4. Consideration of the Alternative Methods

This chapter of the EA documents the results of Waste Connections' assessment of alternative methods of carrying out the proposed landfill expansion. It includes consideration of different ways of expanding the landfill (**Section 4.1**), providing leachate treatment (**Section 4.2**) and managing LFG (**Section 4.3**). As originally documented in **Section 5.2** of the ToR, the following outlines the comparative evaluation methodology steps for each of the alternative methods:

1. Characterize Baseline Conditions: Information on the existing environment has been gathered for the discipline specific Study Areas and is documented in **Section 3.2** of this EA document. **Figure 4-1** depicts the existing site features referred to in the assessment.
2. Develop Alternative Methods: Alternative Methods to expand the Ridge Landfill have been developed. Within each of the following subsections the Alternative Methods for site development, leachate treatment and LFG management are described conceptually and in sufficient detail to allow for a comparative evaluation.
3. Predict Potential Net Environmental Effects for Each Alternative Method: For each alternative method for site development, leachate treatment and LFG management, the potential for environmental effects relative to the future baseline condition has been determined.

   The draft criteria used for this step were initially documented in the ToR. As committed to in the ToR, the refinement of the evaluation criteria was completed in consultation with agency stakeholders, Indigenous Communities and Organizations, and members of the public. In particular, public input on the criteria and indicators was solicited through a workshop in June 2018, and an open house in July 2018 and MECP and Walpole Island First Nation (WIFN) reviewed the evaluation criteria and indicators for all three (3) evaluations (site development, leachate treatment and LFG management). Input received was incorporated where appropriate into the final list of criteria and indicators. The criteria are outlined under the following components of the environment:

   - Natural (Biological) Environment – includes Terrestrial Ecosystems & Aquatic Ecosystems;
   - Natural (Physical) Environment – includes Groundwater, Surface Water, Atmospheric and Climate Change;
   - Social Environment;
   - Economic Environment;

- Cultural Environment; and,
- Built Environment.

The criteria, indicators and rationale for the evaluation of the site development alternatives, leachate treatment and LFG management alternatives are included as **Attachment 1**.

For each alternative a net effects table has been prepared. Framed around the evaluation criteria, this table documents key design considerations and assumptions, the future baseline or the "do nothing" scenario against which the potential for effect will be determined, the potential effect, proposed mitigation measures to minimize potential effects and the net effect – or potential effect once mitigation measures are implemented.

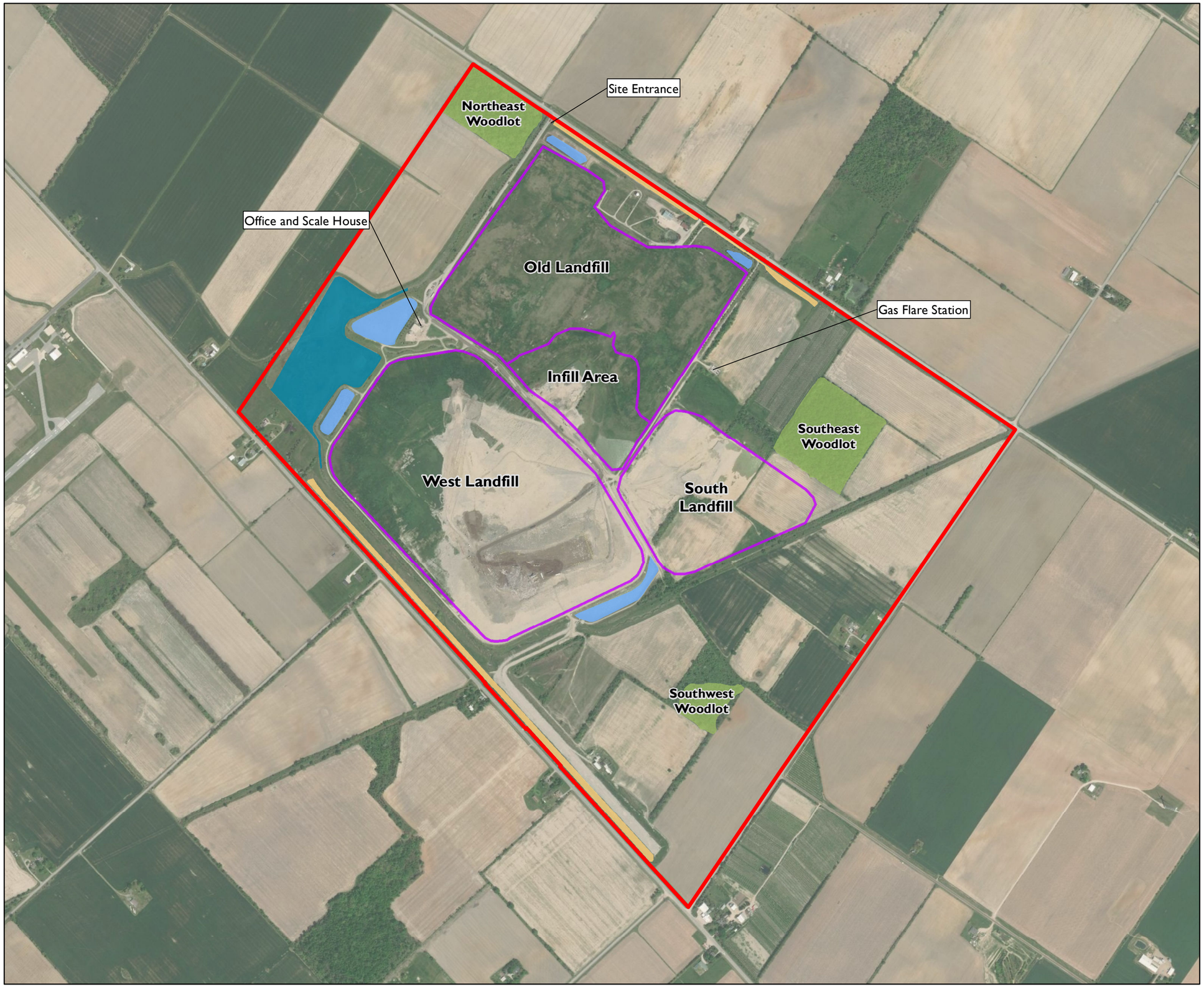
4. Comparatively Evaluate the Alternative Methods to Identify a Preferred Alternative: Once the potential net environmental effects for each alternative method were determined they were then used as the basis to rank the alternatives relative to each other. Alternatives were ranked as equally preferred, preferred, less preferred, or least preferred. The key advantages and disadvantages for each of the alternatives are also documented. A comparative evaluation table highlights the key differences and the rankings and identifies a preferred option for the site development, leachate treatment, and LFG management alternatives.

   The preferred alternative methods for site development, leachate treatment and LFG management will be carried forward as the preferred alternative for the Ridge Landfill Expansion. A more detailed assessment of potential effects and the development/refinement of mitigation and monitoring measures for the preferred alternative can be found in Section 6.0 and Section 7.0 of this document.

4.1 Alternative Methods for Site Development

As documented and shown on **Figure 4-1,** the Ridge site includes the following key features:

- three existing fill areas: the Old Landfill/Infill Area, West Landfill and South Landfill;
- gas collection system and on-site flares;
- stormwater management ponds;
- berms along Erieau Road and Charing Cross Road;
- on-site leachate collection system which pumps collected leachate through a forcemain for treatment at the BWTL; and
- ongoing surface and ground water monitoring indicate the existing site is in compliance with all current MECP approval requirements.



WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

FIGURE 4-1:
EXISTING SITE FEATURES

- Property Boundary and Extent of On-Site Study Area
- Approved Waste Disposal Area
- Berm
- Flood Control Facility
- Stormwater Pond
- Woodlot

1:12,000

0 120 240 480 m

N W E S

MAP DRAWING INFORMATION:
DATA OBTAINED FROM MNRF

MAP CREATED BY: GM
MAP CHECKED BY: MB
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 152456
STATUS: DRAFT
DATE: 2019-07-12

The development of alternative ways to expand the Ridge Landfill was based on the premise that all site development alternatives would provide the same disposal capacity (28.9 million m^3) and must be within the 340 ha property. The following provides design assumptions and common characteristics that were used as the basis for the development of the alternatives:

- Site Footprint – All alternatives have been designed to fit within the 340 ha property;
- Planning period – All site development alternatives have been conceptually designed for a 2021 to 2041 planning period;
- Type of waste – Non-hazardous solid waste is the only waste that will be accepted at the site and this will remain the case for all site development alternatives;
- Height – All expanded fill areas would be limited to the height restrictions imposed by the Chatham-Kent Municipal Airport Zoning Regulations (i.e., approximately 45 m above natural ground level or 241 metres above sea level (masl));
- Howard Drain – Lateral expansion of the West Landfill is common to all site development alternatives and will require relocating the Howard Drain which was previously relocated in 1999;
- Site entrance and scale house – The site entrance off Erieau Road will not change and the scale house and office will remain in the same place;
- Berms – The existing berm on the west side and the partial berm on the east side of the site will remain. New berms will be constructed along the south and south east property lines;
- Flood control – There is an existing flood control area at the north end of the site and available land held for a future flood control area if required for all three (3) alternatives. Ponds will be added to the site to accommodate runoff;
- Woodlots – The woodlot at the northeast of the site will remain regardless of the site development alternative;
- Hours of operation – The hours of operation would be the same for all site development alternatives and will be confirmed as the part of the EA;
- Diversion – The type of on-site diversion implemented would be consistent for all alternatives. It is anticipated that any on-site diversion activities could be located within available lands on the property. The specific location would depend on the site development alternative selected and operational constraints;
- Landfill gas collection and management – Landfill gas collection from existing and new cells and active management will continue at this site. All site development alternatives must be flexible enough to accommodate whatever LFG management alternative is identified as preferred;

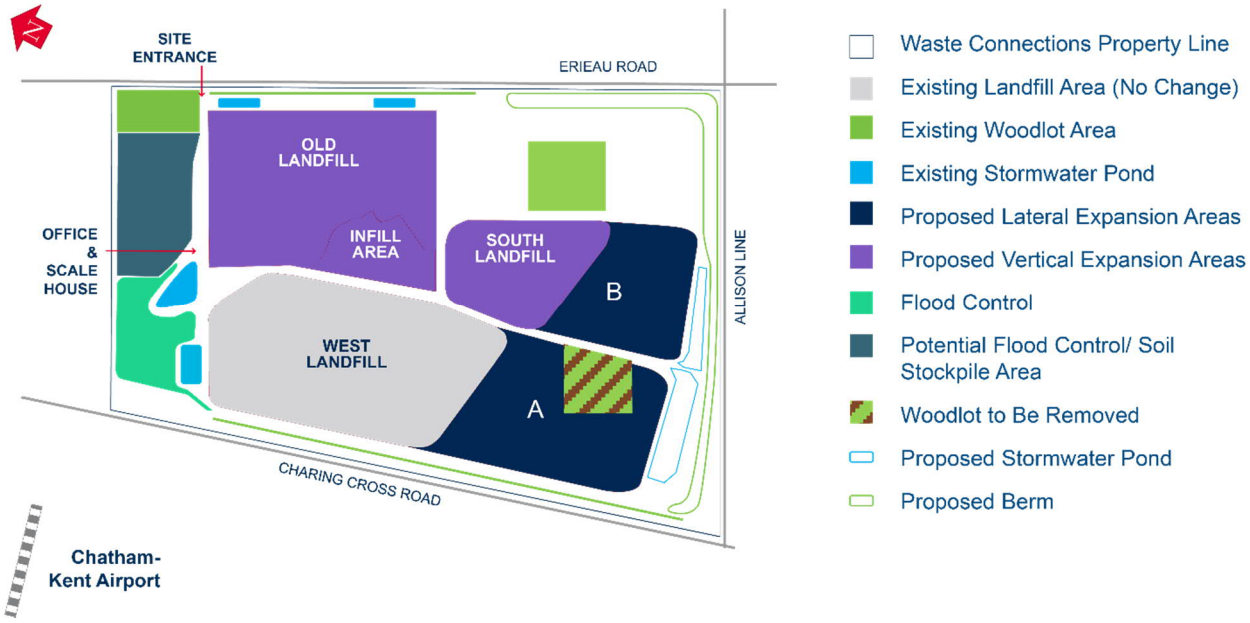
- Leachate collection and treatment – Leachate will be collected from all existing and new cells and will receive treatment. All site development alternatives must be flexible enough to accommodate whatever leachate treatment alternative is identified as preferred; and
- Monitoring – Waste Connections will continue regular monitoring at the site including monitoring of surface water quality and quantity, leachate quality and quantity, ground water quality and movement and private drinking water wells on an as requested basis.

4.1.1 Description of Site Development Alternatives

Three (3) proposed landfill site development alternative methods were identified for the Ridge Landfill EA. Each alternative method of how the landfill could be expanded within the site is described below with the accompanying rationale. **Figure 4-2** to **Figure 4-4** show the layout of the site development alternative methods and depiction of Areas: A, B, C, and Old Landfill. The detailed drawings of the site development alternatives and the calculations used to achieve the disposal capacity of 28.9 million m^3 for each of the three (3) alternatives are included in **Appendix F** – **Other Supporting Documents**.

4.1.1.1 Site Development - Alternative 1

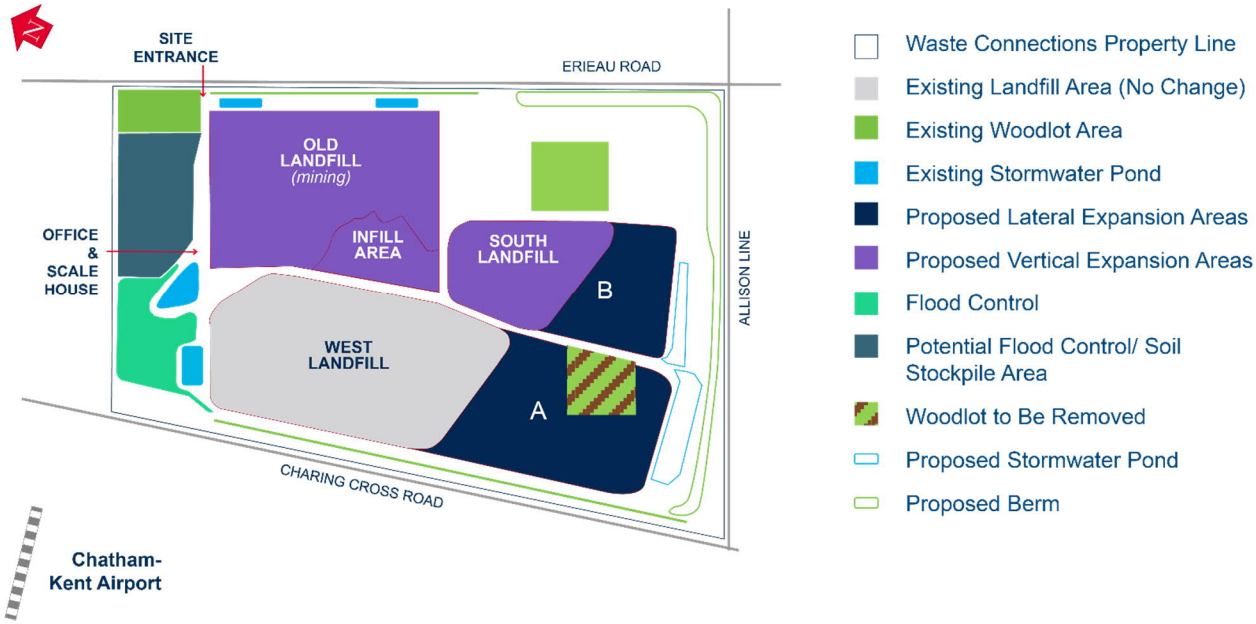
FIGURE 4-2: SITE DEVELOPMENT – ALTERNATIVE 1



Description – Alternative 1 Figure 4-2, Areas A, B, Old Landfill	Rationale
This alternative involves the following components: • **Lateral expansion of the West Landfill (Fill Area A)** This fill area expansion is approximately 36 ha providing approximately 13.2 million m^3 in capacity. It requires the removal of the southwest woodlot, changes to the stormwater management system on-site and the realignment of a section of the Howard Drain. This fill area would have a maximum elevation of 241 metres above sea level (masl) which is 0.3 m below the maximum elevation allowed by the Chatham Airport Zoning Regulations. This expanded fill area accommodates the relocated pond and berm at the south edge of the property. • **Lateral expansion of the South Landfill (Fill Area B)** This fill area expansion is approximately 23 ha providing approximately 8.6 million m^3 in capacity. It involves a slight reshaping of the existing South Landfill and a minor vertical expansion of the South Landfill from its current height to the maximum elevation of 241 masl. This expanded fill area accommodates a new pond and berm at the south edge of the property. • **Vertical expansion of the Old Landfill** This vertical expansion provides approximately 7.2 million m^3 in capacity over an existing waste footprint of approximately 55 ha. It would result in a maximum elevation of 241 masl.	This alternative: • Makes use of the additional vertical space associated with the Old Landfill; and • Minimizes woodlot removal.

