogenic and fossil carbon cycles

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4.4 Treatment processes – Direct GHG emissions

Both aerobic and anaerobic treatment process typically release three GHGs: N_2O, CH_4 and CO_2 in varying quantities. Treatment processes that result in organic waste decomposing anaerobically (e.g. landfill or anaerobic digestion) release much greater quantities of methane, whilst processes that undergo aerobic decomposition release much greater quantities of CO_2. As noted, CO_2 is a biogenic source and not included in carbon accounting. However, the higher GWP of methane means that in the absence of methane capture anaerobic processes tend to result in higher GHG emissions for the same quantity of organic waste.

Landfill sites produce landfill gas as a result of the anaerobic decomposition of organic matter. Landfill gas contains approximately equal amounts of methane (45% to 60%) and CO_2 (40% to 60%), along with a number of trace gases. It is now common to capture landfill gas and flare it (to convert it to CO_2) or the use it to generate electricity. As the carbon from landfills is typically from biogenic source, the conversion from methane to CO_2has the effect of greater lowering the overall GWP of the emissions. Capture systems vary is effectiveness, with capture rates ranging from 50-80% depending on the type of system and landfill.[4]

The combustion of gas recovery from landfill or anaerobic digestion through flaring or energy generation also has associated emissions.

Assuming a biogas yield from the anaerobic digestion of mixed food waste of 200m^3 per tonne of waste (GMI, 2016) and an energy content of 37.7 MJ/m^3 (NGA, 2021), this would result in associated emissions of up to 0.4 kgCO_2e per tonne of waste, negligible compared to other sources. The yield associated with landfill gas capture would be expected to be lower, and hence also negligible. The emissions associated with biogas combustion are therefore not a relevant issue in the comparison of waste options compared to other factors.

Anaerobic digestion (AD) of organic waste is a similar decomposition process to landfill, however it expedites natural degradation processes by optimising the temperature, moisture content and pH of the waste in a sealed vessel. The methane generated can also be captured and flared or combusted to convert it to biogenic CO_2, however this is typically done at much higher efficiencies than landfills, at rates of 90-100%.[5]

Composting, typically being an aerobic process, results predominantly in the emission of biogenic CO_2. Although some of the wastes carbon content can form methane in anaerobic sections of the compost, this is usually oxidised in the aerobic sections before being emitted, resulting in only small proportion (~1%)

[4] Global Methane Initiative (GMI), (2012), *International Best Practices Guide for Landfill Gas Energy Projects – Chapter 6 Landfill Gas Modelling.* https://www.globalmethane.org/resources/details.aspx?resourceid=1975

[5] Intergovernmental Panel on Climate Change (IPCC), (2006a), *2006 IPCC guidelines for national greenhouse gas inventories, Volume 5 Waste, Chapter 4 Biological Treatment of Solid Waste.*

of methane being released to the atmosphere.[6] Composting can also produce small emissions of nitrous oxide, ranging from 0.5 percent to 5 percent of the initial nitrogen content of the waste, however well operated composting systems can minimize the amount of both methane and nitrous oxide produced.[7]

While there are some minor differences in the direct GHG emissions between individual anaerobic digestion or individual composting technologies (e.g. wet vs dry anaerobic digestion or static pile vs in-vessel composting), there are still high uncertainties and these are not typically accounted for within national or corporate inventories.[8] Research has attempted to quantify direct emission differences[9] however the uncertainty range is currently too high to draw meaningful conclusions for decision making between options.

A more effective approach is to focus on the general composting approach (i.e. AD and aerobic composting (or other technology) as this has the largest influence on GHG emissions. In addition there is insufficient confidence in the minor differences of GHG impact between more specific technology types.

4.4.1 Gasification and Pyrolysis

Gasification involves the conversion of solid waste streams to a biogas / or syngas (or liquid / solid waste equivalent) while pyrolysis is a process which also creates a solid fuel in the absence of oxygen. While gasification and pyrolysis may have notable emissions of pollutants affecting air quality, they have negligible emissions of GHGs directly from the process.

The combustion of the residual products from pyrolysis (biogas/ bio-oil/ bio char) for energy does result in emissions. The emissions intensity of energy generation from these by-products can be compared to that of biogas captured from landfill or anaerobic digestion processes. Biochar from pyrolysis can also be used as a soil improver rather than combustion for electricity generation, avoiding further emissions. Biochar may also improve carbon sequestration.

As such landfill is the highest GHG emitting option for dealing with organic waste streams in terms of direct GHG emissions from waste. Diverting organic waste from landfill to other treatment options improves the GHG profile of the waste. This approach is consistent with recommendations from the Climate Change Commission and incorporated in the Governments proposed Emissions Reduction Plan, to cut waste and landfill emissions and increase landfill gas capture.

A summary of the comparative emissions from different end of life options for organic waste is shown in Table 4-3 and Figure 4-2.

Table 4-3: Direct GHG emissions associated with different organic waste options

Waste option	Food (tCO_2e / t waste)	Garden (tCO_2e / t waste)
Municipal (class 1) landfills with gas recovery	0.299	0.398
Municipal (class 1) landfills without gas recovery	1.125	1.500
Non-municipal (class 2-4) landfills	0.525	0.700
Composting	0.172	
Anaerobic digestion	0.02	
Pyrolysis / gasification	0.04*	

[6] IPCC, 2006a. Op. cit.
[7] IPCC, 2006a. Op. cit.
[8] MfE, 2020. Op. cit.
[9] Boldrin, A., Andersen, J. K., Møller, J., Christensen, T. H., & Favoino, E. (2009). *Composting and compost utilization: accounting of greenhouse gases and global warming contributions*. Waste Management & Research, 27(8), 800-812.

*The by-products and resulting emissions intensity of gasification/pyrolysis is variable, the result provided is indicative only based on byproduct compositions for fast pyrolysis from Schmidt et al (2019) and emissions factors from IPCC (2006b)

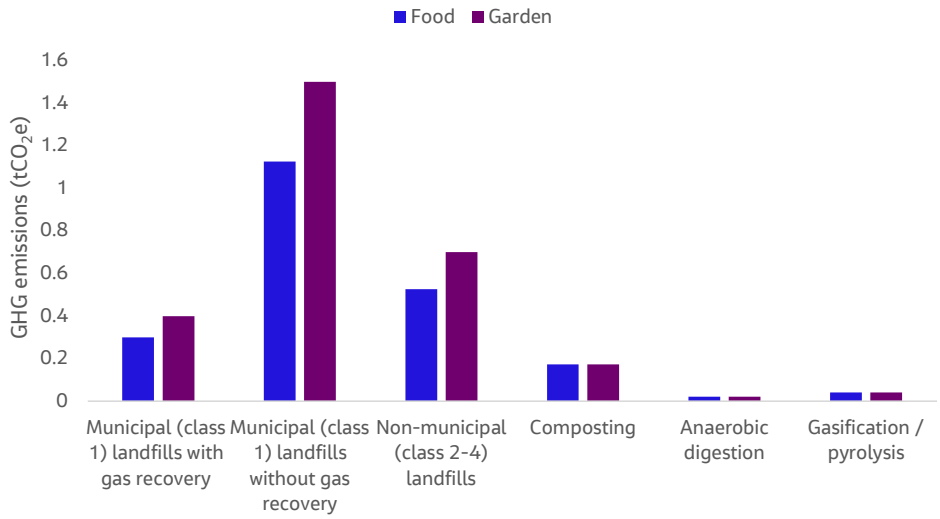

Figure 4-2: Direct GHG emissions associated with different organic waste options

4.5 Treatment processes – indirect GHG emissions

In addition to the direct GHG emissions from the decomposition of waste or the combustion of by-products, the broader life cycle of the waste treatment process should be considered to develop a full picture of the emissions footprint of each option. This includes indirect emissions such as those upstream of the treatment process associated with transportation, electricity and fuel use, and downstream impacts such as application of biproduct (biochar) to land.

An overview of the direct and indirect GHG emissions associated with each organic waste processing option is presented in Figure 4-3. The scale of indirect emissions from each process is highly variable but there are some approximate indications available in terms of their scale relative to direct emissions.

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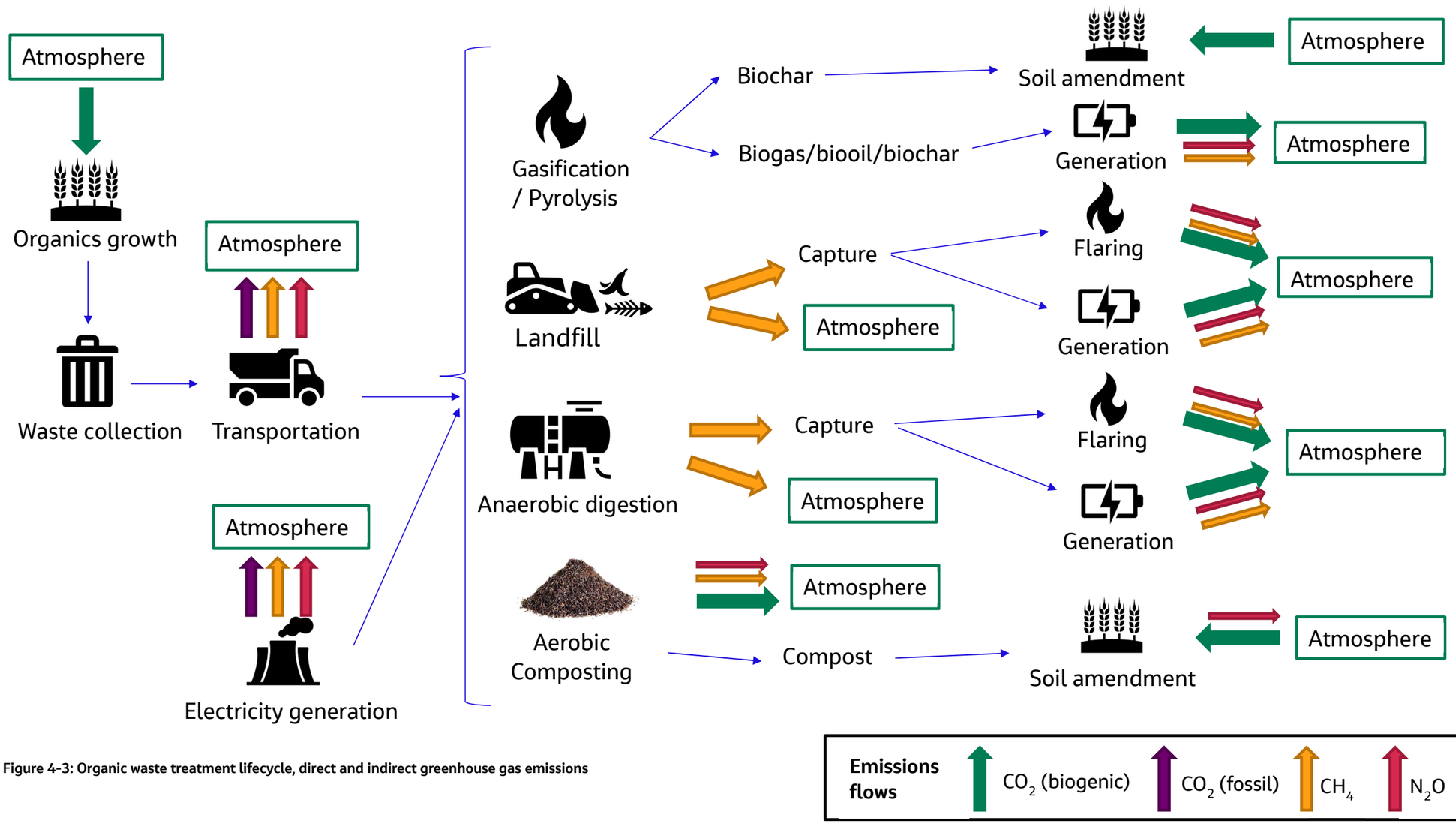

Figure 4-3: Organic waste treatment lifecycle, direct and indirect greenhouse gas emissions

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4.5.1 Transportation

The transportation of waste has emissions associated with fuel combustion in the waste trucks during collection and delivery. The average emissions intensity of waste transport can be considered on a tonne kilometre basis, that is, the amount of GHG emissions produced to transport a tonne of waste one kilometre. The average emissions factor for all trucks freighting goods is 0.135 kg CO_2e / t.km.[10]

Based on this, a difference in transportation distance for waste between sites of up to 20km would generate approximately 2.7 kg CO_2e, or less than 2% of the direct GHG emissions associated with composting. Transportation is therefore a small contribution to indirect emissions and the carbon footprint of any selected waste option, unless a remote site is pursued with considerably greater travel distances.

Although the relative transportation of waste between sites is likely not to be an influential factor when deciding on an option or location, there are ways to reduce the emissions associated with the collection and transportation of waste. The use of alternative waste collection vehicles such as electric or hydrogen vehicles presents an option to eliminate emissions associated with collection and transportation almost entirely. This is likely to be much more influential on the emissions associated with this part of the waste life cycle compared to site selection alone, especially considering this mitigates GHG emissions from organics collection (as well as transfer to the processing facility) which is approximately 85% of the total transportation associated with organics collection and processing.

4.5.2 Electricity and fuel consumption

Each treatment process requires the use of some form of energy, whether that be fuel for operating landfill equipment, aerators for composting or otherwise.

On average, the diesel use for composting activities is 0.4 - 6L per tonne of waste for open composting or 0.13 - 3L per tonne of waste for in-vessel composting.[11] Using the emissions factors for diesel combustion of approximately 2.65 kgCO_2e / L[12], this would be equivalent to between 0.35-16 kg CO_2e or around 2-9% of composting direct emissions. Fuel emissions associated with other processes (landfill, AD, etc) are expected to be at the lower end or less than this range as composting, particularly open composting, is likely to be the most intensive in terms of plant and equipment to maintain aeration.

Electricity use for composting is estimated at between 0.02-19.7 kWh per tonne of waste for open composting or 9 – 77 kWh per tonne of waste for in-vessel composting.[13,14] Using the emissions factors

[10] MfE, 2020. Op. cit.
[11] Boldrin et. al., 2009. Op. cit.
[12] MfE, 2020. Op. cit.
[13] Boldrin et. al., 2009. Op. cit.
[14] Bio Plant South Island Nz Ltd, 2021, Organics Processing Plant Feasibility Study for Christchurch City Council

for electricity consumption[15] of approximately 0.101 kgCO_2e / kWh, this would be equivalent to between ~0- 7.8 kg CO_2e or around 0-5% of composting direct emissions. The electricity consumption for In-tunnel comporting is significantly higher than for Aerated Static Pile, so would be at the higher end of this emissions profile and Aerated Static Pile being at the lower end. Anaerobic digestion, gasification and pyrolysis are expected to be self-sufficient in terms of electricity consumption (i.e. the generation from biogas or other by-products exceeds consumption) and the footprint of electricity for landfill operation is expected to be negligible compared to its direct impact.

Even assuming the upper limits for both fuel and electricity consumption, emissions associated with composting are still expected to be significantly less than those for landfills, even with gas capture, and AD processes remain the least emissions intensive.

Fuel and electricity consumption are therefore likely to be a minor contribution to indirect emissions and the carbon footprint of any selected waste option relative to direct emissions, with Anaerobic Digestion being the lowest, followed by Aerated Static Pile composting then In-tunnel composting.

4.5.3 Application of by-products to land

The impacts of a gasification / pyrolysis system are dependent on the end use for by-products, with the application of biochar to land likely to significantly reduce the emissions footprint comparatively to combustion for energy generation.

The downstream impacts associated with the use of by-products such as compost or bio char to land are typically not accounted for within organisational boundaries (e.g. the Councils corporate GHG reporting) but are an important consideration when comparing the lifecycle impact of each waste processing option.

There are two primary mechanisms in which the application of by-products to land affects the emissions footprint:

1. Directly, through
    - enhancing the sequestration of carbon into the soil, either through direct storage such as persistence of the carbon content in the by-product or accumulation of greater rates of organic carbon
    - release of nitrous oxide emissions from the processes of nitrification and denitrification resulting from nitrogen enhancement of the soils
    - fuel use associated with plant and equipment used in application
2. Indirectly by avoiding the emissions associated with fertiliser use that would have been required in place of the by-product

There is a broad range of potential downstream impacts resulting from the application of compost to land estimates. The combined impact of these processes at between -146 to +19 kg CO_2e per tonne of waste, of which indirect impacts range from -4 to -82 kg CO_2e per tonne of waste.[16]

As such, while there is the potential for downstream impacts to alter the lifecycle impact of composting, it is unlikely to reduce it to the point where it is lower than that of anaerobic digestion or increase it to the point where it is higher than any form of landfilling.

The carbon within biochar lasts at a time scale much longer than that of compost, with storage potentially in the order of hundreds to thousands of years before conversion to biogenic carbon-dioxide.[17] It may

[15] MfE, 2020. Op. cit.
[16] Boldrin et al (2009). Op. cit.
[17] Schmidt, H. P., Anca-Couce, A., Hagemann, N., Werner, C., Gerten, D., Lucht, W., & Kammann, C. (2019). Pyrogenic carbon capture and storage. *Gcb Bioenergy*, *11*(4), 573-591.

also enhance the uptake of organic carbon within the soils over time, accumulating storage of carbon from the atmosphere. However, rates of this occurring are highly variable and likely to be low or absent in temperate soils such as those of New Zealand.[18] There is therefore a low certainty in the extent to which biochar would facilitate downstream carbon sequestration, although it is unlikely to be significant for local applications.

4.6 Comparison of composting options

Considering both the direct and indirect impacts of GHG emissions of each organic waste treatment process, anaerobic digestion, composting and gasification/pyrolysis options are all likely to be lower emissions than sending organic waste to landfill.

Anaerobic digestion is likely to be the least emissions intensive option, followed by gasification / pyrolysis, then Aerated Static Pile composting then In-tunnel composting.

Effective anaerobic digestion requires methane capture and flaring or energy generation system with minimal to no leakage.

5. Key Findings

The treatment of organic waste is a significant part of the Councils GHG footprint, with landfill and composting activities making up 6.9% of the district's GHG emissions profile. The main source of this is landfill gas and the anaerobic decomposition of organic matter in landfills. As such, **diversion of organics from landfill to other processing options presents the opportunity for significant GHG emission reduction.**

Treatment processes for organic waste have varying levels of GHG emissions associated with them, both direct and indirect. The emissions of each organic waste treatment process generally produce lower emissions compared with sending organic waste to landfill. While there are some minor differences in the direct GHG emissions between individual anaerobic digestion or composting technologies (e.g., wet vs dry AD or static pile vs in-vessel composting), there are still uncertainties and such differences are not accounted for within national or corporate inventories such as those that are produced for the Council or New Zealand more generally.

As the uncertainty range is too high to draw meaningful conclusions for decision making between the sub-options and the focus should be at a higher level, between AD and composting more broadly). **Anaerobic digestion is considered the least emission-intensive option, followed by gasification / pyrolysis and then composting,** as presented in Table 5-1.

Table 5-1: Summary of GHG impact of technology options

Technology	GHG Direct Impact	Co-benefits for climate change mitigation and circular economy
AD	Lowest emissions 0.02 t CO_2e / t waste	• Electricity generation
Gasification/pyrolysis	Low emissions 0.04 t CO_2e / t waste	• Electricity generation • Potential soil amendment product

[18] OP. cit.

