

Appendix E

Evaluation Matrix

UK Biosolids MCEA - Phase 3 Evaluation of Alternative Design Concepts

Criteria for Evaluating Alternatives	Alternative Design Concept 1: Focus on maximizing resource recovery	Alternative Design Concept 2: Focus on minimizing utility demands and residuals volume
Description	Key features: - Incorporation of pre-conditioning of feedstock to maximize biogas generation, and, - Produce a liquid biosolids end-product (minimized wastewater treatment demands, maximum nutrient beneficial reuse).	Key features: - No feedstock pre-conditioning (minimized energy inputs required for process); and, - Dewatered biosolids minimized residual volume requiring onsite storage. While some osmote will be reused for blending with incoming material, return of a portion of this liquid for treatment at a City of Kingston WWTP will be required.
4 Natural Environment		
1 Vegetation/Trees (potential to impact or remove vegetation or trees)	Both design concepts propose a similar amount of tree removal within the Proposed Site Location; however, Design Concept #1 would occupy a larger footprint resulting in the removal of more shrubs and meadow vegetation than Design Concept #2. Design Concept #1 is less preferred compared to Design Concept #2.	Both design concepts propose a similar amount of tree removal within the Proposed Site Location; however, Design Concept #1 would occupy a larger footprint resulting in the removal of more shrubs and meadow vegetation than Design Concept #2. Design Concept #2 is more preferred compared to Design Concept #1.
Rating	●	●
2 Terrestrial Habitat & Wildlife (potential to impact wildlife, significant wildlife habitat, habitat connectivity)	Potential impacts may occur to shrubs and meadow vegetation within the Proposed Site Location as they provide potential migratory bird habitat. Design Concept #1 would occupy a larger footprint resulting in the removal of more potential migratory bird habitat than Design Concept #2. The larger footprint for Design Concept #1 occurs in closer proximity to forest habitat located within and adjacent to the north portion of the Proposed Site Location which may increase operational indirect anthropogenic impacts (i.e., noise, light, vibration and human presence) to wildlife, general wildlife habitat and candidate SWH in the area compared to Design Concept #2. Design Concept #1 is less preferred compared to Design Concept #2.	Potential impacts may occur to shrubs and meadow vegetation within the Proposed Site Location as they provide potential migratory bird habitat. Design Concept #2 would occupy a smaller footprint and removal of less potential migratory bird habitat than Design Concept #1. The smaller footprint for Design Concept #2 occurs in further away from forest habitat located within and adjacent to the north portion of the Proposed Site Location compared to Concept #1 and may result in less operational indirect anthropogenic impacts (i.e., noise, light, vibration and human presence) to wildlife, general wildlife habitat and candidate SWH in the area compared to Design Concept #1. Design Concept #2 is more preferred compared to Design Concept #1.
Rating	●	●
3 Fisheries / Aquatic Habitat & Wildlife (potential to impact aquatic habitat & wildlife)	Neither concept are anticipated to have potential impacts to aquatic habitat & wildlife due to the absence of surface water features in proximity to the Proposed Site Location. Design Concepts #1 and #2 are equally preferred.	Neither concept are anticipated to have potential impacts to aquatic habitat & wildlife due to the absence of surface water features in proximity to the Proposed Site Location. Design Concepts #1 and #2 are equally preferred.
Rating	●	●
4 Species at Risk (SAR) (potential to impact habitat of Species at Risk)	Neither of the design concepts will remove SAR. However, there is still the potential for operational indirect anthropogenic impacts (i.e., noise, light, vibration and human presence) to nearby SAR and SAR habitat. These features occur along the western boundary of the Proposed Site Location as part of the Cataragui Clay Creek Ridges Earth Science ANSI, potential SAR and candidate SWH associated with the Fresh – Moist Sugar Maple – Black Maple Deciduous Forest (FODMB-2) and the small section of Fresh - Moist Cottonwood Deciduous Forest (FODMB-3) within and adjacent to the northern boundary of the Proposed Site Location and the southeast portion of Proposed Site Location, respectively. Design Concepts #1 and #2 are equally preferred.	Neither of the design concepts will remove SAR. However, there is still the potential for operational indirect anthropogenic impacts (i.e., noise, light, vibration and human presence) to nearby SAR and SAR habitat. These features occur along the western boundary of the Proposed Site Location as part of the Cataragui Clay Creek Ridges Earth Science ANSI, potential SAR and candidate SWH associated with the Fresh – Moist Sugar Maple – Black Maple Deciduous Forest (FODMB-2) and the small section of Fresh - Moist Cottonwood Deciduous Forest (FODMB-3) within and adjacent to the northern boundary of the Proposed Site Location and the southeast portion of Proposed Site Location, respectively. Design Concepts #1 and #2 are equally preferred.