4.1.1.2 Site Development - Alternative 2

FIGURE 4-3: SITE DEVELOPMENT – ALTERNATIVE 2

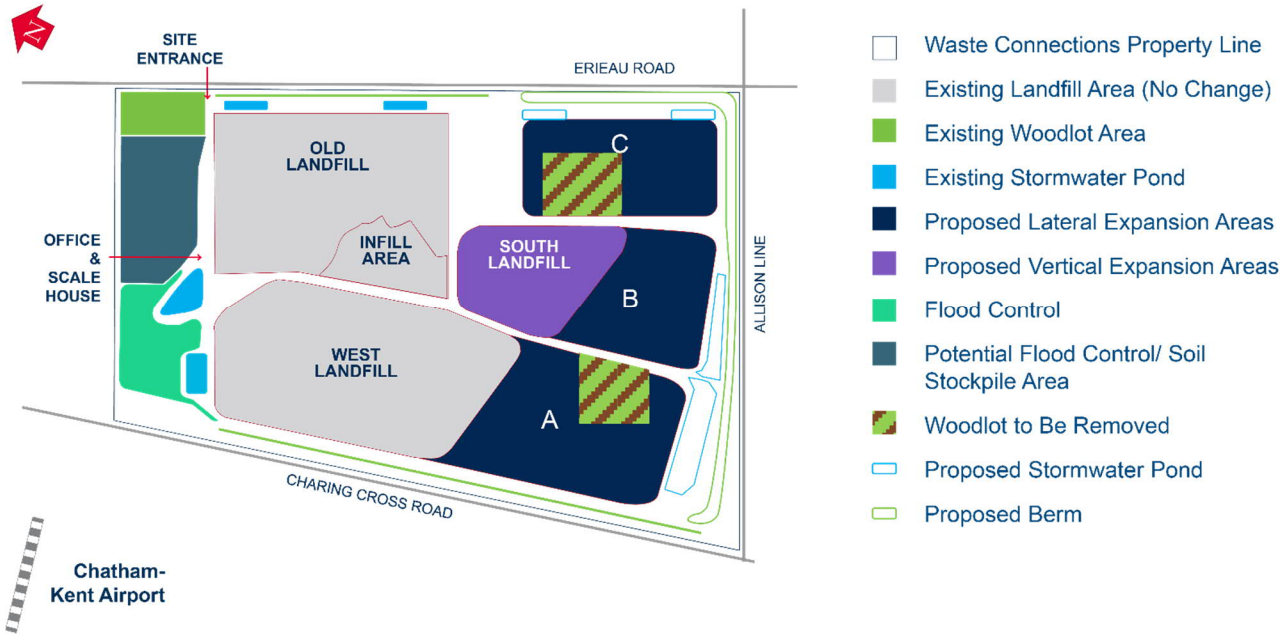


Description – Alternative 2 Figure 4-3, Areas A, B, Old Landfill & Landfill Mining	Rationale
This alternative involves the following components: • **Lateral expansion of the West Landfill (Fill Area A)** See description under Site Development Alternative 1 above. • **Lateral expansion of the South Landfill (Fill Area B)** For Site Development Alternative 2, the footprint of Fill area B is smaller than it is for Site Development Alternative 1 as additional capacity is provided through landfill mining. This fill area expansion is approximately 17 ha providing approximately 6.4 million m^3 in capacity. It involves a slight reshaping of the existing South Landfill and a minor vertical expansion of the South Landfill from its current height to the maximum elevation of 241 masl. This expanded fill area accommodates a new pond and berm at the south edge of the property. • **Landfill Mining** This alternative includes mining of the Old Landfill. Landfill mining is a complex operation that requires excavating buried waste, screening, sorting and moving separated materials either on-site (i.e., new disposal cell) or off-site (i.e.,	This alternative: • Makes use of the additional vertical space associated with the Old Landfill; • Maximizes the capacity of the Old Landfill through landfill mining; and • Minimizes woodlot removal.

Description – Alternative 2 Figure 4-3, Areas A, B, Old Landfill & Landfill Mining	Rationale
another licensed disposal facility). The Old Landfill was developed in three (3) waste disposal areas, from Mound 1 to 3. Mound 3 was the latest waste disposal area developed and was closed in December 1999. Mining the three (3) mounds of the Old Landfill can obtain approximately 1.4 million m^3 in capacity. The assumed air space recovery from landfill mining is the basis for the footprint size of Fill Area B. Further information on landfill mining is included in ***Appendix F***. An additional 0.8 million m^3 of space is created by removing soil from beneath the existing waste in the Old Landfill after it is mined. • **Vertical expansion of the Old Landfill** This vertical expansion provides approximately 7.2 million m^3 in capacity over an existing waste footprint of approximately 55 ha. It would result in a maximum elevation of 241 masl.	

4.1.1.3 Site Development Alternative 3

FIGURE 4-4: SITE DEVELOPMENT – ALTERNATIVE 3



Description – Alternative 3 Figure 4-4, Areas A, B, C	Rationale
This alternative involves the following components: • **Lateral expansion of the West Landfill (Fill Area A)** See description under Site Development Alternative 1 above. • **Lateral expansion of the South Landfill (Fill Area B)** See description under Site Development Alternative 1 above. • **New landform (Fill Area C)** This fill area expansion is approximately 24 ha, providing approximately 7.1 million m^3 in capacity. It requires the removal of the southeast woodlot and would result in a maximum elevation of 241 masl.	This alternative: • Maintains the existing height of the Old Landfill; and • Requires the removal of two (2) woodlots.

4.1.2 Potential Net Effects of Landfill Site Development Alternatives

Each of the three (3) site development alternatives were assessed to determine the potential impacts on the six (6) environments (i.e., Natural - Biological and Natural - Physical, Social, Economic, Cultural and Built Environments).

The following sections list the criteria and indicators considered and summarize the potential effects, proposed impact management measures and net effects of each of the alternatives. Net effects tables for each of the three (3) site development alternatives are included as **Attachment 2**.

4.1.2.1 Natural Environment – Biology

The following documents the natural-biological criteria and indicators, potential effects, proposed mitigation and net effects for each of the alternatives.

Criteria	Indicators
Terrestrial	
Potential for effect on terrestrial systems from construction and operation.	• Area and type of terrestrial systems (e.g., significant woodlots, hedgerows, wetlands, etc.) to be removed on-site.

Criteria	Indicators
	• Area and type of terrestrial systems (e.g., significant woodlots, hedgerows, wetlands, etc.) potentially disrupted within 1 km.
Potential for effect on habitat of Endangered or Threatened species during construction.	• Area of habitat for endangered or threatened species on-site.
Potential effect on medicinal or other culturally sensitive species of importance to Indigenous Communities and Organizations Groups during construction.	• Area and type of species of importance to be removed on-site.
Aquatic	
Potential for effect on aquatic systems during construction.	• Amount and type of aquatic systems (i.e., ponds, drains) that would be displaced on-site.

BIOLOGICAL POTENTIAL EFFECTS

Terrestrial Systems

Construction of any of the three (3) site development alternatives will require removal of the smaller southwest woodlot which is approximately 3.7 ha in size. Based on the field investigation completed in support of the EA, 1.46 ha (or 39%) of this southwest woodlot was associated with a deciduous thicket and no SAR, Species of Conservation Concern (SCC) and/or SWH were identified in association with the southwest woodlot. As a result, and in consideration of the adjacent land uses, the southwest woodlot was identified as having limited ecological function. In addition to removal of the smaller southwest woodlot Alternatives 1 and 2 would require temporary removal of approximately 50 ha of contiguous meadow habitat associated with the vertical expansion of the Old Landfill. Alternative 3 would require the permanent removal of the higher quality approximately 8 ha southeast woodlot.

Compensation for woodlot removal would be provided at a 2:1 ratio, planting two (2) trees for every tree removed. Waste Connections owns property on Erieau Road across from the Ridge Landfill where trees are intended to be planted. Discussions have also taken place with the Lower Thames Valley Conservation Authority (LTVC) and the Chippewas of the Thames First Nation and some trees will be replanted in their territory.

Site operation is not anticipated to negatively impact on-site terrestrial features that remain after construction and there is no disruption to off-site features noted above anticipated from site construction or operation of the proposed expansion.

Endangered Species Habitat

The habitats for endangered or threatened species identified on-site is the potential SAR bat habitat in the 8 ha southeast woodlot and the Eastern meadowlark within the meadow habitat associated with the Old and West Landfills. Alternative 3 requires permanent removal of SAR bat habitat. Alternative 3 would require an Overall Benefit Permit under Section 17(2) c of the ESA for removal of the southeast woodlot. Alternatives 1 and 2 require the temporary removal of up to 50 ha of the eastern meadowlark habitat associated with the vertical expansion of the Old Landfill. This temporary removal will be offset by establishing new habitat across the capped surface of the West Landfill as final cover is completed and the eventual replacement of the removed habitat when landfilling is completed on the Old Landfill.

Culturally Valued Species

As intact and healthy native ecosystems, any healthy woodlots on site are considered culturally relevant and important to Indigenous Communities and Organizations. Alternative 3 would require removal of two (2) woodlots, one with potential habitat for endangered or threatened species specifically a SAR bat.

Aquatic Systems

Municipal drains are common in Chatham-Kent and drains in this area have been in place for many decades. The on-site drains were successfully moved in 1999 to accommodate the landfill expansion at that time. Drains that are currently within the area of the site development alternatives are considered to have limited potential for fish habitat. All three (3) site development alternatives will require the relocation of approximately 1,330 m of the Howard Drain. The Howard Drain would be directed to the south and west of the expansion Fill Area A and would join up with the Scott Drain. Based on the work completed, the sensitivity to fish habitat is considered to be low and the impact of moving drains will be minimal. All three (3) site development alternatives would also remove one (1) existing pond at the south edge of the West Landfill. This pond would be relocated to the southern edge of expansion Fill Area A. Potential impact associated with moving the storm water management pond is anticipated to be minimal.

BIOLOGICAL IMPACT MANAGEMENT

Mitigation measures that Waste Connections proposes to put in place to reduce the potential for impact on terrestrial and aquatic biological features include:

- replanting of trees that need to be removed to accommodate the expansion at a 2:1 ratio;
- vegetation will be removed within appropriate timing windows; and
- replacement of fish habitat within the relocated portion of the Howard Drain.

BIOLOGICAL NET EFFECTS

For all three (3) alternatives the southwest woodlot will need to be removed. This woodlot has no species at risk, species of conservation concern and/or significant wildlife habitat and was identified as having limited ecological function. Alternatives 1 and 2 temporarily remove eastern meadowlark habitat. Alternative 3 removes a second woodlot with potential SAR bat habitat.

The replacement of the woodlots at a 2:1 ratio may result in a more robust woodlot with greater ecological function over time. However, the length of time to provide the same form and function particularly for the southeast woodlot would be significant.

The potential for impact to the aquatic systems will be localized and limited.

4.1.2.2 Natural Environment – Physical

The following documents the natural – physical criteria and indicators, potential effects, proposed mitigation and net effects for each of the alternatives.

Criteria	Indicators
Potential impacts to groundwater quality during construction, operation and post closure. Leachate contaminating lifespan during construction, operation and post closure.	• Qualitative assessment of ability of alternative to meet Reasonable Use Guideline. • Prediction based on tonnes of waste per hectare of footprint area and leachate generation rate.
Potential impacts to groundwater quantity. Potential impacts to water supply wells.	• Landfill footprint. • Extent of natural setting protection.

GROUNDWATER POTENTIAL EFFECTS

Groundwater Quality

To determine the significance of an impact on groundwater quality, the MECP developed Guideline B-7, *The Incorporation of the Reasonable Use Concept into MECP Groundwater Management Activities* (RUG). The essence of this guideline is to establish site specific groundwater quality criteria based on criteria established for the "reasonable use" of the groundwater and background concentrations. These criteria are typically applicable at the landfill boundary.

The “reasonable use” for groundwater at the Ridge Landfill site is drinking water. The RUG specifies that the maximum concentration of a particular contaminant that would be acceptable in groundwater beneath an adjacent property is a fraction of the Ontario Drinking Water Objectives (25% increase over background levels for health related parameters and 50% increase for non-health related parameters). Historical monitoring activity has shown that the Ridge Landfill site consistently meets the RUG. O.Reg. 232/98 (Table 3-1) specifies the water quality parameters that should be assessed as part of the hydrogeological assessment.

Given the protection provided by the natural setting and the supporting long-term historical monitoring data, groundwater impacts related to the construction of the new proposed fill areas prior to solid waste deposition are not considered significant. Also due to the natural setting and supported by appropriate engineering controls, all three (3) alternatives are expected to continue to meet the RUG during landfill operation. To confirm this, a predictive impact assessment will be completed for the preferred alternative using contaminant transport computer modelling to assess the suitability of the site, specifically the compliance with the RUG.

Leachate Contaminating Lifespan

Leachate is the liquid produced in a landfill from the waste material degradation and any water from precipitation that infiltrates into it. Leachate is produced at a landfill over the operating life of the site and after the site is closed. Contaminating lifespan is the time required for leachate concentrations to reduce within the landfill. Understanding the site’s leachate contaminating lifespan will help determine the ongoing mitigation and contingency measures needed to protect the environment into the future. A qualitative assessment of the contaminating life span was completed for the three (3) site development alternatives. The qualitative contaminating lifespan was calculated using a formula that relates leachate

concentrations to the total mass of waste, the tonnes of waste per hectare and anticipated leachate generation rate. The contaminating lifespan was determined based on the time for chloride concentrations in the leachate to reduce to the level allowed under the RUG (187.5 mg/L).

Overall, when considering the total landfill, the three (3) site development alternatives have calculated contaminating lifespans of 308 years (Alternative 1), 316 years (Alternative 2) and 294 years (Alternative 3). The nominal difference (7% or less) between the three (3) site developments alternatives is not considered to be significant.

Groundwater Quantity

The site is situated on a 30 m deposit of low permeability clay till soil and recharge through the till is very low. In addition, recharge to the bedrock aquifer from the fill footprint areas is eliminated while the leachate collection system is active. Therefore the total footprint area of the design alternative can be used to evaluate this indicator:

- Alternative 1 - 190 ha;
- Alternative 2 - 185 ha; and
- Alternative 3 - 214 ha.

(Note - the footprint area includes the existing landfill areas as well as the horizontal expansion).

Alternatives 1 and 2 are nearly the same and Alternative 3 has an approximately 15% greater footprint area. However, given the limited amount of recharge through the thick clay soils at the site, all three (3) site development alternatives are considered to have similar potential to influence recharge at the site.

Water Supply Wells

All three (3) site development alternatives overlay 30 m of natural clay. In addition, engineered protection would also include a leachate collection system. Based on the natural setting and site features it is estimated to take 3,400 years[45] for leachate to get to a potential water well 200 m down gradient of the site and it is anticipated that there would be no difference between the three (3) site development alternatives from the perspective of potential to impact water

[45]Dillon Consulting Limited, Ridge Landfill Expansion: Hydrogeological Impact Assessment, Appendix D7, July 2019.

supply wells. As noted, some of the residences and businesses are municipally serviced, 15 private residential wells are currently monitored on an annual basis.

GROUNDWATER IMPACT MANAGEMENT MEASURES

For all alternatives, groundwater mitigation is included in the design of the landfill with engineering controls such as the leachate collection system for all of the expansion areas. A groundwater monitoring plan will be prepared for the expanded site as well as contingency plans to protect groundwater in the event of an unforeseen incident.

Also all alternatives include the continuation of residential well monitoring with new wells added to the program, when requested.

GROUNDWATER NET EFFECTS

This site has significant natural protection as well as engineered systems and no impact to groundwater quality or quantity or to residential water supply is anticipated as a result of the expansion. The leachate contaminating lifespan will be approximately 300 years, which is well within the 3,000 year estimated travel time of leachate to reach the underlying aquifer. No groundwater net effects are anticipated for any of the alternatives.

4.1.2.3 Surface Water

The following documents the surface water criteria and indicators, potential effects, proposed mitigation and net effects for each of the alternatives. Further information supporting the evaluation of site development alternatives is provided in technical memo included in **Attachment 6**.

Criteria	Indicators
Potential impacts to surface water quantity.	• Changes in peak flows pre- and post-expansion.
Potential impacts to surface water quality.	• Anticipated change in temperature, water quality, benthos and fish habitat.

SURFACE WATER POTENTIAL EFFECTS

Surface Water Quantity

Surface water from the Ridge Landfill is received by three municipal drains (Howard, Duke, and Scott). Changes between pre and post expansion peak flows will represent the most significant potential impact to surface water quantity for each site development alternative. It is noted that for all site development alternatives, stormwater management infrastructure will be constructed as landfill cells are developed to ensure effective surface water management throughout the construction and operation of the site.

The results of the hydrologic analysis indicates that peak flows are maintained at or below the baseline condition for all three (3) of the site development alternatives under the full suite of storm events (2 to 250 years). In addition, the runoff volumes were maintained at or below the baseline condition for site development Alternatives 1 and 2, while there were minor increases (in the order of 1-3%) for site development Alternative 3.