Technology	GHG Direct Impact	Co-benefits for climate change mitigation and circular economy
Composting	Highest emissions 0.172 t CO_2e / t waste	• Soil amendment product

The productive recovery of energy and nutrients from waste through by-products supports circular economy outcomes. Where used in agricultural applications the creation of by-products such as compost or biochar can enhance soil quality.

The electricity generation potential of AD and gasification/pyrolysis also have the co-benefit of replacing electricity that would have been required from the grid.

The contribution of indirect emissions sources such as fuel and electricity use are unlikely to be material compared to direct emissions, however, over time this will become important if climate change targets are to be fully realised. Aerated Static Pile composting has considerably lower electricity demand than In-tunnel composting, so when considering direct and indirect emissions, has an overall lower GHG missions profile.

Similarly, transportation is a negligible additional contribution to the emissions for any location in close proximity to the city and a small additional contribution to the emissions for any remote location selected. Site selection location is therefore not a notable factor of decision making for GHG emissions, however if a remote location is selected then overall transportation GHG emissions will be hgher than for a local location.

The largest influence in reducing transportation emissions lies with greening of the fleet through electrification or hydrogen options, as this mitigates GHG emissions for the transportation of organics to a processing facility, as well as the organics collection which accounts for approximately 85% of transportation requirements associated with organics collection and processing.

While different processing options for organic waste have differing impacts on GHG emissions **in pursuing a circular economy and addressing climate change the priority should be reducing the generation of organic waste and waste to landfill.** Reducing food waste avoids GHG emissions throughout the entire organic life cycle, from collection, transport, processing and beyond and should be the first preference for emissions reduction.

Additional References

Australian Government Department of Industry, Science, Energy and Resources, (2021), National Greenhouse Accounts Factors (NGA, 2021)

Czajczyńska, D., Anguilano, L., Ghazal, H., Krzyżyńska, R., Reynolds, A. J., Spencer, N., & Jouhara, H. (2017). Potential of pyrolysis processes in the waste management sector. *Thermal Science and Engineering Progress*, *3*, 171-197.

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Global Methane Initiative (GMI), (2016), *Overview of Anaerobic Digestion for Municipal Solid Waste*, available at https://www.globalmethane.org/documents/ad-training-presentation_oct2016.pdf

Intergovernmental Panel on Climate Change (IPCC), (2006b), *2006 IPCC guidelines for national greenhouse gas inventories, Volume 2 Energy, Chapter 2 Stationary Combustion*

Appendix E. Transportation Changes

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Subject	**Transportation Assessment Rev B**	**Project Name**	The Future of Organics
Attention	Kent Summerfield	**Project No.**	IA253700-GN-MEM-0004
From	Matt Sheppard		
Date	13 April 2022		
Copies to	CCC project team (via Kent) and Jacobs project team (via Ian)		

1. Introduction

[redacted]

As part of the Future of Organics study, the contribution of the kerbside organics collections transportation and disposal of mature compost to overall operational costs and greenhouse gas emissions has been assessed at a high level, to understand the extent to which site location affects these factors and therefore the criticality of location when considering the future of organics processing in Christchurch.

1.1 Scope

This is a high-level assessment based upon information provided by the current collections Contractor regarding collection truck utilisation and costs, and an assessment of travel times from collection areas across the city.

1.2 Limitations

The following limitations apply to this assessment:

- Information provided by the current Collections contractor is very high-level.
- Election wards and their populations as provided by Census data have been used as the waste collection "catchments".
- Travel times to organics processing facilities are based upon travel times extracted from the Christchurch Assignment and Simulation Traffic model (CAST) from the centroid of an election ward to each potential organics processing site or transfer station site.

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2.

2. Overview of present collection system

At present, one contractor collects all green bins on behalf of Council. They have provided the following general information about the current collection system:

- 15 trucks work full-time on a consistent publicised roster with 4 additional trucks providing cover for truck servicing, breakdown and catch-ups required due to unforeseen events. Servicing is done approximately every 2-weeks and takes 3-4 hours.
- By end of 2022, 12 of the 15 trucks in operation will be 2021 or later models and the balance will be between 2015 and 2020 models.
- The average workday is approximately 10 hours, with approximately 8 hours collecting and 2 hours delivering, with longer days when demand is high and shorter days when demand is low.
- On average a truck makes 2 trips per day and the average load is 8.4 tonnes, with the number of loads reducing over winter.
- Delivery times differ across the city, ranging from approximately 20-minutes from catchments neighbouring the current facility up to 100-minutes from the furthest catchments and are also impacted by traffic and roadworks.
- Collection hours are currently approximately 32,000 hours/year and transport 7,000 hours/year.
- [redacted]
- Trucks work hard during collection due to frequent stop-start and utilisation of hydraulics which require relatively high motor revs, so collection is harder on trucks and uses more fuel than transiting to offload. Truck life and operational costs are therefore considered based on "hours run" rather than "km travelled".
- It takes the same time to empty a partially full container as a full container, so collection efficiency is based on the "presentation" rate, or the number of bins out for collection, of which the current rate is approximately 65%, so approximately 100,000 bins / week out of a total of 155,000 bins.
- The current kerbside collection is approximately 50,000 tonnes / year.
- Every street in the city is driven every week.

3. Overview of present disposal of compost

Annual compost production is in the order of 40,000 tonnes, from a total organics throughput of approximately 70,000 tonnes, including approximately 50,000 tonnes from kerbside collection.

The majority of mature compost is sold outside of the city for use as an organic supplement. Transport is typically in bulk via truck and trailer.

4. Impact of processing facility location on fleet utilisation

To assess the potential impact on fleet utilisation, and therefore costs and greenhouse gas emissions, a simple assessment has been undertaken to estimate the change in fleet utilisation associated with several alternative locations for the compost processing facility.

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The methodology adopted for this assessment is as follows:

- Kerbside organics collected per capita / year determined by total population of Christchurch divided by the annual kerbside collection. Based on 50,000 tonnes divided by 369,000 people (Stats NZ, 2018), this equates to 0.135 tonne / person / year.
- Kerbside organics collected per catchment per year is determined by the catchment population times the per capita contribution. Catchments have been approximated using Christchurch election wards, shown in Figure 1, represented by the approximate population centroid of each ward.
- The number of truck movements per catchment per year is calculated by the total catchment tonnage divided by the average truck load of 8.4 tonnes. This potentially slightly underestimates truck movements as some are likely to return not completely filled, however is reasonable for this initial assessment.
- Total transport hours per year is determined by the total truck movements multiplied by the travel time to each potential organics processing site from each catchment centroid.
- Travel times have been extracted from the 2021 CAST model (v21a), and are a weighted average of morning peak, interpeak, and evening peak travel times (which have different levels of congestion).

[redacted]

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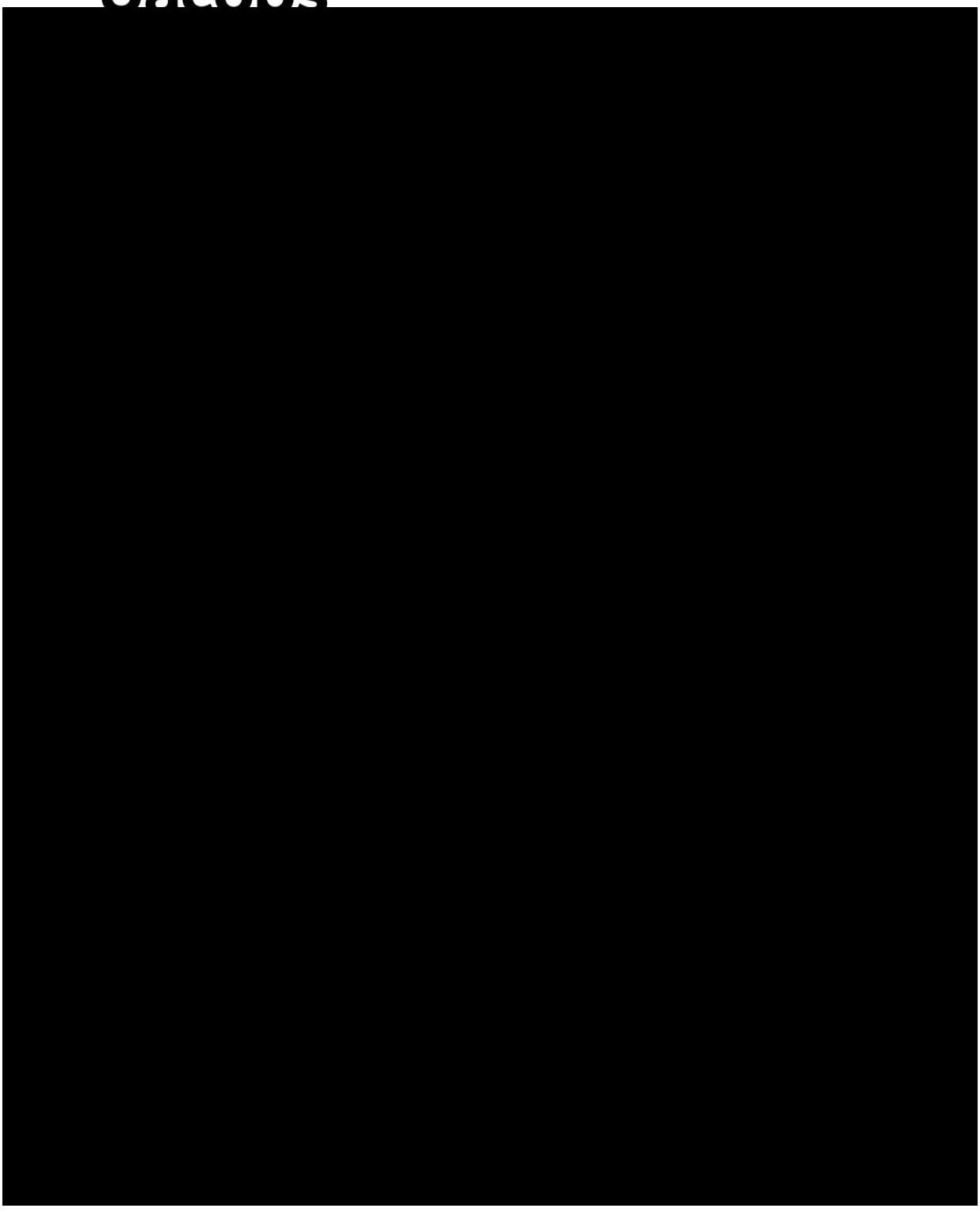

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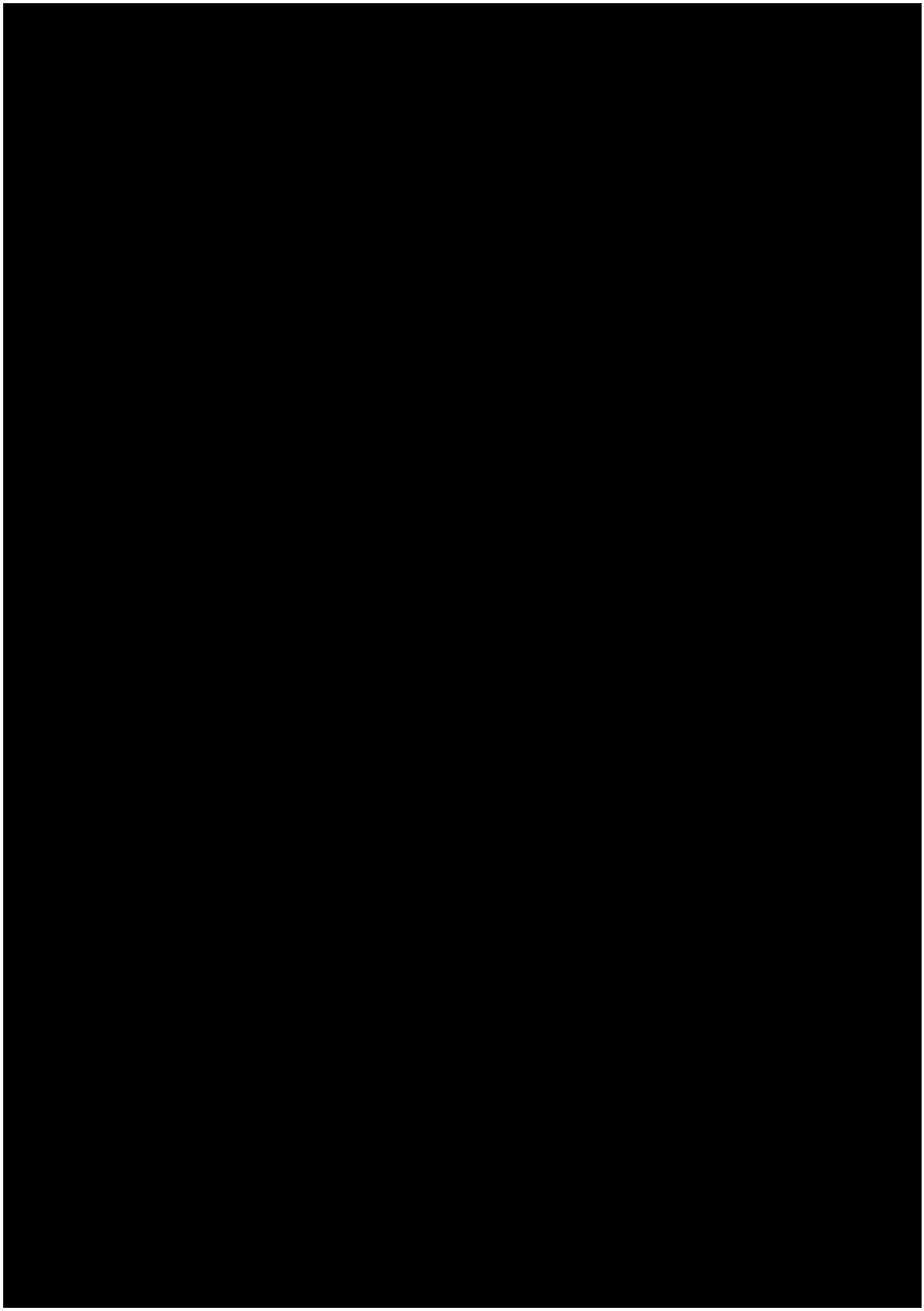
6. Conclusion

For the purposes of the *Future of Organics Study*, the following conclusions are drawn:

- The annual transportation cost differences between the potential processing facility locations considered are **relatively minor**, however they should be considered when assessing the life cycle costs for alternative locations to understand if an alternate location improves or reduces the current cost of service delivery.
- The greenhouse gas emission differences between the potential processing facility locations considered are **relatively minor**, however they should be considered when assessing the greenhouse gas emissions for alternative locations to understand if an alternate location improves or reduces the current greenhouse gas emissions.

A more important outcome for consideration outside of this study is the **significance** of the total transportation hours per year and the associated greenhouse gas emissions, which could be mitigated over time through electrification of the vehicle fleet. This may be of interest when Council next undertakes a service review of its organics collection contract.

Appendix F. Resource Consenting and Location Assessment



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Location Assessment – High-Level Planning Assessment

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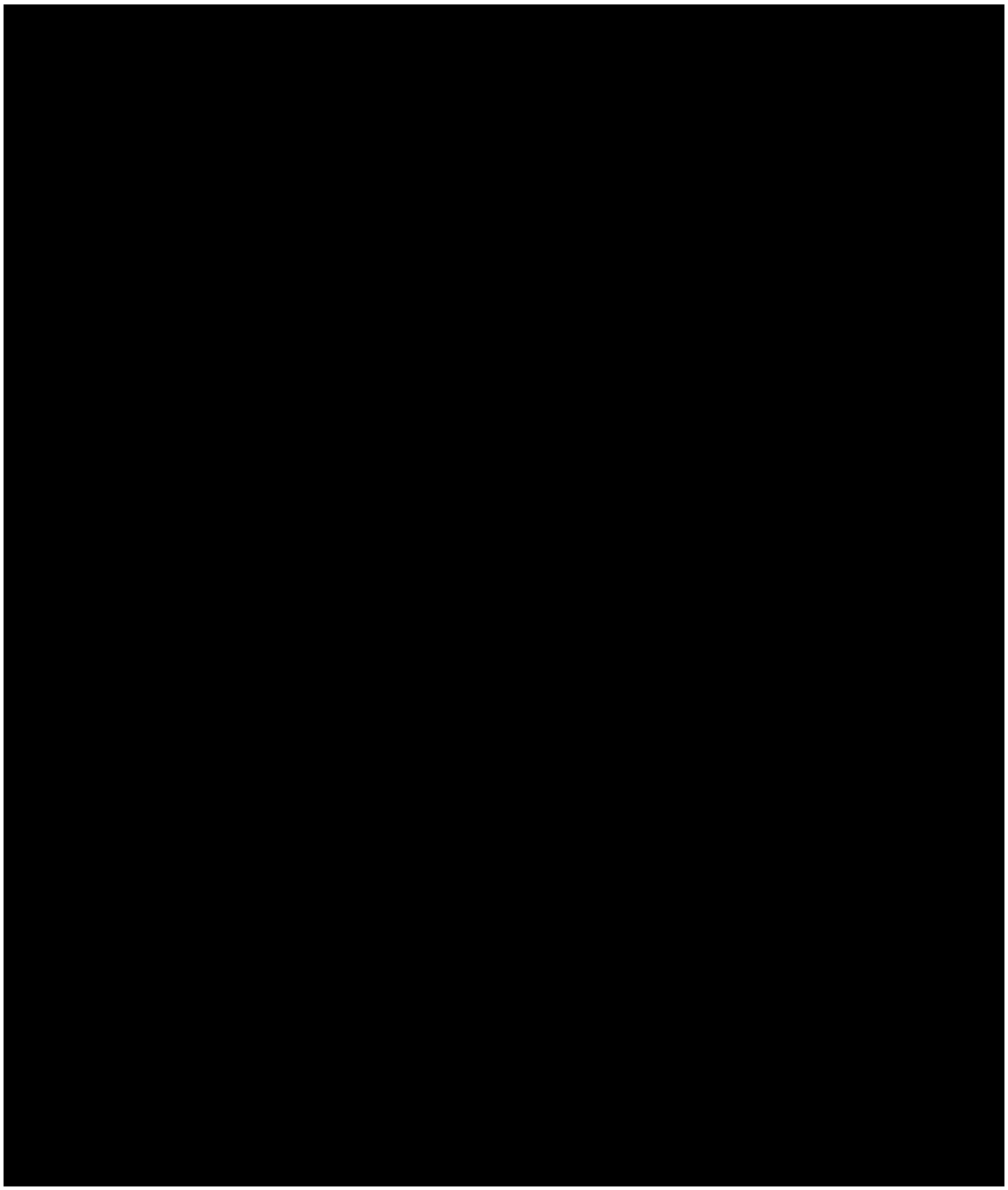

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Location Assessment – High-Level Planning Assessment

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Location Assessment – High-Level Planning Assessment

[redacted]

This memorandum is part of a suite of documents being developed to inform decision-making on the preferred composting technology and site. This memo provides a preliminary overview of statutory approval considerations for organic composting facilities in Christchurch, including:

- A high-level assessment of statutory planning requirements for establishing a new composting facility at new proposed sites
- The information requirements needed to support resource consent applications at a new site
- The likely community interest in this type of activity and need to undertake stakeholder engagement
- Alternative planning routes for approvals pathways
- The consenting requirements of upgrading technology at the existing site.