Rating	●	●
Summary Natural Environment		
5 Physical Environment		
1 Groundwater (potential to impact groundwater resources and source water protection areas)	Both design concepts have the potential risk of spills from digestion tank and/or biosolids storage failure which could result in the contamination of groundwater resources and source water protection areas. Both design concepts are proposed within Significant Groundwater Recharge Areas and partially within Highly Vulnerable Aquifers which are considered Regional areas of sensitive groundwater in the Cataragui Source Protection Plan. Under the Clean Water Act these areas receive a vulnerability score of 6 and activities in these areas are not considered significant drinking water threats. Alternative 1 is expected to have minimal process water demands to be supplied by an onsite well and is more preferred than alternative 2.	Both design concepts have the potential risk of spills from digestion tank and/or biosolids storage failure which could result in the contamination of groundwater resources and source water protection areas. Both design concepts are proposed within Significant Groundwater Recharge Areas and partially within Highly Vulnerable Aquifers which are considered Regional areas of sensitive groundwater in the Cataragui Source Protection Plan. Under the Clean Water Act these areas receive a vulnerability score of 6 and activities in these areas are not considered significant drinking water threats. Alternative 2 is expected to require more water for the digestion process, which may need to be supplied by the onsite well. Alternative 2 is less preferred than alternative 1.
Rating	●	●
2 Surface Water and Area Drainage (potential to impact surface water and area drainage)	For both design concepts, an active storage volume of approximately 4,000 m ³ is necessary to maintain peak flows below existing conditions. The quality and quantity control requirements for the two design concepts are very similar and can be accommodated through the design and implementation of an appropriately sized SWM facility. Further, no contaminated runoff is expected for either design concept and, as a result, no surface water contamination is expected. Therefore, the potential moderate impacts to surface water quality and quantity, and the associated mitigation strategies, are similar between the two design concepts. Design Concepts #1 and #2 are equally preferred.	For both design concepts, an active storage volume of approximately 4,000 m ³ is necessary to maintain peak flows below existing conditions. The quality and quantity control requirements for the two design concepts are very similar and can be accommodated through the design and implementation of an appropriately sized SWM facility. Further, no contaminated runoff is expected for either design concept and, as a result, no surface water contamination is expected. Therefore, the potential moderate impacts to surface water quality and quantity, and the associated mitigation strategies, are similar between the two design concepts. Design Concepts #1 and #2 are equally preferred.
Rating	●	●
3 Climate Change (potential to impact emission of greenhouse gases, carbon removal, carbon storage/sink (e.g., trees and vegetation), and trucking-related GHG impacts)	Processing equipment for Design Concept #1 is expected to be more energy intensive and require comparatively higher utility usage than Design Concept #2. However, Design Concept #1 is expected to yield comparatively higher biogas production than Design Concept #2. This results in a potentially greater overall net reduction in GHGs when considering diversion of natural gas by RNG. Design Concept #1 is more preferred compared to Design Concept #2.	Design Concept #2 is expected to be less energy intensive and require comparatively lower utility usage than Design Concept #1. This results in the potential a greater overall net reduction in GHGs due to the lower expected yield of biogas generated from the process. This results in a potentially less overall net reduction in GHGs when considering diversion of natural gas by RNG. Design Concept #2 is less preferred compared to Design Concept #1.
Rating	●	●