Surface Water Quality

A surface water quality monitoring program has been ongoing at the Ridge Landfill since 1995 and a 12-month program was initiated in May 2017 to collect baseline water quality data for the proposed expansion project. Benthic community sampling was also completed in June 2017. Based on current conditions, which reflect the operation of a landfill, the following can be anticipated for all three (3) site development alternatives:

- **Temperature**: Surface water temperatures measured over the 12-month monitoring program in 2017-2018 generally showed that temperatures were slightly cooler in the watercourses upstream of the landfill site during the summer months; however, the measured temperatures were relatively comparable over the remaining portion of the monitoring period (i.e., fall, winter, and spring months). Significant increases in surface water temperatures are not anticipated for any of the proposed landfill expansion alternatives, once appropriate mitigation measures are implemented.

- **Surface Water Quality and Benthos**: The 12-month surface water quality monitoring program in 2017 involved the collection of samples at four (4) locations, three (3) upstream and one (1) downstream of the Ridge Landfill. The objective was to determine if the landfill was impacting water quality by comparing upstream and downstream sampling results. Samples were collected over nine (9) sampling events, which were analyzed for a suite of

parameters (general chemistry, metals, and inorganics). The analytical results show exceedances to the corresponding Provincial Water Quality Objectives for several parameters at the three (3) sampling locations located upstream of the landfill, and the one (1) downstream location. Similarly, the results of the benthic assessment indicate that invertebrate diversity and richness were low upstream and downstream of the landfill, which is likely related to poor water quality (elevated phosphorus concentrations were identified as a stressor of particular significance). As poor surface water quality was observed at all sampling locations upstream and downstream of the landfill, it is concluded that other land uses (e.g., agricultural) in the watershed are contributing substantially to the elevated contaminant levels (particularly phosphorus).

Surface water quality downstream of the site is similar to that observed upstream of the landfill, demonstrating the landfill engineering controls are effective in preventing surface water quality impacts. The proposed expansion (regardless of development alternative selected) would include further engineering controls to ensure that there continues to be no impacts on water quality in comparison with baseline conditions.

- **Fish habitat**: The Howard, Scott and Duke Drains are warm water intermittent drains and based on field work have limited fish habitat potential. The future, ongoing operations of the site is not anticipated to significantly change quality of fish habitat over the expansion period.

SURFACE WATER IMPACT MANAGEMENT MEASURES

A surface water management plan will be prepared to manage surface water from the expansion appropriately through effective on-site controls. Surface water monitoring will continue at the expanded site.

SURFACE WATER NET EFFECTS

No impacts to surface water quality or quantity are anticipated as a result of the expansion for any of the three (3) site development alternatives. Ongoing monitoring will provide early warning of any surface water quality issues.

4.1.2.4 Air Quality

The following documents the air quality criteria and indicators, potential effects, proposed mitigation and net effects for each of the alternatives. Further information is provided in a technical memo included in **Attachment 6**.

Criteria	Indicators
Potential for dust during construction and operation. Potential for impacts to air quality during construction and operation.	• Relative concentration of dust at sensitive receptors. • Relative concentrations of Nitrogen Oxides, Sulphur Dioxide and Carbon Monoxide (together referred to as criteria air contaminants) at sensitive receptors. • Relative concentration of Hydrogen Sulphide, Vinyl Chloride, Chloroform at sensitive receptors.

AIR QUALITY POTENTIAL EFFECTS

Dust

Relative levels of material movement and vehicular activity are indicators of dust and criteria air contaminant emissions. Standard mitigation practices are put in place to manage emissions at the site including effective vehicle maintenance and the management of fugitive dust through the site's dust management plan. The construction and operation of all three (3) site development alternatives involve material movement and vehicular activity associated with cell construction and closure and ongoing waste receipt and deposition in the landfill. During operation each of the three (3) alternatives would receive the same amount of waste and as such the same number of waste trucks. Approximately 500 to 750 trucks per year will be required for construction of the alternatives and over the 5-10 year period of landfill mining additional trucks may also be required to transport mined material. Conservative screening level modelling identifies potential for off-property dust impacts for all alternatives.

Air Quality

Construction and landfilling of waste have the potential to result in impacts to air quality. The level of vehicular activity for each alternative will act as an indicator for the amount of fuel combusted and the resulting potential for Nitrogen Oxides, Sulphur Dioxide and Carbon Monoxide. For the purposes of the screening level model undertaken levels of material movement and associated vehicular activity were considered relatively comparable for all three alternatives and conservative screening level modelling identified a low potential for off-property air contaminant impacts.

The anticipated LFG emissions for each of the site development alternative were used to indicate the potential for Hydrogen Sulphide, Vinyl Chloride, and Chloroform from the site. Site specific monitoring conducted during ongoing operations demonstrated compliance with MECP Vinyl Chloride and Chloroform criteria. During operation, all alternatives will have waste deposited at the same rate as is currently and for the same duration into the future, resulting in similar annual emissions generation as current activities. The term "contaminating lifespan" typically refers to the period of time over which LFG, if released to the natural environment would have an adverse effect. It is expected that most gas generation will occur within 60 years of completion of the expansion for all alternatives and would be down to low levels of generation by the year 2100. Given the very thick clay layer under the landfill and the engineered controls, the potential for migration to occur and cause an adverse effect is negligible.

The landfill mining included as part of site development Alternative 2 will result in an increase in the release of by-products of waste decomposition (e.g., Hydrogen Sulphide) and therefore a greater potential for air quality impacts during landfill mining because of the required exposure and handling of previously buried waste.

AIR QUALITY IMPACT MANAGEMENT MEASURES

Standard dust mitigation measures such as reduced vehicle speeds and the use of dust suppressants will continue to be used to manage dust as they are done today. Proper vehicle maintenance will also be implemented to help to minimize the air quality impact of vehicular activity.

Landfill gas capture and control is currently used to minimize impacts to air quality and it will continue.

AIR QUALITY NET EFFECTS

Dust generation during landfill cell construction and operation is likely to occur, and will be mitigated through the continued implementation of the best management practice plan for fugitive dust. It is expected that some fugitive dust from the landfill as well as the surrounding farming operations may reach neighbouring properties depending on wind conditions. This reflects the current conditions that landfill neighbours experience.

No impact to ambient air quality is expected from predicted air dispersion modelling as part of regular landfill operations. The potential for the release of by-products of waste decomposition

related to landfill mining for Alternative 2 may result in air quality impacts that cannot fully be mitigated. These impacts would extend over the 5-10 year period of landfill mining.

4.1.2.5 Climate Change

The following documents the climate change criteria and indicators, potential effects, proposed mitigation and net effects for each of the alternatives. Further information is provided in a technical memo included in **Attachment 6**.

Criteria	Indicators
Potential for greenhouse gas emissions during construction and operation.	• Daily/annual waste volume landfilled; • Anticipated differences in on-site vehicular activity; and • Extent of woodlot removal.
Resilience of engineered systems.	• Qualitative assessment of the resiliency of proposed infrastructure.

CLIMATE CHANGE POTENTIAL EFFECTS

Greenhouse Gas

Landfilling waste has the potential to release GHG, primarily methane, which can contribute to climate change. All three (3) site development alternatives will have waste deposited over the proposed 20-year planning life at the same rate as is done currently. This will result in similar annual LFG generation rates and total potential emissions over the lifetime for all alternatives. LFG collection will occur regardless of the site development alternative selected and at a minimum, LFG will be treated through active flaring to destroy the methane and thereby significantly reduce potential GHG emissions.

Site development Alternatives 1 and 2 involve the removal of one (1) woodlot with Alternative 3 also removing a second woodlot. Trees will be replanted within Ecoregion 7E, the same ecoregion as the Ridge Landfill at a 2:1 ratio to compensate for the loss of the southwest woodlot. Given the replanting of trees will be at a higher ratio, the potential for climate change impacts from on-site woodlot removal is not considered significant.

The landfill mining included in Alternative 2 will result in an increase in vehicular activity over historical operations during the 5-10 year period of mining, resulting in an increase in GHG from

vehicle emissions. In addition, exposing and processing previously landfilled waste will increase GHG through the release of by-products of waste decomposition.

Resiliency of Landfill Systems

For all alternatives, landfill systems need to take climate change into consideration by meeting design standards that ensures system resilience. Landfill systems will be designed in accordance with current regulations and design standards and will also take climate change into consideration. All alternatives have a similar ability to incorporate climate resilient designs.

CLIMATE CHANGE IMPACT MANAGEMENT MEASURES

LFG capture and control is currently used to minimize GHG emissions. The replanting of removed trees will also assist in maintaining the ability to absorb GHGs. A climate change risk assessment was completed for the EA and measures to reduce risk will be incorporated as appropriate.

CLIMATE CHANGE NET EFFECTS

It is recognized that landfills have the potential to emit GHGs; however, with effective LFG capture, the extent of GHG emissions is minimized under regular landfill operations for all three alternatives.

The significant increase in vehicle traffic and potential for the release of by-products of waste decomposition for Alternative 2 may result in an increase in GHG emissions impacts that cannot fully be mitigated. These impacts would extend over the 5-10 year period of landfill mining. Landfill engineered systems will be designed to perform in potential extreme climate conditions.

4.1.2.6 Social Environment

The following documents the social criteria and indicators, potential effects, proposed mitigation and net effects for each of the alternatives.

Criteria	Indicators
Potential for noise/vibration impacts on residents during site construction and site operation.	• Number of households in the Study Area who may experience noise/vibration impacts.
Potential for odour during construction and operation.	• Relative concentration of odour at sensitive receptors.

Criteria	Indicators
Potential for visual impacts on residents during site construction and site operation.	• Percent change in view within the Study Area.
Potential for landfill traffic effect on residents during construction and operation.	• Number of waste trucks during operation. • Number of trucks for construction.
Potential for effect on worker safety during construction and operation.	• Likelihood of safety concerns with alternative.

SOCIAL POTENTIAL EFFECTS

Noise and Vibration

Ambient noise levels for the residents in the landfill vicinity include noises of nature, traffic, agricultural activities, the existing airport and the existing landfill operation. In 2010 to 2011 a noise impact assessment for the current landfill was undertaken in support of an application to adjust the annual fill rate. The results of the 2010 to 2011 noise assessment indicated that the predicted receptor sound levels at residences in the vicinity of the landfill were below the MECP's criterion of 55 dBA for landfills. Given that past noise assessment work did not identify significant off-site noise impacts from the current landfill operations, it is reasonable to assume that this will be the case for the proposed expansion given no changes are proposed to the landfilling activities and annual disposal rate.

Each of the proposed alternatives generally moves the active fill areas to the south. This will result in noise causing activities moving away from some residences and closer to others. The construction of berms along the south, west and east sides of the site will help to mitigate potential noise impacts. A qualitative noise assessment was completed for the three (3) alternatives and of the 27 receptors considered, seven (7) to 13 may experience a moderate noise level increase 96-11 dBA). Further information on noise in support of the evaluation of site development alternatives can be found in **Attachment 6**.

This site has a long operating history and vibration has not been raised as a concern by the nearby receptors to date. Based on the location of existing receptors and the types of activities at the landfill, a vibration assessment is not warranted for the proposed changes.

Odour

The proposed expansion will continue to use similar landfilling practices as done today, with the landfill tipping face and fugitive LFG emissions being the main potential odour sources. Odour

complaints have occurred over the operational life of the Ridge Landfill which are addressed by Waste Connections on a case-by-case basis. The active tipping face will shift away from some residences and move closer to others. Conservative screening level modelling identifies low potential for off-property impacts for Alternative 1 and medium potential for impacts for Alternative 3 as the landfill footprint shifts.

Alternative 2, which includes landfill mining over a period of 5 to 10 years is identified as a potentially significant, widespread odour source for which there would be no means to effectively mitigate.

Visual

Residents in the vicinity of the site may have different views of the landfill based on the site development alternatives. The height of development of any of the three (3) alternatives will not exceed the restricted height of 241.3 masl dictated by the Chatham Airport Zoning Regulation and will be built no higher than the current highest elevation of the existing landfill. Based on the analysis undertaken, all three (3) alternatives may be visible from approximately 43% of the land within 3 km of the site, compared to current visibility at approximately 27% of the land within 3 km.

Traffic

As noted there are 31 residences on the existing designated haul route to and from the Highway 401 interchange to the site, and approximately 200 waste trucks/day[46] (this includes a combination of tractor trailers and collection vehicles) currently access the Ridge Landfill. The annual tonnage and the designated haul route will remain unchanged for the three (3) site development alternatives. As a result, no significant change is anticipated in the number of waste trucks that will access the site on an annual basis for any of the alternatives.

Concerns have been raised at consultation events relating to trucks not staying on the designated haul route and fugitive litter from trucks going to the landfill. Waste Connections has put in place a protocol to ensure trucks use the designated haul route, and all loads are properly covered/tarped. Waste Connections encourages residents along the designated haul route to report any litter concerns that need to be addressed. Following the summer of 2018 consultations for the EA, Waste Connections met with the Municipality of Chatham-Kent to discuss additional signs to remind drivers to stay on the designated haul route and these signs have since been installed.

[46] The number of trucks is based on Ridge Landfill scale data for a typical waste receiving month (October 2018)

All three (3) site development alternatives will require material for the construction of cells in the new fill areas. As previously noted, the number of trucks required to transport construction materials to the site for all three (3) alternatives are comparable and between 500 and 750 per year over the 20-year operation of the landfill.

Worker Safety

Waste Connections' #1 core operating value is safety. "*We strive to assure complete safety of our employees, our customers and the public in all of our operations. Protection from accident or injury is paramount in all we do.*" Precautions are taken to make the landfill site a safe work place. All alternatives involve the construction of cells and the landfilling of solid non-hazardous waste of which Waste Connections has significant experience at this site. Landfill mining which is included in Alternative 2, adds an increased level of risk to workers from elevated levels of dust and odours generated during the extended period that landfill mining would occur. In addition, landfill mining is a complex operation that involves the movement and operation of heavy equipment and the excavation, sorting/screening and either re-landfilling or off-site removal of material for an extended time period of 5 to 10 years.

SOCIAL IMPACT MANAGEMENT MEASURES

Waste Connections has historically and will continue to address the potential for site construction and operation to disrupt residential neighbours as follows:

- Regular communication with neighbours;
- Employing recognized operational practices such as minimizing the size of the working face, the application of daily and intermediate cover material, expansion of the LFG collection system and destruction of the LFG (flaring), and installing and operating odour neutralizing systems;
- Protocols and signage to ensure trucks use the designated haul route, and all loads are properly covered/tarped;
- On and off-site road watering for dust suppression;
- Encouraging residents in the site vicinity and along the haul route to raise concerns directly to Waste Connections to be addressed;
- Continued implementation of worker health and safety best practices;
- Construction of berms and plantings to reduce visual impact;
- Use of both permanent and temporary litter fences; and
- Regular off-site inspection and litter collection from neighbouring properties and along the haul route.

SOCIAL NET EFFECTS

Noise from the proposed expansion will not exceed MECP criteria. While there may be periodic instances where fugitive odours are noticeable by residents, regular landfill operation is generally not expected to result in significant odour. However it is noted that Alternative 2 does have the potential to result in fugitive odours over the extended 5-10 year time period of landfill mining. The expanded landfill will be able to be seen by a greater number of people than the current landfill; however, there will be no increase in height. The potential impact from landfill traffic during construction and operation will be low and similar to what is experienced today.

Worker health and safety procedures and protocols will remain the same with continued construction and operation of the landfill; however, the introduction of landfill mining would have potential worker health and safety impacts.

4.1.2.7 Economic Environment

The following documents the economic criteria and indicators, potential effects, proposed mitigation and net effects for each of the alternatives.

Criteria	Indicators
Potential for effect on businesses during construction and operation.	• Number of businesses (e.g., agricultural operations) in the Study Area who may experience disruption.
Potential for landfill traffic effect on businesses during construction and operation.	• Number of waste trucks during operation. • Number of trucks for construction.
Potential for effect on agriculture during construction.	• Area of on-site crop production lost; and • Area of Class 1-3 soils lost.
Cost of facility.	• Approximate cost of site development alternative.

ECONOMIC POTENTIAL EFFECTS

Construction and Operation Effect on Businesses

As noted above, construction and operation of all site development alternatives will shift the working area of the Ridge Landfill to the south. This will result in landfill activities moving closer to some businesses and further from others. The construction of a berm around the perimeter

of the site will help separate the landfill from agricultural operations and other businesses in the vicinity. Mitigation measures to reduce noise, dust, litter and odour impacts will also be in place. These same mitigation measures have been employed to date and along with regular communications with neighbours have successfully minimized disruption. It stands to reason that continuing to employ these practices with the proposed expansion will continue to minimize disruption. This particularly holds true for Alternatives 1 and 3; however, the landfill mining component of Alternative 2 brings a greater potential for impacts (e.g., dust and odour).

Traffic Effect on Businesses

Businesses including agricultural operations located along the designated haul route use the route for access to their business for employees and customers, shipping and receiving goods and services, and in the case of agricultural operations the haul route is used by agricultural machinery and for the movement of agricultural product.

Currently, there are approximately 200 waste trucks/day that access the Ridge Landfill. These trucks have some potential to cause traffic impacts for the businesses and farmers along the designated haul route. The annual tonnage and designated haul route for a future expanded site will not change and as such, there is no proposed change in the approximate number of waste trucks accessing the site and no difference between the site development alternatives in this regard. Traffic conditions currently on the haul route operate at an acceptable level of service and this will continue over the expansion period regardless which development alternative is selected.