This assessment informs the Multi Criteria Assessment (MCA) process and final report to Council in April 2022.

2. Background

[redacted]

Council is exploring the viability of building a new organics processing facility. As part of Council resolution CNCL/2021/00001, Council requested (among other matters):

- A detailed assessment of processing technology options
- A detailed assessment of potential locations for a new facility and planning, consenting and cost requirements
- An assessment of the impacts of each option on greenhouse gas emissions.

This memorandum addresses the assessment of potential locations for a new facility and planning and consenting. This memorandum also provides an assessment of the consentability of the existing site to provide a complete picture of site options and associated consenting risks and opportunities[4].

[4] Separate memorandums address cost analysis of options and Greenhous Gas (GHG) created from technology and transport associated with these options. This memorandum should be read in conjunction with these other memorandums.

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Location Assessment – High-Level Planning Assessment

[redacted]

2.1 Scope of Planning Assessment

This memorandum considers general operating requirements and activities associated with an organic processing plant including land use and operational discharges to air, land and water. As identified the consenting requirements of both the existing site, as well as a potential new site are examined. Ancillary activities that may be required (for example, site preparation, earthworks and site layout, service provision, upgrades to local roads) have *not* been considered at this stage. Ancillary activities will need to be assessed as part of a detailed planning assessment if the Council pursues development of the new site. The current operations and resource consent provide a useful baseline for understanding operational requirements.

[redacted]

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Location Assessment – High-Level Planning Assessment

4. Key Considerations in Assessing Proposed Sites

In assessing the proposed options there are a number of key considerations that inform the formation of the evaluation criteria. The key considerations are extrapolated below.

4.1.1 Timing of Resource Management Act Reforms

The timing of the establishment of a new composting facility is a key consideration. The reform of the Resource Management Act (RMA) and the management of the transitional period presents a significant amount of uncertainty at this point in time. The transition to the new regulatory framework is expected to occur from 2023 through to 2028. It is possible that there will not be a non-complying activity in the new regime, and it is likely that there will be new Natural and Built Environment Plans that replace the existing District Plans. Details such as consenting processes, designations are not included in the NBA exposure draft.

However, this uncertainty over future planning processes should not be a deterrent to moving forward under the current regime.

4.1.2 Timing and Cost of Resource Consent Application and Notice of Requirement

Regional Consents

Any new site will require resource consent as a non-complying activity under the Canterbury Regional Air Plan under Rule 7.64 and will require a thorough assessment of effects, particularly in regard to air quality. Obtaining regional consents for air discharge are likely to be the primary consenting challenge to obtaining statutory approvals at any site. Odour will be the key issue and will have to be assessed carefully with regards to the location, density and type of sensitive receptors near the site. Groundwater and surface water would also require technical assessment [redacted]

Notice of Requirement

A Notice of Requirement for designating a new site is the preferred option for obtaining territorial authority statutory approvals. Traffic and noise assessments will be required at a minimum, as well as an Outline Plan of Works. I[redacted]

The post lodgement period could take anywhere between 6 and 18 months depending on the pathway chosen (i.e. bundling of regional and territorial approvals), the level of stakeholder opposition and any land acquisition requirements. The costs of the post-lodgement period will depend on the level of notification, number of submitters, approvals pathway and appeals.

4.1.3 Stakeholder and Community Engagement

The Council will consider the extent of community engagement and the form of engagement that might be required that is necessary to understand the community's view before deciding which option to pursue in an RMA process.

The RMA also requires consideration of whether the proposal will require notification to affected persons (s.95A & 95B). This RMA engagement will follow any Council led engagement and the stance of affected parties will have implications on the timeline for statutory approvals.

4.1.4 Cumulative effects and compatibility of activities

It will be important to consider cumulative effects as part of the approvals processes, [redacted]

A further consideration is adjoining land use or zoning that may support activities that could utilise energy generated if methane gas is captured from plant operations. This has not been considered in any detail in this memo.

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Location Assessment – High-Level Planning Assessment

4.1.5 Assessment of Alternatives

In any application or notice of requirement for an activity that results in significant adverse effects on the environment, it is necessary to demonstrate that other alternatives have been considered and that the chosen option is in fact suitable across a range of criteria including environmental considerations. Given the public interest in this activity, and based on previous variations to the existing consents, this is anticipated to be a requirement.

5. Evaluation Criteria

An assessment of the new proposed sites has been formulated against the following assessment criteria:

- Contaminated land assessment
- District Plan zoning
- Regional Plan zoning and overlays
- Activity status under relevant planning instruments (including National Environmental Standards)
- Natural hazards – noting several sites are in flood management areas particularly near the coast. It is expected that these sites will also progressively face increasing challenges from sea level rise associated with climate change[5]
- Natural & cultural heritage
- Infrastructure – such as proximity to reticulated water, electricity distribution lines, rail infrastructure
- Adjoining zones – such as proximity to residential zoning, open space community zones etc. which have a higher level of sensitive receptors
- Location of sensitive receptors – such as existing land users
- Access; and
- Aquifer type and depth to groundwater (as well as distance to downgradient users).

The assessment of all new sites against each of the above criteria is provided as **Appendix A** to this assessment. The existing site is also included. From this assessment performance evaluation criteria can be developed to assess each of the options against.

6. Summary of Findings

[redacted]

[5] It is noted that the Council is currently in the process of developing a district-wide plan change, which will address the coastal impacts of climate change. This plan change could limit activities and physical development in certain locations.

[redacted]

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Location Assessment – High-Level Planning Assessment

[redacted]

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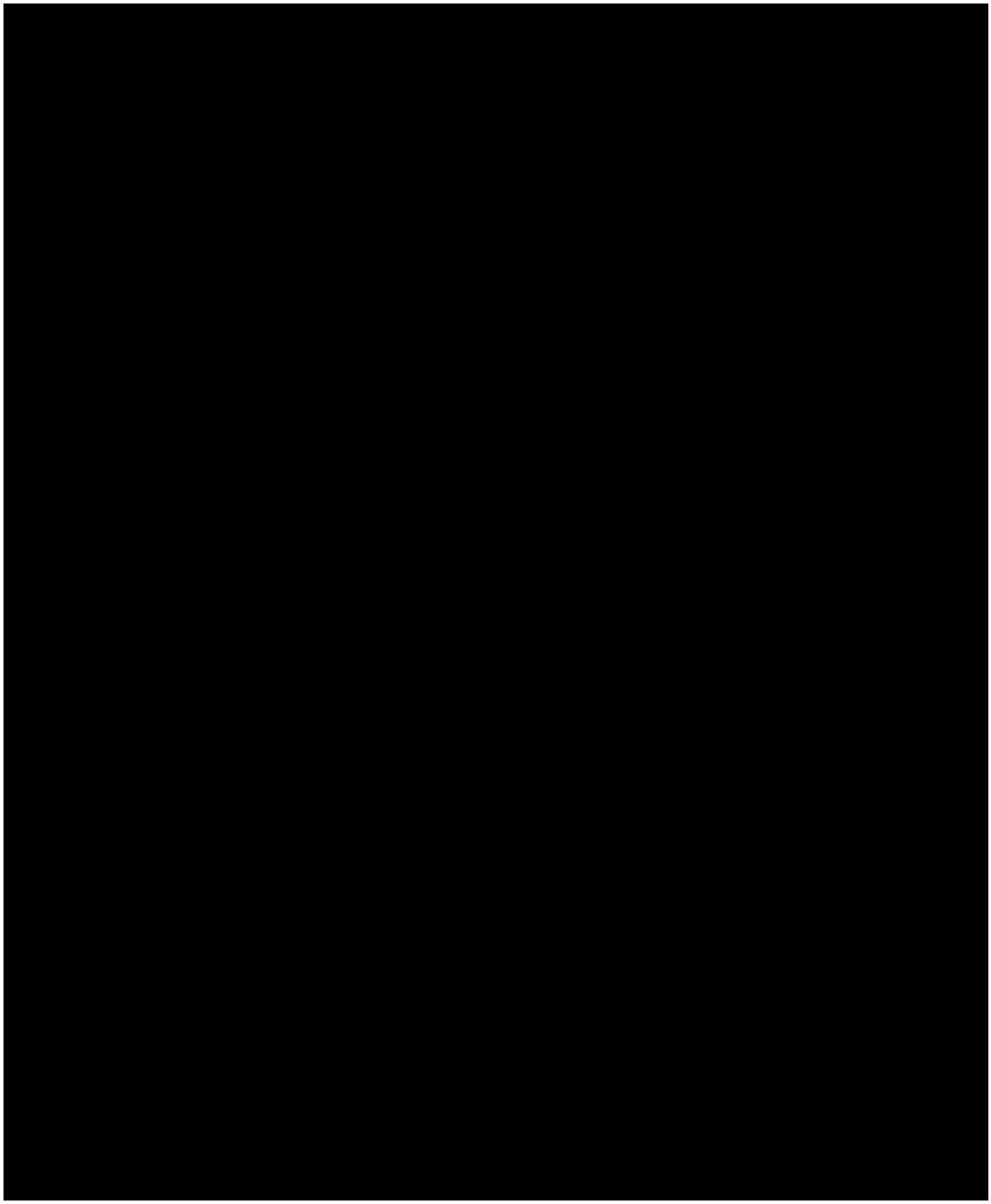
Location Assessment – High-Level Planning Assessment



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6.1.1 Comparison of Options

Noting that all options allow for public input, a comparison of options is provided for in **Table 1**.

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Table 1 Comparison of Approvals Pathway Options for Section 9(3) RMA land use approval under Christchurch District Plan

Option	Advantages	Disadvantages
Land use approval under s 9(3) of the RMA	▪ Process is well understood by the public ▪ Allows bundling of consents ▪ Flexibility in following the traditional council pathway or the option remains for direct referral to the Environment Court.	▪ Will have to prove that effects are no more than minor under first limb of s104D, or satisfy the policy framework for non-compliant activities within the Christchurch District (or Timaru for Temuka Site) ▪ Does not future proof the site ▪ Can subsequently be appealed to the Environment Court
Designation	▪ Removes the requirement for any land use consent normally required under s.9(3) RMA. Not subject to the non-complying test that the majority of sites are for resource consent although underlying land use zoning remains relevant for activities outside the purpose of designation. ▪ Time – does not take as long as a plan change (although likely slightly longer compared resource consent if Outline Plan of Works submitted) ▪ Able to be bundled with resource consent applications for a joint hearing when compared to the plan change process ▪ Generally provide for longer-term and more flexible protection compared with a resource consent or plan change. ▪ Compared to a plan change cannot be altered by anyone else (other than the requiring authority). ▪ The territorial authority is only able to make a recommendation	▪ May be seen by the community as circumventing the plan change process to which they are more accustomed

Option	Advantages	Disadvantages
	to the requiring authority compared to a decision made to grant or decline a resource consent. Where a territorial authority serves a notice of requirement on itself (s168A) the territorial authority **decides** on the application, on the basis listed above (as the territorial authority is also the requiring authority).	
Schedule 1 Plan Change	▪ Process is well-understood by the public ▪ Multiple opportunities for the community and stakeholders to provide input	▪ Time – can take up to 2 years ▪ Can subsequently be appealed to the Environment Court
Streamlined Plan Change	▪ Time – has proved to be faster than Schedule 1 ▪ Limited appeal rights	▪ Time – can take up to 2 years ▪ Limited appeal rights

Given the advantages of quicker processing, if an alternative site is selected outside the Industrial Heavy Zone within the Christchurch District, it is recommended that the option of a designation of the selected site is pursued. If the [redacted] sites are shortlisted further investigation should occur into whether land use consent as a discretionary activity or designation is pursued.

A designation is still subject to any restrictions on land use under s 9(1), and in relation to air and water. Relevant regional resource consents will also be required.

Notices of requirement (NORs) can be processed in two main ways, either by themselves in a way similar to a comprehensive resource consent or as part of a proposed district plan. It is anticipated that a standard pathway would take 6-9 months minimum post lodging of the notice of requirement.

6.2 Regional Authority Requirements

Regional Plans apply to the discharge of contaminants to land, air and water. Resource consents would be required under the *Canterbury Air Regional Plan* and the *Canterbury Land and Water Regional Plan* for discharges from a composting facility at a new site. An assessment of the relevant rules is provided in **Appendix B**.

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The discharge of contaminants to air or water is permitted where certain conditions are met. Given the scale of operation, and based on the existing activity, it is anticipated that resource consent would be required as a discretionary activity under the *Canterbury Land and Water Regional Plan* and a non-complying activity under the *Canterbury Air Regional Plan*.

Table 2 Consent Requirements under Canterbury Regional Plans

Plan	Rule #	Activity Status
Canterbury Land and Water Regional Plan	5.6 – Use of land for the stockpiling of decaying organic matter (including compost) that does not meet the condition of Rule 5.40, as it will not be subject to a Farm Environment Plan.	**Discretionary**
Canterbury Air Regional Plan	The discharge of contaminants into air that does not comply with condition 1 of Rules 7.47, 7.48, 7.49, 7.50 7.51, 7.55, 7.59 and 7.62 is a non-complying activity.	**Non-complying**

It is considered that the decision of granting or declining a consent will be decided predominantly on odour. Any new site would require resource consent as a non-complying activity under the Canterbury Air Regional Plan. This requires that a resource consent application would have to demonstrate that the actual and potential effects of the activity will have to be proven to be no more than minor or establish that it will meet the objectives and policies of the relevant planning instruments. The path to obtaining approvals will depend on the efficacy of on-site management for odour, the meteorology, topography and location of the site, as well as the location, density and nature of sensitive receptors[10].

To resolve the residual subjectivity about whether a resource consent at any new location is likely to be successful it is recommended that a technical air quality assessment is undertaken for any short-listed site that the Council lands on.

6.3 Likelihood of Notification

Depending on the specific site, access routes and separation from sensitive receptors, because of the scale of potential and actual effects, a resource consent or Notice of Requirement for a new site could be publicly notified. If there is public interest in such a site CCC could request this up front.

The distance to sensitive receptors and predominant wind direction and predicted dispersion conditions are likely to be important in assessing the level of effects under the Canterbury Regional plans. An air quality assessment is recommended for short listed sites and will be able to inform whether an application could be limited notified.

[10] Noting that the location of sensitive receivers for each site is traversed extensively in the corresponding locations assessment and provides one of the crucial elements for settling on shortlisted options that are contained in the main report.

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6.4 Decision-Making Pathway Options for Resource Consent Applications

After considering the requirements under the relevant planning instruments it is important to look further at the decision-making pathway options for resource consent applications. The standard two-step council pathway option and direct referral to the Environment Court are relevant in this instance. A Board of Inquiry process is not likely to be available as the project does not meet the test as one of national significance.

6.4.1 Standard Two Step Council Pathway

The standard two-step pathway involves a Council hearing, with the decision subject to an appeals period. Any appeals are subsequently heard by the Environment Court.

6.4.2 Direct Referral to Environment Court

An applicant can request that an application be determined by the Environment Court at any point from the day the application is made until five working days after the date on which the period for submissions on the application closes. Only notified resource consent applications or notices of requirement may be directly referred.

The direct referral process cannot be used for plan changes. This process follows the traditional process to the point of receiving submissions. Instead of continuing onto a Council hearing, an applicant can request the Council to agree to direct referral to the Environment Court for hearing and determination.

6.4.3 Comparison of Options

Table 3 below identifies the comparison of options for the decision-making pathway for approvals under the RMA.

Table 3 Options for Decision Making Pathway under the RMA

	Standard Two-Step	Direct Referral to Environment Court
Advantages	• Process is familiar and accessible to the public • Can narrow and focus contentious issues in the first hearing prior to entering the Environment Court • Refining issues through a more collaborative process	• Time and Cost
Disadvantages	• Risk of subsequent appeals to the Environment Court • Time and Cost	• Submitters who are less entrenched in their position lose the opportunity to have their issues resolved in the initial hearing and mediation, and are potentially forced into a more expensive process

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		[redacted]

[redacted]

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[redacted]

6.5.4 Heritage New Zealand Pouhere Taonga Act 2014

Under the Act, archaeological sites are not to be modified or destroyed without an Archaeological Authority obtained from Heritage New Zealand Pouhere Taonga. When the final site is selected, it is recommended that a qualified archaeologist is engaged to undertake a risk assessment and determine whether an archaeological authority is required for any site excavations.

[redacted]

6.5.5 Section Conclusion

It is anticipated that statutory considerations will not be a significant barrier for obtaining approvals at any of the identified sites, apart from those incurring reserve status. These sites are more likely to have

programme and cost implications where these matters need to be examined further and addressed appropriately.

[redacted]

7.2 Parameters of Existing Air Discharge Consent CRC080301.1

Resource consent CRC080301.1 is specific to the discharging contaminants to air from activities that include an odour extraction system and discharges to air via biofilters. Under resource consent CRC080301.1 the discharge of odour and dust are confined to the following sources:

[11] This technology offers the ability to contain and capture odour emissions via ventilation, in most cases this is directed to a biofilter. Biofiltration is the predominate odour control technology used at composting facilities and biofilters are broadly used around the world to reduce the concentration of odour and VOC's in exhaust air.

- Construction activities associated with the establishment of the organics processing plant
- An odour extraction system on the process building which discharges to air via biofilters
- Composting of organic material in managed windrows, and
- Screening, blending, packaging and stockpiling of matured compost.[12]

Acceptable organic material that can be processed under this CRC080301.1 include green waste, food waste and river weed.[13] The organics processing plant shall discharge contaminants to air via a biofilter with an average loading of not greater than 80 m^3 of air per hour per cubic metre of bed material.[14]

In accordance with the consent, the discharges to air shall not cause odour or dust which is offensive or objectionable beyond the boundary of the site on which this consent is exercised.[15]

As part of addressing and identifying the current odour issues, ECan have identified several sources of odour onsite:

- Odour from the processing hall and biofilter is minimal
- Onsite activity makes minimal difference to odour emissions
- Maturing compost odour that is present beyond the site boundary and
- Increased odour reports from the Bromley residential area happen predominantly with wind directions of between 45° to 90° (East to North-East) at a speed of one to five metres per second.

An analysis of the existing consent has also identified a stumbling block with the existing condition 27 of CRC080301.1 '*the discharges to air shall not cause odour or dust which is offensive or objectionable beyond the boundary of the site on which this consent is exercised*.' Jacobs recent experience has highlighted that while this is a standard condition it does not provide sufficient certainty for the Consent Holder, the regulatory authority or any third party. Any consent condition describing an offensive or objectionable effect beyond the boundary should explicitly state that FIDOL factors are to be considered and based on the Ministry for the Environment Good Practice Guidelines.[16]. Odour compliance remains fraught with subjectivity, and it is understood this is a key issue currently faced by existing operations. It is recommended that if a variation or new consent is pursued for the existing site, this condition is amended to include reference to the FIDOL factors and the relevant Good Practice Guidelines.

7.2.1 Resource Consents for New Technology

The three options for consenting at the existing site include operating under the existing consent, a variation to the existing consent, or application for a new consent.

[12] Condition 3 of CRC080301.1.
[13] Condition 6 of CRC080301.Organic waste containing putrescible matter (food waste and river weed) shall be processed in a tunnel compost system contained within the process building.
[14] Condition 21 of CRC080301.1.
[15] Condition 27 of CRC080301.1.
[16] Refer to Section 4.1.1 and Table 6 of the Ministry for the Environment Good Practice Guide for Assessing and Managing Odour (2016) or Section 4.2.1 and Table 8 of the Ministry for Environment Good Practice Guide for Assessing Dust (2016).

