4.0 Consideration of the Alternative Methods

This section 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**), managing landfill gas (LFG) [**Section 4.2**] and providing leachate treatment (**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.

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 between the alternatives and identifies a preferred option for site development, leachate treatment, and LFG management.

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, 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;
- Socio-Economic Environment - Social;
- Socio-Economic Environment - Economic;
- 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 within each of the discipline related subsequent sections.

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 **Section7.0** of this document.

4.1 Alternative Methods for Site Development

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

- Three (3) 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
- On-going surface and ground water monitoring indicates that the existing site is in compliance with all current MECP approval requirements.

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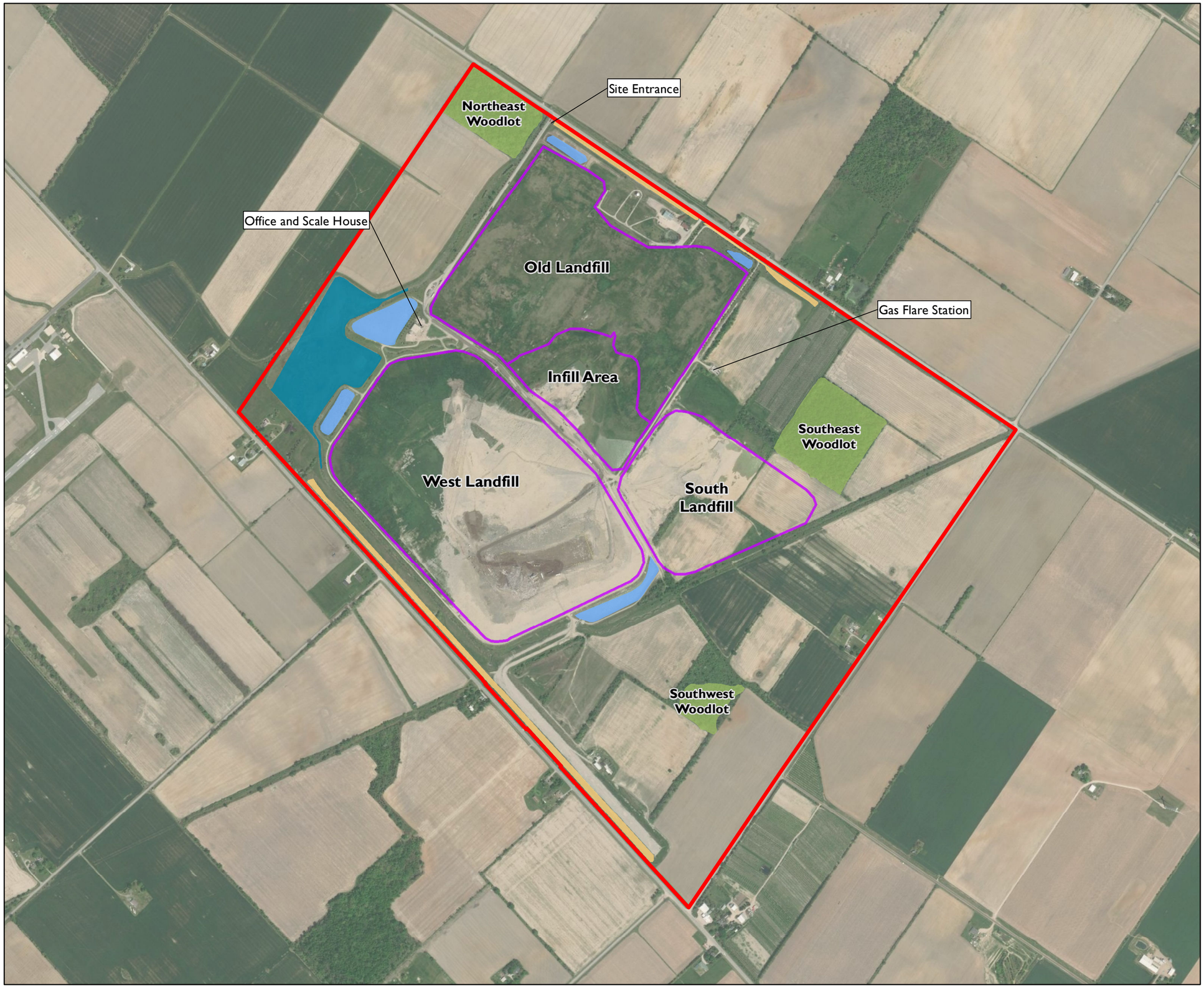

WASTE CONNECTIONS OF CANADA

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

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PROJECT: 152456

DATE: 2019-07-12

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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 including daily cover; plus an additional 1,300,000 m^3 for the final cover) 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[109] (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;
- Buffers and setbacks – space for appropriate buffers and setbacks have been allowed for in all development alternatives;
- 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

[109] Transport Canada (1991). *Chatham Airport Zoning Regulations, SOR/91-173*. Last Updated: January 30, 2019.

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. **FIGURES 4-2** to **4-7** show the layout of the site development alternative methods including depiction of Areas: A, B, C, and Old Landfill as well as cross-sections for each alternative. The calculations used to achieve the disposal capacity of 28.9 million m^3 for each of the three (3) alternatives are shown in **Table 4-1.**

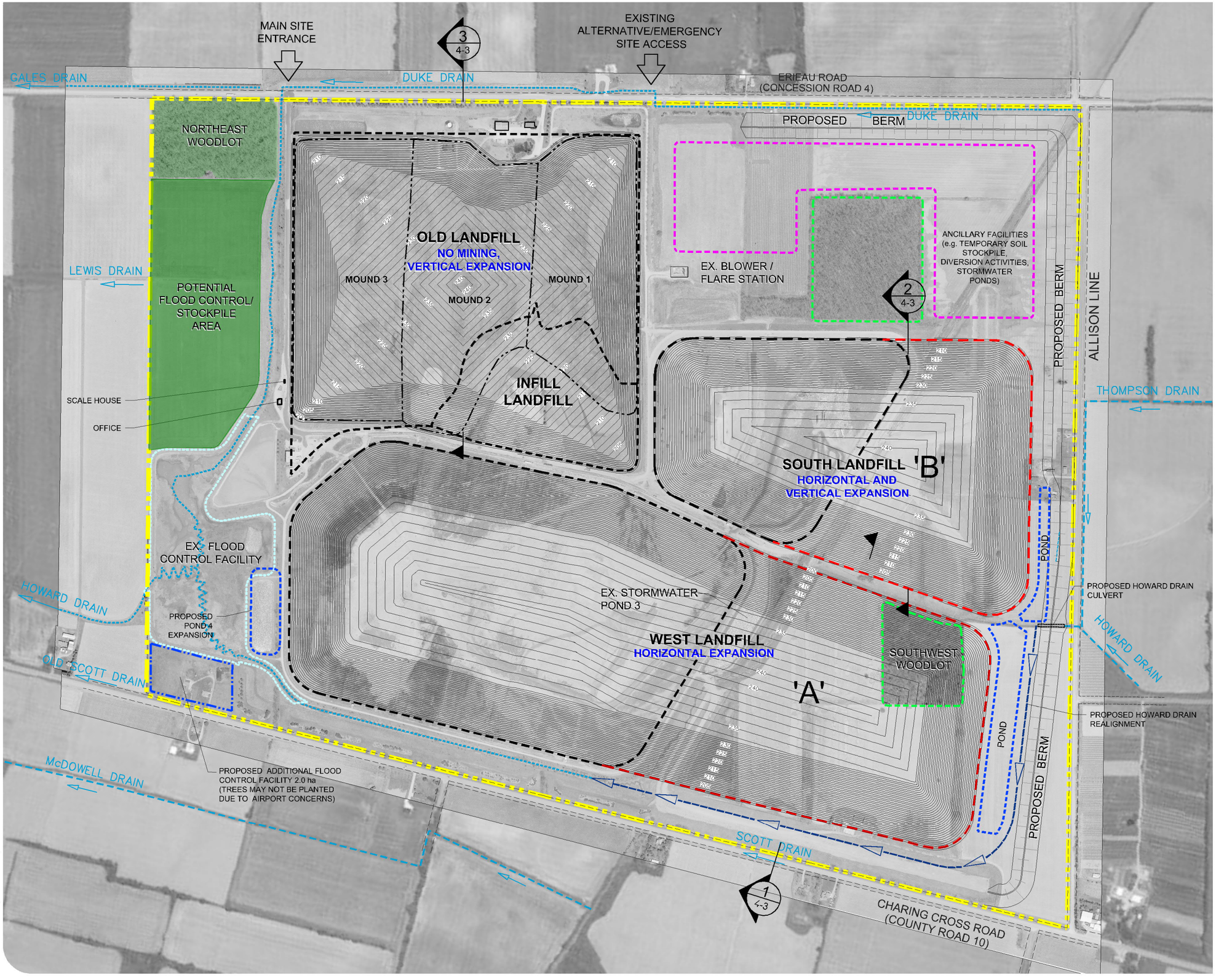
Table 4-1: Ridge Landfill Capacity Calculations

Alternative ID and Figure #	Composition	A (Mm^3)	B (Mm^3)	Reduced B (Mm^3)	C (Mm^3)	Old Landfill Mounds 1, 2 and 3 Mining (Mm^3)	Old Landfill Mound 2 Base (Mm^3)	Vertical Expansion of Old Landfill (Mm^3)	Disposal Capacity (Mm^3)
	Available Capacity (Mm^3)	13.2	8.6	6.4	7.1	1.4	0.5	7.2	
Alternative 1 Figure 4-2	Lateral expansions of West Landfill (Area A) and South Landfill (Area B), South Landfill (Area B) and Old Landfill vertical expansion.	13.2	8.6					7.2	28.9
Alternative 2 Figure 4-4	Lateral expansions of West Landfill (Area A) and South Landfill (Area "Reduced" B)*, South Landfill and Old Landfill vertical expansions. Landfill mining of Old Landfill.	13.2		6.4		1.4	0.5	7.2	28.9
Alternative 3 Figure 4-6	Lateral expansions of West Landfill (Area A) and South Landfill (Area B). Vertical expansion of the South Landfill and creation of new landform C.	13.2	8.6		7.1				28.9

Note: *For Alternative 2, the size of Area B is reduced from Alternatives 1 and 3 because of the capacity gained through landfill mining activity.
All calculations rounded to the nearest 0.1 Mm^3 (million cubic meters).
Volume of vertical expansion of South Landfill included in Area A and B calculations.