Soil movement during cell construction for any of the site development alternatives will occur on-site; however, all three (3) alternatives require the transport of stone and granular material to the site for the development of the new cells (approximately 500 to 750 truckloads per year, on average).

Removal of Agricultural Lands

The portion of the Ridge Landfill that is proposed for the expansion is currently being leased to tenant farm operators for crop production (88 ha). A 6 ha apple orchard is located on the east side of the site, south of the landfill entrance. A review of Canada Land Inventory mapping indicates the soils in the on-site area are Class 2 with a limitation of excess water (i.e., land that typically experiences flooding in the spring or after storm events throughout the summer). However, a network of tile drains has enabled many operations to grow common field crops.

All three (3) site development alternatives will require the displacement of some agricultural uses on the site; however, farming operations will still be permitted until those lands are required for landfilling or soil storage. Farming operations would progressively be displaced as movement increases toward the southwest portion of the site and therefore some operations could remain in place several years into the expansion. In some cases operations might be able to continue throughout the expansion period and this will be determined with the detailed design of the preferred alternative. Alternative 3 has a slightly higher displacement area compared to Alternatives 1 and 2, as it requires the area of the on-site apple orchard for landfilling. It is noted that landfills can often be returned to some form of agricultural use, as has been done at other locations in Ontario once filling is complete.

Facility Cost

For comparison purposes, a per hectare cost for an expansion of a landfill such as the Ridge Landfill could be assumed to be in the order of $1 million per hectare based on historical costs at this and other landfills. Using this per hectare unit cost, Alternative 1 would cost in the order of $60 million and Alternative 3 would cost approximately $80 million. The cost for landfill mining is in the order of $25 per cubic metre and would add approximately $112 million to the total cost. Alternative 2, including the landfill mining would likely cost in the order of $165 million. The operating cost will be similar for all site development alternatives as the same amount of waste will be landfilled, except for leachate treatment for Alternative 3 that would be about 15% higher than Alternatives 1 and 2 due to the larger overall area of the alternative.

ECONOMIC IMPACT MANAGEMENT MEASURES

Waste Connections has historically and will continue to address the potential for site construction and operation to disrupt business neighbours in the same way as residential neighbours as follows:

- Regular communication with business neighbours.
- Employing recognized operational practices such as minimizing the size of the working face, the application of daily and intermediate cover material, expansion of the LFG collection system and destruction of the LFG (flaring), and installing and operating odour neutralizing systems.
- Protocols and signage to ensure trucks use the designated haul route, and all loads are properly covered/tarped.
- On and off-site road watering for dust suppression.
- Encouraging businesses in the site vicinity and along the haul route to raise concerns directly to Waste Connections to be addressed.

- Construction of berms and plantings to reduce visual impact.
- Use of the permanent and temporary litter fences.
- Regular off-site inspection and litter collection from neighbouring properties and along the haul route.

Impact management measures specific to the agricultural lands include allowing the farming of future on-site landfill areas for as long as possible, regular communication with local farming neighbours and consideration of some form of agricultural use as part of the closure plan.

ECONOMIC NET EFFECTS

Noise from the proposed expansion will not exceed MECP criteria. While there may be periodic instances where fugitive odours are noticeable by businesses, regular landfill operation is generally not expected to result in significant odour. However it is noted that Alternative 2 does have the potential to result in fugitive odours over the extended 5-10 year time period of landfill mining. The potential impact on businesses from landfill traffic during construction and operation will be low and similar to what is experienced today.

Current on-site farming will be enabled for as long as possible. Some of this land, particularly for Alternative 3 will be permanently removed from agriculture.

From a cost perspective, Alternatives 1 and 3 are within the expected per hectare cost for a landfill. Alternative 2 has a significantly higher cost due to landfill mining.

4.1.2.8 Cultural Environment

The following documents the cultural criteria and indicators, potential effects, proposed mitigation and net effects for each of the alternatives.

Criteria	Indicators
Potential effects to archaeological resources as a result of construction.	• Area of undisturbed land affected by the expansion alternative.
Potential effects to cultural heritage resources as a result of construction.	• Number and type of cultural heritage resources affected by expansion alternative.

CULTURAL POTENTIAL EFFECTS

Archaeological Resources

The three (3) site development alternatives have the potential to impact the following amount of undisturbed lands:

- Alternative 1 - approximately 59 ha;
- Alternative 2 – approximately 54 ha; and
- Alternative 3 – approximately 83 ha.

Any archaeological resources (if identified) will be removed prior to the construction of any expansion. As such no archaeological impact is anticipated.

Cultural Heritage Features

All three (3) site development alternatives will result in the removal/demolition of the residence, barns and farmscape (with residence) along Allison Line identified as cultural resources. A Heritage Impact Assessment has been completed which includes documentation of the feature in a Cultural Heritage Documentation Report. No impact is anticipated.

CULTURAL IMPACT MANAGEMENT MEASURES

Should archaeological resources be uncovered during construction, Waste Connections will stop work and notify the appropriate agencies/authorities.

Cultural heritage features will be assessed to ensure documentation/salvage of heritage features prior to any removal/demolition.

CULTURAL NET EFFECTS

No net effects on archaeological or cultural resources are anticipated as a result of construction under all three site development alternatives.

4.1.2.9 Built Environment

The following documents the built environment criteria and indicators, potential effects, proposed mitigation and net effects for each of the alternatives.

Criteria	Indicators
Effects on land use as a result of construction.	• Size of landfill footprint.
Potential effects on existing transportation infrastructure and transportation operation.	• Number of waste trucks during operation; • Number of trucks for construction; and • Anticipated impact on the Chatham-Kent airport.
Potential for effects on existing landfill infrastructure as a result of construction.	• Extent and type of change required to existing site facilities.
Ease to implement/construct and maintain/operate.	• Anticipated complexity of construction and operation.

BUILT ENVIRONMENT POTENTIAL EFFECTS

Land Use

The three (3) proposed site development alternatives have different landfill footprints that provide different opportunities for the long term development and use of the land. For example, a smaller landfill footprint results in less land used for landfilling of waste, leaving some land flexible for a greater variety of uses during the 20-year expansion period and upon-site closure.

Amendments to the Chatham-Kent Official Plan and Zoning By-law will be needed for all site development alternatives. Discussions to date with planning staff at the Municipality of Chatham-Kent have identified that a simplified site zoning that would provide flexibility for the landfill operation may be appropriate and that the Official Plan Amendment and Zoning By-law Amendment should identify steps to be taken once landfill operation ceases.

Alternatives 1 and 2 have the smallest footprint and would result in the greatest flexibility for future use in the southeast corner of the property once the site is permanently closed. Alternative 3 has a larger footprint as it makes full use of the property, limiting land use flexibility in the future.

Transportation Operation and Infrastructure

As previously noted, the designated haul route to the site and the annual tonnage being hauled to the site will remain the same. Currently, approximately 200 waste trucks/day are traveling between the landfill and Highway 401 interchange via Erieau Road, Drury Line and

Communication Road (CR 11). As noted, construction truck traffic will involve approximately 500-750 trucks per year for all of the alternatives.

Concerns were raised by a few residents through recent consultation regarding trucks not adhering to the designated haul route. Other residents were concerned about damage to the roads. Waste Connections has since met with the Municipality of Chatham-Kent who have added additional road signs to reinforce to drivers the appropriate route to take to-and-from the landfill. Waste Connections also provides funding to Chatham-Kent for road maintenance along the designated haul route. Recent discussions with Chatham-Kent have resulted in plans for upgrades to both the turning apron at the corner of Communication Road and Drury Line and a portion of Drury Line. This practice would be continued with the expansion. Given that Waste Connections provides funding to address the impact that landfill trucks have on road infrastructure the net effect to transportation infrastructure is anticipated to be minimal for all three (3) site development alternatives.

Transportation infrastructure includes the Chatham-Kent Municipal Airport. Waste Connections works closely with the airport to control wildlife and birds. Programs that are currently in place that would continue with the proposed expansion include:

- **Habitat Management** – This involves making the landfill site as uninviting as possible to wildlife by keeping the active working face small, applying cover daily, minimizing loafing/resting areas (bare areas), and keeping unused areas thickly vegetated where possible, eliminating temporary ponding, and monitoring of stormwater management ponds; and
- **Aviation/Bird Hazard Management** – This is a daily practice that includes the use of falcons and hawks to control birds as well as a range of active controls including pyrotechnics, distress calls, and lethal control if necessary.

The Chatham Airport Zoning Regulations define that within the regulation area (which includes the proposed landfill expansion) construction of anything permanent taller than 45 m above the Airport Reference Point elevation of 196.3 m masl is prohibited, i.e., above 241.3 masl. This regulation is what dictates the maximum height of the landfill. All site development alternatives will result in the active landfilling area moving further from the airport. As a result no additional impact to the airport is expected for any of the proposed site development alternatives since the height of each alternative, 241 masl, is within the regulated height limitation. There is also no ground traffic interference between the landfill and airport users as the airport is not located on the designated haul route.

Landfill Infrastructure

Existing landfill infrastructure includes the site entrance, access roads, two (2) weigh scales, scale house, office, equipment maintenance building, stormwater management facilities, LFG blowers/flares and a leachate storage tank. While some relocation/expansion of stormwater ponds will be required other infrastructure will remain as is and the impact of all three (3) site development alternatives is considered minimal.

Ease of Construction and Operation

All three (3) alternatives represent a continuation of current landfilling operations and practices employed by Waste Connections. Alternative 2; however, also includes a landfill mining component which is a very specialized, prolonged and complicated undertaking.

BUILT ENVIRONMENT IMPACT MANAGEMENT MEASURES

Waste Connections will work with the Municipality of Chatham-Kent to develop an amendment to the Official Plan and Zoning By-law that is acceptable to Municipal Council. They will also continue to provide funding to the municipality for upkeep of the designated haul route.

Waste Connections employs a bird management program in coordination with the Airport and this will continue with the proposed expansion.

No new mitigation is required related to the ease of implementation/construction and operation/maintenance or the potential for effects on existing infrastructure.

BUILT ENVIRONMENT NET EFFECTS

For Alternatives 1 and 2 some lands in the southeast corner of the site could have more flexibility for use following closure of the landfill. There is less flexibility post-closure with Alternative 3 given its larger landfill footprint. None of the alternatives will have a negative net effect on existing roads or the Chatham-Kent Airport. None of the alternatives will negatively impact the existing landfill infrastructure and Alternatives 1 and 3 are straightforward to construct and operate. Alternative 2 will be more complex to construct and operate due to landfill mining.

4.1.3 Comparative Evaluation of Site Development Alternatives

The comparative evaluation of site development alternatives was completed using the results of the net effects analysis. The comparative evaluation involved the following steps:

- Alternatives were ranked as preferred, less preferred, least preferred or equally preferred for each of the indicators.
- Qualitative reasoning was used to consolidate the individual indicator rankings into a ranking for each environmental component and then from each environmental component to an overall rank.

Table 4-1 provides a summaries of the ranking results for the six (6) environmental components and the overall ranking. A detailed table providing the ranking and associated rationale for all criteria and indicators is provided in **Attachment 5**.

The following highlights the key advantages and disadvantages of the three (3) site development alternatives:

Alternative 1 - Vertical Expansion of Old Landfill, Addition of Footprint A + B
Key Advantages
• No potential to impact groundwater quality during construction, operation or post-closure; • Reasonable leachate contaminating lifespan considering engineering controls of approximately 308 years; • No impact on groundwater quantity; • Residential groundwater wells will not be impacted; • No potential impacts to surface water quality or quantity; • No impact to air quality is expected as part of regular landfill operations with minimal GHG emissions under regular landfill operations; • Noise will be within MECP criteria; • Regular landfill operation is not expected to result in significant odour; • No increase in overall landfill height; • Landfill traffic during construction and operation will be low and similar to what is experienced today; • Farming of on-site lands will be continued for as long as possible; • No potential for effects on cultural or archaeological resources; • No effect on existing transportation infrastructure or major existing on-site infrastructure; • Optimization of land already used as landfill (Old Landfill); and • Keeping southeast woodlot in place.

Alternative 1 - Vertical Expansion of Old Landfill, Addition of Footprint A + B

Key Disadvantages

- Removes the southwest woodlot. The woodlot will be replanted;
- Temporarily removes eastern meadowlark habitat;
- Requires the realignment of Howard Drain with localized and limited impact to aquatic systems;
- Potential for some fugitive dust to reach neighbouring properties depending on wind conditions; and
- Requires amendment to the Official Plan and Zoning.

Alternative 2 - Vertical Expansion of Old Landfill, Landfill Mining of Old Landfill, Addition of Footprint A + Reduced Footprint B

Key Advantages

- No potential to impact groundwater quality during construction, operation or post-closure;
- Reasonable leachate contaminating lifespan considering engineering controls of approximately 316 years;
- No impact on groundwater quantity;
- Residential groundwater wells will not be impacted;
- No potential impacts to surface water quality or quantity;
- Noise will be within MECP criteria;
- No increase in overall landfill height;
- Farming of on-site lands will be continued for as long as possible;
- No potential for effects on cultural or archaeological resources;
- No effect on existing transportation infrastructure or major existing on-site infrastructure;
- Optimization of land already used as landfill (Old Landfill); and
- Keeping southeast woodlot in place.

Key Disadvantages

- Impact to odour, air quality and GHG emissions expected as part of landfill mining of Old Landfill. These impacts would extend over a 5-10 year time period of landfill mining;
- Potential health and safety concerns with employees during landfill mining;
- Removes the southwest woodlot. The woodlot will be replanted;
- Temporarily removes eastern meadowlark habitat;
- Requires the relocation of Howard Drain with localized and limited impact to aquatic habitat systems;
- Potential for some fugitive dust to reach neighbouring properties depending on wind conditions; and
- Requires amendment to the Official Plan and Zoning.

Alternative 3 - No Vertical Expansion, Addition of Footprint A+B+C
Key Advantages
• No potential to impact groundwater quality during construction, operation or post-closure; • Reasonable leachate contaminating lifespan considering engineering controls of approximately 294 years; and • No impact on groundwater quantity. • Residential groundwater wells will not be impacted; • No potential impacts to surface water quality or quantity; • No impact to air quality is expected as part of regular landfill operations with minimal GHG emissions under regular landfill operations; • Noise will be within MECP criteria; • Regular landfill operation is not expected to result in significant odour; • No increase in overall landfill height; • Landfill traffic during construction and operation will be low and similar to what is experienced today; • Farming of on-site lands will be continued for as long as possible; • No potential for effects on cultural or archaeological resources; and • No effect on existing transportation infrastructure or major existing on-site infrastructure.
Key Disadvantages
• Removes the southwest and southeast woodlots. The woodlots will be replanted; • Removes the significant SAR bat habitat in the southeast woodlot; • Requires the relocation of Howard Drain with localized and limited impact to aquatic habitat systems; • Potential for some fugitive dust to reach neighbouring properties depending on wind conditions; • Requires amendment to the Official Plan and Zoning; and • Limits the flexibility of the long term use of the greatest amount of land.

SITE ALTERNATIVES CONCLUSION

Based on the work completed, Alternative 1 is the preferred or equally preferred option over the other site development alternatives for all of the environments considered, and is therefore considered the preferred alternative overall.