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4	<p>Climate Change Resilience (potential impact of the effects of climate change on the undertaking)</p>	<p>Minimal impacts to project activities as a result of variation in climate parameters such as temperature (extreme cold/heat), precipitation, and wind are anticipated. There is potential for temporary impacts (e.g., delays) to the project during construction due to extreme weather events. The Study Area is not located within a flood plain area limiting the potential impact of extreme storm events on the project.</p> <p>Design Concepts #1 and #2 are equally preferred.</p>
	<p><i>Rating</i></p>	<p><i>Rating</i></p>
5	<p>Noise & Vibration (potential to impact noise and vibration levels)</p>	<p>The predicted noise impacts are slightly lower for Design Concept #1, however, as the difference is less than 1 dBA it is not considered significant. Therefore, both design concepts can be compliant with the applicable noise limits and are suitable from a noise perspective. There are no significant sources of vibration associated with either design concept.</p> <p>Design Concepts #1 and #2 are equally preferred.</p>
	<p><i>Rating</i></p>	<p><i>Rating</i></p>
6	<p>Air Quality (potential to impact air quality emissions)</p>	<p>The process for design concept #1 is more energy intensive than Design Concept #2. Therefore, it is estimated that Design Concept #1 will consume more natural gas and have an increased magnitude of air emissions released from this source.</p> <p>Design Concept #1 is less preferred compared to Design Concept #2.</p>
	<p><i>Rating</i></p>	<p><i>Rating</i></p>
7	<p>Odour (potential to impact odour emissions)</p>	<p>Indoor, ventilated facility footprints will differ slightly between the two design concepts, with Design Concept #1 requiring a lower level of odour mitigation than Design Concept #2.</p> <p>The storage of biosolids in liquid form has the potential for odour generation, however with liquid biosolids being contained within a covered lagoon to mitigate odour escape, its odour mitigation needs from digestate storage/handling is likely to be lower than that of Design Concept #2 which would rely, presumably, on top-loading trailers.</p> <p>Design Concept #1 is more preferred compared to Design Concept #2.</p>
	<p><i>Rating</i></p>	<p><i>Rating</i></p>
<p>Summary Physical Environment</p>		
<p>c Socio-Economic Environment</p>		
8	<p>Conformity to and Consistency with Local, Provincial and Municipal Policies (including Provincial Policy Statement, City of Kingston Official Plan, Kingston Climate Leadership Plan, and Ontario Resource Recovery and Circular Economy Act)</p>	<p>Both design concepts are generally consistent with the provincial and municipal policies. Section 3.1.1 of the Official Plan notes that municipal infrastructure may be permitted in all land use designations, provided they can be made compatible with surrounding land uses and subject to the Environmental Protection Act (EPA) and the Ministry of the Environment, Conservation and Parks (MECP) regulations; however, both design concepts are adjacent to the EPA land use designation and would likely require demonstration that there will be no negative impacts on the natural heritage features and areas or on their ecological functions which may require consultation with the appropriate authorities (i.e., MECP) and the completion of an environmental impact assessment as per Section 6.1.8 of the Official Plan. It is noted that the requirements of an environmental impact assessment will be satisfied and incorporated into the Environmental Study Report (ESR) of the EA. Both design concepts align with the provincial direction to consider waste as a resource, divert organics from disposal and to find opportunities to create RNG and reduce GHG emissions.</p> <p>Both concepts would likely require Zoning Bylaw Amendments in order to develop the proposed Facility.</p> <p>Design Concepts #1 and #2 are equally preferred.</p>
	<p><i>Rating</i></p>	<p><i>Rating</i></p>
9	<p>Community Nuisance Impacts During & Post-Construction (potential to impact nearby land uses and activities, including residential, recreational, transportation, public service facilities, and infrastructure)</p>	<p>The majority of sensitive receptors (e.g., residences and hotels) are located south of Highway 401 and both design concepts are relatively equal in terms of their impacts from noise and vibration, air quality and odour perspectives. The Little Cataraqui Creek CA Trails are located within approximately 100 m of the Proposed Site Location and may be impacted by the proposed Facility. While impacts to other nearby land uses and activities are similar for both concepts, Design Concept #1 storage lagoon requires construction closer the CA Trails.</p> <p>Construction of the lagoon may require additional truck traffic; however, it is anticipated that truck traffic will be relatively equal for both alternatives during operation of the facility.</p> <p>Design Concept #1 is less compared to Design Concept #2.</p>
	<p><i>Rating</i></p>	<p><i>Rating</i></p>
<p>Summary Socio-Economic Environment</p>		
<p>d Cultural Environment</p>		
10	<p>Heritage Resources (potential to impact built heritage resources and/or cultural heritage landscapes)</p>	<p>No cultural heritage resources were identified within or adjacent to the property in the Cultural Heritage Assessment Report (CHAR) (ARA, Dec 2022).</p> <p>Design Concepts #1 and #2 are equally preferred.</p>
	<p><i>Rating</i></p>	<p><i>Rating</i></p>