4.1.1.1 Site Development - Alternative 1

Description – Alternative 1 **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.



FILENAME: C:\PROJECTWISE\WORKING DIRECTORY\ACTIVE\40SKB\D0723223\152456-00-PLAN-FIG2.DWG

WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

PROPOSED EXPANSION FILL AREAS
Figure 4-2
Alternative 1
(HORIZONTAL AND VERTICAL EXPANSION)

- PROPERTY LIMITS
- APPROVED WASTE LIMIT
- OLD LANDFILL EXISTING WASTE LIMIT
- EXISTING WATER COURSE
- PROPOSED WASTE LIMIT FOR EXPANSION AREAS
- PROPOSED STORMWATER POND
- PROPOSED WATERCOURSE
- PROPOSED ROAD
- EXISTING WOODLOT AREAS

0 100 200 400m

TRUE NORTH

PLAN NORTH

MAP/DRAWING INFORMATION
MAPPING FROM THE BASE MAP CO. LTD., MAY 1, 2018

CREATED BY: SKB
CHECKED BY:
DESIGNED BY: FG

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PROJECT: 15 2456

DATE: 05/31/17

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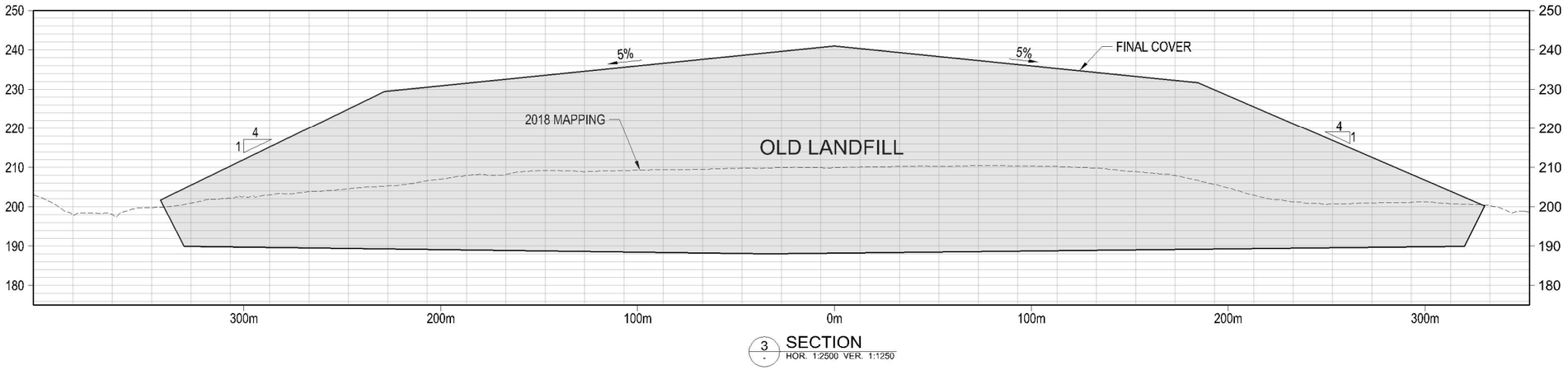

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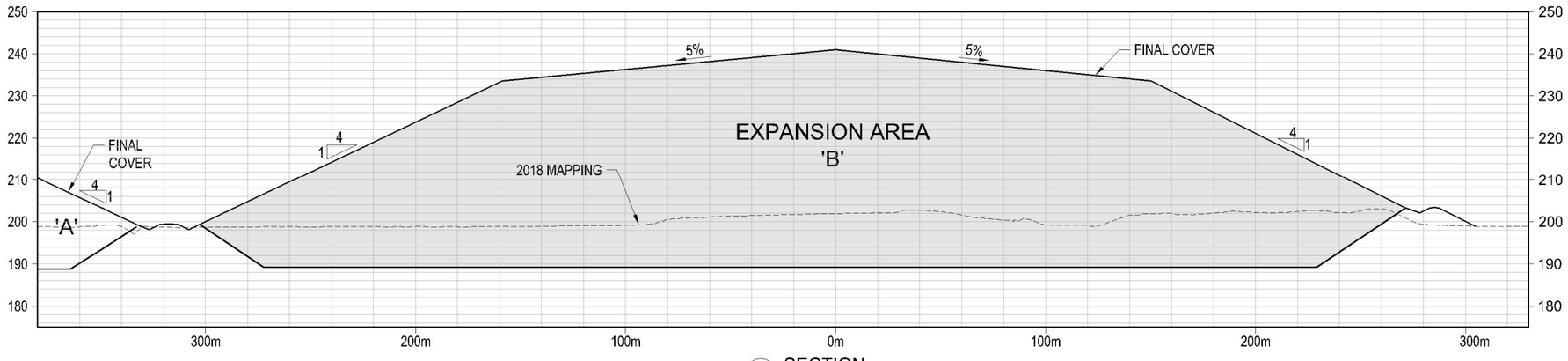

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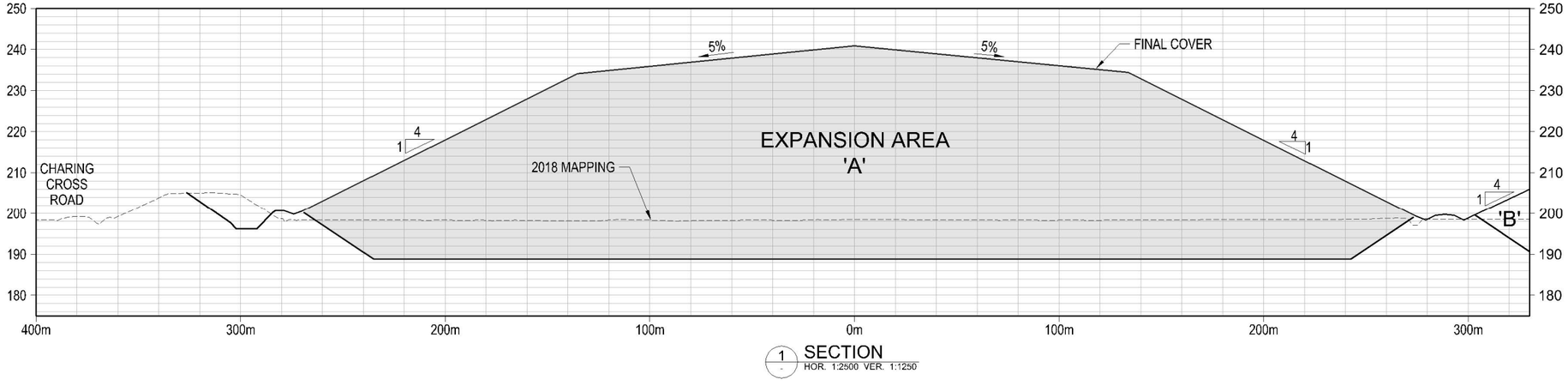

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WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

PROPOSED EXPANSION FILL AREAS
FIGURE 4-3
CROSS-SECTIONS
ALTERNATIVE 1
(HORIZONTAL AND VERTICAL EXPANSION)

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4.1.1.2 Site Development - Alternative 2

Description – Alternative 2 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., 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 – Other Supporting Documents. 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.	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.

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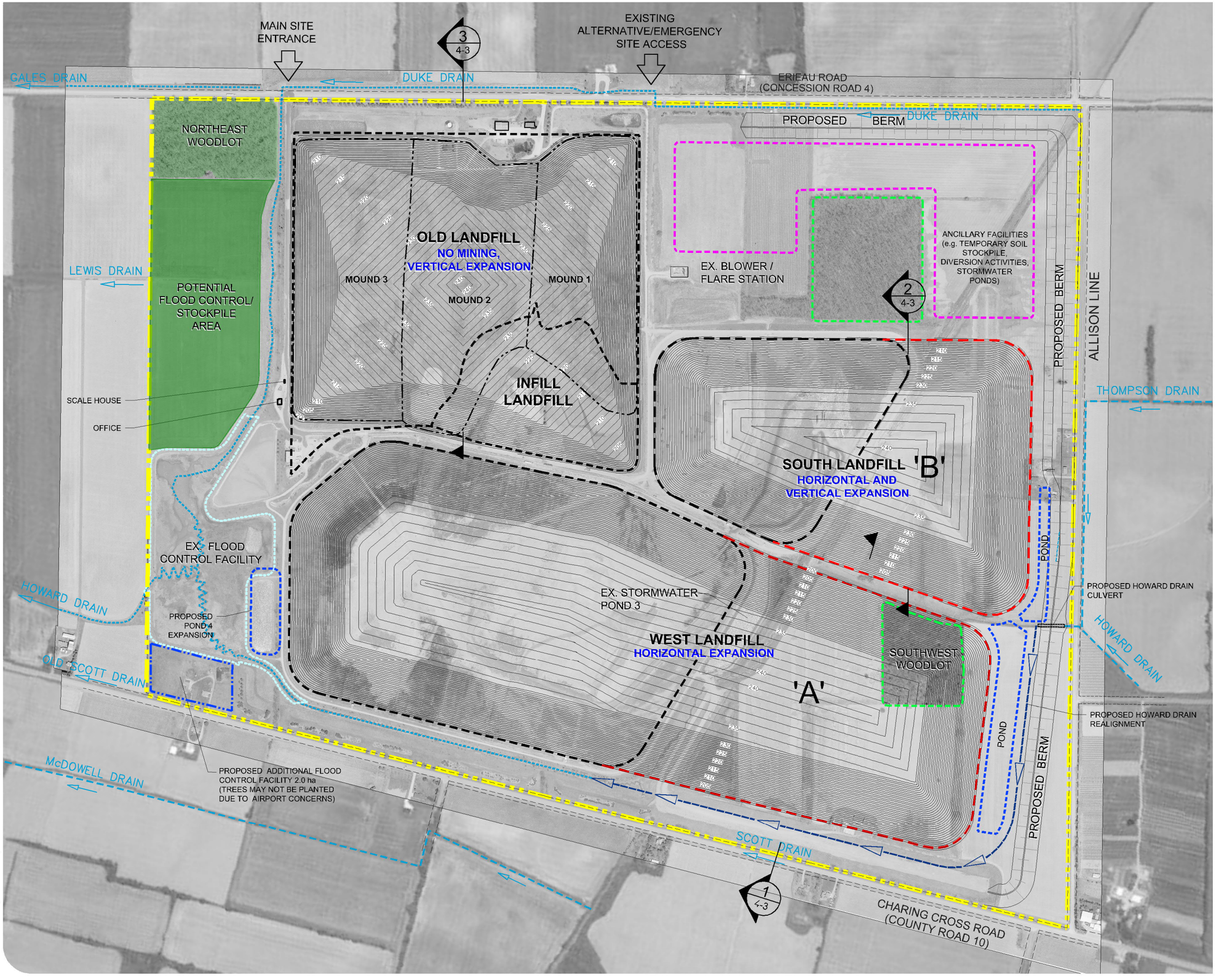