Table 4-1: Overview of Comparative Evaluation Rating - Site Development

Environment	Alternative 1	Alternative 2	Alternative 3	Do Nothing
Natural Environment (Biological) Ranking	Preferred – Only removes the lower quality SW woodlot and has some temporary impact on eastern meadowlark an endangered or threatened species.	Preferred – Only removes the lower quality SW woodlot and has some temporary impact on eastern meadowlark an endangered or threatened species.	Less Preferred – Removes both the SW and SE woodlots and permanently removes potential SAR bat habitat. Does not impact eastern meadowlark habitat.	The southwest woodlot would remain.
Natural Environment (Groundwater) Ranking	Equally Preferred – All alternatives are underlain by 30 m of clay and will have no impact on groundwater quality or quantity. With the limited groundwater movement there is no impact to residential water supply wells.	Equally Preferred – All alternatives are underlain by 30 m of clay and will have no impact on groundwater quality or quantity. With the limited groundwater movement there is no impact to residential water supply wells.	Equally Preferred – All alternatives are underlain by 30 m of clay and will have no impact on groundwater quality or quantity. With the limited groundwater movement there is no impact to residential water supply wells.	Historical monitoring activity has shown that the Ridge landfill site consistently meets the Reasonable Use Guideline.
Natural Environment (Surface Water) Ranking	Equally Preferred – None of the three (3) site development alternatives will significantly impact surface water quality or quantity.	Equally Preferred – None of the three (3) site development alternatives will significantly impact surface water quality or quantity.	Equally Preferred – None of the three (3) site development alternatives will significantly impact surface water quality or quantity.	The existing site would continue to have minimal to no impact on surface water.
Natural Environment (Atmospheric) Ranking	Preferred – Alternatives 1 and 3 represent a continuation of the potential for dust and air quality impacts that can be mitigated through continued best management practices.	Less Preferred – Typical landfill operation associated with Alternative 2 will be similar to Alternatives 1 and 3 where potential impacts can be managed. However, the landfill mining component of this alternative has a greater potential for air quality and dust impacts.	Preferred – Alternatives 1 and 3 represent a continuation of the potential for dust and air quality impacts that can be mitigated through continued best management practices.	LFG emissions would continue to be managed by flaring or utilization. Traffic related dust would diminish and air quality would improve once site is no longer operational.
Natural Environment (Climate Change) Ranking	Preferred: Alternatives 1 and 3 will result in similar potential for greenhouse gas emissions as exists today.	Less Preferred: The landfill mining associated with site development alternative 2 has the potential to result in increased greenhouse gas emissions over 5-10 years.	Preferred: Alternatives 1 and 3 will result in similar potential for greenhouse gas emissions as exists today.	LFG emissions and associated GHG emissions would continue to be managed by flaring or utilization.
Social Environment Ranking	Preferred –Alternatives 1 and 3 would operate similar to current operation and landfill neighbours would experience minimal change related to noise, odour and traffic. The site will be more visible for all alternatives.	Less preferred – Alternative 2 introduces landfill mining which has a greater potential to result in odours experienced by site neighbours over the 5-10 year mining period. The site will be more visible for all alternatives.	Preferred – Alternatives 1 and 3 would operate similar to current operation and landfill neighbours would experience minimal change related to noise, odour and traffic. The site will be more visible for all alternatives.	Upon closure disruption from noise and truck traffic would be reduced. The landfill will continue to generate LFG and have the potential for odours. The site will remain visible from some surrounding residences/businesses.
Economic Environment Ranking	Preferred –Alternatives 1 and 3 would operate similar to current operation and businesses in the vicinity would experience minimal change. This alternative represents the lowest cost to contruct and operate.	Least preferred – Alternative 2 introduces landfill mining which has a greater potential to result in odours experienced by businesses over the 5-10 year mining period. This alternative is also the most expensive.	Less Preferred –Alternatives 1 and 3 would operate similar to current operation, businesses in the vicinity would experience minimal change. This alternative would be more expensive than Alternative 1.	Upon closure, disruption impacts such as noise and truck traffic would be reduced. The on-site lands that are currently leased for farming could continue to be farmed.
Cultural Environment Ranking	Equally Preferred – None of the alternatives are expected to result in significant impacts to archaeological or cultural heritage resources.	Equally Preferred – None of the alternatives are expected to result in significant impacts to archaeological or cultural heritage resources.	Equally Preferred – None of the alternatives are expected to result in significant impacts to archaeological or cultural heritage resources.	Any archaeological resources will remain undiscovered and on-site cultural features may remain, subject to property owner wishes and/or the site closure plan.
Built Environment Ranking	Preferred – Alternative 1 has a relatively small overall footprint and is relatively easy to construct and operate.	Less Preferred – Alternative 2 also has a relatively small overall footprint but is more complex to construct and operate due to landfill mining.	Less Preferred – Alternative 3 has a larger footprint than Alternatives 1 and 2 and is relatively easy to construct and operate.	The designated haul route would not be required and Waste Connections would no longer pay for its maintenance and upkeep.
	Preferred Site Development Alternative			

4.2 Alternative Methods of Landfill Gas Management

4.2.1 Development of Landfill Gas Management Alternative Methods

Landfill gas (LFG) is produced as organic waste biodegrades, typically increasing throughout the operational period of landfill development, and peaking upon closure. The LFG production rate slowly declines over the years after the landfill is closed, until the waste has finished decomposing.[47]

The existing LFG collection system at the Ridge Landfill consists of perforated or slotted pipe (i.e., extraction wells) installed vertically in the waste mound of landfill cells that have reached final approved waste grades. The existing system was commissioned in late 2009 and initially consisted of twenty-nine vertical LFG extraction wells installed on the final slopes in the north half of the West Mound of the landfill, including nine (9) connections to capture LFG from the leachate collection system. Between 2011 and 2016 the LFG collection system was expanded with the installation of an additional sixty-three vertical LFG extraction wells. An additional twenty-three LFG extraction wells were installed in the fall of 2018 and 13 in the spring of 2019. In the future, additional wells will be installed as required, to optimize LFG capture and odour mitigation. The subsurface migration of LFG is highly unlikely given the underlying geologic conditions and site engineering features. However, as a safety precaution, combustible gas alarms are installed at all on-site buildings in compliance with provincial regulations. LFG is also collected in the perimeter of the leachate collection system mainly for odour abatement purposes.

The installed extraction wells are connected to a series of LFG collection pipes and a header system that conveys the LFG to the two (2) on-site LFG flares for destruction by combustion. Blowers provide a vacuum on the extraction system (i.e., wells and collection pipe) to actively extract the LFG from the landfill cells. The current system design and approval includes a third blower and flare, to be constructed in 2020.

[47] Golder, Technical Memo: Ridge Landfill Expansion EA: Landfill Gas Contaminating Lifespan & Subsurface Migration, 2019.

The following are some of the key assumptions and common characteristics considered in the identification of LFG management alternatives:

- **Landfill Gas Collection** - Future expansion of the on-site LFG collection system would be an extension of the existing network of LFG wells and collection system into the proposed new cells. The collection system would continue to be designed in accordance with Provincial regulations and be subject to MECP review and approval;
- **Passive Venting** - Passive venting is typically installed at smaller landfills were LFG volumes do not warrant expensive active LFG extraction systems. Ontario Regulation 232/98 (O.Reg. 232/98) and O.Reg. 347 (General Waste Management) as amended in June 2008 under the *Environmental Protection Act* (EPA), requires that new, expanding, and operating landfills with capacity larger than 1.5 million m^3 must actively collect and flare (burn), or recover and use, LFG. The Ridge Landfill has a capacity greater than 1.5 million m^3 and would not be permitted to use passive venting for LFG management. Passive venting is therefore not a feasible alternative to consider for the purposes of alternative methods assessment and is not carried through the evaluation; and
- **Landfill Gas Generation** – The current predicted average daily quantity of LFG produced at the Ridge Landfill once the currently approved landfill is fully built out and the final gas collection system installed will be approximately 7,000 standard cubic feet per minute (scfm) (12,000 m^3/hour or 300,000 m^3/day) (see **Figure 4-5)**. This number is influenced by a number of factors including rainfall received in the area and climatic conditions.[48]

It is expected that additional LFG will be generated in the proposed expansion areas at a rate similar to that from the existing landfill. The expanded Ridge Landfill is predicted to have a peak gas generation rate of up to 14,000 scfm (23,800 m^3/hour or 570,000 m^3/day) in approximately the year 2042.[49]

4.2.2 Description of Landfill Gas Management Alternatives

Three (3) LFG management alternative methods were identified for the Ridge Landfill EA.[50] All three (3) alternatives provide responsible management of the LFG produced on-site over the EA

[48] See Appendix D6 – Design and Operations Report for technical information relating to landfill gas generation.
[49] Golder, Preliminary Design and Operations Report, July 2019.
[50] Waste Connections submitted a memo to MECP with initial alternatives identified for landfill gas management on June 29, 2018. This memo identified the following four alternatives: flaring, energy recover through direct use as an industrial fuel, gas utilization through renewable natural gas and gas utilization through electricity. Since this memo was submitted it has been determined that the on-site infrastructure required and potential impacts for gas utilization via direct use as industrial fuel and renewable natural gas are the same. As such these two alternatives have been combined into one for the EA.

planning period (2021 to 2041) and are further described within this Section. Each alternative method of how LFG from the proposed Ridge Landfill expansion can be managed is outlined below with the accompanying rationale.

Landfill Gas Management Alternative Method	Description	Rationale
Alternative 1 **Flaring**	Involves the active collection of LFG through a network of vertical wells and pipes, and its conveyance to a flare (a facility designed to combust LFG under high temperatures and controlled conditions). This process destroys the methane and trace organic compounds in LFG. There are currently two (2) flares in operation at the Ridge Landfill and a third flare is included in the current approval. For the expansion, additional flares will be required The additional flares would be located in the same area as the current flares. This alternative would be entirely within the control of Waste Connections and would be constructed on-site.	A widely accepted LFG management method at large landfills and is currently used at Ridge Landfill. Significantly reduces the level of LFG, and GHG emissions. In Ontario, LFG collection and destruction is mandatory for a landfill the size of Ridge.
Alternative 2 **Gas Utilization – Renewable Natural Gas (RNG)**	Involves the active collection of LFG through a network of vertical wells and pipes, and its conveyance to a facility that, through the application of technology, recovers renewable natural gas (RNG) for beneficial use. This alternative is not entirely within the control of Waste Connections as the energy needs at the landfill do not support a standalone RNG project. Based on this, it is anticipated that Waste Connections would not develop an RNG facility but would contract the supply of its existing LFG to a third party. The opportunity for a RNG project is therefore dependent on being able to develop a commercially viable project with a third party who can either use or market the energy. Potential off-site uses could be either at an industrial facility that would use the gas as an alternate fuel source in its operations, or the	Similar GHG reduction as flaring at local scale. On a larger scale, beneficial use of the gas offsets use of traditional fuels.

Landfill Gas Management Alternative Method	Description	Rationale
	LFG could be treated and injected into the wider natural gas distribution system as a RNG.[51] If such an undertaking is determined to be economically viable and moves forward, LFG collected in the future from the expansion areas could also be provided to this third party. Since there is no existing third party agreement or confirmed RNG project at this time, the assessment of this alternative must be qualitative in nature. An RNG facility would likely be located off-site due to space limitations at the landfill site. Other off-site infrastructure required would include a pipeline to transfer the gas to the off-site RNG facility. On-site infrastructure would include a compressor and equipment to condition the gas. In addition, the flares included as Alternative 1 would still be required to be able to burn LFG in the event that it cannot fully be used at the RNG facility.	
Alternative 3 Gas Utilization – Electricity	Involves the active collection of LFG through a network of vertical wells and pipes and its conversion to electricity. As there is a limited amount of electricity needed at the landfill, external uses for the electricity would need to be identified and assessed. There is currently no opportunity to supply electricity generated from LFG to the provincial grid. In the event that a LFG-to-electricity project becomes viable, Waste Connections would likely seek an agreement with a third party to construct and operate the facility. An assessment of the feasibility to deliver electricity off-site in	Similar GHG reduction as flaring at local scale. On a larger scale, beneficial use of the gas offsets use of traditional fuels.

[51] As noted in a memo to MECP on June 29, 2018, these were previously treated as two separate alternatives but have been combined into one for the purposes of this evaluation as the on-site impacts are identical.

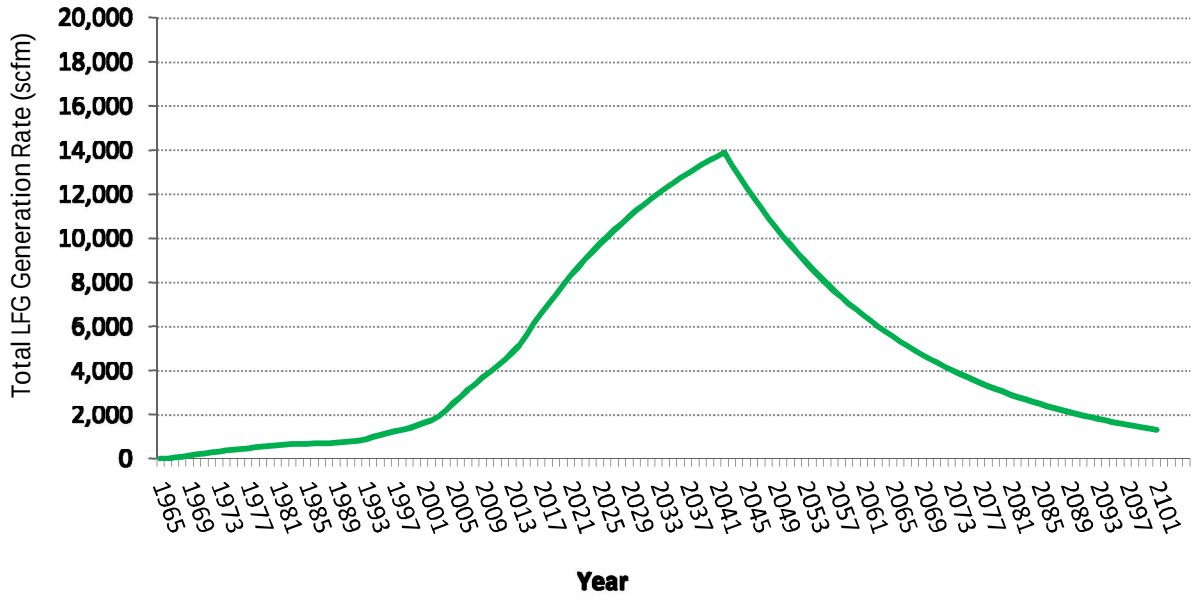
Landfill Gas Management Alternative Method	Description	Rationale
	the future would need to be undertaken as project specific opportunities arise in response to changes in the electricity market and regulations. In the event that a utilization project is identified, the necessary approvals will be pursued as required at that time. As there is no current project, the assessment of this alternative must be qualitative in nature. Producing energy from the LFG would require the construction of infrastructure to convert LFG to electricity and transmission lines to feed it into the local electricity grid. The infrastructure could be located on-site or off-site. In addition, the flares included as Alternative 1 would still be required for this alternative to be able to burn LFG in the event that it cannot fully be used.	

4.2.3 Potential Net Effects of Landfill Gas Management Alternatives

The three (3) LFG management alternatives were assessed to determine their potential for impact on the Natural, Social, Economic, Cultural and Built Environments. Evaluation criteria and indicators specific to the consideration of LFG management are used to identify net effects of the alternatives relative to the future baseline conditions and to comparatively evaluate the alternatives.

The following sections list the criteria and indicators considered and summarize the potential effects, proposed impact management measures and net effects of each of the alternatives. Potential effects during construction, operation and closure/post closure are identified. Net effects tables for each of the three (3) LFG management alternatives are included as **Attachment 3**. A full table of all LFG management evaluation criteria, indicators, data sources and rationale is included in **Attachment 1**.

FIGURE 4-5: LANDFILL GAS GENERATION



QUALITY OF LANDFILL GAS

Only non-hazardous solid waste predominately from IC&I customers will be accepted at the site regardless of the development alternative preferred. This is reflective of what happens currently so the quality of LFG is expected to remain relatively unchanged from what is currently flared. The past six (6) year average methane concentration in the LFG at the Ridge Landfill is approximately 53%.

GAS UTILIZATION

Currently there are no programs available that would allow a connection to supply electricity generated from LFG to the grid and there is insufficient demand for electricity at the landfill to warrant installation of generating equipment. It is noted that in the past, Waste Connections pursued and secured an ECA approval to construct and operate electric power generators on the site. However, a landfill-gas-to-electricity project was never developed because an economically viable project could not be identified due to electricity grid access constraints. Waste Connections is currently in discussions with a natural gas pipeline company who are interested in conveying gas from the existing landfill to an off-site location where it would be treated before injecting it into the gas distribution system. These discussions are being held outside the scope of the EA and are on-going. The decision to proceed with this potential

opportunity or indeed any LFG utilization project will be based on an available third party and commercial viability and the current generation rates from the existing landfill.

4.2.3.1 Natural Environment – Physical – Atmospheric and Climate Change

The following documents the natural environment criteria and indicators, potential effects, proposed mitigation and net effects for each of the alternatives.

Criteria	Indicators
Atmospheric Potential impacts to air quality during construction and operation.	• Relative levels of construction as an indicator of the generation of air contaminants from equipment exhaust (nitrogen oxides, sulphur dioxide and carbon monoxide). • Relative amount of energy required to operate facility.
Climate Change Potential for reduction of greenhouse gas (GHG) emissions during construction and operation.	• Qualitative assessment of the potential for GHG emissions reduction as a result of LFG alternatives.

ATMOSPHERIC AND CLIMATE CHANGE POTENTIAL EFFECTS

Air Quality

The potential to impact air quality is a factor of construction and operation/post closure. Alternatives with greater construction will result in greater equipment emissions and during operation/post closure, alternatives that require greater energy will have more potential for air quality impacts.

The first alternative consists of on-site flares which is a continuation of the current LFG management system. Minor construction would be required to install additional flares. There would be minimal change in the amount of energy used to operate the flares for an expanded landfill as is used currently.

The RNG alternative requires minimal construction to pump the gas off-site for use and construction of the additional back-up flares which would have no impacts on air quality. Any facilities required to transport or process the gas would be developed by a third party and are not considered in this EA. This alternative would include back-up flares requiring similar energy

as Alternative 1. The extent of energy required to pump the gas off-site will depend on the specifics of the RNG facility, which are undefined at this time but anticipated to be minimal.

Generating electricity, the third alternative, requires construction of a facility, either off-site or on-site, to convert the gas to electricity. It is anticipated that this alternative would involve construction in proximity to the Ridge for a new facility and transmission line. It is noted, however, that the construction activities associated with this alternative cannot be confirmed until the project is more clearly defined. This alternative would include additional back-up flares requiring similar energy as Alternative 1 when the flares need to be operating. The extent of additional energy required for operation of a new electricity facility would depend on the specific facility, which is undefined at this time but anticipated to be minimal.

GHG Emissions Reduction

The potential for GHG emissions related to construction activities is minimal for all alternatives. The key difference between LFG alternatives from a reduction of GHG perspective concerns the ability to offset emissions from traditional carbon based fuels.