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2	Archaeological Resources (potential to impact archaeological resources)	Minimal potential for negative impacts to archaeological resources. The Stage 2 Archaeological Assessment (AA) found no significant archaeological resources within the areas of archaeological potential identified in the Stage 1 AA (ARA, October 2023). Design Concepts #1 and #2 are equally preferred.	Minimal potential for negative impacts to archaeological resources. The Stage 2 AA found no significant archaeological resources within the areas of archaeological potential identified in the Stage 1 AA (ARA, October 2023). Design Concepts #1 and #2 are equally preferred.
	<i>Rating</i>	●	●
1	Indigenous Communities (potential to impact traditional land and resource use and treaty rights)	No specific concerns has been received to-date from Indigenous communities to indicate potential impacts to traditional lands and treaty rights. Minimal potential for negative impacts to archaeological resources. The Stage 2 Archaeological Assessment (AA) found no significant archaeological resources within the areas of archaeological potential identified in the Stage 1 AA (ARA, October 2023). Design Concepts #1 and #2 are equally preferred.	No specific concerns has been received to-date from Indigenous communities to indicate potential impacts to traditional lands and treaty rights. Minimal potential for negative impacts to archaeological resources. The Stage 2 AA found no significant archaeological resources within the areas of archaeological potential identified in the Stage 1 AA (ARA, October 2023). Design Concepts #1 and #2 are equally preferred.
	<i>Rating</i>	●	●
	Summary Cultural Environment	●	●
Financial Factors			
1	Estimated Capital Costs (includes Engineering and Construction Costs)	Design Concept #1 has a slightly lower (11% overall cost) than Design Concept #2. Design Concept #1 is more preferred compared to Design Concept #2.	Design Concept #1 has comparatively lower capital costs than Design Concept #2. Design Concept #2 is less preferred compared to Design Concept #1
	<i>Rating</i>	●	●
2	Estimated Operating & Maintenance Costs	Design Concept #1 has comparatively higher operating costs associated with utilities necessary to operate the planned thermal hydrolysis pre-treatment and upgrade the biogas. Trucking costs associated with offsite transportation of liquid biosolids product may be greater due to greater volume than a solid, dewatered biosolids product. Increased operating costs are partially offset by the potential for greater revenue from RNG sale compared to Design Concept #2. This will be addressed as part of the upcoming business case assessment. Design Concept #1 is less preferred compared to Design Concept #2.	Design Concept #2 has comparatively lower operating costs associated with utilities necessary to operate the AD process, and decreased final product transportation costs due to reduced volume of the solid biosolids product. Design Concept #2 has a decreased potential for revenue from RNG sale compared to Design Concept #1. The cost of managing liquid centrate generated as the biosolids are dewatered to a solid has not yet been quantified and may reduce the difference in overall operating costs between Design Concept #1 and Design Concept #2. Design Concept #2 is more preferred compared to Design Concept #1
	<i>Rating</i>	●	●
1	Estimated Lifecycle Costs	Design Concept #1 has a slightly higher life cycle cost (LCC) over the project lifespan. Design Concept #1 is less preferred compared to Design Concept #2. Increased revenue opportunities from biogas production and higher value liquid fertilizer may offset differences in lifecycle costs. This will be addressed as part of the upcoming business case assessment.	Design Concept #2 has a slightly lower life cycle cost (LCC) over the project lifespan. Design Concept #2 is more preferred compared to Design Concept #1
	<i>Rating</i>	●	●
	Summary Financial Factors	●	●