FILENAME: C:\PROJECTWISE\WORKING DIRECTORY\ACTIVE\40SKB\D0723223\152456-00-PLAN-FIG2.DWG

WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

PROPOSED EXPANSION FILL AREAS
Figure 4-4
Alternative 2
(HORIZONTAL AND VERTICAL EXPANSION)

- PROPERTY LIMITS
- APPROVED WASTE LIMIT
- OLD LANDFILL EXISTING WASTE LIMIT
- EXISTING WATER COURSE
- PROPOSED WASTE LIMIT FOR EXPANSION AREAS
- PROPOSED STORMWATER POND
- PROPOSED WATERCOURSE
- PROPOSED ROAD
- EXISTING WOODLOT AREAS

0 100 200 400m

TRUE NORTH

PLAN NORTH

MAP/DRAWING INFORMATION
MAPPING FROM THE BASE MAP CO. LTD., MAY 1, 2018

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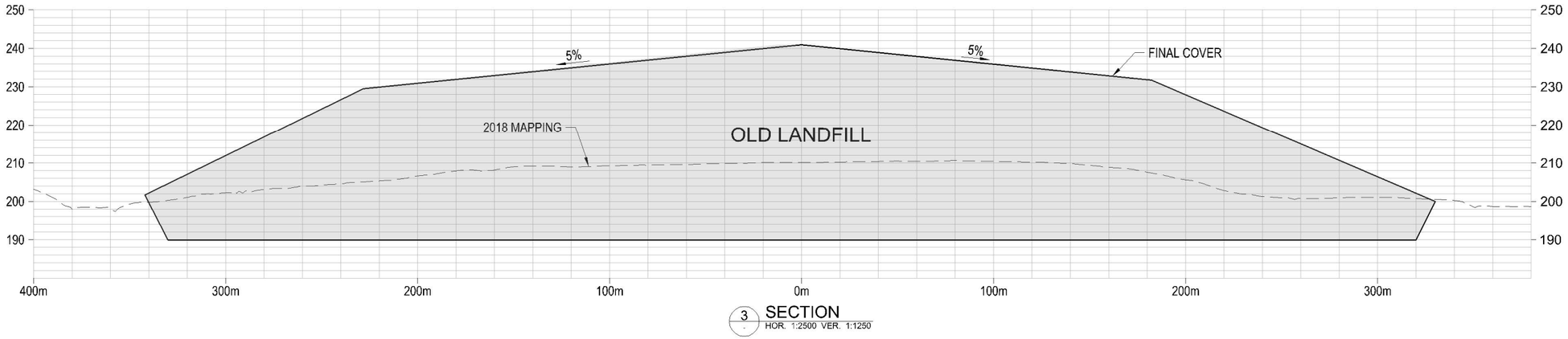

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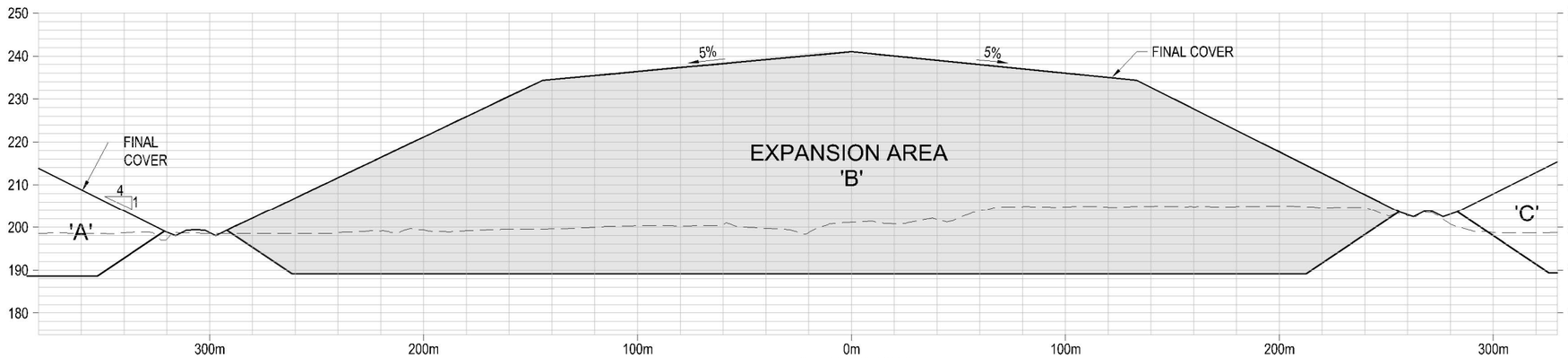

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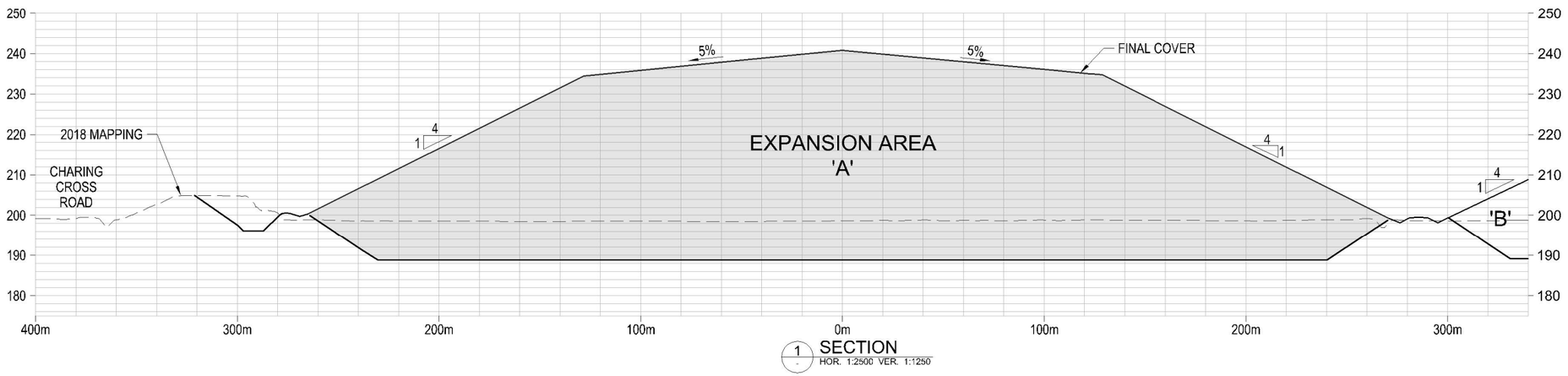

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WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

PROPOSED EXPANSION FILL AREAS
FIGURE 4-5
CROSS-SECTIONS - ALTERNATIVE 2
(HORIZONTAL AND VERTICAL EXPANSION PLUS LANDFILL MINING)

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4.1.1.3 Site Development - Alternative 3

Description – Alternative 3 **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.

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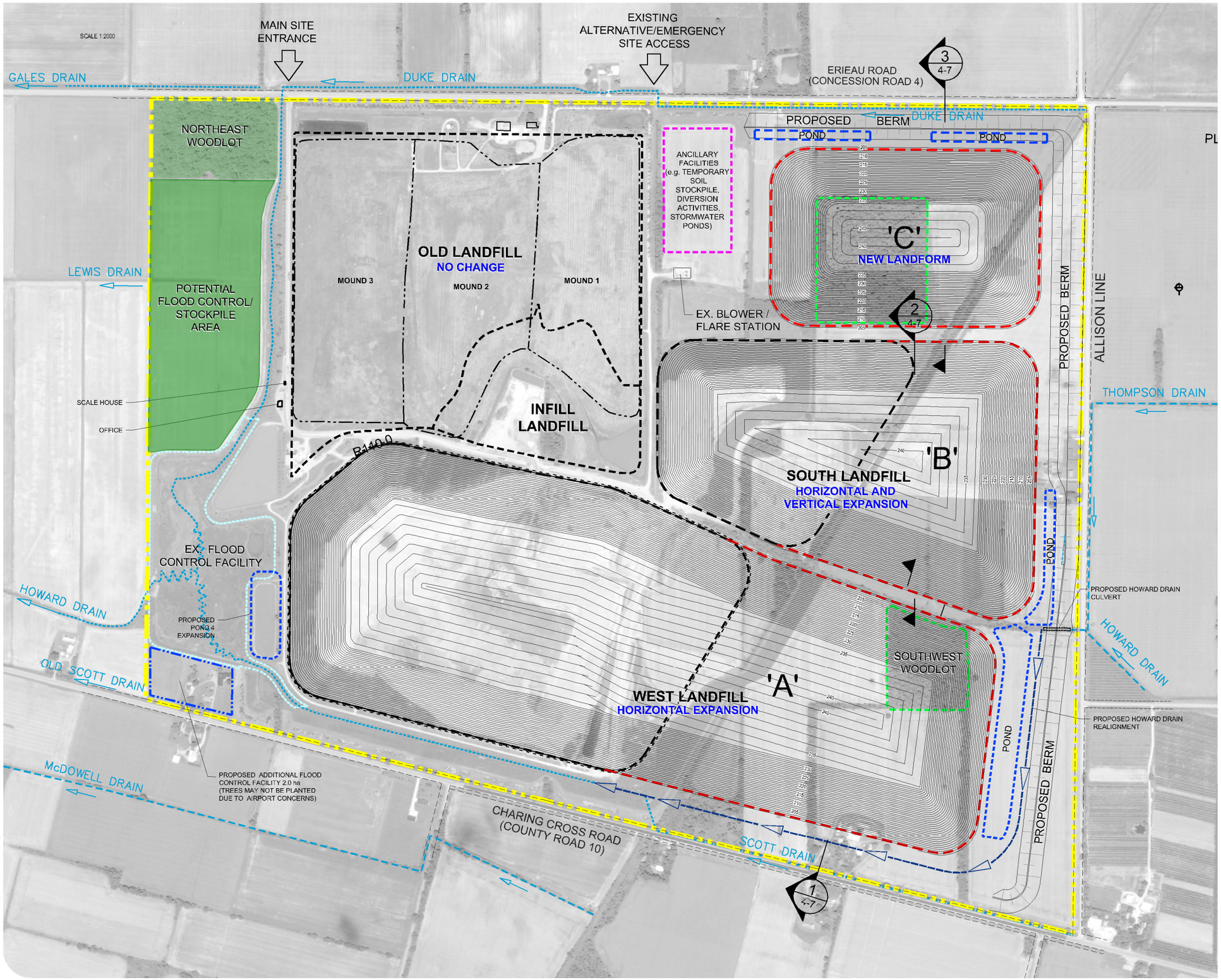