All three alternatives will include flares that reduce GHG emissions. Alternative 1 is expected to remain similar to existing conditions with regard to GHG emission levels. Alternatives 2 and 3 have the potential for a positive impact on climate change from the offset of the use of traditional fuels.

ATMOSPHERIC AND CLIMATE CHANGE IMPACT MANAGEMENT

Standard construction mitigation measures such as regular construction vehicle maintenance and minimizing idling would be put in place to reduce the potential for nitrogen oxides, sulphur dioxide and carbon monoxide from equipment exhaust for all construction activity.

High efficiency equipment will be used where possible to minimize the amount of energy used for all alternatives.

No mitigation is proposed to reduce GHG emissions as the alternatives themselves accomplish this reduction.

ATMOSPHERIC AND CLIMATE CHANGE NET EFFECTS

No significant change in air quality is anticipated from the construction of any of the alternatives. The energy used for operation may differ for the alternatives; however, it is not

possible to predict as the RNG and electricity alternatives are not clearly defined. All three alternatives result in similar GHG emission reduction with Alternatives 2 and 3 having the opportunity to off-set traditional fuel use.

4.2.3.2 Social Environment

The following documents the social criteria and indicators potential effects, proposed mitigation and net effects for each of the alternatives.

Criteria	Indicators
Social	
Potential for noise as a result of LFG management facility construction and operation.	• Number of households in the Study Area who may experience noise or other disturbance.
Potential for odour during construction and operation.	• Number of potential odour sources, relative significance of odour sources (if characterization is possible), distance of odour sources to sensitive receptors.

SOCIAL POTENTIAL EFFECTS

There are 24 residences within 1 km of the Ridge landfill property, primarily on Charing Cross Road, Erieau Road and Allison Line. These residents are already familiar with the landfill operations. It is noted there are also two (2) leased residences on-site and these leases will be terminated should the expansion be approved regardless of the site development alternative selected. The following provides an overview of the potential impacts that different LFG management alternatives could have on landfill neighbours.

Noise

Flaring, has not historically and would not likely disturb households. There have been no complaints related to noise in the Annual Monitoring Reports from 2007 to 2018. Given this and the fact that this alternative has limited construction and associated noise, it is expected that neighbouring households will experience limited noise impacts from flaring similar to the existing conditions.

For Alternatives 2 and 3 projects have not been identified so the level of construction that might occur on-site, beyond what would be required as back-up flare capacity (same as Alternative 1) is not known but is anticipated to be minimal (approximately 1-2 weeks for

Alternative 2 and approximately 3-4 weeks for Alternative 3). The degree of noise associated with this short duration construction activity is anticipated to be minimal.

Odour

The flaring alternative would not change the location of potential odour sources. With full combustion of the LFG by the flares, the significance of any odour and the potential for odour impact on residents is minimal.

In general the infrastructure to pipe LFG off-site to a third party RNG facility (Alternative 2) or a to a third party facility to convert LFG to electricity (Alternative 3) would be contained and no odour impacts on residents would be expected.

SOCIAL IMPACT MANAGEMENT MEASURES

Mitigation measures to minimize noise include construction best management practices related to equipment maintenance and timing, construction of the berms as included in the landfill design and containment of on-site infrastructure where necessary within an enclosed structure with appropriate noise dampening equipment.

Back-up and contingency plans would be in place to deal with any upset condition to prevent or mitigate the escape of fugitive LFG in the design of the system.

SOCIAL NET EFFECTS

No off-site noise impacts on Study Area residents are anticipated for the flaring of LFG. For Alternatives 2 and 3, there could be potential for noise depending on the extent of construction beyond the construction of the common flares; however, the length of construction is anticipated to be minimal (approximately 1-2 weeks for Alternative 2 and approximately 3-4 weeks for Alternative 3).

No odour impacts on residents in the Study Area are anticipated for any of the LFG management alternatives.

4.2.3.3 Economic Environment

The following documents the economic criteria and indicators potential effects and proposed mitigation for each of the alternatives.

Criteria	Indicators
Economic	
Potential for effect on businesses during construction and operation.	• Number of potential odour sources and relative significance of odour sources (if characterization is possible), distance of odour sources to sensitive receptors. • Number of businesses in the Study Area who may experience noise or other disturbance.
Cost of facility.	• Approximate cost of LFG recovery facility.

ECONOMIC POTENTIAL EFFECTS

Businesses operating within the Study Area include an equipment dealer, a farm market and numerous farmed parcels that are part of agricultural operations.

Odour

Alternative 1 would not change the location of potential odour sources. The use of flares to date has not resulted in odour impacts to neighbours, to date. With full combustion of the LFG by the flares, the significance of any odour and the potential for odour impacts on businesses is minimal and the same as is currently experienced. Alternatives 2 and 3 include the same number of flares as Alternative 1 as back-up should the RNG or electricity plant shut down.

Noise

New flare equipment will meet noise requirements and will not result in an impact on residents. Equipment associated with piping LFG to an off-site RNG facility (Alternative 2) would involve minimal noise during operation. Equipment associated with transforming LFG into electricity (Alternative 3) would be contained within a structure as necessary to mitigate noise during operation. Some temporary noise could occur during construction.

Cost of Facility

Some minimal costs will be incurred for additional flares. These costs are a very minimal part of the cost of the expansion and as flares will be required for back-up for the other two alternatives the cost of the flares is the same for all three alternatives.

Alternatives 2 and 3 would require significant expenditures for construction of the required infrastructure for projects that are undefined beyond the construction of any additional flares required as back-up (same as to Alternative 1). The cost of these alternatives cannot be determined without a third party agreement and a defined project. If an agreement was in place it is assumed that the cost to build the infrastructure would be off-set through the resulting sale of RNG or electricity.

ECONOMIC IMPACT MANAGEMENT MEASURES

Mitigation measures to minimize noise include construction best management practices related to equipment maintenance and timing, construction of the berms as included in the landfill design and containment of on-site infrastructure where feasible within an enclosed structure with appropriate noise dampening equipment.

Back-up and contingency plans would be in place to deal with any upset condition to prevent or mitigate the escape of fugitive LFG in the design of the system.

Waste Connections will effectively manage any on-site construction to minimize costs while meeting regulatory requirements and commitments.

ECONOMIC NET EFFECTS

No off-site noise impacts are anticipated on local businesses resulting from the flaring of LFG. For Alternatives 2 and 3, there could be potential for noise depending on the extent of construction; however, the length of additional construction beyond the construction the flares common to all alternatives is anticipated to be minimal ranging from approximately 1-2 weeks for Alternative 2 and approximately 3-4 weeks for Alternative 3.

No odour impacts on businesses are anticipated from any of the LFG management alternatives.

Costs will vary with the alternatives. The cost associated with adding flares for the expanded landfill is required for all three alternatives and Alternative 2 and 3 are anticipated to have additional costs which could be off-set depending on the third party agreement to purchase electricity or LFG.

4.2.3.4 Cultural Environment

The following documents the cultural criteria and indicators, potential effects and proposed mitigation for each of the alternatives

Criteria	Indicators
Cultural	
Potential effects to archaeological resources as a result of construction.	• Area of undisturbed land affected by the on-site component of LFG management alternative.

CULTURAL POTENTIAL EFFECTS

All alternatives require that additional flares be constructed on-site. These flares would be constructed in the same location as the existing flares which is not identified as an area having archaeological potential in the Stage 1 Archaeological Assessment (refer to **Appendix D2B – Archaeological Impact Assessment**).

Construction of the infrastructure required to pipe LFG off-site to an RNG facility or convert LFG to electricity would also be constructed in an area cleared of archaeological resources.

CULTURAL IMPACT MANAGEMENT MEASURES

As noted, all work will be undertaken in areas that have been identified as disturbed or have been cleared through Archaeological Assessments. Should archaeological resources unexpectedly be discovered during any construction, Waste Connections will immediately stop work and notify the Ministry of Tourism, Culture and Sport.

CULTURAL NET EFFECTS

No negative effects on archaeological resources are anticipated.

4.2.3.5 Built Environment

The following documents the built environment criteria and indicators, potential effects and proposed mitigation for each of the alternatives.

Criteria	Indicators
Built	

Criteria	Indicators
Ease to implement/construct and maintain/operate.	• Anticipated complexity of construction and operation.

BUILT ENVIRONMENT POTENTIAL EFFECTS

Alternative 1 is easy to implement and maintain/operate as it currently is today. Determining the design parameters for Alternative 1 will be technical and regulatory based. The construction and operation of this alternative is entirely within the control of Waste Connections.

Alternatives 2 and 3 involving gas utilization are not defined and will be more complex than Alternative 1. They will require third party agreements, specialized technology and equipment. In addition to engineering design and regulation, Alternatives 2 and 3 will be commercially driven.

BUILT ENVIRONMENT IMPACT MANAGEMENT MEASURES

None required.

BUILT ENVIRONMENT NET EFFECTS

Flaring (Alternative 1) is an alternative with lower complexity, is readily implemented and is completely within the control of Waste Connections. As noted, Alternatives 2 and 3 are not fully defined at this point.

4.2.4 Comparative Evaluation of Landfill Gas Management Alternatives

The comparative evaluation of LFG management alternatives was completed using the results of the net effects analysis. The comparative evaluation involved the following steps:

- Alternatives were ranked as “preferred”, “less preferred”, “least preferred” or “equally preferred” for each of the indicators; and
- Qualitative reasoning was used to consolidate the individual indicator rankings into a ranking for each environmental component and then from each environmental component to an overall rank.

Table 4-2 summarizes the ranking results for the environmental components and overall. A detailed table providing the ranking and associated rationale for all criteria and indicators is provided in **Attachment 5**.

The following highlights the key advantages and disadvantages of each of the three LFG management alternatives.

Alternative 1 – Flaring
Key Advantages
• Involves no change to impact on air quality and provides effective reduction of GHG emissions. • Neighbouring residents and businesses would not notice any change to noise. • No odour impacts are anticipated. • Relatively simple to operate based on current experience.
Key Disadvantages
• Does not provide the opportunity to off-set the use of traditional fuels and further reduce GHG emissions.

Alternative 2 – Gas Utilization – Renewable Natural Gas (RNG)
Key Advantages
• Involves no change to impact on air quality and provides effective reduction of GHG emissions. • Neighbouring residents and businesses would not notice any change to noise • No odour impacts are anticipated. The flares would provide a back-up should there be any upset to RNG plant. • Provides an opportunity to further reduce GHG emissions by off-setting the use of traditional fuels.
Key Disadvantages
• Requires complex agreement with a third party for the utilization and/or sale of LFG.

Alternative 3 – Gas Utilization - Electricity Generation
Key Advantages
• Involves no change to impact on air quality and provides effective reduction of GHG emissions. • Neighbouring residents and businesses would not notice any change to noise. • No odour impacts are anticipated. The flares would provide a back-up should there be any upset to electricity generation. • Provides an opportunity to further reduce GHG emissions by off-setting the use of traditional fuels.
Key Disadvantages
• Requires a complex agreement with a third party for the generation of electricity.
• Currently no opportunity to supply electricity generated from LFG to the grid.

LANDFILL GAS ALTERNATIVES CONCLUSION

The identified flaring and gas utilization applications are all very good alternatives for the management of collected LFG for the proposed Ridge Landfill expansion. Flaring of the LFG destroys GHG emissions, is readily implementable and is a reliable and proven technology and is a component of all three alternatives.

A gas utilization project provides the benefit of reducing GHG emissions by offsetting the traditional use of carbon based fuel. However, for a gas utilization project to go forward there must be a market or user for the resulting RNG or electricity. Waste Connections does not have an agreement with a third party to utilize the LFG from the existing landfill. Waste Connections proposes to manage LFG through flaring in accordance with O.Reg.232/98 and to continue to investigate opportunities for commercially viable gas utilization projects at the Ridge Landfill.

For the purposes of this EA, the preferred alternative for LFG management is Alternative 1 - Flaring.

TABLE 4-2: COMPARATIVE EVALUATION OVERALL RANKING OF LANDFILL GAS ALTERNATIVES

Environment	Alternative 1 - Flaring	Alternative 2 – Gas Utilization (RNG)	Alternative 3 – Gas Utilization (Electricity)	Do Nothing
Natural Environment - Atmospheric Ranking	Equally Preferred – The difference in anticipated construction and energy use is minor.	Equally Preferred - The difference in anticipated construction and energy use is minor.	Equally Preferred - The difference in anticipated construction and energy use is minor.	The do nothing alternative is the same as Alternative 1 as it involves continued flaring of LFG which has minimal impact on air quality.
Natural Environment – Climate Change Ranking	Less Preferred –This alternative reduces GHG emissions.	Preferred - This alternative minimizes GHG emissions and has the potential for a positive impact on climate change from the offset of the use of traditional fuels.	Preferred - This alternative minimizes GHG emissions and has the potential for a positive impact on climate change from the offset of the use of traditional fuels.	The do nothing alternative is the same as Alternative 1 as it involves continued flaring of LFG which manages GHG emissions.
Social Environment Ranking	Equally Preferred – Flaring involves minimal construction and potential for noise impacts on residents. No odour impacts are anticipated.	Equally Preferred – Gas utilization involves minimal construction and potential for noise impacts on residents. No odour impacts are anticipated.	Equally preferred - Gas utilization involves minimal construction and potential for noise impacts on residents. No odour impacts are anticipated.	The do nothing alternative is the same as Alternative 1 as it involves continued flaring of LFG which has not proven to result in noise or odour impacts to neighbours.
Economic Ranking	Preferred - None of the alternatives are anticipated to result in noise or odour impacts to businesses. This alternative involves minimal costs which are relatively low.	Less preferred - None of the alternatives are anticipated to result in noise or odour impacts to businesses. The gas utilization alternatives are likely higher costs and without a known project and third party agreement the costs are uncertain.	Less preferred - None of the alternatives are anticipated to result in noise or odour impacts to businesses. The gas utilization alternatives are likely higher costs and without a known project and third party agreement the costs are uncertain.	The do nothing alternative involves continued flaring of LFG which has proven to result in no noise or odour impacts to businesses.
Cultural Environment Ranking	Equal – all construction for LFG management will take place in areas that have been identified as previously disturbed or have been cleared of archaeolgical resources.	Equal – all construction for LFG management will take place in areas that have been identified as previously disturbed or have been cleared of archaeolgical resources.	Equal – all construction for LFG management will take place in areas that have been identified as previously disturbed or have been cleared of archaeolgical resources.	The do-nothing alternative is in an area that is previously disturbed and no construction is required.
Built Environment Ranking	Preferred – Flaring is a straight forward LFG management alternative that is completely within Waste Connections control.	Less preferred - Gas utilization opportunities will require third party agreements, and specialized technology and equipment.	Less preferred - Gas utilization opportunities will require third party agreements, and specialized technology and equipment.	The do nothing alternative involves continued use of the flaring to manage LFG which is straight forward to maintain/operate.
Overall Landfill Gas Management Ranking	**Preferred Landfill Gas Management Alternative**			

4.3 Alternative Methods of Leachate Treatment

The existing leachate collection system at the Ridge Landfill consists of a series of collection drains and perimeter drains, with leachate flowing by gravity to low points around the waste mounds, where it is pumped to a central leachate storage tank, and then pumped via underground sanitary sewer/forcemain for treatment at the BWTL. There is currently no on-site pre-treatment of leachate. Installation of the underground forcemain was completed as part of a 1997 Host Community Agreement with the Municipality of Chatham-Kent. The current agreement requires the BWTL to reserve capacity for leachate generated from the Ridge Landfill for a 100-year period and for a specified daily maximum of 340,000 litres/day (340 m^3/day). The ECA for the BWTL indicates that the average day rated capacity of the BWTL is 4,045 m^3/day, and peak flow shall not exceed 12,046 m^3/day. The BWTL and the Ridge Landfill is in compliance with these limitations.

4.3.1 Development of Leachate Treatment Alternatives

As an initial step in the consideration of alternative methods and as committed to in the ToR, Waste Connections reviewed the existing leachate collection and treatment system, including the BWTL and the associated municipal sanitary sewer, in order to confirm whether there is sufficient capacity for leachate management from an expanded landfill. This review is documented in a memo *Ridge Landfill Off-site Leachate Infrastructure* found in **Appendix D6 – Design and Operations Report** and it included a review of the Chatham-Kent Wastewater Master Plan (2012 updated in 2018), and a meeting with the Chatham-Kent PUC on July 25th, 2018. A letter was also received from the Chatham-Kent PUC and is included in **Attachment 6**. The review identified the following:

- The five year (2013-2017) average volume of leachate treated at BWTL was 170 m^3/day and the maximum future leachate average daily volume at 919 m^3/day;
- Given current sewage flow and expected population increase, the average daily flow of sewage together with the maximum future leachate average daily volume is within the capacity of the BWTL; and
- The concentrations of total suspended solids and phosphorous in leachate are lower than what is found in sewage.