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Option 1 – Operating under existing consent

Confirmation from the Canterbury Regional Council would be required to ascertain whether operating new technology under the existing consent is a viable option. Given the significance of the investment, historical compliance issues, the fact the original consent was granted in 2003 and the potential for the nature and scale of the existing site to change, caution is urged with this approach. Whilst tenders for the existing site have intended to comply with the existing consent none of these designs have been tested with the Canterbury Regional Council. The Canterbury Regional Council have displayed conservatism when faced with potential changes to the nature and scale of an activity.

To operate under the existing consent, the nature, scale and parameters of the concept design would need to remain the same as the existing consented activity.

Option 2 - Consent Variation

Case law on variations is relatively extensive and indicates that a key consideration when applying for a variation is whether the nature and extent of adverse effects will be altered. *Body Corporate 970101 v Auckland City Council*[17] considered the issue in the High Court and the Court of Appeal and has identified when a variation can apply Relevant considerations established in case law include a comparison between the activity for which the consent was originally granted and the nature of the activity if the variation were approved.[18] The key consideration is to compare adverse effects which there may have been from the activity in its original form and any adverse effects which would arise from the proposal in its varied form. A variation can be applied for if the activity is the same and adverse effects are not materially different in nature from the original activity.

If the adverse effects after variation would not be materially different in nature or in extent, then there is no requirement for written approvals to be obtained from persons who may be affected by the activity but not by the change to it.[19]

If in-tunnel composting is adopted, it will provide better site and odour management.[20] Consequently, the adverse effects of the upgrade in technology should not be more than currently consented and may improve. Therefore, if the concept design for the use of upgraded technology via in-tunnelling and discharged via biofiltration identifies that some conditions are not suitable and need to be varied, and adverse effects will reduce, a section 127 variation will be available under the RMA and the application could be non-notified.

We recommend that the Council find out whether Environment Canterbury as the regulatory authority for this consent has a view as to whether a new consent or a variation is required. It is good practice to receive their input once a concept design has been developed.

Were the activity would expand or extend the original activity it should be treated as a new application.

[17] [2002] NZRMA 202 and upheld *Body Corporate 970101 v Auckland City Council* [2000] 3 NZLR 513.
[18] Ibid.
[19] Ibid at para [38].
[20] Refer to technology memorandum.

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Option 3 – New Consent

The existing discharge consent is limited to processing no more than 90,000 tonnes of organic material per year and provides for discharge of odour from:

- Construction activities associated with the establishment of the organics processing plant
- From an odour extraction system for the process building that discharges to air via biofilters
- From composting of organic material in managed windrows and
- From screening, blending, packaging and stockpiling of matured composts

Operating new technology under this existing consent may constrain a new development to the activities and parameters of the existing consent. Following discussions with the Canterbury Regional Council, further consideration should be given to pursuing a new consent considering a wider analysis that includes broader responsibilities on the Council including:

- Public interest and expectations
- The requirement to future proof the site for a large investment
- Adaptive management techniques for managing odour at the source and
- Adequate allowance for the potential expansion or extension of new technology.

The existing consent conditions are generally based on the earlier plant and processes and the conditions are based on the original application. This may create inflexibility or implementing the proposed technology .

8. Conclusion

The recommendations of this memo are as follows:

If a new site is preferred by Council:

a) It is recommended that an air quality assessment is undertaken for any shortlisted sites to remove some of the inherent subjectivity that surrounds whether a resource consent application to the Canterbury Regional Council for air discharge would be successful.

b) A designation is pursued from the relevant territorial authority for any new site (apart from [redacted] to remove the requirement for land use consent under s9(3) of the RMA If the [redacted] site is shortlisted further investigation should occur into whether land use consent as a discretionary activity or designation is pursued.

c) Further planning assessment is undertaken for any new site shortlisted to analyse the functional and operational need for it to be there against the objectives and policies of the relevant district plan as required by section 171(1)(a)(iv) of the RMA.

If the existing site preferred by Council:

d) The implementation of new technology is tested with the Canterbury Regional Council as early as possible to determine whether existing consent CRC080301.1 can continue to be utilised.

e) Following discussions with the Canterbury Regional Council undertake a broader analysis (incorporating planning inputs and Council's wider obligations as a representative of the community) as to whether a new consent would be appropriate; and

f) If the existing consent is utilised, consider a variation to condition 27 of CRC080301.1 to provide more certainty on measuring and complying with the offensive and objectionable standard. Any consent condition describing an offensive or objectionable effect beyond the boundary should explicitly state that FIDOL factors are to be considered and based on the Ministry for the Environment Good Practice Guidelines.[21]

[21] Ibid.

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Appendix A: Planning Assessment Overview

[redacted]

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Appendix B: Relevant Rules of Canterbury Regional Plans

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Memorandum

Level 2, Wynn Williams Building
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Rule	Canterbury Air Plan	Status
7.35	The discharge of contaminants into air from the *handling of bulk solid materials* is a permitted activity provided the following conditions are met: 1. The discharge of dust does not cause an offensive or objectionable effect beyond the boundary of the property of origin, when assessed in accordance with Schedule 2; and 2. The handling occurs indoors, or where the handling occurs outdoors the rate of handling does not exceed 100t per hour; or 3. Where handling occurs outdoors on less than 21 days per calendar year, the rate of handling does not exceed 250t per hour and 4. Where the handling occurs outdoors and the rate of handling exceeds 20t per hour, a dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and 5. The dust management plan is supplied to the CRC on request; and 6. The discharge does not occur within 200m of a sensitive activity, wāhi tapu, wāhi taonga or place of significance to Ngāi Tahu that is identified in an Iwi Management Plan; and 7. Notwithstanding condition 6, where the discharge is from production blasting at a quarry site the discharge does not occur within 500m of a sensitive activity wāhi tapu, wāhi taonga or a place of significance to Ngāi Tahu that is identified in an Iwi Management Plan.	Permitted if conditions are meet
7.36	The discharge of contaminants into air from the *outdoor storage* of bulk solid materials is a permitted activity provided the following conditions are met: 1. The discharge of dust does not cause an offensive or objectionable effect beyond the boundary of the property of origin, when assessed in accordance with Schedule 2; and 2. The amount of material stored does not exceed 1000t when it has an average particle size of less than 3.5mm; and 3. Where the storage exceeds 200t, a dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and 4. The dust management plan is supplied to the CRC on request; and 5. The discharge does not occur within 100m of a sensitive activity, wāhi tapu, wāhi taonga or place of significance to Ngāi Tahu that is identified in an Iwi Management Plan.	Permitted Unlikely to meet condition 1 or 2
7.38	The discharge of contaminants into air from the generation, conveyance, collection, storage or filtration of wood waste, is a permitted activity provided the following conditions are met:	Permitted if conditions are meet

	1. The discharge does not cause an offensive or objectionable effect beyond the boundary of the property of origin, when assessed in accordance with Schedule 2; and 2. If there is a discharge of dust beyond the boundary of the property of origin, a dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and 3. The dust management plan is supplied to the CRC on request; and 4. The storage of wood shavings and sawdust is in a covered hopper or container; and 5. Surfaces where wood waste may accumulate are cleaned at a frequency that prevents wind-blown dispersal or deposition of wood particles beyond the boundary of the property where the discharge originates.	
7.48	The discharge of contaminants into air from waste transfer sites is a permitted activity provided the following conditions are met: 1. The discharge does not cause an offensive or objectionable effect beyond the boundary of the property of origin when assessed in accordance with Schedule 2; and 2. The discharge does not occur within 50m of a sensitive activity on another property; and 3. The discharge is only from the handling of non-hazardous municipal solid waste, green waste, or cleanfill; and 4. If there is a discharge of odour or dust beyond the boundary of the property of origin, an odour and/or dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and 5. The odour and/or dust management plan is supplied to the CRC on request; and 6. The quantity of solid waste on the property does not exceed 10t per day averaged over a calendar month	Permitted Unlikely to meet condition 1 or 6
7.59	The discharge of contaminants into air from cooking or processing by application of heat, steam or smoke of up to 10t of animal or plant matter per day is a permitted activity provided the following conditions are met: 1. The discharge does not cause an offensive or objectionable effect beyond the boundary of the property of origin when assessed in accordance with Schedule 2; and 2. If there is a discharge of odour or dust beyond the boundary of the property of origin from the cooking or processing by application of heat, steam or smoke of between 1t and 10t of animal or plant matter per day, an odour and/or dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and 3. The odour and/or dust management plan is supplied to the CRC on request; and 4. The discharge is not from:	

	(a) extraction, distillation or purification of animal fats, other than as a process incidental to the cooking of food; or (b) rendering and reduction of animal matter by application of heat; or (c) the processing of skins, including fellmongery and tanning; or (d) the roasting of more than 200kg of coffee beans per day.	
7.62	The discharge of contaminants into air from the ventilation of buildings located on industrial or trade premises, where that discharge is not via forced extraction to an emission stack or treatment system, is a permitted activity provided the following conditions are met: 1. The discharge does not cause an offensive or objectionable effect beyond the boundary of the property of origin, when assessed in accordance with Schedule 2; and 2. At the point that the discharge exits the building, the concentration of any contaminant does not exceed the relevant Workplace Exposure Standard; and 3. If there is a discharge of odour or dust beyond the boundary of the property of origin, an odour and/or dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and 4. The odour and/or dust management plan is supplied to the CRC on request.	Permitted
7.63	The discharge of contaminants into air: 1. that does not comply with one or more of the conditions of Rules 7.47 to 7.62, excluding condition 1 of Rules 7.47, 7.48, 7.49, 7.50 7.51, 7.55, 7.59 and 7.62; or 2. that is from an industrial or trade premise and is not managed by Rules 7.47 -7.62; and is not a prohibited activity, is a discretionary activity.	Discretionary
7.64	The discharge of contaminants into air that does not comply with condition 1 of Rules 7.47, 7.48, 7.49, 7.50 7.51, 7.55, 7.59 and 7.62 is a non-complying activity.	Non-Complying
Land and Water Regional Plan		
5.29	The discharge of solid animal waste (excluding any discharge directly from an animal to land), or vegetative material containing animal excrement or vegetative material, including from an intensive farming process or industrial or trade process, into or onto land, or into or onto land in circumstances where a contaminant may enter water is a permitted activity, provided the following conditions are met: 1. The material does not contain any hazardous substance; and 2. The material does not include any waste from a human effluent treatment process; and 3. The material is not discharged: (a) onto the same area of land more frequently than once every two months; or	Permitted

	(b) onto land where solid animal waste, or vegetative material containing animal excrement or vegetative material from a previous application is still visible on the land surface; or (c) onto land when the soil moisture exceeds field capacity; or (d) within 20 m of a bore used for water abstraction, a surface waterbody not listed in Schedule 17 or the Coastal Marine Area; or (e) within 50 m of a surface waterbody listed in Schedule 17; or (f) within a Community Drinking-water Protection Zone as set out in Schedule 1.	
5.30	The discharge of solid animal waste, (excluding any discharge directly from an animal to land), or vegetative material containing animal excrement or vegetative material, including from an intensive farming process or industrial or trade process, into or onto land, or into or onto land in circumstances where a contaminant may enter water that does not meet one or more of the conditions in Rule 5.29	Discretionary
5.38	The use of land for a silage pit or the stockpiling of decaying organic matter (including compost) and any associated discharge into or onto land where a contaminant may enter water is a permitted activity, provided the following conditions are met: 1. The volume of any silage pit or stockpile is less than 20 m^3; and 2. Any liquid that drains from the stockpile does not enter a surface waterbody, other than a wetland constructed primarily to treat animal effluent; and 3. Any decaying organic matter does not originate from an industrial or trade process.	Permitted if conditions are met Cannot meet Condition 1.
5.39	The use of land for a silage pit or the stockpiling of other decaying organic matter (including compost) not permitted by Rule 5.38 and any associated discharge into or onto land where a contaminant may enter water is a permitted activity, provided the following conditions are met: 1. The silage pit or stockpile is not sited: (a) within 50 m of a surface waterbody, the boundary of the property, a bore, or the Coastal Marine Area; or (b) within a Community Drinking-water Protection Zone as set out in Schedule 1; or (c) within the Christchurch Groundwater Protection Zone as shown on the Planning Maps; and 2. Any liquid that drains from the silage pit or stockpile does not enter a surface waterbody, other than a wetland constructed primarily to treat effluent; and 3. Any decaying organic matter does not originate from an industrial or trade process.	Permitted Most sites cannot meet Condition 1(c), and cannot meet Condition 3.
5.40	The use of land for a silage pit or the stockpiling of other decaying organic matter (including compost) and any associated discharge into or onto land where a contaminant may enter water, that does not meet one or more of the conditions in Rule 5.39 is a restricted discretionary activity where the following condition is met:	Restricted Discretionary Cannot meet Condition 1 as the

	1. The silage pit, stockpile, and discharge is the subject of a Farm Environment Plan that has been prepared in accordance with Schedule 7 Part A.	activity will not be subject to a Farm Environment Plan.
5.6	Any activity that— (a) would contravene sections 13(1), 14(2), s14(3) or s15(1) of the RMA; and (b) is not a recovery activity; and (c) is not classified by this Plan as any other of the classes of activity listed in section 87A of the RMA — is a discretionary activity.	Discretionary

Appendix G. Capital and Life-cycle Costs

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Memorandum

Costs and Revenues

Subject	**Costs and Revenues**	**Project Name**	Future of Organics
Attention	Kent Summerfield	**Project No.**	IA253700-GN-MEM-0002
From	Matt Sheppard		
Revision History	1		
Date	13 April 2022		
Copies to	**Lynne Armitage and Kent Summerfield (to circulate to relevant CCC staff)**		

Abbreviations

Abbreviation	Explanation
AD	Anaerobic digestion
ASP	Aerated Static Pile composting
NPV	Net Present Value
OPEX	Operational Expenditure
PV	Present Value
RFI	Request for information

1. Introduction

Christchurch City Council (the Council) is reviewing the future of organics processing in the city (*Future of Organics study*). [redacted]

The memorandum provides an assessment of anticipated costs and revenues for a range of potentially appropriate technology options for the existing and potential new locations.

2. Related Information

Additional memorandums provide information on related matters including:

- Project objectives and Evaluation Criteria
- Greenhouse gas emissions
- Transportation
- Location and resource consenting
- Future of organics RFI
- Technology Options

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Costs and Revenues

3. Cost Components

Costs have been prepared for the following components of the Organics Processing scheme:

- Initial capital costs including site facilities, land purchase and bulk infrastructure
- Future capital replacement costs including mechanical and electrical equipment
- Facility operational costs including labour, plant, maintenance and electricity
- Facility income for the case where power is generated
- Changes in collection transportation costs for potential new locations, relative to the collection transportation costs [redacted]
- Transport costs for the sale of compost based upon assumed distance to market from potential new locations

These components enable the assessment of initial capital cost, typical operational costs and whole-of-life costs for the range of technologies and locations being considered.

A 25-year effective operation life has been assumed for this assessment, due to the harsh and continuous operating environment, however it is expected that key infrastructure components including buildings and civil works would have an economic life longer than this if well maintained.

4. Technology and Locations Considered

The technologies considered are as reported in the Technology Options Memorandum and include:

- In-tunnel composting (In-tunnel)
- Aerated static pile composting (ASP)
- Anaerobic digestion (AD)

Windrow technology has not been considered as this technology has been determined as being not suitable for the Future of Organics project.

The short-listed locations as reported in the Main Report have been considered, however costs are presented in this memorandum for the following locations that remain viable for consideration:

[redacted]

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Costs and Revenues

[redacted]

5. Cost Estimating Basis

Costs have been developed primarily to enable relative comparison between the options but have been based upon market available information where possible and implementation costs considered, in order to provide an indication of likely overall cost of implementation.

The broad basis of development of costs for the various components is as follows:

- **Design Capacity** - Development of nominal facility design for all technology options based upon a design feedstock of 84,000 tonnes/annum
- **In-tunnel composting facility costs** - utilisation of 2021 tendered capital and operational costs, adjusted to accommodate increase in market costs since tendering
- **Aerated static pile composting facility costs** – pricing sought from the US for proprietary equipment supply and cost estimates for civil works, costings for Timaru District Councils ASP composting plant from 2011 extrapolated to today's costs and costing from 2021 tendered In-tunnel costs by considering common elements
- **Windrow composting facility costs** – component cost work up for civil works and utilization of 2021 tendered In-tunnel costs for common elements
- **Land Purchase** – [redacted] This reflects the value of the site, even though there may be no financial transaction.
- **Bulk Infrastructure** - [redacted]
- **Capital replacement costs** – As noted in the costing assumptions, for plant and equipment with economic life expectancy lower than the 25-year financial forecasting period.
- **Changes in collection transport costs – locations in and around Christchurch** - Utilization of the Christchurch transport model to assess changes in travel times from the various sub-catchments within the city to the potential new locations and application, [redacted]
- **Changes in collection transport costs – locations remote to Christchurch** – [redacted]

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Memorandum

Costs and Revenues

[redacted]

- **Disposal costs** – [redacted]

Additional specific costing assumptions are presented in Appendix A.

To account for the additional costs incurred for project implementation, the following allowances have been applied to the capital costs:

- **Escalation** – [redacted]
- **Consenting** – [redacted]
- **Design and management** – [redacted]
- **Council costs** – [redacted]
- **Contingency** – [redacted]

Escalation has been applied to **Capital Costs** only, based upon the nominal time to construction identified above.

The operational and capital replacement costs are stated in real 2022 dollars.

[redacted] Operational efficiencies are expected relative to the present operations due to reduced loader movements and associated plant and labour costs, [redacted] These costs have been applied consistently across all options and they are considered accurate enough to demonstrate the relative scale of operations costs relative to capital costs. It is recommended that operational costs be reviewed as detail is developed for Councils preferred option.

It is highlighted that the cost estimates rely upon application of a range of cost information sources for a highly conceptual composting approach at nominal site and therefore there are many uncertainties and assumptions are required to establish cost estimates for each of the project components.

Jacobs

Memorandum

Costs and Revenues

6. Options to be Costed

Costs are presented for potentially viable technology options at the short-listed locations identified in the Main Report as follows:

The provision of costs for the technology and location options above should not be construed as implying feasibility and the Main Report should be read to understand the suitability of the identified technology and location options.

7. Costs

The following costs are presented below and are stated in real 2022 dollars:

- **Capital** – present day costs factored for allowances as outlined in Section 5
- **Average annual operating costs** - present day costs not factored for allowances
- **NPV** –
- **Total Cost** – Sum of present day capital costs (inclusive of escalation, design, CCC and contingency allowances), capital replacement costs and average annual operating costs as outlined above incurred over a 25-year period

[1] https://www.treasury.govt.nz/information-and-services/state-sector-leadership/guidance/financial-reporting-policies-and-guidance/discount-rates

Jacobs

Memorandum

Costs and Revenues

A summary of costs is presented below and detailed costings provided in Appendix A.

[redacted]

Notes:

- [redacted]
- [redacted]

The colour highlighting provides guidance as to how significant the difference in cost is relative to the median cost based on the MCA gradings presented below.