FILENAME: C:\PROJECTWISE\WORKING DIRECTORY\ACTIVE\40SKB\D0723223\152456-00-PLAN-FIG4.DWG

WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

PROPOSED EXPANSION FILL AREAS
Figure 4-6
Alternative 3
(HORIZONTAL EXPANSION)

- PROPERTY LIMITS
- APPROVED WASTE LIMIT
- OLD LANDFILL EXISTING WASTE LIMIT
- EXISTING WATER COURSE
- PROPOSED WASTE LIMIT FOR EXPANSION AREAS
- PROPOSED STORMWATER POND
- PROPOSED WATERCOURSE
- PROPOSED ROAD
- EXISTING WOODLOT AREAS

0 100 200 400m

TRUE NORTH

PLAN NORTH

MAP/DRAWING INFORMATION
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PROJECT: 15 2456

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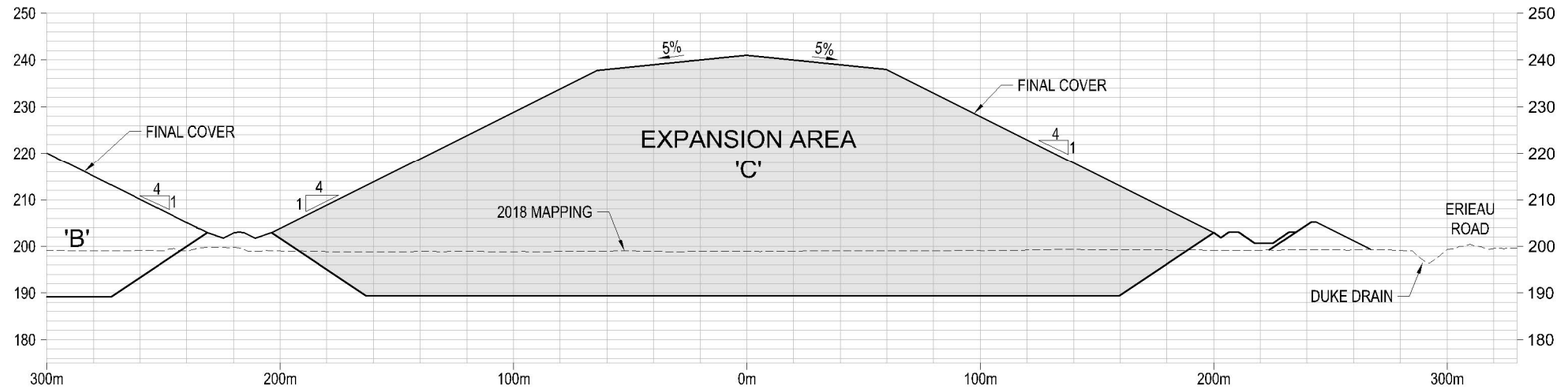

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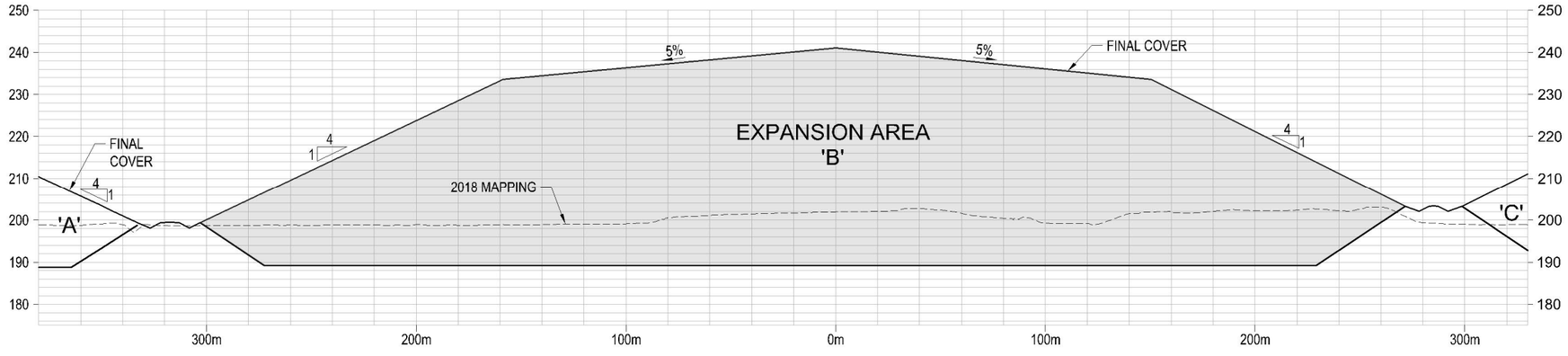

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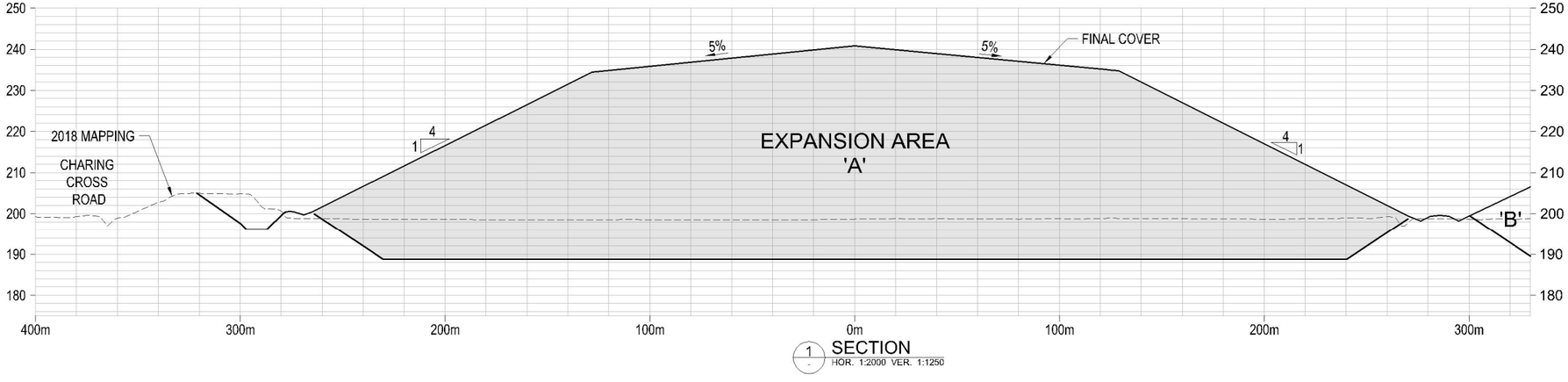

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WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

PROPOSED EXPANSION FILL AREAS
FIGURE 4-7
CROSS-SECTIONS
ALTERNATIVE 3
(HORIZONTAL EXPANSION)

MAP/DRAWING INFORMATION
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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.

4.1.2.1 Natural Environment – Biological (Terrestrial)

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

4.1.2.1.1 Terrestrial Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Potential for effect to terrestrial wildlife and habitat during construction and operation.	• Area and type of wildlife habitat such as significant woodlots, hedgerows, wetlands, etc. to be removed or disrupted.	• Existing and proposed facility characteristics. • Natural Environment Existing Conditions Report. • Aerial photography & GIS mapping. • ELC mapping. • Official Plan mapping. • Communication with agencies (e.g., MNRF) and knowledgeable citizens.	• There are minimal features on-site as it is an active landfill property. However, in the Chatham Kent context woodlots in particular are important. The woodlots and meadows provide habitat for wildlife species.
	• Wildlife with the potential to be effected during construction and operation.	• Natural Environment Existing Conditions Report. • Wildlife surveys.	• This criterion addresses the wildlife species that would be impacted by the site expansion.

Criteria	Indicators	Data Sources	Rationale
Potential for effect on habitat of Endangered or Threatened species during construction.	• Area of habitat for endangered or threatened species on-site.	• Natural Environment Existing Conditions Report.	• This criterion addresses the importance of endangered species.
Potential effect on medicinal or other culturally sensitive species of importance to Indigenous Communities and Organizations during construction.	• Area and type of species of importance to be removed on-site.	• Existing and proposed facility characteristics. • Natural Environment Existing Conditions Report. • Aerial photography & GIS mapping. • ELC mapping. • Official Plan mapping. • Communication with agencies (e.g., MNRF) and knowledgeable citizens.	• This criterion was added to reflect the importance of species to Indigenous Communities and Organizations.

4.1.2.1.2 Overview of Terrestrial Considerations and Assumptions

There are limited areas of significant terrestrial habitat on-site beyond the northeast, southeast and southwest woodlots and these woodlots are adjacent to an existing landfill. Based on a review of the Chatham-Kent Official Plan and available MNRF data, there are no provincial parks, conservation reserves, Areas of Natural and Scientific Interest (ANSIs) or wetlands within the 1 km Study Area. Seven (7) woodlots (including the northeast, southeast and southwest woodlots on the Ridge Landfill property) are within the 1 km Study Area.