Based on this information and confirmed in the letter from Chatham-Kent PUC, it is concluded that the BWTL have adequate capacity now and into the future, to treat the quality and quantity of leachate expected from the existing Ridge Landfill operation and from the proposed landfill expansion. A recent review of the data indicated that a minor upgrade to the BWTL may be needed for additional Total Kjeldahl Nitrogen (TKN) removal. The level of TKN in the BWTL is being monitored and enhancement to the treatment processes will be implemented as needed to maintain regulatory compliance of the BWTL. There is adequate capacity in the existing leachate transmission forcemain to convey the leachate.

On-site leachate collection for the proposed landfill expansion would be designed to be consistent with the current leachate collection system concept in accordance with applicable regulations and subject to MECP review and approval, prior to installation. As such, no leachate collection alternatives were considered in this EA.

Alternatives for leachate management that provide responsible handling of leachate produced on-site over the EA planning period (2021 to 2041) were identified for consideration. The following are some of the key assumptions and common characteristics considered in the identification of leachate management alternatives:

- **Leachate Quantity** – Alternatives must address an anticipated maximum quantity of approximately 900 m^3/day from the combined current and proposed expanded landfill;
- **Leachate Quality** – Only non-hazardous solid waste will be accepted at the site regardless of the alternative selected. This is reflective of what happens currently so the quality of leachate is expected to remain relatively unchanged from what is currently released;
- **Treatment Contingency** - There are no other existing wastewater treatment facilities sufficiently close to the Ridge Landfill to feasibly construct another transmission forcemain. However, the Chatham-Kent PUC, (a public entity) has indicated that if Waste Connections needs to discharge leachate at the Chatham Wastewater Treatment Plant (an existing public facility licensed to accept landfill leachate), the facility is setup to off-load trucks. Receiving leachate by truck is the preferred method at the Chatham Wastewater Treatment plant as it allows discharge to holding tanks that enables the operators to meter leachate into the plant at their discretion. It currently receives leachate by truckload from other facilities on a daily basis. There are also other privately-owned wastewater treatment facilities identified in the Province of Ontario that hold the appropriate licenses to accept leachate that Waste Connections could potentially consider as a disposal receiver. Should this treatment contingency be

needed for the current operation of the landfill, approximately seven (7) trucks would be required on average per day to haul leachate offsite. As the landfill continues to operate over the expansion period, the number of trucks could increase to approximately 14 on average per day; and

- **Treatment Contingency Haul Route** – In the event that leachate had to be trucked to a facility, the trucks would adhere to roads that are designated for truck use.

4.3.2 Description of Leachate Treatment Alternatives

The following leachate treatment alternatives were initially identified for consideration.[52]

1. No on-site pre-treatment with discharge to Blenheim Wastewater Treatment Lagoons (BWTL) (current method);
2. No on-site pre-treatment with discharge to a treatment facility other than BWTL;
3. On site pre-treatment and discharge to BWTL;
4. On-site pre-treatment with discharge to a treatment facility other than BWTL; and
5. Full on-site treatment and discharge to local drain.

Waste Connections reviewed the above five (5) alternatives to determine which were reasonable to carry forward through an alternative methods evaluation. Part of this review involved an assessment of the viability of the BWTL to continue to accept leachate from the Ridge Landfill.

As noted, information from the Chatham-Kent PUC and the review of the BWTL and forcemain noted previously, identified that the BWTL and the associated forcemain can continue to be viable for leachate transmission and treatment for the existing landfill and proposed expansion. Given this determination, Waste Connections reviewed the options of discharging untreated or pre-treated leachate to treatment facilities other than the BWTL (options 2 and 4 above). These treatment methods were not identified as reasonable as permanent treatment methods based on the following:

- The Chatham Wastewater Treatment Plant, the closest treatment plant that could accept the leachate, is 20 km from the Ridge Landfill; and
- The closest known private treatment facilities are 75 to 100 km from the Ridge Landfill.

[52] Full treatment on site with discharge to Lake Erie was not considered feasible due to the need to construct a new outfall to Lake Ontario and a six km forcemain. Leachate evaporation was not considered feasible due to the large volume of leachate anticipated.

It was considered reasonable to incorporate transportation to another treatment facility as a contingency. The Chatham-Kent PUC has indicated that the Chatham Wastewater Treatment Plant is designed and licensed to accept leachate by truck and that trucking leachate to this plant is considered a reasonable contingency should one be required.

Following the review of possible alternatives, three (3) leachate treatment alternative methods were considered reasonable methods to treat leachate for the Ridge Landfill EA. Each alternative method of how leachate can be treated at the Ridge Landfill is outlined below with the accompanying rationale.

Leachate Treatment Alternative Method	Description	Rationale
Alternative 1 **Direct Discharge to Sanitary Sewer**	Leachate that is collected at the site is conveyed to the area east of the Old Landfill and is pumped via the existing underground sanitary sewer to the BWTL. This alternative requires an agreement with the Chatham-Kent PUC to discharge untreated leachate to the BWTL. This agreement is currently in place for leachate from the existing landfill. Leachate is and would continue to be conveyed to the BWTL via the existing sanitary sewer. No change is required. The Chatham-Kent PUC has confirmed that the BWTL have sufficient capacity to treat the quantity of leachate expected over the EA planning period. A letter from the PUC is included in **Attachment 6** that provides further detail on the treatment of leachate. **Energy Use Requirements:** On-site pumping station requires energy, similar to what is required currently. **Approximate Construction Footprint and Location**: No additional construction required. **Leachate Transportation:** Via existing forcemain. **Discharge Location**: Discharged to the BWTL. **Contingency Transportation**: In the event that the BWTL are unable to continue to receive the leachate for treatment, it will be transported by truck to the Chatham Wastewater Treatment Plant.	Maintains the current practice and allows for a contingency.

Leachate Treatment Alternative Method	Description	Rationale
Alternative 2 **On-site Pre- treatment Prior to Discharge to Sanitary Sewer**	This alternative would require the construction of a fully enclosed pre-treatment facility on the Ridge Landfill property. At this point the specific type of pre-treatment cannot be defined. The pre-treatment system would be designed to treat/remove one or more specific parameters in the event that the BWTL could not treat for these specific parameters should regulations change or other circumstances arise. An example could be that if the BWTL could not effectively remove a specific metal from the leachate and this was impacting its effluent quality then a pre-treatment system could be installed at the landfill to address this. The pre-treated leachate would be conveyed via the existing sanitary sewer to the BWTL. **Energy Use Requirements:** On-site pumping station requires energy, similar to what is required currently. The pre-treatment process will require additional energy. **Approximate Construction Footprint and Location**: Pre-treatment facility could be approximately 100 m^2 depending upon the treatment processes and leachate storage volumes required. It would be located where the current leachate storage tank is east of the Old Landfill or in available space in the southeast segment of the property. **Leachate Transportation:** Via existing sanitary sewer. **Discharge Location**: Discharged to the BWTL. **Contingency Transportation**: In the event that the BWTL are unable to continue to receive the leachate for treatment, it will be transported by truck to the Chatham Wastewater Treatment plant.	Pre-treats the leachate for specific parameters to levels that render it acceptable for final treatment at BWTL and allows for a contingency.

Leachate Treatment Alternative Method	Description	Rationale
Alternative 3 **On-Site Full Treatment Prior to Discharge to Surface Water**	On-site full treatment involves treating the leachate to meet surface water discharge criteria and discharging the effluent directly to the environment. Based on the required level of leachate treatment a full treatment facility could involve the construction of complex on-site facilities within an enclosed building. The following treatment units could be included as part of the full treatment alternative depending on the required level of treatment: - Physical and chemical pre-treatment; - Biological treatment removal of ammonia, Total Kjeldahl Nitrogen (TKN), biological oxygen demand (BOD), and some volatile organic compounds (VOCs), and phenolic compounds; - Reverse osmosis (RO), a water purification technology that uses a semi-permeable membrane to remove ions, molecules and larger particles (i.e., sodium, potassium, chloride, and trace contaminants) from effluent; and - Activated carbon, treatment and ultraviolet (UV) disinfection of effluent prior to discharge to the environment. **Energy Use Requirements:** A treatment plant would require significant electrical and natural gas energy to operate the facility. **Approximate Construction Footprint and Location**: Pre-treatment facility would be approximately 1500 m^2 and likely be located in the southeast section of the property. **Leachate Transportation:** On-site discharge. In the event that the leachate cannot be treated to meet surface water discharge criteria the effluent would then be discharged via the existing sanitary sewer to the BWTL or trucked off-site for treatment. **Discharge Location**: Discharged to on-site drain. **Contingency Transportation**: In the event that leachate	Treats leachate to meet surface water discharge criteria which allows direct discharge to environment and allows for a contingency.

Leachate Treatment Alternative Method	Description	Rationale
	cannot be fully treated on-site and the BWTL are unable to receive the effluent from treatment, it will be transported by truck to the Chatham Wastewater Treatment plant. A treatment plant would likely be located in the southeast section of the property and would require significant electrical and natural gas energy to operate the facility. Some off-site trucking will be required to remove liquid waste separated from the leachate through the reverse osmosis process for off-site disposal and delivery of supplies to the facility.	

4.3.3 Potential Net Effects of Leachate Treatment Alternatives

The three (3) leachate treatment alternatives were assessed to determine their potential for impact on the Natural, Social, Economic, Cultural and Built Environments. Evaluation criteria and indicators specific to the consideration of leachate treatment are used to identify net effects of the alternatives relative to the future baseline conditions and to comparatively evaluate the alternatives.

The following sections list the criteria and indicators considered and summarize the potential effects, proposed impact management measures and net effects of each of the alternatives. Potential effects during construction, operation and closure/post closure are identified. Net effects tables for each of the three leachate management alternatives are included in **Attachment 4**. A full table of all leachate treatment evaluation criteria, indicators, data sources and rationale is included in **Attachment 1**.

4.3.3.1 Natural Environment – Biological

The following documents the natural environment (biology) criteria and indicators potential effects, proposed mitigation and net effects for each of the alternatives.

Criteria	Indicators
Aquatic	
Potential for effect on aquatic systems during construction and operation.	• Volume of leachate stored and/or treated on site at any one given time. • Proximity to on-site watercourse/aquatic habitat.

BIOLOGICAL POTENTIAL EFFECTS

Leachate is managed at the east side of the site near the site entrance. Stormwater on-site in the area of the existing leachate storage tank and pump is collected in ditches that convey it to stormwater ponds for retention. The stormwater ponds are tested before release to the local drains which flow north from the site. The nearest local drain to the leachate management area, the Duke Drain, is located outside of the site, beyond the perimeter berms, along Erieau Road and on-site north of the site entrance. It is considered to have limited potential for fish habitat. None of the alternatives will result in construction that physically alters the Duke Drain.

- **Alternative 1**, no on-site pre-treatment and discharge to the BWTL has some potential for leachate collection activities to impact this limited aquatic environment as a result of a leakage or spill given the proximity to the Duke Drain. It is noted that should there be a leak or spill leachate would enter the ditches in proximity to the tank where it would be transported to the stormwater pond and tested prior to release to the Duke Drain. The leachate is transported by the existing sanitary sewer to the BWTL and the leachate is treated to meet appropriate MECP criteria before being released back into the environment. This existing transmission and treatment process has been working effectively for 14 years. Based on the assessment completed for the BWTL and discussions with Chatham-Kent PUC no negative effects from this alternative on aquatic habitat are anticipated.
- **Alternative 2** involves the addition of an enclosed pre-treatment system which would have similar potential for spills as Alternative 1. This Alternative also uses the existing sanitary sewer and pre-treated leachate would continue treatment at the BWTL. As noted the BWTL is expected to continue to effectively treat leachate from the expanded landfill. As this alternative includes the handling and treatment of leachate on-site, there is some potential for aquatic impact should a malfunction in the system occur resulting in a spill.

- **Alternative 3** involves construction of an enclosed full treatment system which would outlet directly to a local drain adjacent the site. The specific drain(s) used for discharge would need to be determined through assimilative modelling to determine the capacity of individual drains to accept the resulting effluent. With Alternative 3 there is a potential risk to aquatic habitat resulting from potential treatment malfunction and the accidental direct release of either raw or partially treated leachate to the environment.

BIOLOGICAL IMPACT MANAGEMENT

Mitigation to reduce the potential for impact to aquatic habitat for all alternatives includes best management practices during construction to avoid impacts including sedimentation to the on-site stormwater management system. Regular monitoring of the operating system will allow Waste Connections to detect system upsets and malfunctions. There is the ability to pause pumping and to hold leachate within the waste mounds should there be a problem with its management.

All alternatives include a contingency to truck leachate to the Chatham Wastewater Treatment Plant. In the contingency situation, where leachate is trucked to a licensed treatment facility, there is some potential for an accidental spill. To mitigate the potential for impact on the aquatic environment, only MECP licensed/approved and regulated liquid waste haulers would be used to transport the leachate and best practices for transportation would be used.

BIOLOGICAL NET EFFECTS

No negative effects to aquatic habitat are anticipated during construction. Proposed mitigation and available contingency measures will effectively manage leachate during operation such that there is no potential for impact to aquatic systems anticipate during regular operation. It is noted that Alternatives 2 and 3 have a greater risk of an upset that could result in a short term release of untreated or partially treated leachate which could negatively impact surface water quality on-site.

4.3.3.2 Natural Environment – Physical

The following documents the natural environment (physical) criteria and indicators potential effects, proposed mitigation and net effects for each of the alternatives.

Criteria	Indicators
Groundwater	
Potential impacts to groundwater quality during construction, operation and post closure.	• Approximate travel time to groundwater aquifer.
Surface Water	
Potential impacts to surface water quantity and quality.	• Volume of leachate stored and/or treated on site at any one given time.
Atmospheric	
Potential impacts to air quality during construction and operation.	• Nitrogen Oxides, Sulphur Dioxide and Carbon Monoxide (together referred to as criteria air contaminants): relative levels of construction as an indicator. • Relative amount of energy required to operate facility.
Climate Change	
Potential for GHG emissions during construction and operation.	• Relative amount of energy required to operate facility.

NATURAL PHYSICAL POTENTIAL EFFECTS

Groundwater

None of the alternatives involve construction that would result in spills or leakage that would impact groundwater. Alternatives 2 and 3 involve treatment of leachate on-site and have some potential for leaks or spills; this site affords significant natural protection in the form of 30 metres of natural clay under the site and the approximate travel time to the groundwater aquifer should there be an operational upset, spill or leak is approximately 3,000 years.

All three (3) alternatives involve the same contingency of trucking the leachate to another licensed facility which has some potential to result in a spill. As noted above, the use of licensed haulers and appropriate best practices will minimize the potential for impacts to groundwater.

Surface Water

None of the alternatives involve construction that would be in proximity to surface water to result in spills or leakage that would impact surface water. During operation and post closure Alternatives 1 and 2, which continue to use the existing sanitary sewer to the BWTL. Alternative 3 will change the water quantity in the local drains as the result of direct discharge. Alternatives 2 and 3 both involve treatment of leachate on-site and have a greater risk of impact to surface water quality should a treatment malfunction occur.

Atmospheric

There is no construction related to Alternative 1 and energy require for operation is the same as is used currently so there is no anticipated air quality impact. Alternative 2 requires minimal construction (4-6 weeks) but the impact is minimal and short term. Alternative 3 requires a much greater amount of construction activity (6-9 months) with a potential to impact air quality as a result of this longer construction period.

Climate Change

There is no construction related to Alternative 1 and no construction related GHG emissions. Alternatives 2 and 3 both require construction although it is not anticipated that the short term nature of the construction associated with Alternative 2 (4-6 weeks) will contribute significantly to GHG emissions. Alternative 3 will require a much longer construction period (6-9 months) which is typical for a complex treatment facility and outfall to a local drain. During operation, Alternative 1 and 2 would use minimal energy and have minimal potential to generate GHG emissions. For Alternative 3, significant energy is required to operate a full treatment facility on-site resulting in a higher potential for GHG emissions.

NATURAL PHYSICAL IMPACT MANAGEMENT

Mitigation measures to minimize impacts on the physical environment include:

- Using best management practices during construction to minimize spills;
- Keeping construction machinery in good working order to minimize air quality and greenhouse gas emissions;
- For all alternatives, should an operational upset occur, leachate pumps can be cycled off and the landfill can contain leachate for a significant period of time to allow for effective clean up and repair; and
- Should it be required, contingency measures to temporarily truck leachate to the Chatham Wastewater Treatment Plant will be in place. Licensed/approved haulers would be used.

NATURAL PHYSICAL NET EFFECTS

With mitigation in place, no significant negative effects to groundwater, surface water, air quality or climate change are anticipated during construction or operation for Alternative 1. Construction associated with Alternative 2 is minimal and not anticipated to result in any negative effects; however, the operation of on-site pre-treatment introduces the potential for a malfunction that could cause a short term release to surface water of either untreated or partially treated leachate. Even with mitigation this potential for release remains. Alternative 3 also includes the potential for a malfunction that could cause a release to surface water. In addition, the construction of a full treatment facility requires construction activity over 6-9 months and both construction and operation requires significant energy resulting in potential air quality and GHG emissions that cannot be fully mitigated.

4.3.3.3 Social Environment

The following documents the social criteria and indicators, potential effects, proposed mitigation and net effects related to the social environment for each of the leachate treatment alternatives.