More than 15% above Median cost
5% to - 15% above Median cost
Median cost +/- 5%
5% to + 15% below Median cost
More than 15% below Median cost

The **NPV** and **Total Cost** values provide an approximation of life-cycle costs over a 25-year period so are considered the most appropriate values when deciding between options.

Total Cost is considered the most appropriate financial metric when considering the likely overall costs for a facility over 25-years.

8. Cost Risks

The high level nature of the development of option and location combinations makes it difficult to determine option specific contingencies.

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Memorandum

Costs and Revenues

[redacted]

More working detail is needed about each option to reduce the uncertainty associated with risk and allow a more accurate cost estimate and contingency allowance to be calculated.

9. Conclusions

Based upon the costs presented above and in the Appendices and focusing on **Total Cost** as the primary financial metric of interest, the following outcomes are noted:

- ASP has lower capital, operating, NPV and total costs than In-tunnel.
- [redacted]
- [redacted]
- [redacted]
- AD yields income benefits however has relatively high initial capital and capital renewals costs so overall has a long pay-back period
- Actual land purchase and bulk infrastructure costs may change relatively significantly from the assumptions made, however as these costs are only a small proportion of the overall NPV cost, such change is not likely to alter the overall relativity of the costs of the various options

10. Limitations

The following limitations apply to this assessment:

- The cost estimates developed assume a facility design for 84,000 tonne/annum of feedstocks, which has been recommended to be reviewed in the Feedstock Assessment Memorandum. If this is modified, all cost estimates should be adjusted pro-rata accordingly.
- The cost estimates developed rely upon application of a range of cost information sources with varying accuracy for a highly conceptual composting facility at nominal site and therefore there are many uncertainties and assumptions required to establish cost estimates
- The infrastructure required for ASP and In-tunnel composting is common for all sites where applied, however as no site specific concept development has been undertaken, should be considered indicative only

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Memorandum

Costs and Revenues

- [redacted]
- Transport cost assumptions are based on limited market input so have potential to vary from actual market pricing. Costs have been applied consistently across the various options so any inaccuracies in transportation rates are not expected to change the relative assessment of transport costs between options
- Cost estimates are expected to have an estimated accuracy aligned with the Class 4 level, based on the American Association of Cost Estimating (AACE) guidelines for Process Industries, as defined below.

CLASS 4 ESTIMATE	
Description: Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Typically, engineering is from 1% to 15% complete, and would comprise at a minimum the following: plant capacity, block schematics, indicated layout, process flow diagrams (PFDs) for main process systems, and preliminary engineered process and utility equipment lists. **Level of Project Definition Required:** 1% to 15% of full project definition. **End Usage:** Class 4 estimates are prepared for a number of purposes, such as but not limited to, detailed strategic planning, business development, project screening at more developed stages, alternative scheme analysis, confirmation of economic and/or technical feasibility, and preliminary budget approval or approval to proceed to next stage.	**Estimating Methods Used:** Class 4 estimates virtually always use stochastic estimating methods such as equipment factors, Lang factors, Hand factors, Chilton factors, Peters-Timmerhaus factors, Guthrie factors, the Miller method, gross unit costs/ratios, and other parametric and modeling techniques. **Expected Accuracy Range:** Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. **Effort to Prepare (for US$20MM project):** Typically, as little as 20 hours or less to perhaps more than 300 hours, depending on the project and the estimating methodology used. **ANSI Standard Reference Z94.2-1989 Name:** Budget estimate (typically -15% to + 30%). **Alternate Estimate Names, Terms, Expressions, Synonyms:** Screening, top-down, feasibility, authorization, factored, pre-design, pre-study.

- Key costing inputs assumptions that should be further validated prior to Council making final decisions on a preferred technology and site location include:
  - [redacted]

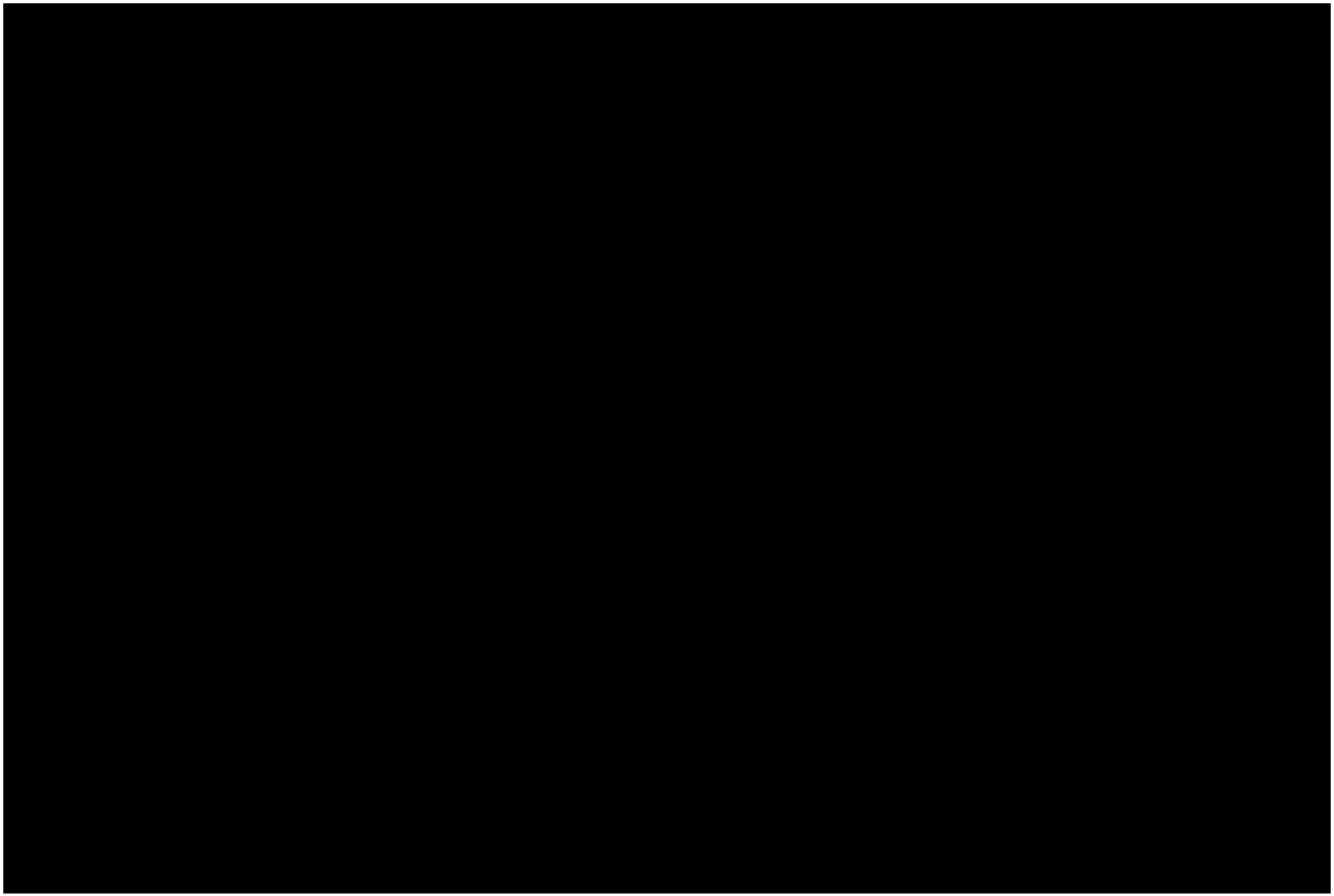
Jacobs

Memorandum

Costs and Revenues

Appendix A – Costing Details

The Future of Organics
Costing Assumptions
Revision G
7-Apr-22



Appendix H. Council RFI Process

Document No.

Jacobs

Memo

Council RFI

Subject	**Council RFI Process**	**Project Name**	Future of Organics
Attention	Kent Summerfield	**Project No.**	IA253700-GN-MEM-0003
From	Matt Sheppard		
Revision History	B		
Date	13 April 2022		
Copies to	**Lynne Armitage (to circulate to relevant CCC staff)**		

Abbreviations

Abbreviation	Explanation
AD	Anaerobic digestion
CCC	Christchurch City Council
GETS	Government Electronic Tender System
RFI	Request for Information
WWTP	Wastewater Treatment Plant

1. Introduction

Christchurch City Council (the Council) is reviewing the future of organics processing in the city (*Future of Organics study*).

As part of the *Future of Organics* study, Council sought requests for information from the market to assist in understanding what interest there may be from the private sector to participate in the *Future of Organics*.

The memorandum provides an overview of the process, responses received and a preliminary assessment of how these responses have been considered in the Future of Organics study.

2. RFI Process

The Council RFI dated 09NOV21 was advertised on GETS on 09NOV21 and closed on 23NOV21. A copy of the RFI document issued is attached in Appendix A.

3. RFI Evaluation

Responses were received from nine respondents, with responses proposing varying technologies for some of all of the organics waste stream. The majority of submissions provide a high level overview of their potential interest and involvement.

The RFI responses received are not attached to this memorandum as some contain commercially sensitive information.

Jacobs evaluation of these submissions is presented in Table 1.

Jacobs

Memorandum

Council RFI Process

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Council RFI Process

As outlined in Table 1, most proposals do not provide the necessary confidence in either the technology, the application at scale or the evidence of organisation stability to participate in the management of organics processing at scale.

[redacted]

Some of the technologies presented are already included in the *Future of Organics* study, including **ASP** and **AD**, and their relative merits have been assessed and are included in the *Future of Organics* study report and associated memorandums.

Some of the technologies presented have potential to play a role in the *Future of Organics,* including vermiculture, pyrolysis and wet AD, however they require additional investigation and proving. As Council has a need to implement reliable organics composting at full scale and within the next year or to, these technologies are not considered further.

Appendix A – Council RFI Document

REQUEST FOR INFORMATION

ORGANICS PROCESSING PLANT FEASIBILITY STUDY - OPTIONS FOR CONSIDERATION

RFI Number	25065759
Date of issue:	9 November 2021
Closing Date and Time:	23 November 2021 at 12:00pm NZST
Electronic submission of Response must be: **(1) Emailed to:** **(2) uploaded to:**	(1) Tawny.Harris@ccc.govt.nz (2) www.gets.govt.nz website
RFI information contact person:	Tawny.Harris@ccc.govt.nz

Table of Contents

Section A – Introduction and Background

1. Introduction and background

The Christchurch City Council (the **Council**) has engaged Jacobs New Zealand Limited to undertake an independent options feasibility study in respect of the Organics Processing Plant [redacted] (**Feasibility Study**). The purpose of the Feasibility Study is to provide the Council with information to enable the Council to make an informed investment decision. The Feasibility Study is intended to be presented to Council in March 2022.

Council has released this RFI with the aim of providing the market with the opportunity to inform the Feasibility Study.

It is the Council's intention through this RFI that it:

- has obtained the market's input into solutions and options for the Organics Processing Plant
- understands whether further efficiency, effectiveness and value can be delivered by the market.
- assists in the development of the next stage of the procurement for the Organics Processing Plant Project.

2. Indicative Timeline

Below is an indicative timeline for the RFI process. The Council reserves the right to modify the steps and/or dates at any time, at its sole discretion.

RFI issued	9 November 2021
Last date for questions and explanatory notices by Prospective Suppliers	15 November 2021 at 12:00pm NZST
RFI closes	23 November 2021 at 12:00pm NZST
Prospective Suppliers advised of outcome of RFI	Not applicable. The information obtained from the market may or may not be used in the Feasibility Study that will be presented to Council in March 2022.
RFP Process	Not applicable. The information obtained from the market may or may not be included in the Feasibility Study that will be presented to Council in March 2022. Depending on the outcome of the Council's consideration of the Feasibility Study; Council may engage the market in accordance with its Procurement Policy and Framework.

Section B – Information Required

1. Information Required

Fundamentals of the future of organic waste processing in Christchurch being considered by the Feasibility Study include:

- A detailed assessment of processing technology options;
- A detailed assessment of potential locations for a new facility and planning, consenting and cost requirements;
- An assessment of the impacts of each option on greenhouse gas emissions; and
- A review of partnership models, including the options of:
    - procurement of the new building under a design-build-operate or build-operate contract with a contractor; and
    - investment from the private sector to provide organic waste processing services to the Council.

The intent is that information received from the market, maybe considered and referenced in the Feasibility Study to inform the Council staff report back to Council on options for:

1. Building a new organics processing facility, or
2. Upgrading the existing organics processing plant.

Council is open to considering any solutions or options that directly relate to Organic Waste processing in Christchurch. Some of the key criteria we are interested to receive submissions on, but not limited to, are:

- Feedstock
- Technology
- Partnership models
- Locations
- Indicative costings

Please note, should you participate in this RFI process, with regards to the information that you will provide:

a) Your response will be shared with Jacobs New Zealand Limited, the Consultant preparing the Feasibility Study for Council;

b) All, some or none of the information provided in your submission may be included in the Feasibility Study;

c) Do not provide any information that is commercially sensitive;

d) The appropriate market approach in respect of the Organics Processing Plant will be chosen following the decision of the Council and in accordance with Council's Procurement Policy and Framework. Information that you provide in your response to this RFI may be referred to in the Council's procurement strategy, market documents (RFX and Contract) and/ or the technical tender documents (specifications)

In terms of responding to this RFI; please note there are 2 submission phases:

1. Email your RFI response to Tawny.Harris@ccc.govt.nz on or before the closing date of this RFI (We will review these as they come in)
2. Upload your RFI response to GETS on or before the closing date of this RFI

IMPORTANT NOTE: Do not contact Jacobs New Zealand Limited or any other organisation or person regarding this RFI' other than the RFI Information Contact Person details provided in Section C below.

Section C – Schedule of Conditions to RFI

Clause number references refer to Section D (RFI Conditions)

Clause	Description	Condition
3.2	**RFI Information Contact Person**	Tawny.Harris@ccc.govt.nz
3.3	**Last date for questions and requests for explanatory notices**	15 November 2021 at 12:00pm NZST
4.1	**Closing Date and Time**	23 November 2021 at 12:00pm NZST
4.1	**Address for submission of Response**	**Address for submission of electronic Response:** Responses must be: 1. Emailed to Tawny.Harris@ccc.govt.nz 2. Uploaded via the www.gets.govt.nz website
4.12	**Information to be submitted with the Response**	**Electronic Submission:** Email to Tawny.Harris@ccc.govt.nz and upload to www.gets.govt.nz website: • Appendix 2 (Form of Response) • Appendix 3 (Prospective Supplier's Response Form and Declaration including all information required in Parts A and B of this Appendix). • Appendix 4 (Conflict of Interest Declaration).

Section D – RFI Conditions

The General Conditions of this RFI are those set out below.

1. DEFINITIONS

The following words and expressions (where they appear in this RFI and/or any attachments) have the meanings set out below:

Closing Date and Time means the deadline for Responses to be received as set out **Section C**

Confidential Information means information that (a) is by its nature confidential, (b) is marked as "Confidential" or (c) is provided "In Confidence"

Council means the Christchurch City Council

GETS means the Council Tender Portal at www.gets.govt.nz

Goods means the goods described in **Section B**

RFI means this Request for Information process

RFI Documents means the documents which are issued to Prospective Suppliers

RFI Information Contact Person means the person identified in **Section C**

Prospective Supplier means the person or entity that submits, or expresses an interest in submitting, a Response in response to this RFI

Response means the Prospective Supplier's submission responding to this RFI process

RFP/RFT Process means the process that may be conducted following the RFI where selected Prospective Suppliers are invited to submit a proposal for the Goods and/or Services

Schedule of Conditions to RFI means the schedule attached as **Section C**

Services means the services described in **Section B**

2. PREPARING A RESPONSE

RFI Documents

2.1 RFI Documents issued to Prospective Suppliers for use in the preparation of a Response remain the property of the Council.

2.2 Any information provided by the Council to Prospective Suppliers has been provided to assist Prospective Suppliers in preparing Responses. The Council does not represent or warrant the completeness or accuracy of such information. Prospective Suppliers shall rely on all information at their own risk and are responsible for the interpretation of the information.

Prospective Suppliers to inform themselves

2.3 Each Prospective Supplier shall be deemed to have examined the RFI Documents and any other information supplied in writing.

3. COMMUNICATIONS DURING THE RFI PROCESS

3.1 All communications to Prospective Suppliers from the Council will be via GETS.

3.2 The RFI Information Contact Person identified in **Section C** is the only person authorised to receive questions, requests for information or other communications by Prospective Suppliers or related parties regarding this RFI. Any such questions, requests for information or other communications must be submitted in the forum facility via the administrator's Tender Portal at www.gets.govt.nz and should not be directly sent to the RFI Information Contact Person, unless clause 3.7 below applies.

3.3 The RFI Information Contact Person may be contacted via GETS, before the last date for questions and requests for explanatory notices as specified in the indicative timeline in **Section A**. Questions submitted to the forum will only be responded to during business hours.

3.4 The Council shall not be bound by any statement, written or verbal, made by any person including the RFI Information Contact Person unless that statement is subsequently expressly incorporated in writing in any agreement that may be entered into following the RFP/RFT Process.

3.5 Where the RFI Documents issued to Prospective Suppliers are ambiguous or unclear to a Prospective Supplier, it may request the issue of an explanatory notice. If an explanatory notice is issued, it shall be communicated via GETS to all Prospective Suppliers and shall upon issue become part of the RFI Documents. Requests for information or clarifications that relate solely to the Prospective Supplier's Response will be provided to the Prospective Supplier requesting the information for clarification only.

3.6 In the absence of an explanatory notice, Responses may be submitted subject to any reasonable interpretation of any ambiguity or uncertainty in the RFI Documents.

3.7 For enquiries that the Prospective Supplier considers to be of a private or confidential nature, the Prospective Supplier should contact the RFI Information Contact Person directly at the address listed in **Section C**.

3.8 After the date for submission of Responses has closed, the RFI Information Contact Person may further communicate with Prospective Suppliers directly in order to advise the outcomes of the Council's review of the Responses.

4. SUBMISSION OF RESPONSE

Closing Date and Time

4.1 The Council requires that Responses are submitted by the Closing Date and Time detailed in **Section C**. Each Response shall be identified as a Response for the particular RFI and addressed as detailed in **Section C**. While every care will be taken to place Responses in the Tender Box, the Council has no responsibility for failure to do so before the Closing Date and Time.

Extension of Closing Time and Date

4.2 Responses cannot be uploaded onto the Council Tender Portal after the Closing Date and Time. If the Response arrives after the latest date and time required for Responses, it may be considered as invalid. However, the Council reserves the right to accept a late submission or extend the Closing Date and/or Time for the uploading of Responses at its sole discretion. Any late Response in respect of which the Council chooses not to exercise its discretion shall be returned to the Prospective Supplier unopened.

Required Method for Submitting Responses

4.3 The Council requires that in the event that Responses are uploaded to GETS, the files submitted are created in MS Office (the Council's software) and are zipped when multiple files are being submitted.

4.4 Where Responses are electronically submitted, Prospective Suppliers are allowed to upload a maximum of 50MB per Response.

Rules and Guidelines for Electronic Response Submissions

4.5 The electronic Tender Box clock operates in New Zealand Standard Time (NZST).

4.6 Electronic submissions can only be submitted via the electronic file upload facility on www.gets.govt.nz.

4.7 All electronic files are to be clearly named referencing the Prospective Supplier's company name and the Council's RFI title and number reference.