The following highlights key information about the on-site terrestrial systems that were considered in the evaluation of alternative methods:

- The southwest woodlot - 39% of this southwest woodlot was associated with a deciduous thicket and no Species at Risk (SAR), Species of Conservation Concern (SCC) and/or Significant Wildlife Habitat (SWH) were identified;
- The southeast woodlot - Bat acoustic monitoring identified SAR bat activity in association with the southeast woodlot. This woodlot provides habitat for SAR bats

and was assessed as significant wildlife habitat for special concern and rare wildlife species (stiff cowbane and eastern wood-pewee); and bat maternity colonies;

- The northeast woodlot - Assessed as candidate significant wildlife habitat for special concern and rare wildlife species; and bat maternity colonies. The northeast woodlot is not a candidate for removal in any of the site development alternatives considered;
- Portion of the existing flood control facility was assessed as significant wildlife habitat for special concern and rare wildlife species (pale avens);
- On-site hedgerows were assessed, determined to have no significance and were removed based on a letter of opinion from the MNRF; and
- Meadow habitat exists on the completed landfill sections.

The following significant species were observed during field work associated with this project and considered in the evaluation of alternative methods:

- Eastern meadowlark (threatened under the ESA) was observed within the meadows associated with the Old and West Landfills;
- Stiff cowbane was observed within the northeast and southeast woodlot;
- Pale avens was observed within a portion of the existing flood control facility;
- Barn swallows were observed during breeding bird surveys and nests were observed in association with on-site agricultural buildings;
- Eastern wood-pewee was observed within the southeast woodlot; and
- Bats were heard during the acoustical surveys in the southeast woodlot.

As noted in **Section 3.1**, the on-site biology Study Area extends 120 m beyond the site limits to ensure the assessment of impacts on adjacent lands of significant habitat. Off-site terrestrial effects were not considered as there will be no change to the haul route and the vehicle traffic volumes (construction and waste vehicles) will not significantly change from today.

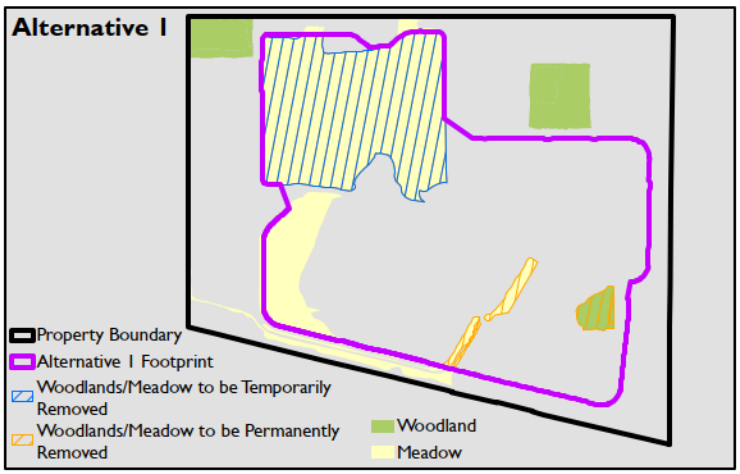
It is noted that input from WIFN identified that intact and healthy native ecosystems are considered culturally relevant.

The following section shows the three (3) alternatives and their potential impact on terrestrial systems.

4.1.2.1.3 Terrestrial Net Effects

4.1.2.1.3.1 Site Development Alternative 1

4.1.2.1.3.1.1 Terrestrial Wildlife and Habitat



Potential Effect – The design associated with this alternative would require the removal of the 3.76 ha southwest woodlot which includes removal of approximately 2.07 ha of Moist Green Ash Hardwood Deciduous Forest, 0.23 ha of Fresh Black Walnut Deciduous Forest and 1.46 ha of Gray Dogwood Deciduous Thicket. While the southwest woodlot does help to support local birds and wildlife, it was identified as having limited ecological function, lower quality and no significant habitat. Construction of Site Development Alternative 1 will avoid the northeast and southeast woodlots.

In addition to removal of the smaller southwest woodlot, Site Development Alternative 1 would require temporary removal of up to 50 ha of regularly maintained, meadow habitat associated with the vertical expansion of the Old Landfill. There would also be a permanent removal of a small amount (approximately 3.5 ha) of non-contiguous meadow habitat.

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 anticipated from site construction or operation of the proposed expansion.

Site Development Alternative 1 involves the temporary displacement of grassland breeding bird habitat.

Mitigation – Compensation for woodlot removal would be provided at a 2:1 ratio, planting two (2) trees for every tree removed. Approximately 3,000 trees will be planted in association with the Chippewas of the Thames and 1,000 trees in association with the Oneida Nation of the Thames on their lands which are in the same ecoregion as the Ridge Landfill. Approximately 7,000 trees will be planted on Waste Connections owned lands east of Erieau Road across from the

Ridge Landfill adjacent to an existing woodlot which over time will become a larger woodlot feature. It is recognized that it will take time for the trees and understory to grow; as such discussions have been initiated about replanting as soon as possible to plant before the southwest woodlot is removed. Removal of trees and any other vegetation will be completed within the appropriate/regulated timing window to avoid nesting birds/roosting bats.

The removal of the contiguous meadow habitat is considered temporary as once the vertical expansion of the Old Landfill is complete it will be capped and re-seeded. Existing areas on-site and the new berms will also be naturalized with native species which will add habitat and balance to the temporary removal of existing meadow. Waste Connections will work with Chatham-Kent, WIFN, the Lower Thames Valley Conservation Authority and others as appropriate to determine whether naturalization of other parts of the site can be implemented.

Net Effect – Construction will require removal of the southwest woodlot, a small section of non-contiguous meadow and up to 50 ha of regularly maintained, contiguous meadow. With mitigation over time both the woodlot and meadow will be re-established so there are no anticipated net effects on terrestrial systems during construction, operation or post closure.

4.1.2.1.3.1.2 Endangered or Threatened Species Habitat

Potential Effect – To complete the vertical expansion of the Old Landfill up to 50 ha of regularly maintained, contiguous meadow habitat will require temporary removal. This is habitat for the eastern meadowlark. The removal of on-site agricultural buildings could disrupt barn swallows. Site Development Alternative 1 involves the temporary displacement of grassland breeding bird habitat.

Mitigation – Vegetation removal will be subject to appropriate timing windows and a qualified person will be on-site during vegetation removals. The habitat will be replaced once the Old Landfill expansion is complete and re-seeded. Given the size of the parcel, the fact that the removal is temporary and the meadows location within an operating landfill site this effect is not considered significant.

Prior to removal of agricultural buildings or culverts an environmental monitor will assess for the presence of barn swallow nest(s). In the event barn swallow nest(s) are observed, the removal of the structures is a registerable activity under s.23.5 of O.*Reg. 242/08* as long as the rules in the regulation can be met.

The MECP has determined that the activities associated with the project as currently proposed, will likely not contravene Section 9 (species protection) and/or Section 10 (habitat protection) of the *Endangered Species Act* (ESA)[110] for the species at risk listed above provided the recommendations detailed in their correspondence of September 13, 2019 (see Appendix B – Record of Consultation) are implemented. Waste Connections will implement the following mitigation noted in this correspondence:

- Impacts to the southeast woodlot and meadow community must occur outside the bat active and breeding bird seasons;
- Section 23.6 (bobolink, eastern meadowlark) of O.*Reg. 242/08* must be followed, including online registration of the project, development of a habitat management plan and creation of new habitat;
- All on-site personnel must be made aware of the potential presence of eastern foxsnake in the area, its habitat and the protection afforded under the ESA 2007[111] prior to conducting work on the site;
- Any species listed as endangered, threatened or on the Species at Risk in Ontario (SARO) List that are encountered at the project location will be protected from all harm and harassment;
- Any SAR individual (presumed to be unharmed) that is incidentally encountered in the project location must be allowed to leave of its own accord. Activities within 30 metres must cease until the individual disperses;
- If an injured or deceased SAR is found, the specimen must be placed in a non-airtight container that is maintained at an appropriate temperature and a Wildlife Custodian (authorized under the *Fish and Wildlife Conservation Act*) should be contacted. MECP must be contacted immediately after the occurrence;
- Any SAR individual that is present at the project site should be reported to MECP staff within 48 hours of the observation or the next working day, whichever comes first;
- The use of mesh or netting type stabilization material must not be used for erosion control measures;
- During active season for snake species, individuals may find and occupy materials and equipment stored on-site; therefore, a clean, debris-free work site should be

[110] Government of Ontario (2007). *Endangered Species Act*, 2007, S.O. 2007, c. 6. Available at: https://www.ontario.ca/laws/statute/07e06
[111] Government of Ontario (2007). *Endangered Species Act*, 2007, S.O. 2007, c. 6. Available at: https://www.ontario.ca/laws/statute/07e06

maintained (e.g., storage of flat materials like plywood and rubber mats in open areas should be avoided);

- Care should be taken to limit the creation and duration of debris stockpiles (e.g. soil, lumber, topsoil, bricks, other construction materials, etc.) with the development footprint to ensure that no potential SAR snake habitat is created during the construction period; and
- Barn swallows nest in burrows in natural and human-made settings where there are vertical faces in silt and sand deposits such as stockpiled sand/silt material and excavated trenches. Construction activities should avoid the creation of vertical faces and stockpiles or excavated areas. The Best Management Practices for the Protection, Creation and Maintenance of Barn Swallow Habitat in Ontario[112] should be followed throughout the project.

Net Effect – With the appropriate mitigation measures the temporary removal of habitat for the eastern meadowlark and the removal of potential barn swallow habitat during construction is not anticipated to result in a significant net effect. There are no anticipated net effects on endangered or threatened species habitat during operation or post closure.

4.1.2.1.3.1.3 Medicinal or Culturally Sensitive Species

Potential Effect – As intact and healthy native ecosystems, any healthy woodlots on-site are considered culturally relevant and important to Indigenous Communities and Organizations. This alternative removes one (1) woodlot and some meadow habitat. Removal of these features could be viewed as a potential impact to species of importance to Indigenous Communities and Organizations. However it is noted that the southwest woodlot has limited ecological function and no significant habitat and that both the woodlot and meadow are part of an active landfill site.