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Technical Factors		
1	Construction Complexity	<p>Similar level of complexity for construction of product storage and material handling areas, as well as civil works required.</p> <p>Design Concepts #1 and #2 are equally preferred.</p>
	<i>Rating</i>	●
2	Process and Maintenance Complexity	<p>Design Concept #1 will produce a liquid biosolids product which will be stored on site. This eliminates the need to treat wastewater produced from product dewatering at City treatment plants, and simplifies handling of product with only pumping equipment required. This is comparatively less complex process than Design Concept #2.</p> <p>Both Design Concepts require transportation of the same quantities of Green Bin material and raw sludge from WWTPs, to the Knox Farm site as digestion process feedstock. Both alternatives are also expected to have similar staffing requirements.</p> <p>Design Concept #1 is more preferred compared to Design Concept #2.</p>
	<i>Rating</i>	●
3	Quantity of Biogas Production	<p>As a result of the thermal hydrolysis pre-treatment, Design Concept #1 is able to achieve greater volatile solids destruction in the downstream digestion process which generates a significantly higher biogas yield per tonne of feedstock digested.</p> <p>Design Concept #1 is substantially more preferred compared to Design Concept #2.</p>
	<i>Rating</i>	●
4	Expandability	<p>The Design Concept #1 material processing and digestion processes are relatively compact and can easily be expanded on the Knox Farm site. The liquid biosolids product produced will have a greater volume than a solid biosolids product proposed under Design Concept #2. Onsite capacity for storage of a greater quantity liquid product may be more limited in the event of future expansion.</p> <p>Design Concept #1 is less preferred compared to Design Concept #2.</p>
	<i>Rating</i>	●
5	Process Wastewater Treatment Requirements	<p>Design Concept #1 is not anticipated to require onsite or offsite treatment of process-generated wastewater.</p> <p>Design Concept #1 is substantially more preferred compared to Design Concept #2.</p>
	<i>Rating</i>	●
6	Residuals Nutrient Content	<p>Design Concept #1 is expected to produce a concentrated liquid CFIA regulated fertilizer which will be stored on site. This results in retention of soluble nutrients in the liquid digestate and potentially more favourable product for agricultural applications due to simplified spreading requirements.</p> <p>Design Concept #1 is substantially more preferred compared to Design Concept #2.</p>
	<i>Rating</i>	●
7	Residuals Volume	<p>Both design concepts are receiving the same feedstock and are assumed to have similar levels of contaminants or residuals requiring disposal.</p> <p>Design Concepts #1 and #2 are equally preferred.</p>
	<i>Rating</i>	●
8	Proven Technology (including design life)	<p>Anaerobic digestion is a proven technology with a long design life and established vendors capable of replacing components as required. Pre-processing technology is supplied by a few specialized technology vendors, but has been well established with full scale operating installations. Both design concepts have a demonstrated history of marketing the finished products.</p> <p>Design Concepts #1 and #2 are equally preferred.</p>
	<i>Rating</i>	●
Summary Technical Factors		●

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Criteria for Evaluating Alternatives	Alternative Design Concept 1: Focus on maximizing resource recovery	Alternative Design Concept 2: Focus on minimizing utility demands and residuals volume
Overall Summary	Least Preferred	Least Preferred

Order of Preference

- Most Preferred ●
- More Preferred ●
- Somewhat Preferred ○
- Less Preferred ○
- Least Preferred ○