4.8 It is recommended that the Prospective Suppliers begin the uploading of Response files allowing sufficient time for the upload to be **fully** completed before the Response Closing Date and Time. This is particularly important if the Prospective Supplier is submitting large size files.

4.9 In cases where a Response cannot be uploaded by the Closing Date and Time due to GETS system outages or communication link failures beyond the control of the Prospective Supplier, the Prospective Supplier should notify the RFI Information Contact Person as soon as possible. The Council will consider the circumstances and whether or not to accept a late submission on a case by case basis and at its sole discretion.

4.10 If any of the files submitted are not readable by the Council (such as due to file or data corruption), the Council will consider the circumstances on a case by case basis. The Council may at its sole discretion ask the Prospective Supplier to resend a readable version. If this request is made, evidence that there have been no changes to the file content since the Closing Date and Time may be sought from the Prospective Supplier.

4.11 If technical support is required relating to the functioning of the website www.gets.govt.nz, the Prospective Suppliers should contact the GETS Helpdesk during business hours by phoning 0508 438 743 or emailing info@gets.govt.nz

Form of Responses

4.12 Responses shall be prepared in the form required by the RFI Documents, including the provision of any information requested in **Section B** and **Section C**.

4.13 The Response shall be signed by or on behalf of the Prospective Supplier.

4.14 The cost of preparing and submitting a Response shall be borne by the Prospective Supplier.

4.15 The Council may request any Prospective Supplier to clarify and/or adjust aspects of its Response, and also reserves the right to negotiate with any Prospective Supplier.

Prospective Supplier Warranties

4.16 The Prospective Supplier warrants that:

(a) all information provided by the Prospective Supplier is complete and accurate; and

(b) the provision of information to the Council, and the use of it by the Council in considering Responses, in any subsequent RFP/RFT Process or for the negotiation of any resulting contractual agreement, will not breach any third party intellectual property rights.

5. RESERVATION OF COUNCIL'S RIGHTS

5.1 The Council reserves the right at its sole discretion to:

(a) waive or change the requirements of this RFI process from time to time without prior (or any) notice being given;

(a) waive any non-conformities or other irregularities or informalities in the RFI process;

(b) seek clarification or documents in respect of a Prospective Supplier's Response;

(c) re-invite Responses on the same or any alternative basis;

(d) to accept none or any of the Responses;

(e) at any time withdraw the RFI; or

(f) not proceed with any RFP process.

6. NO OBLIGATIONS

6.1 No legal or other obligations shall arise between the Prospective Supplier and the Council in relation to the conduct or outcome of the RFI process.

6.2 The Council and its agents or advisors will not be liable in contract or tort or in any other way for any direct or indirect damage, loss or cost incurred by any Prospective Supplier or other person in respect of the RFI process.

7. GENERAL INFORMATION

The Council to Make Enquiries

7.1 The Council reserves the right to make enquiries regarding the Prospective Supplier and to consider relevant information obtained from any source in the consideration of the Response. The Council may verify with any third party any information included in the Response or disclosed to the Council in connection with the Response, including carrying out a credit check on the Prospective Supplier.

Canvassing of Council Officers and/or Elected Members of the Council

7.2 Any attempt made by a Prospective Supplier to influence the outcome of the RFI process by canvassing, lobbying or otherwise seeking support of the Council officers or elected representatives of the Council, shall be deemed valid grounds for the exclusion of that Response from consideration.

Ethics

7.3 By submitting a Response, Prospective Suppliers acknowledge that they have not and shall not engage in any practices that gives one party an improper advantage over another, and/or engage in any unfair and unethical practices, in particular any collusion, secret commissions or such other improper practices.

Confidentiality

7.4 The information supplied by the Council (either itself or through its consultants, agents or advisors) in connection with this RFI, or any subsequent RFP/RFT Process, is confidential. Prospective Suppliers should not release or disclose any of the information to any other person (other than their employees or advisors), without the prior written consent of the Council. Any publicity or media statements also require the Council's prior written consent.

7.5 The Council may, at its discretion, require any Prospective Supplier to sign a confidentiality agreement before releasing any Confidential Information to the Prospective Supplier. The Prospective Supplier agrees to sign the confidentiality agreement, if required to do so.

7.6 The Council is subject to the Official Information Act 1982 and the Local Government Official Information and Meetings Act 1987. Information provided by a Prospective Supplier may be required to be disclosed under those Acts.

Due Diligence

7.7 As part of the RFI process, the Council, together with its agents, professional advisors and/or consultants, may carry out due diligence investigations of any or all of the parties that submit a Response.

7.8 Where due diligence investigations are undertaken by Council, any information which is marked confidential will be acknowledged as confidential however the Prospective Supplier acknowledges that the Council is subject to the Local Government Official Information and Meetings Act 1987 under which the Council is required to treat each request for information in accordance with the provisions of that Act.

7.9 By submitting a Response, a Prospective Supplier consents to the Council (and its agents, professional advisors and consultants) carrying out all due diligence investigations of the Prospective Supplier as may be required by the Council, acting reasonably. The Prospective Suppliers will promptly provide all information and answer all questions as may be required by the Council, acting reasonably, in carrying out such investigations subject only to:

(a) confidentiality obligations owed to unrelated third parties (which if applicable, must be identified and, if then requested by the Council, the Prospective Supplier will take all reasonable steps to have such confidentiality waived to enable disclosure to the Council); or

(b) the rules of any stock exchange on which the Prospective Supplier or its parent company is listed (which, if applicable, must be identified).

Conflict of Interest

7.10 Prospective Suppliers shall complete the declaration at Appendix 4 and disclose any potential conflict of interest that may arise. Council shall, at its sole discretion, determine whether a conflict may prevent a Prospective Supplier's Response from being considered.

Appendix 1 – Key Information required from Prospective Suppliers

The checklist below sets out the information that must accompany any Response. Please tick to indicate that the documentation is included.

Note: This form is for Prospective Suppliers use only and does not need to be returned to the Council with the Response.

Document	Included
Appendix 2 - Form of Response	☐
Appendix 3 - Prospective Suppliers Response Form and Declaration including: • **Part A – Profile of Organisation** • **Part B – Response to the Council's requirements**	☐
Appendix 4 – Conflict of interest Declaration	
Check form of Response submission (hardcopy only, electronic only, hardcopy or electronic) has been adhered to	☐

Appendix 2 – Form of Response

Response for:	Organics Processing Plant Feasibility Study - Options for Consideration
RFI Number:	25065759

Prospective Supplier's acknowledgment

1. We, being the Prospective Supplier named below, acknowledge and agree:

   a. that we are interested in participating in this RFI process;

   b. that we have downloaded and examined the following Notices issued in relation to the RFI:
   (please circle the Notices you have downloaded)

   Notice to Prospective Suppliers number:

   1 2 3 4 5 6 7 8 9 10

   c. that we have downloaded and examined the following Questions & Replies posted on GETS in relation to the RFI:

   Questions & Replies **1 to .....** (please state the last number)

   d. that allowance for the impact of changes from the Notice to Prospective Suppliers and Questions & Replies is considered in the Response; and

   e. that we understand that the Council is not bound to proceed to a competitive process or enter into any commitment to purchase any Goods and/or Services from us as a result of the Council issuing this RFI or our participation in this RFI.

2. We understand that no legal or other obligations shall arise between the Prospective Supplier and the Council in relation to the conduct or outcome of the RFI process.

3. We attach the information required to be submitted with this Response (as set out in the Key Information checklist in **Appendix 1**), and confirm that all such information is complete and accurate.

4. We nominate the following person to communicate on our behalf in relation to the RFI process and our Response:

Name of Prospective Supplier:	
Name of contact person:	
Position of contact person:	
Contact person's address:	
Contact person's telephone number:	
Contact person's email address:	

Signed by authorised signatory of the Prospective Supplier:	
Name and title of authorised signatory:	
Date:	

Appendix 3 – Prospective Supplier's Response Form and Declaration

Part A - Profile of Organisation

Prospective Suppliers organisational profile	
Full legal name:	
Trading name: (if different)	If applicable
Type of entity (legal status):	Sole trader / partnership / limited liability company / other please specify
Company registration number:	If applicable, registered number for a company
GST registration number:	NZ GST number / if overseas please state
Country of residence:	Insert country where organisation is resident for tax purposes
Physical address for service of notices:	
Postal address:	If different from above
Location of head office	City in New Zealand / if overseas please specify city and country
Name of parent company:	If applicable, provide details of parent company
Consortium or joint venture:	If applicable, include details of: • the basis of the consortium or joint venture agreement, indicating the lead company and any respective liabilities of the members of the consortium or joint venture; and • confirmation that the liability of members of an unincorporated joint venture must be joint and several
Council Interests:	If applicable, provide details of any interest held by a councillor of the Council or a Council employee in the Tenderer's business, company or consortium
Website details:	If applicable – www.
Type of business:	Brief description of the type of business the organisation specialises in
Year established:	

Part B – Response to the Council's Requirements

Detailed Information to be included in RFI Response	
Describe how the proposed supply of Goods and/or Services could be supplied to meet the Council's requirements as set out in Section B:	
Financial options (if applicable)	Does the solution involve leasing or financing? If so, please provide details
Provide a "high level" cost estimate breakdown of the proposed Goods/Services	

Appendix 4 – Conflict of Interest Declaration

Note: This form must accompany each submitted Response.

Response for:	Organics Processing Plant Feasibility Study - Options for Consideration
RFI Number:	25065759

CONFLICT OF INTEREST DEFINITION:

A conflict of interest is a situation in which a Prospective Supplier could gain (or be seen to gain) an unfair advantage through an association with an individual or organisation. Associations include financial, personal, professional, family-related or community-related relationships.

- An *actual* conflict of interest is where there already is a conflict
- A *potential* conflict of interest is where the conflict is about to happen or could happen
- A *perceived* conflict of interest is where other people might reasonably think there is a conflict

QUESTIONNAIRE:

Note: Each organisation involved in a joint Response must submit a *separate* questionnaire and declaration.

	Question	**Response** (Select one answer for each question. Select "potentially" if others could perceive that a conflict exists.)
1	Does any person in the Prospective Supplier's organisation have a close friend or relative who they are aware is (or could be) involved in any decision-making relating to this RFI process?	[yes] / [no] / [potentially]
2	Has any person in the Prospective Supplier's organisation recently offered any special discounts, gifts, trips, hospitality, rewards or favours to any person they are aware is (or could be) involved in any decision-making relating to this RFI process? *(e.g. free travel, free samples for personal use)*	[yes] / [no] / [potentially]
3	Is the Prospective Supplier aware of any person involved in any decision-making relating to this RFI process having a financial interest in the Prospective Supplier's organisation? *(e.g. the person is an employee of, or a shareholder in, the Prospective Supplier's organisation)*	[yes] / [no] / [potentially]
4	Is the Prospective Supplier aware of anything that might give the appearance that any person involved in the decision-making stage of this RFI process is biased towards or against the Prospective Supplier's organisation? *(e.g. the person has used the Prospective Suppliers organisation's corporate box)*	[yes] / [no] / [potentially]

5	Is the Prospective Supplier aware of any other arrangement it currently has, or clients it currently provides works to that may give rise to a conflict with the RFI?	[yes] / [no] / [potentially]
6	Is there anything else that the Council should know?	[yes] / [no]

If the Prospective Supplier answered "**yes**" or "**potentially**" to any of the questions above, please set out the details of the situation below.

Declaration	**Yes**	**No**
I am authorised to provide this information and sign this form.	☐	☐
The information provided in this form is true and correct.	☐	☐
I understand that if the information I have provided is not true and correct, the Council may terminate any future contract (if the Council has reasonably relied on the accuracy of information provided in this questionnaire), at any time and with immediate effect by written notice.	☐	☐

Signed by authorised signatory of the Prospective Supplier:	
Name and title of authorised signatory:	
Date:	

Appendix I. Existing Resource Consent Conditions

RMA Authorisation Number	CRC080301.1	**Client Name**	Christchurch City Council
Consent Location	40 Metro Place, BROMLEY	**State**	Issued - Active
To	To discharge contaminants to air.		
Commencement Date	15 Feb 2008		
Date This Consent Number Issued	23 Jun 2011		
Expiry Date	15 Feb 2033		

1. The discharges shall be only odour and dust from an organics processing plant and green waste composting facility located at 40 Metro Place, Bromley, Christchurch at map reference NZMS 260 M35: 8627-4087 and indicated as "Applicant's Site" on plan CRC080301A attached as part of this consent.
2. The organics processing plant shall process not more than 90,000 tonnes of organic material per year.
3. The discharges of odour and dust shall only occur from the following sources:
   a. From construction activities associated with the establishment of the organics processing plant;
   b. From an odour extraction system on the process building those discharges to air via biofilters;
   c. From composting of organic material in managed windrows; and
   d. From screening, blending, packaging and stockpiling of matured compos

Construction of Organics Processing Plant

4. The consent holder shall provide to the Canterbury Regional Council a Construction Management Plan to be submitted for approval before commencement of the works on site that includes but is not limited to the following requirements:
   a. Regular watering of dusty surfaces during dry windy conditions;
   b. Restricting traffic speed within the site to less than 15 kilometres per hour;
   c. Covering loads of excavated soil whenever visible dust occurs from this source;
   d. Locating stockpiles in areas that are less likely to be affected by prevailing winds and at least 50 metres from boundaries; and
   e. Stabilisation of exposed areas as soon as possible after work is completed.

Organics Processing Plant

5. The consent holder shall provide to the satisfaction of the Canterbury Regional Council a Facilities Operation Manual before operating the organics processing plant.
6. The material processed shall only include the following:
   a. Green waste;
   b. Food waste; and
   c. River weed.
7. Organic waste containing putrescible material (food waste and river weed) shall be processed in a tunnel compost system contained within the process building.
8. Organic waste not containing putrescible material may be composted in managed windrows.
9. The tunnel compost system shall consist of a process building, outdoor uncovered windrows and screening and stockpiling.
10. The process building shall:

a. House all receiving, shredding and blending of organic waste that is to be composted in the tunnel composting process; and
b. Be operated under a negative pressure system with all discharges to air being treated via a biofilter.

11. The incoming organic material shall be placed into the tunnel composting system on a daily basis within 24 hours of receipt.
12. The tunnel composting process shall have a duration of not less than seven days, which includes an allowance of up to half a day for tunnel emptying, cleaning and filling. During the tunnel composting process, the temperature of all the compost shall be maintained at greater than 55 degrees Celsius for a minimum of three continuous days or less at higher temperatures, so that pathogen destruction has occurred in compliance with New Zealand Composting Standard NZ4454. At the same time or after the tunnel composting process, the compost shall be aerobically treated for 14 days or longer, during which time the temperature must always be over 40 degrees Celsius and the average temperature must be higher than 45 degrees Celsius.
13. Records shall be maintained showing compliance with Condition (12). Such records shall be available to Canterbury Regional Council on request.
14. The maturation composting stage shall be an uncovered windrow system that allows the process to meet Condition (27) of this consent.

Greenwaste Windrow Compost System

15. Organic wastes not containing putrescibles are to be shredded, blended and formed into windrows within 24 hours of receipt.
16. Any organic waste which contains putrescible material is to be redirected into the tunnel composting system.
17. Not more than 30,000 tonnes per annum of greenwaste shall be composted in full in the outdoors windrows.
18. The uncovered windrows shall meet the following criteria:
    a. The windrow shall be maintained in an aerobic state throughout; and
    b. The state of the windrows shall be monitored for oxygen, temperature and moisture as follows (and records retained):
    c. Oxygen: Weekly for the first four weeks after the row is constructed and thereafter if the row is suspected of turning anaerobic;
    d. Temperature: Weekly;
    e. Moisture Content: Every second day.

Odour Extraction System - Organics Processing Plant

19. The odour extraction system on the process building shall be designed by a person competent in this area of technology to industry best practices.
20. 2The odour extraction system shall be of sufficient capacity to prevent any fugitive discharge of odours from the process building under all operating conditions.
21. The discharge shall exhaust via a biofilter with an average loading of not greater than 80 cubic metres of air per hour per cubic metre of bed material.
22. The odour extraction systems shall operate at all times during processing of raw materials or products.
23. The bio filters shall be maintained in such a way as to effectively reduce odours from the organics processing plant so Condition (27) is met. This shall include but not be limited to:

Dust Control

24. The consent holder shall implement the following measures to minimise the generation and discharge of dust:

a. Use water sprays with any mechanical handling of compost when conditions are likely to generate dust.

a. Provide an impervious base to all outdoor composting areas.
b. Limit the height and slope of outdoor piles to less than five metres in height.
c. Bulk carriers removing material from site shall be covered.
d. Use water tankers and/or sprinklers to dampen down areas of heavy vehicle access when wind speed exceeds five metres per second (five minute average) during dry conditions.
e. Suspend all product load-out and windrow turning operations during dry conditions when the wind speed measured by the on-site meteorological station, blowing from between 10 degrees and 130 degrees, exceeds 10 metres per second for two consecutive five-minute averages. Recommencement of load-out and windrow turning operations may occur if recorded wind speeds from that sector are less than 10 metres per second for two consecutive five minute averages.

25.
a. A Within 12 months of this consent coming into effect the consent holder shall establish and maintain suitable tree windbreaks around all areas where compost is stored.
b. Notwithstanding condition 25(a), a further line of tree shelter shall be established along the boundary with Affordable Storage Limited and the boundary with Dogwatch Sanctuary Trust, to fill in gaps in the existing tree shelter plantings where establishment or growth has been poor such that a continuous shelter belt more than 1.8 metres high has not been formed. These additional shelter trees shall be planted within six months of commencement of the change to conditions. All shelter trees shall have a minimum height of 1.8 metres and shall be maintained and irrigated until they reach a height of at least five metres. Any dead, diseased or damaged trees shall be replaced immediately. The trees shall be protected from the prevailing wind during at least the initial three years of establishment of the trees by wind cloth fencing or similar in order to optimise tree growth.
c. A plan showing planting and landscaping works to be undertaken to comply with Condition 25(b) shall be prepared by a suitably qualified person and shall be submitted to the Canterbury Regional Council within three months of commencement of the change to conditions.

26. On-site vehicle speeds in the outside windrow, compost storage and compost screening areas shall be restricted to not more than 15 kilometres per hour. A sign, capable of being read at a distance of five metres, shall be erected at the main vehicle entrance to the outside storage area to inform all drivers of this requirement.
27. The discharges to air shall not cause odour or dust which is offensive or objectionable beyond the boundary of the site on which this consent is exercised.
28. Notwithstanding Conditions 24 and 27, all product load-out, heavy vehicle operation and windrow turning activities shall cease at any time when these activities cause visible suspended particulate matter beyond the western site boundary, including at properties occupied by Affordable Storage Limited, Dogwatch Sanctuary Trust or their successors.
29. The consent holder shall maintain records of any odour or dust complaints received by the consent holder. These records shall include:
a. Location of complainant when odour or dust was detected;
b. Date and time of odour or dust detection;
c. Weather conditions, including wind direction, at the composting facility when odour or dust was detected;
d. Strength of the odour complained of, assessed on a scale of 1 to 5 by the complainant with the following rating system: 1 odour noticeable but not persistent; 2 odour clear and persistent; 3 odour unpleasant and persistent; 4 odour strong, offensive and persistent; 5 odour very strong and offensive.
e. The amount of dust complained of, assessed on a description of the visible quantities and extent of dust deposits on a scale of 1 to 5 by the complainant with the following rating system: 1 noticeable and not extensive; 2 clear and minor coverage; 3 nuisance and moderate coverage; 4 objectionable and extensive

coverage; 5 significant extensive deposits, offensive. A description of the appearance of the dust shall also be recorded;

f. Any possible cause for the odour or dust complained of; and

g. Any corrective action taken.