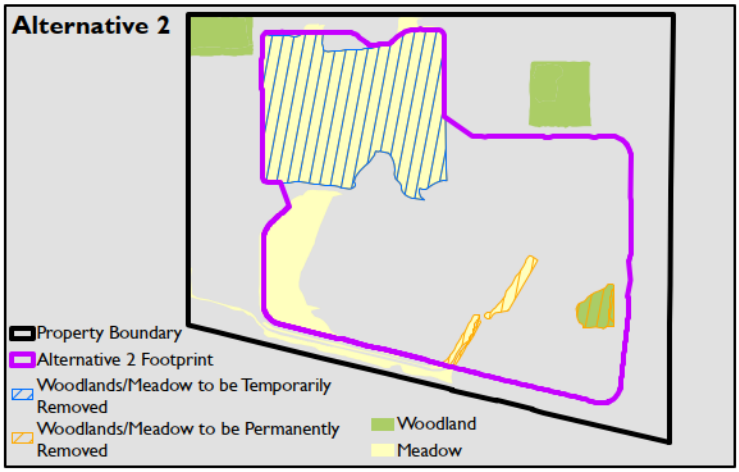
Mitigation – As a result of discussions with WIFN, it has been determined that an appropriate way to incorporate Indigenous Community knowledge of native species into the replanting/restoration would be to involve Indigenous Community members in the replanting/restoration. Waste Connections will seek opportunities to engage WIFN or other Indigenous communities in the replanting/restoration work.

[112] Ministry of Natural Resources and Forestry (2017). Best Management Practices for the Protection, Creation and Maintenance of Barn Swallow Habitat in Ontario. Queen's Printer for Ontario, 2017. 37 pp.

Net Effect – The involvement of Indigenous Community members in the replanting/restoration during planning and construction will provide valuable insights into appropriate native species resulting in natural systems outside of the active landfill site that can thrive as healthy native ecosystems into the future. There is no anticipated net effect given appropriate mitigation. There are no anticipated net effects during operation or post closure.

4.1.2.1.3.2 Site Development Alternative 2

4.1.2.1.3.2.1 Terrestrial Wildlife and Habitat



Potential Effect – The design associated with Site Development Alternative 2 would require the removal of the 3.76 ha southwest woodlot which includes removal of approximately 2.07 ha of Moist Green Ash Hardwood Deciduous Forest, 0.23 ha of Fresh Black Walnut Deciduous Forest and 1.46 ha of Gray Dogwood Deciduous Thicket. While the southwest woodlot does help to support local birds and wildlife, it was identified as having limited ecological function, lower quality and no significant habitat. Construction of Site Development Alternative 2 will avoid the northeast and southeast woodlots. In addition to removal of the smaller southwest woodlot Site Development Alternative 2 would require temporary removal of up to 50 ha of regularly maintained meadow habitat associated with the vertical expansion of the Old Landfill. There would also be a permanent removal of a small amount (approximately 3.5 ha) of non-contiguous meadow habitat.

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 anticipated from site construction or operation of the proposed expansion.

Site Development Alternative 2 involves the temporary displacement of grassland breeding bird habitats.

Mitigation – Compensation for woodlot removal would be provided at a 2:1 ratio, planting two (2) trees for every tree removed. Approximately 3,000 trees will be planted in association with

the Chippewas of the Thames (COTTFN) and 1,000 trees in association with the Oneida Nation of the Thames on their lands which are in the same ecoregion as the Ridge Landfill. Approximately 7,000 trees will be planted on Waste Connections owned lands east of Erieau Road across from the Ridge Landfill adjacent to an existing woodlot which over time will become a larger woodlot feature. It is recognized that it will take time for the trees and understory to grow; as such discussions have been initiated about replanting as soon as possible to plant before the southwest woodlot is removed. Removal of trees and any other vegetation will be completed within the appropriate timing window to avoid nesting birds/roosting bats.

The removal of the contiguous meadow habitat is considered temporary as once the vertical expansion of the Old Landfill is complete it will be capped and re-seeded. Existing areas on-site and the new berms will also be naturalized with native species which will add habitat and balance to the temporary removal of the existing meadow. Waste Connections will work with Chatham-Kent, WIFN, the LTVCA and others as appropriate to determine whether naturalization of other parts of the site can be implemented.

Net Effect – Construction of Site Development Alternative 2 will require removal of the southwest woodlot, a small section of non-contiguous meadow and up to 50 ha of regularly maintained, contiguous meadow. With mitigation over time both the woodlot and meadow will be re-established so there are no anticipated net effects on terrestrial systems during construction, operation or post closure.

4.1.2.1.3.2.2 Endangered or Threatened Species Habitat

Potential Effect – To complete the vertical expansion of the Old Landfill for Site Development Alternative 2 up to 50 ha of regularly maintained meadow habitat will be temporarily removed. This is habitat for the eastern meadowlark. The removal of on-site agricultural buildings could disrupt barn swallows. Alternative 2 involves the temporary displacement of grassland breeding bird habitats.

Mitigation – The MECP has determined that the activities associated with the project as currently proposed, will likely not contravene Section 9 (species protection) and/or Section 10 (habitat protection) of the *Endangered Species Act*[113] for the species at risk listed above provided the recommendations detailed in their correspondence of September 13, 2019 are implemented. This mitigation, described under Alternative 1 above would also be implemented for Alternative 2.

[113] Government of Ontario (2007). *Endangered Species Act*, 2007, S.O. 2007, c. 6.

Vegetation removal will be subject to appropriate timing windows and a qualified person will be on-site during vegetation removals. The habitat will be replaced once the Old Landfill expansion is complete and re-seeded. Given the size of the parcel, the fact that the removal is temporary and the meadows location within an operating landfill site, this effect is not considered significant.

Prior to removal of agricultural buildings or culverts an environmental monitor will assess for the presence of barn swallow nest(s). In the event barn swallow nest(s) are observed, the removal of the structures is a registerable activity under s.23.5 of *O.Reg. 242/08* as long as the rules in the regulation can be met.

Net Effect – With the appropriate mitigation measures the temporary removal of habitat for the eastern meadowlark and the removal of potential barn swallow habitat during construction of Site Development Alternative 2 is not anticipated to result in a significant net effect. There are no anticipated net effects on endangered or threatened species habitat during operation or post closure.

4.1.2.1.3.2.3 Medicinal or Culturally Sensitive Species

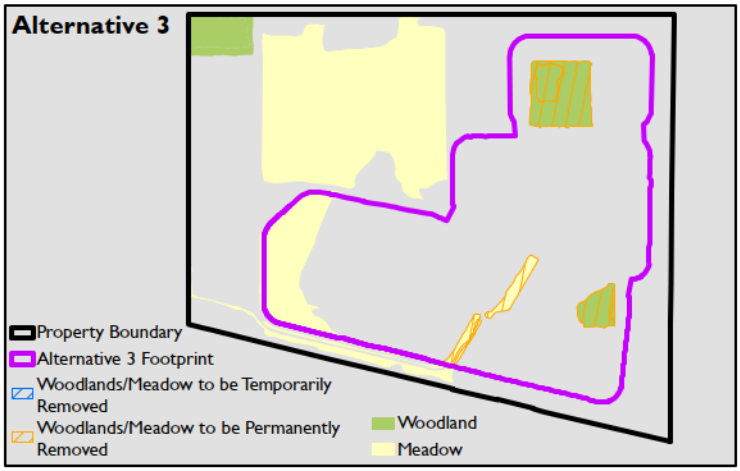
Potential Effect – As intact and healthy native ecosystems, any healthy woodlots on-site are considered culturally relevant and important to Indigenous Communities and Organizations. Site Development Alternative 2 removes one (1) woodlot and temporarily some meadow habitat. Removal of these features could be viewed as a potential impact to species of importance to Indigenous Communities and Organizations. However it is noted that the southwest woodlot has limited ecological function and no significant habitat and that both the woodlot and meadow are part of an active landfill site.

Mitigation – As a result of discussions with WIFN, it has been determined that an appropriate way to incorporate Indigenous Community knowledge of native species into the replanting/restoration would be to involve Indigenous Community members in the replanting/restoration. Waste Connections will seek opportunities to engage WIFN or other Indigenous communities in the replanting/restoration work.

Net Effect – The involvement of Indigenous Community members in the replanting/restoration during planning and construction will provide valuable insights into appropriate native species resulting in natural systems outside of the active landfill site that can thrive as healthy native ecosystems into the future. There is no anticipated net effect given appropriate mitigation. There are no anticipated net effects during operation or post closure.

4.1.2.1.3.3 Site Development Alternative 3

4.1.2.1.3.3.1 Terrestrial Wildlife and Habitat



Potential Effect – The design associated with Site Development Alternative 3 would require the removal of the 3.76 ha southwest woodlot which includes removal of approximately 2.07 ha of Moist Green Ash Hardwood Deciduous Forest, 0.23 ha of Fresh Black Walnut Deciduous Forest and 1.46 ha of Gray Dogwood Deciduous Thicket. While the southwest woodlot does help to support local birds and wildlife, it was identified as having limited ecological function, lower quality and no significant habitat.

The footprint expansion for this alternative will also permanently remove the 8 ha higher ecologically functioning, higher quality southeast woodlot which includes approximately 3.51 ha of Swamp Maple Mineral Deciduous Swamp, 1.0 ha of White Elm Mineral Deciduous Swamp and 0.65 ha of Fresh-Moist Shagbark Hickory Deciduous Forest/Dry-Fresh Basswood Deciduous Forest. The southeast woodlot provides significant wildlife habitat for species of special concern, bat maternity colonies as well as species at risk bats.

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 anticipated from site construction or operation of the proposed expansion.

Site Development Alternative 3 involves the permanent displacement of bats and bat habitat.

Mitigation – Compensation for woodlot removal would be provided at a 2:1 ratio, planting two (2) trees for every tree removed. For the southwest woodlot, approximately 3,000 trees will be planted in association with the Chippewas of the Thames and 1,000 trees in association with the Oneida Nation of the Thames on their lands which are in the same ecoregion as the Ridge Landfill. Approximately 7,000 trees will be planted on Waste Connections owned lands east of Erieau Road across from the Ridge Landfill adjacent to an existing woodlot which over time will become

a larger woodlot feature. For compensation for the removal of the southeast woodlot, approximately 25,000 additional trees would need to be planted.