Criteria	Indicators
Social	
Potential for noise / vibration impacts on residents during construction and operation.	• Number of households in the Study Area who may experience noise/vibration impacts as a result of leachate treatment facility construction and operation.
Potential for odour during construction and operation.	• Number of potential odour sources from leachate treatment facility construction and operation; relative significance of odour sources and relative distance of odour sources to sensitive receptors.
Potential for landfill traffic effect on residents during construction and operation.	• Number of trucks during construction and number of trucks required for chemicals and disposal of residue during operation.

SOCIAL POTENTIAL EFFECTS

There are 24 residences within 1 km of the Ridge landfill property, primarily on Charing Cross Road, Erieau Road and Allison Line. These residents are already familiar with the landfill operations. It is noted there are also two (2) leased residences on-site and these leases will be terminated should the expansion be approved. The following provides an overview of the potential impacts that different leachate treatment alternatives could have on area residences.

Noise

Alternative 1 involves no change in the leachate treatment system so there would be no additional noise sources during construction or operation. Alternative 2 involves minor construction of a pre-treatment facility over 4-6 weeks which has potential for minimal and intermittent construction noise as much of the pre-treatment infrastructure is pre-assembled. Alternative 3 would require significant on-site construction (approximately 6-9 months) to build a full treatment plant, and would have a longer duration of potential noise associated with construction activity. Limited noise is anticipated for any of the alternatives during operation.

Odour

Odour is not anticipated during construction for any of the Alternatives. Alternative 1 represents no change to the current operation and based on operating experience, does not result in any significant odour. The operation of an on-site pre-treatment or full treatment facility adds potential new sources of odour to the site. During normal operating conditions, neither of these facilities are expected to emit odour. However, there is potential for these facilities to generate odours if the plant is not working properly or if there are climatic or changed conditions during operation (e.g., severe heat wave). The potential for odour generation is anticipated to be greater for the more complex on-site treatment system required for Alternative 3.

Traffic

There is no construction related to Alternative 1 and no chemical delivery is required, so there is no additional traffic impact. Alternatives 2 and 3 will result in truck traffic for construction (approximately 5-10 trucks per day for Alternative 3 which is involves the most construction) and chemical delivery and residue removal (2-5 trucks per day for Alternative 3). Traffic effects associated with leachate treatment are minimal especially in the context of continued operation of the site and the typical 200 waste trucks per day.

All three (3) alternatives include a contingency to truck leachate to the Chatham-Kent Wastewater Treatment Plant licensed wastewater facility should it be required for short periods of time. For the current operation of the landfill, approximately seven (7) trucks would be required per day on average to haul leachate offsite. As the landfill continues to operate over the expansion period, the number of trucks could increase to approximately 14 per day on average. The liquid haul trucks would use appropriate truck routes.

SOCIAL IMPACT MANAGEMENT

Mitigation to manage potential social impacts will include:

- Planned extension of the site berms;
- Maintenance of construction equipment to minimize noise during construction;
- Enclosed pre-treatment and full treatment facilities to minimize noise and odour during operation;
- Designate routes for construction traffic; and
- Use of licensed haulers should leachate trucking be required. Haulers will be required to use appropriate truck routes.

SOCIAL NET EFFECTS

There is some potential for residual noise effects associated with construction for Alternative 3. While no odour is anticipated from any of the alternatives during regular operation, Alternatives 2 and 3 have the potential for residual odour effects during upset or abnormal conditions. This is particularly true for Alternative 3 as the full treatment process requires leachate to remain on-site for a longer period for treatment, increasing the risk of a potential upset. No significant net effects related to traffic are anticipated.

4.3.3.4 Economic Environment

The following documents the criteria and indicators, potential economic effects, proposed mitigation and net effects for each of the leachate management alternatives.

Criteria	Indicators
Economic	
Potential for effect on businesses during construction and operation.	• Number of potential odour sources and relative significance of odour sources. • Number of trucks during construction and number of trucks required for chemicals and disposal of residue

Criteria	Indicators
	during operation.
Cost of facility.	• Approximate cost of leachate treatment facility alternative.

ECONOMIC POTENTIAL EFFECTS

Businesses operating within the Study Area include an equipment dealer, a farm market and numerous farmed parcels that are part of agricultural operations. The following provides an overview of the potential impacts that different leachate treatment alternatives could have on businesses near the landfill.

Odour

Odour is not anticipated during the construction of any of the alternatives. There is a difference between the alternatives in the potential for odour impacts that businesses may experience during operation. Alternative 1 represents no change to the current operation and based on operating experience does not result in any significant odour. During normal operating conditions, the pre-treatment and full treatment facilities are not expected to emit odour. However, there is potential for these facilities to generate odours if the plant is not working properly or if there are climatic or changed conditions during operation (e.g., severe heat wave). The potential for odour generation is anticipated to be greater for the more complex on-site treatment system required for Alternative 3.

Extent of Trucking

With respect to truck traffic, Alternative 1 involves no construction and no construction related trucking. Alternatives 2 and 3 will require on-site construction and require on-going delivery of treatment products and the disposal of treatment residue. In general traffic effects associated with leachate treatment are considered to be minimal especially in the context of continued operation of the site and the typical 200 waste trucks per day.

Cost of Facility

Alternative 1 has no additional expenditures. Alternative 2 requires significant expenditure for a pre-treatment facility (estimated in $3 to $5 million range) and some operating staff time commitment. Alternative 3 would require a very significant expenditure for construction of a full wastewater treatment plant and associated infrastructure (estimated in $15 to $20 million range) and a full time staff compliment.

ECONOMIC IMPACT MANAGEMENT

Mitigation to manage potential economic impacts will include:

- Enclosed pre-treatment and full treatment facilities to minimize noise and odour during operation; and
- Use of licensed haulers should leachate trucking be required. Haulers will be required to stay on appropriate truck routes.

ECONOMIC NET EFFECTS

It is anticipated that the mitigation will be sufficient to manage the potential for trucking effects on businesses. There may be some residual potential for odour effects on neighbouring businesses with the on-site pre-treatment and full treatment should upset conditions occur. It is also note that Alternatives 2 and 3 have significant and very significant cost impacts respectively.

4.3.3.5 Cultural Environment

The following documents the cultural criteria and indicators, potential cultural environment effects, proposed mitigation and net effects for each of the leachate management alternatives.

Criteria	Indicators
Cultural	
Potential effects to archaeological resources as a result of construction.	• Area of undisturbed land affected by the on-site component of the leachate treatment alternative.

CULTURAL POTENTIAL EFFECTS

Within the Ridge Landfill property on-site leachate treatment facilities required for Alternatives 2 and 3 would be located in an area that has been found to exhibit no archaeological potential based on the completed Archaeological Assessments. Given that any archaeological resources will be removed prior to the construction of any expansion no archaeological impact is anticipated for any of the all three (3) leachate management.

CULTURAL IMPACT MANAGEMENT

Mitigation will include the removal of any identified archaeological resources and the clearance of the site by the Ministry of Tourism, Culture and Sport prior to construction. Should archaeological resources be uncovered during construction, Waste Connections will stop work and notify the appropriate agencies/authorities.

CULTURAL NET EFFECTS

No net effects on the cultural environment are anticipated.

4.3.3.6 Built Environment

The following documents the built environment criteria and indicators, potential cultural environment effects, proposed mitigation and net effects for each of the leachate management alternatives.

Criteria	Indicators
Built	
Potential effects on existing transportation infrastructure and transportation operation.	• Anticipated number of trucks required.
Ease to implement/construct and maintain/operate.	• Anticipated complexity of construction and operation.

BUILT ENVIRONMENT POTENTIAL EFFECTS

Transportation Infrastructure

Alternative 1 would have no impact to existing transportation operations or infrastructure. There would be additional traffic associated with facility construction for Alternative 2 (2 trucks per day for 4-6 weeks) and more significantly for Alternative 3 (5-10 trucks per day for 6-9 months). Alternatives 2 and 3 also require some delivery of treatment chemicals and some disposal of treatment waste e.g., liquid waste (up to 2 trucks per day for Alterative 2 and 2-5 trucks per day for Alternative 3). This number of trucks utilizing the transportation network for construction and operation will not have a noticeable impact on the transportation infrastructure or operation.

All three (3) alternatives include a contingency to truck leachate to a licensed wastewater facility should it be required for short periods of time. For the current operation of the landfill, approximately 7 trucks would be required per day, on average to haul leachate offsite. As the landfill continues to operate over the expansion period, the number of trucks could increase to approximately 14 per day on average. The liquid haul trucks would use approved truck routes and the same contingency and number of trucks would apply to all alternatives.

Ease of Implementation

Alternative 1 is the 'status quo' and as such is easily implemented, maintained and operated. Alternative 2 is expected to be more complex than Alternative 1, as it requires construction of a pre-treatment facility, some additional operating staff time commitment and related training. Alternative 3 would include the construction of a complex full leachate treatment facility and an outfall to a local drain, a full staff compliment and extensive training to operate the facility. The full staff complement would be required to operate the facility, handle chemicals required for treatment and manage the waste streams from the treatment. It should also be noted that it is anticipated that the regulatory requirements associated with securing permits and approvals to discharge treated effluent to the environment would severely limit the proponent's ability to manage leachate from the site. For example, leachate needs to be managed throughout the year from the landfill. Year round discharge to a local drain could be an issue given the quantity of the surface water in the drains and local climatic conditions (dry in the summer and frozen part of the winter) and any discharge restrictions that would be imposed as part of the full treatment plant approval process.

BUILT ENVIRONMENT IMPACT MANAGEMENT

During construction best management practices, including effective management of transportation of materials to and from the site, will minimize the potential for impacts on transportation infrastructure and operation. Should there be an instance during operation where the contingency trucking of leachate occurs, Waste Connections will use licensed haulers who will be required to stay on appropriate truck routes.

To address complexity associated with either Alternatives 2 or 3 Waste Connections would complete appropriate staff training. Discussions with Chatham-Kent for the pre-treatment alternative would be necessary for continued discharge to the BWTL.

BUILT ENVIRONMENT NET EFFECTS

No net effects on the transportation built environment are anticipated. Related to ease of implementation/operation, the operational complexity will increase with the level of on-site treatment regardless of mitigation.

4.3.4 Comparative Evaluation of Leachate Treatment Alternatives

The comparative evaluation of leachate treatment alternatives was completed using the results of the net effects analysis. The comparative evaluation involved the following steps:

- Alternatives were ranked as "preferred", "less preferred", "least preferred" or "equally preferred" for each of the indicators; and
- Qualitative reasoning was used to consolidate the individual indicator rankings into a ranking for each environmental component and then from each environmental component to an overall rank.

Table 4-3 summarizes the ranking results for the six (6) environmental components and overall. A detailed table providing the ranking and associated rationale for all criteria and indicators is provided in **Attachment 5**.

The following highlights the key advantages and disadvantages of each of the three leachate treatment alternatives:

Alternative 1 – Direct Discharge to Sanitary Sewer
Key Advantages
• No impact to surface water quantity or quality or associated aquatic habitat. • No impact to groundwater quality during construction, operation or post-closure. • No change to air quality or GHG emissions as a result of construction or operation. • No change for residential or business neighbours in the potential to experience noise, odour or traffic disruption. • No cost to implement as this represents the existing system. • Existing leachate management system is straightforward to operate.
Key Disadvantages
• No disadvantages for this alternative.

Alternative 2 – On-Site Pre-Treatment and Discharge to Sanitary Sewer
Key Advantages
• Minimal change to air quality and GHG emissions.
Key Disadvantages
• Adds an additional process step increasing complexity. • Results in a cost of $3-5 million.

Alternative 3 – On-Site Full Treatment and Discharge to Surface Water
Key Advantages
• There are no key advantages for this alternative.
Key Disadvantages
• Will increase downstream surface water quantity and has the potential to release untreated or partially treated leachate. • Has the potential to cause odour impacts to residents and businesses during upset conditions or abnormal weather (e.g., prolonged heat wave). • Results in a cost of $15-20 million plus significant on-going operating costs. • Adds a very complex process at the landfill requiring a full complement of trained staff. • Anticipated challenge to obtain permitting related to direct discharge to the environment.

LEACHATE TREATMENT ALTERNATIVES CONCLUSION

Based on the work completed, Alternative 1, Direct Discharge to Sanitary Sewer and treatment at the BWTL is preferred or equally preferred over the other leachate treatment alternatives, and is therefore preferred overall.

TABLE 4-3: OVERVIEW OF COMPARATIVE EVALUATION RANKING OF LEACHATE TREATMENT ALTERNATIVES

Environment	Alternative 1	Alternative 2	Alternative 3	Do Nothing
Natural Environment Biological Ranking	Preferred: Continuing to discharge leachate to the existing forcemain has the least potential to impact aquatic systems during construction or operation.	Less Preferred: Pre-treatment retains all leachate on-site for a period of time and has potential for an accidental release of untreated or partially treated leachate to a watercourse with some impact to fish habitat.	Less Preferred: Full treatment retains all leachate on-site and has potential for an accidental release of untreated or partially treated leachate to a watercourse with some impact to fish habitat.	The do-nothing alternative would continue with the existing discharge to forcemain with limited potential for aquatic impact.
Natural Environment Groundwater Ranking	Equally Preferred: For all the alternatives, any leachate spill would take approximately 3000 years to reach the aquifer.	Equally Preferred: For all the alternatives, any leachate spill would take approximately 3000 years to reach the aquifer.	Equally Preferred: For all the alternatives, any leachate spill would take approximately 3000 years to reach the aquifer.	If no change was made to the leachate treatment, any leachate spill would take approximately 3000 years to reach the aquifer
Natural Environment Surface Water Ranking	Preferred: Continuing to discharge leachate to the existing forcemain has the least potential to impact surface water and is preferred.	Less Preferred: This alternative retains all leachate on-site for a period of time and has potential for an accidental release of untreated or partially treated leachate to surface water.	Least Preferred: Full treatment has potential for an accidental release of untreated or partially treated leachate to surface water. It also increases the quantity of water released to the Duke Drain.	The do-nothing alternative would continue with the existing discharge to forcemain with limited potential for aquatic impact.
Natural Environment Atmospheric Ranking	Preferred: This alternative has no construction related air quality impacts and the energy required for operation is minimal.	Preferred: This alternative has minimal short term construction related air quality impacts and the energy for operation is minimal.	Less Preferred: This alternative has some shore term construction related air quality impacts and requires significant energy for long term operation.	The do nothing alterntaive has no constructionand requires minimal energy for operation.
Natural Environment Climate Change Ranking	Preferred: Alternatives 1 and 2 have similar energy use to today and do not significantly change GHG emissions.	Preferred: Alternatives 1 and 2 have similar energy use to today and do not significantly change GHG emissions.	Less Preferred: The full treatement uses significant energy which results in higher GHG emissions.	The do nothing alternative maintains the existing leachate treatment system which does not significantly change GHG emissions.
Social Ranking	Preferred: This alternative will not change the potential for noise and odour impacts from what is experienced today which is minimal.	Less Preferred: This alternative results in some potential for construction noise over a short duration (4-6 weeks) and some potential for odour from leachate on site during upset conditions.	Least Preferred: This alternative results in the potential for construction noise over a 6-9 month duration. This alternative also has greater potential for odour from leachate during upset conditions due to the complex on-site treatment processes.	The do nothing alternative will continue the status quo which results in minimal noise or odour attibutable to leachate treatment.
Economic Ranking	Preferred: This alternative has minimal potential for impact to businesses and no cost to implement.	Less Preferred: This alternative has some potential for odour impact to businesses during upset conditions and a significant construction cost of $3-5 million.	Least Preferred: This alternative has the greatest potential for odour disruption to businesses during upet conditions and a very significant construction cost of $15-20 million.	The do nothing alternative has no potential impact to businesses beyond what is currently experienced which is minimal and no cost.
Cultural Ranking	Equally Preferred: Alternative 1 involves no construction or disturbance to land and has no archaeological impact.	Equally Preferred: Alternatives 2 and 3 would be constructed in an area that has no archaeological potential or will be cleared prior to construction.	Equally Preferred: Alternatives 2 and 3 would be constructed in an area that has no archaeological potential or will be cleared prior to construction.	The do nothing alternative involves no construction or disturbance to land and has no archaeological impact.
Built Environment Ranking	Preferred: This alternative represents a continuation of existing operation and is considered straightforward to operate.	Less Preferred: This alternative involves a new process step at the landfill and is more complex that the current leachate management.	Least Preferred: Full treatment on-site is the most complex requiring a full compliment of trained staff.	The do nothing alternative is status quo and straightforward to operate.
Overall Leachate Ranking	**Preferred Leachate Treatment Alternative**			

4.4 Alternatives Methods Evaluation Subsequent Review

The alternative methods evaluation identified that site development Alternative 1 is the preferred landfill development option, that continuation of flaring of LFG is the preferred LFG management option and that the continuation of treating leachate at the BWTL is the preferred method for leachate treatment. Subsequent to this evaluation, the details of the landfill development, LFG and leachate treatment options were further developed and defined through **Appendix D6 - Design and Operations Report** and described in **Section 5.0** of this report. Upon completion of the Design and Operations Report, the alternative methods evaluations described in this section were reviewed with the fully defined preferred alternative to ensure that the evaluation results were still valid. It is confirmed that the minor changes identified while developing the design of the preferred alternative did not change the outcome of the evaluations.