Monitoring

30. The consent holder shall undertake site-boundary odour assessments at least once per day, in a manner consistent with Work Instruction WI30 Issue 6, dated 1 September 2010, submitted with the application, or an equivalent later document. These assessments shall occur at no fewer than eight locations around the site boundary, including at least one location downwind of the composting tunnels and the maturation windrows. In the event of strong odours being detected, that may create adverse effects beyond the site boundary, then the consent holder shall take all practicable efforts to mitigate the odour using measures that may include the use of masking agents, capping the source, and returning odorous material to the tunnels. Records shall be kept that include the date and time of the assessment, meteorological parameters at the time, odour descriptions and odour intensities at each monitoring location. Staff members responsible for these assessments shall have calibrated noses, determined by suitably qualified persons at an accredited laboratory. These staff members shall be recalibrated for odour sensitivity at least once every three years.

31. The consent holder shall, prior to unloading a tunnel, undertake an odour assessment of the compost material, in a manner consistent with Work Instruction WI4 Issue 6, dated 1 September 2010, submitted with the application, or an equivalent later document. In the event of strong odours being detected, that may create adverse effects beyond the site boundary, then the consent holder shall return the assessed material to the tunnel and shall not empty the tunnel until it has been determined that the material is no longer odorous to the point where it may create an adverse effect beyond the site boundary. Staff members responsible for these assessments shall have calibrated noses, determined by suitably qualified persons at an accredited laboratory. These staff members shall be recalibrated for odour sensitivity at least once every three years.

32. At all times during exercise of this consent, wind speed and wind direction shall be measured by an anemometer established on the site.

    a. The anemometer shall be installed at a height of at least five metres above ground level at a location free from any obstruction that has potential to significantly affect wind flow.

    b. Wind speed resolution of measurement shall be not more than 0.1 metres per second and wind speed accuracy of measurement shall be at least within +/-0.2 metres per second.

    c. The anemometer shall be established, located and operated to the satisfaction of the Canterbury Regional Council.

    d. Wind speed and direction shall be continuously recorded with an averaging time for each parameter of not more than five minutes.

    e. These data shall be:
    (i) recorded using an electronic data logging system; and
    (ii) provided to the Canterbury Regional Council upon request.

33.

    a. Dust deposition monitoring shall occur in at least two dust gauges sited near to the boundary with Affordable Storage Limited or successor and the boundary with Dogwatch Sanctuary Trust or successor and at least one further control dust gauge. The location of the dust deposition gauges shall be determined by a suitably qualified person and shall be provided in writing to the Canterbury Regional Council. The method of monitoring shall be ISO DIS-4222.2 or a similar method to the satisfaction of the Canterbury Regional Council. Samples shall be collected monthly and the monitoring results shall be included and summarised in the Annual Environmental Report required under Condition 36.

b. Dust control measures shall be implemented to maintain the rate of dust deposition at the consent holder's boundary, measured in accordance with Condition 33(a), at less than 4g/m^2/30 days above the background concentration measured at the control site. Any exceedance of this trigger level shall be reported to the Canterbury Regional Council, including the likely reasons for exceedance and any remedial action undertaken.

Management Plan

34.

(a) The consent holder shall prepare and implement an Environmental Management Plan (EMP) that addresses the control of discharges to air from the site.
(b) The EMP shall be prepared and provided to the Canterbury Regional Council: attention: RMA Compliance and Enforcement Manager, within three months of the granting of this consent variation and within one month of the completion of annual reviews.
(c) The EMP shall be reviewed annually.
(d) The EMP and any revisions shall include all measures necessary to achieve compliance with the conditions of this consent.
(e) The EMP shall include, but not be limited to:

a. A description of the dust and odour sources on site;
b. The methods to be used for controlling dust and odour at each source;
c. A description of consent and monitoring requirements;
d. A system of training for employees and contractors to make them aware of the requirements of the EMP; and
e. Identifying staff responsible for implementing and reviewing the EMP.

Community Liaison Group

35.

a. Within one month of the commencement of the change of conditions, the consent holder shall invite local residents and interested people to attend a meeting to establish a Community Liaison Group. The invitation to attend and establish a Community Liaison Group shall be extended to include:
(i) all property owners and occupiers with boundaries adjoining, or but for the presence of roads, with boundaries immediately next to the site; and
(ii) all parties who made a submission on the application to change consent conditions.
b. A representative of the consent holder shall attend all meetings of the Community Liaison Group. The Canterbury Regional Council shall be invited to send a representative to attend all meetings.
c. The consent holder shall ensure that members of the Community Liaison Group are provided with the opportunity and facilities to meet at least once every three months.
d. The main purposes of the Community Liaison Group shall be to:
e. Identify and address any adverse effects of discharges to air from the site, including possible remedial action; and
f. Discuss the results of all monitoring and reporting required under this consent.

Reporting

36. The consent holder shall, no later than the 30th of June of each year, provide an Annual Environmental Report to the **Canterbury** Regional Council setting out all monitoring and reporting results required by conditions of consent and their interpretation by an appropriately qualified person, including dust deposition monitoring and

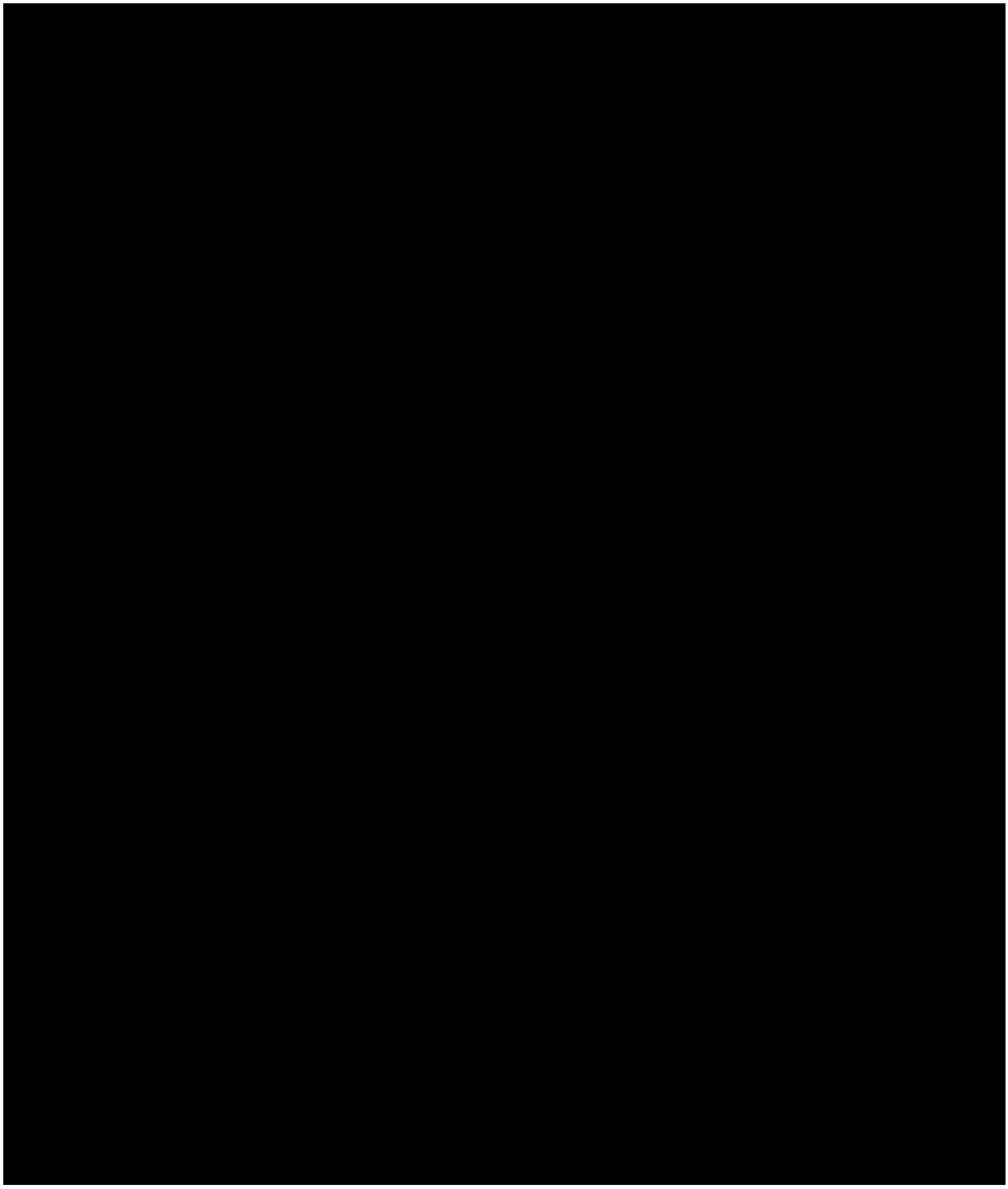
complaints recording undertaken in relation to this consent over the previous period. Where the result of any test or monitoring undertaken in relation to this consent exceeds the relevant limit/trigger level or does not comply with the relevant condition, then the steps that were taken to rectify the non-compliance shall be specified.

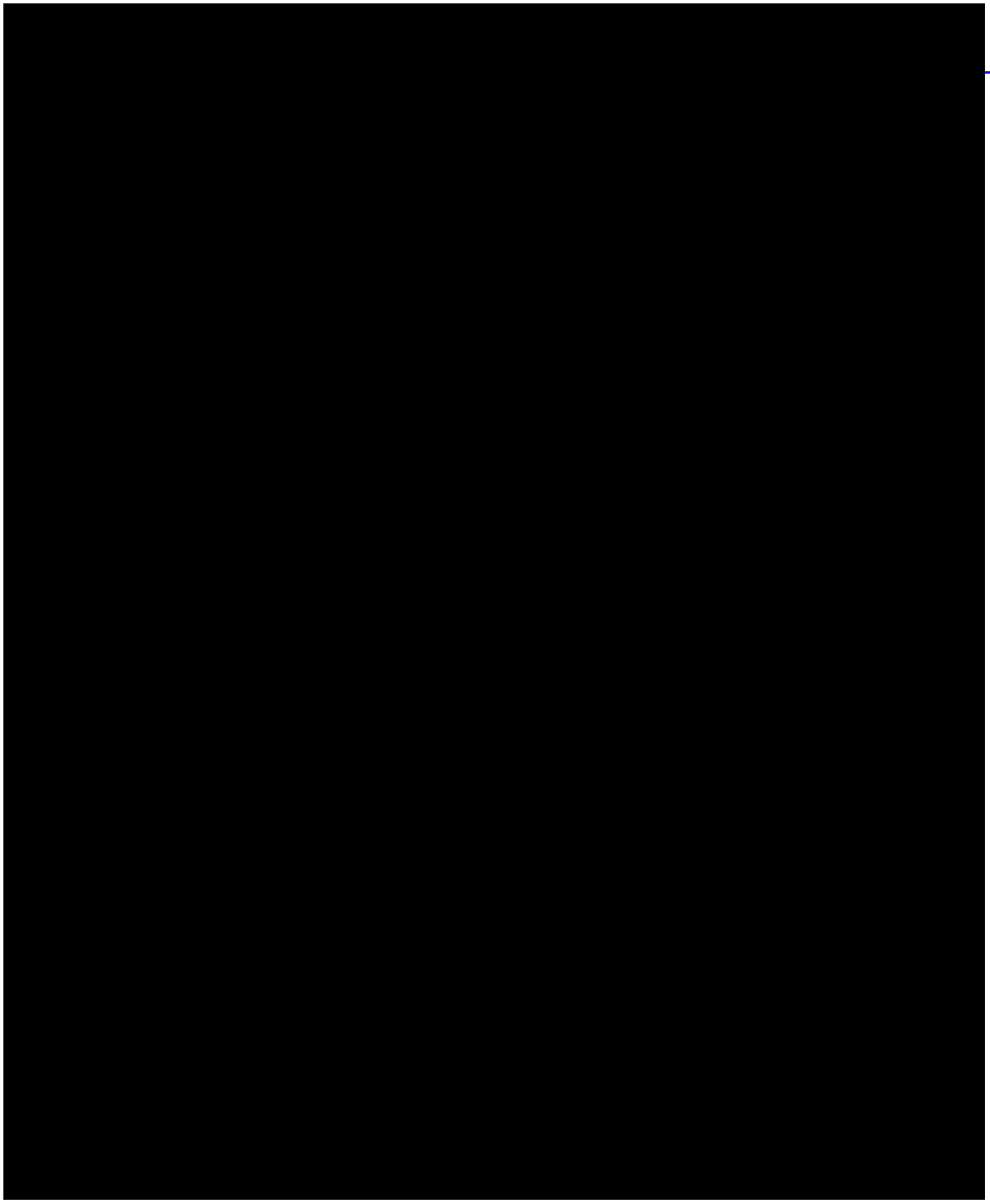
Administration

37. This consent shall **not be exercised concurrently with CRC930514.**

38. **The Canterbury Regional Council may annually, on or about the last working day of March each year, serve notice of its intentio**n to review the conditions of this consent for the purposes of:
    a. Dealing with any adverse effect on the environment which may arise from the exercise of the consent; or
    b. Requiring the adoption of the best practicable option to remove or reduce any adverse effect on the environment; or
    c. Complying with the requirements of an operative regional plan.

Appendix J. Aerial Images of Shortlisted Sites





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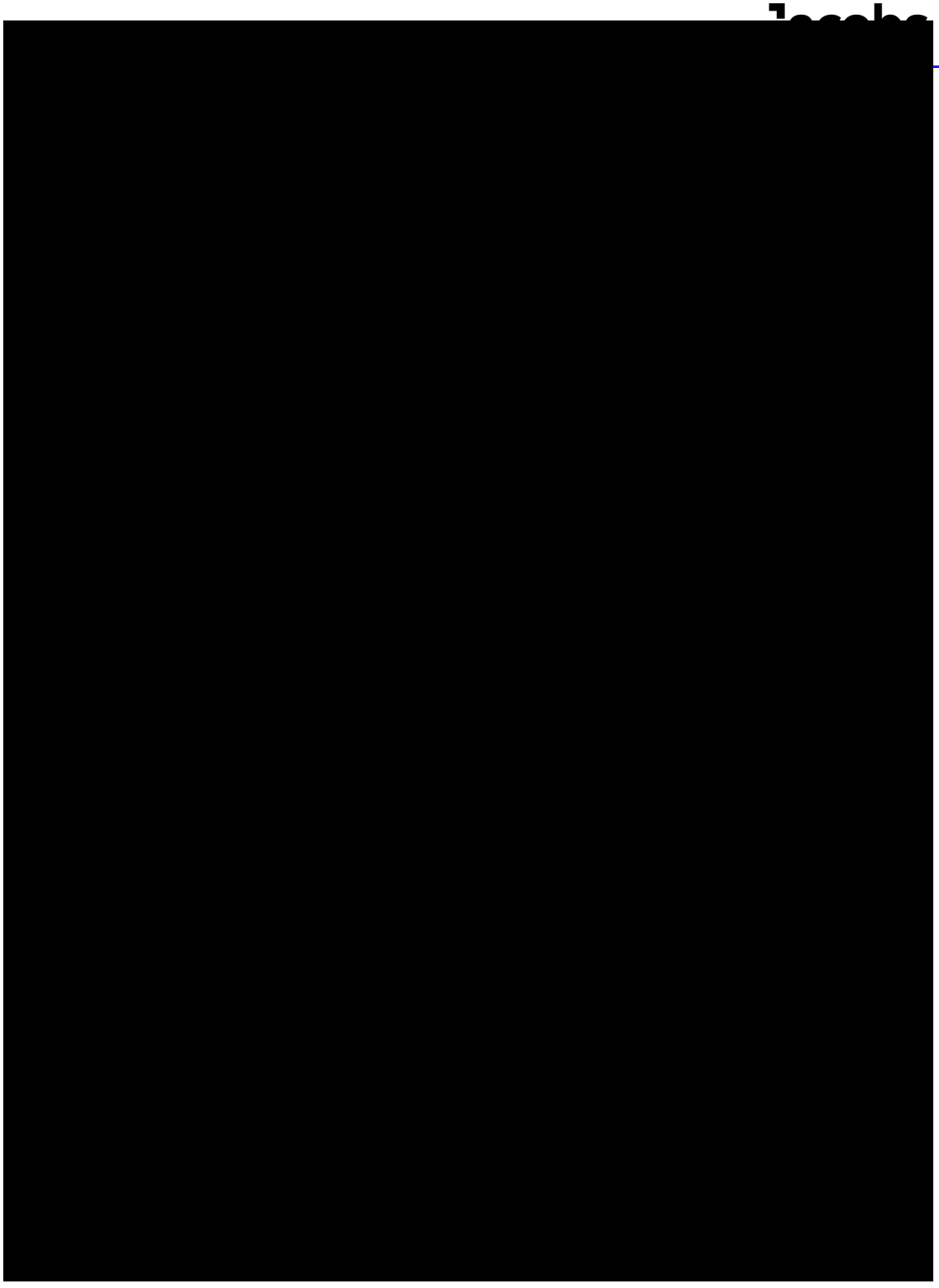

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14 April 2022

Jaco Kleinhans
Branch Manager
Living Earth Limited
42 Metro Place,
Bromley,
CHRISTCHURCH 8062

Dear Jaco

LIVING EARTH ODOUR ASSESSMENT: CURRENT OPERATIONS, CONTROLS & EFFECTIVENESS

1.0 Background

Living Earth Limited (Living Earth) operates an organics processing plant and green waste composting facility located at 40 Metro Place, Bromley, Christchurch (shown in Figure 1) (the Site). Living Earth's air discharges are subject to the conditions attached to air discharge consent CRC080301.1 ("the consent") from Canterbury Regional Council (CRC) to discharge contaminants (odour and dust) to air.

Specifically, Condition 27 of the consent states that:

> *"The discharges of air shall not cause odour or dust which is offensive or objectionable beyond the boundary of the site on which this consent is exercised."*

While Living Earth operates the composting facility, Christchurch City Council (CCC) holds the consent.

Living Earth has recently made a number of changes to its operation to reduce the potential for offensive or objectionable odours to occur.

Pattle Delamore Partners Limited (PDP) have been providing assistance to CCC and Living Earth regarding assessing the odour effects from the site.

PDP has been engaged by Living Earth to provide a summary of the current site operations, their relative contribution to the generation of odour onsite, and how the current controls are working. This information will be used to support and manage continued operations at the site.

This letter provides PDP's assessment of Living Earth's site operations, the odour risks these pose and the effectiveness of odour controls.

2.0 Key Personal Details

This assessment was undertaken by Dr Steve Pearce. Dr Pearce is an experienced air quality professional with experience assessing odour from a range of sources including composting operations, landfills, waste transfer stations, wastewater treatment plants, irrigation of wastewater to land, food processing facilities and wood processing plants.

Dr Pearce has prepared and presented odour related expert witness evidence at both Regional and Environment Court hearings.