It is recognized that it will take time for the trees and understory to grow; as such discussions have been initiated about replanting as soon as possible before the southwest woodlot is removed. Removal of trees and any other vegetation will be completed within the appropriate timing window to avoid nesting birds/roosting bats.

Net Effect – Construction of Site Development Alternative 3 will require the removal of the southwest and southeast woodlots. The effect is considered temporary as with mitigation over time the woodlot will be re-established. It is noted that the southeast woodlot provides significant habitat and that it will take a long period of time for the replanted woodlots to provide this same form and function.

There are no anticipated net effects on terrestrial systems during operation or post closure.

4.1.2.1.3.3.2 Endangered or Threatened Species Habitat

Potential Effect – Site Development Alternative 3 would require the removals of the southeast and southwest woodlots. The habitats for endangered or threatened species identified on-site are 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. Site Development Alternative 3 requires permanent removal of SAR bat habitat. Given that the southeast woodlot is confirmed habitat for SAR bats, an Overall Benefit Permit under s.17(2)c of the ESA would be required in support of the woodlot removal. Barn swallows were observed during breeding bird surveys and nests were observed in association with on-site agricultural buildings which will be removed.

Mitigation – A s.17(2) permit under the ESA (Overall Benefit Permit) is required prior to the removal of the southwest woodlot. A permit for the southeast woodlot removal would likely include habitat compensation at a minimum of 2:1 ratio, monitoring commitments as well as possible research components specific to SAR bats.

Vegetation removal will be subject to appropriate timing windows and a qualified environmental monitoring person will be on-site during vegetation removals.

Prior to removal of agricultural buildings or culverts an environmental monitor will assess for the presence of barn swallow nest(s). In the event barn swallow nest(s) are observed, the removal of

the structures is a registerable activity under s.23.5 of *O.Reg. 242/08* as long as the rules in the regulation can be met.

The mitigation recommended by MECP to avoid SAR as described under Site Development Alternative 1 above would also be implemented for this alternative.

Net Effect – Removal of the southeast woodlot to construct Site Development Alternative 3 results in the permanent removal of SAR bat habitat. There are no anticipated net effects on endangered or threatened species habitat during operation or post closure.

4.1.2.1.3.3.3 Medicinal or Culturally Sensitive Species

Potential Effect – As intact and healthy native ecosystems, any healthy woodlots on-site are considered culturally relevant and important to Indigenous Communities and Organizations. Site Development Alternative 2 removes two (2) woodlots. Removal of these features could be viewed as a potential impact to species of importance to Indigenous Communities and Organizations particularly as the southeast woodlot provides habitat for SAR bats. It is noted that the woodlots and meadow are part of an active landfill site.

Mitigation – As a result of discussions with WIFN, it has been determined that an appropriate way to incorporate Indigenous Community knowledge of native species into the replanting/restoration would be to involve Indigenous Community members in the replanting/restoration. Waste Connections will seek opportunities to engage WIFN or other Indigenous Communities in the replanting/restoration work.

Net Effect – The involvement of Indigenous Community members in the replanting/restoration during planning and construction will provide valuable insights into appropriate native species resulting in natural systems outside of the active landfill site that can thrive as healthy native ecosystems into the future. Given that this alternative involves removal of the southeast woodlot which provides habitat to SAR bats it is considered to result in some net effects during construction. With appropriate mitigation there are no anticipated net effects during operation or post closure.

4.1.2.2 Natural Environment – Biological (Aquatic)

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

4.1.2.2.1 Aquatic Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Aquatic			
Potential for effects to endangered aquatic species and habitat during construction.	• Amount and type of aquatic systems (i.e., ponds, drains) that would be displaced on-site. • Presence of endangered aquatic species.	• Natural Environment Existing Conditions Report. • Existing and proposed facility characteristics. • Communication with MNRF and LTVCA.	• There are drains on-site that may need to be moved for the site development alternatives.

4.1.2.2.2 Overview of Aquatic Considerations and Assumptions

All watercourses that cross the site are municipal drains, identified as intermittent, ephemeral or unclassified. Municipal drains are common in Chatham-Kent and drains in this area have been in place for many decades. The drains are classified as warm water systems. The Howard Drain is the largest of the drains on-site. The on-site drains were successfully moved in 1999 to accommodate the landfill expansion at that time.

A 2016 fisheries site assessment identified low sensitivity fish and fish habitat throughout all the on-site drains. The habitat in the drain varies from being flat and channelized to meandering with in-stream vegetation to algae covered. Fish species observed in the drain include creek chub, pumpkinseed, goldfish and emerald shiner none of which are considered species at risk federally or provincially.

All on-site ponds are operated as offline stormwater ponds for the landfill and not considered to be fish habitat.

4.1.2.2.3 Aquatic Net Effects

4.1.2.2.3.1 Site Development Alternative 1

Potential Effect – Site Development Alternative 1 requires the re-location of approximately 1,330 linear m of the Howard Drain which will temporarily impact fish and fish habitat. This drain has been re-aligned previously within the landfill property. The re-aligned drain would be directed to the south and west of the expansion Fill Area A and would join up with the Scott Drain for a

completed length of approximately 1,500 m. As is noted, field work completed for this EA identified that the existing fish habitat is not considered sensitive. Furthermore, there are no known aquatic species at risk in the drains. The relocation of the drain offers an opportunity to design the drain with enhanced fish habitat features over a longer length. The relocation is contained within the site and no impacts to downstream fish habitat are anticipated. Future site operation will be similar to current and ongoing operation is not expected to significantly impact fish habitat.

There are no endangered fish species in the on-site drains. Overall, the aquatic habitat is of low sensitivity.

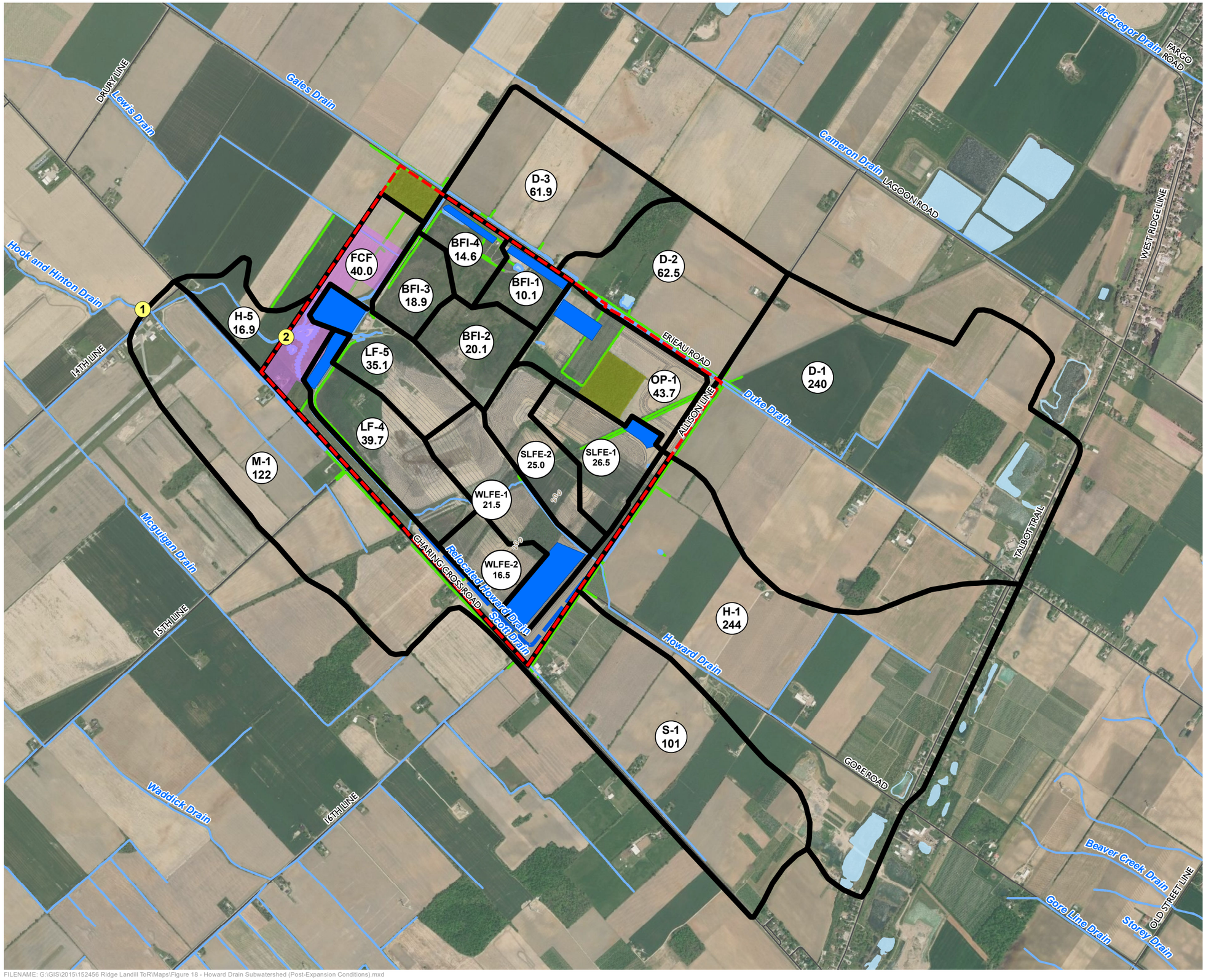
Mitigation – Fisheries and Oceans Canada (DFO) "measures to avoid causing harm to fish and fish habitat"[114] will be consulted prior to any in-water works. The following mitigation measures will be put into place:

- To protect sensitive life stages/processes of resident fish, in-water work will occur between July 1 and March 14 of any given year.
- Prior to removal of Howard Drain or any other in-water works, the site should be isolated from flow while maintaining flow to downstream reaches.
- Prior to the start of in-water works, a fish salvage should be performed under a Licence to Collect Fish for Scientific Purposes.
- Water intakes or outlet pipes should be screened to prevent entrainment or impingement of fish.
- Effective erosion and sediment control should be implemented to prevent sediment from entering the water body.
- Handling of fuel, excess material and debris will be properly managed on-site and removed in a way to protect watercourses.
- Materials used or generated will be temporarily stored, handled and disposed of during site preparation, construction and clean-up in a manner that prevents entry into the drains.
- Ensure that machinery arrives on-site in a clean condition and maintained free of fluid leaks, invasive species and noxious weeds.