Dr Pearce is a member of the Clean Air Society of Australia and New Zealand (CASANZ) and is a Certified Air Quality Professional (CAQP). Additionally, Dr Pearce has a 'calibrated' nose for the purposes of assessing odour having been tested to, and meeting, the requirements of AS/NZS 4323.3:2001 Section 9.7.2.

3.0 Site Familiarity

Dr Pearce has visited the site a number of times since January 2022 and has been undertaking proactive odour observations in the Bromley area on behalf of Living Earth and CCC. A site visit was undertaken on the 12th of April 2022 to assess current site odour sources and controls. At the time of the site visit, the screening plant was not operating.

4.0 Overview of Site Operations

Living Earth receive curb side organic (KSO) waste and green waste for processing from a number of sources which it processes into compost. The key site operations are summarised in the following sections.

4.1 In-Tunnel Composting

The fresh incoming material is mixed with oversize tailings and sawdust, ideally to achieve a 30:1 C/N ratio, before being shredded and placed in a tunnel to undergo an in-vessel composting process with forced air to maintain aerobic composting conditions. The air exhausted from the composting tunnels is treated via a biofilter prior to discharge. The tunnel process typically has a duration of 14 days before the immature compost is removed from the tunnels. A probiotic is now being added prior to the tunnel composting process to improve microbial activity in the composting process and reduce odour.

4.2 Screening

Fresh compost is taken straight from the composting tunnels and put through an undercover screening process to produce screened compost and oversize tailings. The fresh compost is hot and moist, and a proportion of the fines stick to the oversize material during the screening process. Air is extracted from the top of the screening building and directed through a biofilter.

Tailings are stored in piles prior to being blended with fresh incoming green waste and being reprocessed. These piles are not turned prior to being reprocessed.

4.3 Compost Maturation

The screened compost is stored in piles and transported offsite.

5.0 Potential Sources of Odour and Controls

Based on the description of the composting operation in the preceding section and using our on-site observations, PDP has identified five sources of odour (see also **Figure 1**):

1. The organics processing plant (OPP);
2. The tunnel composting and biofilter;
3. The operation of the screening plant;
4. Storage of oversize tailings; and,
5. Storage and loadout of compost.

Figure 1: Living Earth Odour Sources

The risks to offsite offensive and objectionable odours from each of these sources, and the controls in place to mitigate these risks, as discussed in the following sections.

5.1 Organics Processing Plant (OPP)

The OPP is where KSO and green waste is mixed with oversize tailings and sawdust (if required), shredded, sprayed with probiotic, and loaded into one of the eighteen composting tunnels. Living Earth's experience is that the use of a probiotic improves the composting process resulting in better product being produced with a reduction in associated odour.

Roller doors are opened when required to allow access for trucks dropping off waste, bringing in oversize tailings, and the transport of compost to the screening plant. Air is extracted to the biofilter from ducts within the OPP to minimise the escape of fugitive odours when all doors are shut. The main route for discharge of odour from the OPP is through the truck access roller doors. **Table 1** presents an assessment of the frequency of odour release from the OPP, the current controls in place to minimise odour, and an assessment of the effectiveness of the controls to minimise the generation of odour.

Table 1: Organics processing plant (OPP) odour generation potential	
Frequency of odour release	Only during operating hours Via roller doors when open to admit trucks or front-end loaders Minimal discharge of fugitive odours from building envelope
Current controls	Roller doors are kept closed when not in use Slight negative pressure maintained in OPP from air extraction SCADA control of tunnel airflow when tunnel door opened
Effectiveness of controls	Good

Based on PDP's observations, the current controls are working well to minimise the contribution of the OPP to the generation of on-site odour.

5.2 Tunnel Composting and Biofilter

The air exhausted from the composting tunnels is directed to a biofilter located adjacent to the OPP, for treatment prior to discharge into the atmosphere. Biofilters are regarded as best practice for the treatment of odours discharges from a wide range of sources such as rendering plants, fish factories, cooking odours and wastewater treatment plants. The exhaust from the biofilter has a sweet character which is recognisably different to the character of the compost odours (which is more bitter in character) observed offsite during odour scouting.

Table 2 presents an assessment of the frequency of odour release from the biofilter, the current controls in place to minimise odour, and an assessment of the effectiveness of the controls to minimise the generation of odour.

Table 2: Biofilter odour generation potential	
Frequency of odour release	Continuous (24/7)
Current controls	Use of probiotics in the composting operation Correctly designed to treat required air flowrates Correct biofilter operating conditions ⁘ Bed material fresh and replaced when necessary ⁘ Bed material kept moist ⁘ Monitoring of biofilter bed backpressure ⁘ Monitoring of air parameters (Temp, pH, humidity) Largest possible buffer distance to members of the public
Effectiveness of controls	Good – biofilter odour character not recognised offsite

Based on PDP's observations, the current controls are working well to minimise the contribution of the biofilter to the generation of on-site odour.

5.3 The Screening Plant

Fresh compost from the OPP is transported by front end loader to the screening plant for processing. The purpose of screening is twofold:

- Remove foreign objects such as stones and plastic; and,
- Separate the fine, compost product from the larger material that is discharged as tailings. These tailings are used back as an input.

Screening is undertaken undercover in an open fronted building with air being extracted from the top of the building and directed through a biofilter. The biofilter was observed to have vegetation growing on its surface indicating that it is potentially not operating in an optimal manner.

The screening process results in the release of dust in addition to odour, so a water mister blows across the open front of the building, primarily for dust control.

Discussions with Living Earth staff indicated that they view the screening plant as a larger source of odour than the OPP, biofilter or compost, but lower than that of the oversize tailings.

Table 3 presents an assessment of the frequency of odour release from the screening plant, the current controls in place to minimise odour, and an assessment of the effectiveness of the controls to minimise the generation of odour.

Table 3: Screening plant odour generation potential	
Frequency of odour release	When screening (4.00am until 11.00pm). Not on Sundays.
Current controls	Takes place in partially enclosed building Air above the drum screen extracted to a biofilter Water mister across entrance to the building for dust (and odour) Buffer distance to the south
Effectiveness of controls	Good but could be improved. – odour can escape from the open front of the screening enclosure and the biofilter should be assessed to ensure it is operating effectively.

Based on PDP's observations and discussions with Living Earth staff, the current controls are to working reduce the contribution of the screening plant to the generation of on-site odour. The effectiveness of the controls are limited by the open front on the screening enclosure not being able to fully contain odours and direct them to the biofilter for treatment. Additionally, a visual inspection of the biofilter indicates that it may not be operating as effectively as it could be.

5.4 Tailings

Oversize material from the screening process is stored in piles at the northern end of the site prior to being blended with fresh incoming KSO and green waste and being reprocessed. Once placed these piles are not turned (to reoxygenate) prior to being reprocessed. Odour is released during the formation of these piles which decreases in intensity over time as the outer layer forms a mature layer. More intense odours are released when the piles are moved back into the OPP for blending with fresh KSO and green waste prior to composting.

As odour is discharged from the surface of the oversize tailings piles, the total odour discharge rate, and therefore the potential for offsite odour effects will decrease with decreasing volumes being stored.

Table 4 presents an assessment of the frequency of odour release from the oversize tailings, the current controls in place to minimise odour, and an assessment of the effectiveness of the controls to minimise the generation of odour.

Table 4: Tailings odour generation potential	
Frequency of odour release	Semi continuous Higher odour when forming piles Odour discharge reduces over a period of days after formation Higher odour discharge when removed for reprocessing
Current controls	Not turned after placement Located at the north end of the site resulting in the largest possible buffer distance to members of the public
Effectiveness of controls	Could be improved – odour is released semi continuously. Odour discharge related to the total volume (surface area) of the tailing piles.

Based on PDP's observations, the current controls are having a limited impact on reducing the contribution of the tailings to the generation of on-site odour. The effectiveness of the controls is limited by the volume of oversize tailings that are currently being stored on site. Reducing the volume of tailings stored onsite will improve the effectiveness of the controls and significantly reduce the impact of this source of odour.

5.5 Compost Fines

The freshly screened compost is not fully mature, and the composting process will continue for several weeks before a stable material results. During this time the maturing compost requires a plentiful supply of oxygen to support the composting microbes. Failure to supply sufficient oxygen results in anaerobic conditions and the formation of offensive and objectionable odours when stored in a pile.

To mitigate this risk, the screened immature compost is stored in piles and regularly removed from site and spread to land.

Table 5 presents an assessment of the frequency of odour release from the immature compost, the current controls in place to minimise odour, and an assessment of the effectiveness of the controls to minimise the generation of odour.

Table 5: Compost odour generation potential	
Frequency of odour release	Semi continuous when onsite
Current controls	Removed from site as soon as possible to prevent anaerobic conditions and offensive or objectionable odours forming Regular loadout resulting in small volumes on-site at any one time Storage pile located at the northern most end of the site adjacent to the OPP resulting in the largest possible buffer distance to members of the public Trucks are covered before leaving site to minimise odour discharge from the truck themselves leaving site A mister is located adjacent to the compost pile to manage any dust produced which can also have a beneficial effect on odour discharges
Effectiveness of controls	Good – small volumes onsite for minimal time

Based on PDP's observations, the current controls are working well to minimise the contribution of the compost to the generation of on-site odour.

5.6 Site wide controls

In addition to the specific controls detailed above for each of the site odour sources, there are some additional controls that are applied across the site.

5.6.1 Portable Misters

Three portable misters have been located along the south western boundary of the operational portion of the site, primarily to provide mitigation against dust discharges, but the misters can also have a beneifical effect on odour discharges (see **Figure 2** and **Figure 4**).

5.6.2 Mister Lines

Mister lines are in place along the southern and southwestern boundary of the site to deliver a fine water/deodorant mist to provide mitigation of odour discharges from the site (see **Figure 3** and **Figure 4**).

5.6.3 Increased Buffer Distance

The change to the compost maturation process has resulted in a large reduction in the volume of material being stored onsite. Windrows have been removed from the southern and western end of the site to create a buffer area between the operations and the site boundary downwind of the prevailing north easterly wind which will further reduce the potential for offsite offensive of objectionable odour (see **Figure 4**).

Figure 2: Portable mister

Figure 3: Misting line on southern boundary

6.0 Future Changes to Odour Controls

As described above, the major contributor to offsite odour is thought to be the storage of oversize tailings from the screening process.

It is estimated by Living Earth that there are currently 14,200 tonnes of oversize tailings stored on site. During the autumn and winter period, KSO and green waste supply to the site decreases. Living Earth plan to take advantage of this reduction to reprocess the tailings through the composting process and reduce the tonnage of tailings stored onsite to 3,000 tonnes, a reduction of nearly 80%.

As the discharge rate of odour from the storage of oversize tailing is proportional to the amount (surface area) being stored and length of storage, PDP anticipates that if the planned reduction in tailing volumes is achieved, the potential odour from the site will be significantly further reduced at the end of the winter period.

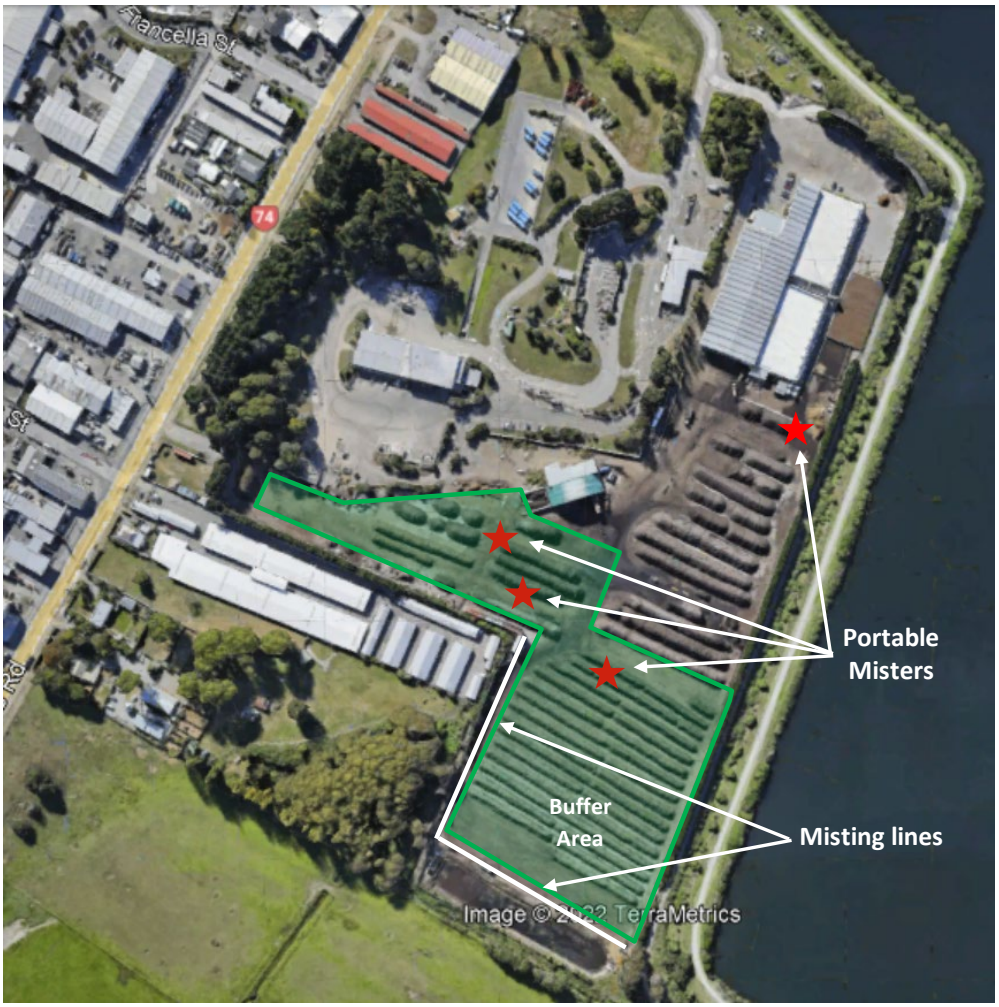

Figure 4: Mister lines, portable mister and buffer locations

7.0 Summary

PDP have assessed Living Earth's composting operations during a site visit on the 12th of April and identified five sources of odour along with their potential relative contribution to onsite odour generation and how effective the current controls are. The five sources and the effectiveness of the current controls are:

- The organics processing plant (OPP) **Good**
- The biofilter **Good**
- The operation of the screening plant **Good but could be improved**
- Storage of oversize tailings **Limited and could be improved**
- Storage and loadout of immature compost **Good**

Based on PDP's observations, the current controls are generally working well to minimise the generation of onsite odour.

PDP's assessment is that the controls in place to minimise the generation of odour from the oversize tailings are having a limited effect. It would further improve the effectiveness of the odour mitigation if the volume of tailings being stored were to be reduced.

Living Earth plan to reduce the tonnage of tailings stored onsite over the winter period by nearly 80% which should reduce the potential discharge of odour from this source by a similar amount.

8.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Living Earth Limited. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Living Earth Limited for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Yours Faithfully

PATTLE DELAMORE PARTNERS LIMITED

Prepared by	Reviewed and approved by
Dr Steven Pearce	**Jeff Bluett**
Technical Director – Environmental Management	Technical Director – Air Quality

23. Resolution to Exclude the Public

Section 48, Local Government Official Information and Meetings Act 1987.

I move that the public be excluded from the following parts of the proceedings of this meeting, namely items listed overleaf.

Reason for passing this resolution: good reason to withhold exists under section 7.
Specific grounds under section 48(1) for the passing of this resolution: Section 48(1)(a)

Note

Section 48(4) of the Local Government Official Information and Meetings Act 1987 provides as follows:

"(4) Every resolution to exclude the public shall be put at a time when the meeting is open to the public, and the text of that resolution (or copies thereof):

(a) Shall be available to any member of the public who is present; and
(b) Shall form part of the minutes of the local authority."

This resolution is made in reliance on Section 48(1)(a) of the Local Government Official Information and Meetings Act 1987 and the particular interest or interests protected by Section 6 or Section 7 of that Act which would be prejudiced by the holding of the whole or relevant part of the proceedings of the meeting in public are as follows:

ITEM NO.	GENERAL SUBJECT OF EACH MATTER TO BE CONSIDERED	SECTION	SUBCLAUSE AND REASON UNDER THE ACT	PLAIN ENGLISH REASON	WHEN REPORTS CAN BE RELEASED
22.	ORGANICS PROCESSING OPTIONS				
	ATTACHMENT B - IA237000 - FUTURE OF ORGANICS - FINAL - 13APR22 (PUBLIC EXCLUDED)	S7(2)(B)(II), S7(2)(I), S7(2)(J)	PREJUDICE COMMERCIAL POSITION, CONDUCT NEGOTIATIONS, PREVENTION OF IMPROPER ADVANTAGE	PUBLIC RELEASE COULD POTENTIALLY PREJUDICE FUTURE COMMERCIAL NEGOTIATIONS IN RELATION TO THE EXISTING COMPOSTING OPERATION AND /OR THE PURCHASE OF A NEW SITE OR NEGOTIATION OF A NEW COMMERCIAL SERVICE	UPON THE COMPLETION OF THE PROCUREMENT ACTIVITY AND WHEN THE CEO DETERMINES THERE IS NO LONGER REASON TO WITHHOLD THE INFORMATION.
	ATTACHMENT C - 20220411_MEMO OPP PROPERTY OPTIONS (PUBLIC EXCLUDED)	S7(2)(B)(II), S7(2)(I), S7(2)(J)	PREJUDICE COMMERCIAL POSITION, CONDUCT NEGOTIATIONS, PREVENTION OF IMPROPER ADVANTAGE	REASON: PUBLIC RELEASE COULD POTENTIALLY PREJUDICE FUTURE COMMERCIAL NEGOTIATIONS IN RELATION TO THE EXISTING COMPOSTING OPERATION AND /OR THE PURCHASE OF A NEW SITE OR NEGOTIATION OF A NEW COMMERCIAL SERVICE REVIEW EVENT: UPON THE COMPLETION OF THE PROCUREMENT ACTIVITY AND WHEN THE CEO DETERMINES THERE IS NO LONGER REASON TO WITHHOLD THE INFORMATION.	UPON THE COMPLETION OF THE PROCUREMENT ACTIVITY AND WHEN THE CEO DETERMINES THERE IS NO LONGER REASON TO WITHHOLD THE INFORMATION.

	ATTACHMENT E - ORGANICS PROCESSING OPTIONS : PX REDACTIONS FROM THE OFFICER REPORT TO COUNCIL 28 APRIL 2022	S7(2)(B)(II), S7(2)(I), S7(2)(J)	PREJUDICE COMMERCIAL POSITION, CONDUCT NEGOTIATIONS, PREVENTION OF IMPROPER ADVANTAGE	REASON: PUBLIC RELEASE COULD POTENTIALLY PREJUDICE FUTURE COMMERCIAL NEGOTIATIONS IN RELATION TO THE EXISTING COMPOSTING OPERATION AND /OR THE PURCHASE OF A NEW SITE OR NEGOTIATION OF A NEW COMMERCIAL SERVICE REVIEW EVENT: UPON THE COMPLETION OF THE PROCUREMENT ACTIVITY AND WHEN THE CEO DETERMINES THERE IS NO LONGER REASON TO WITHHOLD THE INFORMATION.	UPON THE COMPLETION OF THE PROCUREMENT ACTIVITY AND WHEN THE CEO DETERMINES THERE IS NO LONGER REASON TO WITHHOLD THE INFORMATION.