[114] Fisheries and Oceans Canada (2018). Measures to Avoid Causing Harm to Fish and Fish Habitat. Available at: https://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html

The Fisheries Act Self-Assessment process will be consulted to determine next steps in relation to the *Fisheries Act.*

The design of the Howard Drain realignment will incorporate the creation of suitable fish habitat into the design. Refer to **FIGURE 4-8**.



WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

FIGURE 4-8
HOWARD DRAIN SUBWATERSHED CATCHMENT PLAN (POST-EXPANSION)

- Property Boundary
- Road
- Watercourse / Constructed Drain
- Relocated Howard Drain
- Waterbody
- Ditch
- Proposed Landfill Contours
- Subwatershed / Subcatchment Boundary
- Proposed Flood Control Facility
- Proposed Ponds
- Proposed Woodlot Areas
- Subcatchment ID (S-1 / 101) Area (ha)
- 1 Flow Nodes

1:20,000

0 200 400 800 m

N W E S

MAP DRAWING INFORMATION:
DATA OBTAINED FROM MNRF

MAP CREATED BY: 44PH
MAP CHECKED BY: 42JW
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 15-2456

DATE: 2019-06-26

FILENAME: G:\GIS\2015\152456 Ridge Landill ToR\Maps\Figure 18 - Howard Drain Subwatershed (Post-Expansion Conditions).mxd

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Net Effect – Fish habitat will be temporarily impacted during construction. The impact is considered temporary as the re-located drain can be designed to incorporate suitable fish habitat where possible providing a net gain of 170 linear meters of additional habitat and providing an improvement over the existing condition. There are no anticipated net effects during operation or post closure.

4.1.2.2.3.2 Site Development Alternative 2

The aquatic potential effects, mitigation and net effects for Site Development Alternative 2 are identical to those described above for Site Development Alternative 1.

4.1.2.2.3.3 Site Development Alternative 3

The aquatic potential effects, mitigation and net effects for Site Development Alternative 3 are identical to those described above for Site Development Alternative 1.

4.1.2.3 Natural Environment - Hydrogeological

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

4.1.2.3.1 Groundwater Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Potential impacts to groundwater quality during construction, operation and post closure.	• Concentrations based on predictive contaminant transport modelling.	• Site data collected through intrusive investigations. • Leachate characteristics taken from Table 1, Section 10 of *O.Reg 232/98*. • Landfill design input.	• Differences in site development footprints and heights may result in different abilities to meet reasonable use guidelines.
Leachate contaminating lifespan during construction, operation and post closure.	• Prediction based on tonnes of waste per hectare of footprint area and leachate generation rate.	• Leachate characteristics taken from Table 1, Section 10 of *O.Reg 232/98*. • Estimation from the	• Differences in site development alternative footprints and heights may result in different

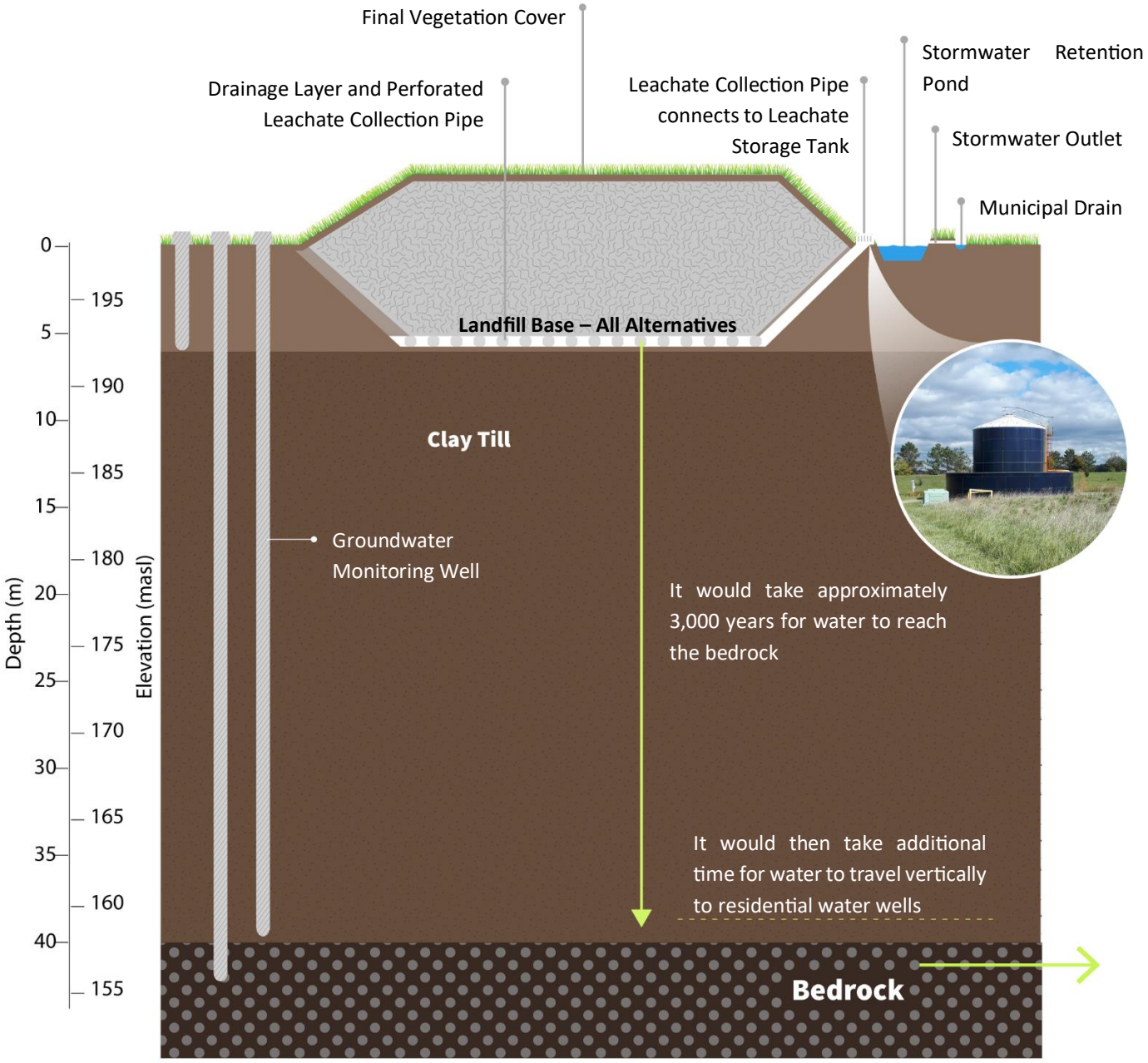
Criteria	Indicators	Data Sources	Rationale
		method used by Rowe et.al (2004).	contaminating lifespans. This criterion was added based on feedback from MECP at the ToR approval stage.
Potential impacts to groundwater quantity.	• Reduction in infiltration rate to bedrock aquifer.	• Site data collected through intrusive investigations. • Existing and proposed facility characteristics.	• The size of the footprint represents the area removed from infiltration.
Potential impacts to water supply wells.	• Predictive impact assessment using contaminant transport computer modelling to predict expected concentrations in the bedrock aquifer.	• Existing and proposed facility characteristics. • Water supply well survey. • Site data collected through intrusive investigations. • Leachate characteristics taken from Table 1, Section 10 of *O.Reg. 232/98*. • Leachate generation rates (HELP™ modelling).	• Local residents have expressed concerns about drinking water.

4.1.2.3.2 Overview of Groundwater Considerations and Assumptions

The site is underlain by more than 30 m of unweathered homogeneous clay and given the extent of clay, recharge in this area is limited. In addition, engineered protection would also include a leachate collection system. Over 30 years of historical groundwater monitoring data indicates that the existing landfill has shown no impact on the regional basal/bedrock aquifer groundwater. Based on the natural setting and site features it is estimated to take 3,000 years for leachate to

get to the bedrock aquifer by which time the water will meet drinking water quality criteria. This is consistent for all site development alternatives and is as show in **FIGURE 4-9**.

FIGURE 4-9: DEPICTION OF TRAVEL TIME TO BEDROCK



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 to acceptable levels. Understanding the site's leachate contaminating lifespan will help determine the ongoing mitigation and contingency measures needed to protect the environment into the future. The contaminating lifespan of the existing site is approximately 325 years.

Residents along Erieau Road and Charing Cross Road are currently supplied by municipal water. As shown in **FIGURE 3-11** in **Section 3.2.2** of this EA, 15 residential wells in the vicinity of the landfill are monitored annually. The closest residential water well to the landfill is approximately 60 m from the site property boundary.

It is noted that engineering controls such as a clay liner and leachate collection system will be part of the site expansion design.

4.1.2.3.3 Groundwater Net Effects

4.1.2.3.3.1 Site Development Alternative 1

4.1.2.3.3.1.1 Groundwater Quality

Potential Effect – 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)[115]. 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 (ODWO) (25% increase over background levels for health related parameters and 50% increase for non-health related parameters). Historical monitoring activity has shown that the

[115] Ministry of the Environment, Conservation and Parks (1994a). Guideline B-7: Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities. (Formerly Policy 15-08).

Ridge Landfill site consistently meets the RUG. *O.Reg. 232/98*[116] (**Table 3-1**) specifies the water quality parameters that should be assessed as part of the hydrogeological assessment.

Contaminant transport modelling has indicated that the Site Development Alternative 1 will meet the RUG. The only parameter that will increase in the basal/bedrock aquifer is chloride (a non-health related parameter) with maximum concentrations well below that allowed by the RUG. Other critical parameters (health related) will not have measureable increases in the underlying aquifer.

Mitigation – A clay liner and leachate collection system will be extended to the expansion areas. A groundwater monitoring plan for the expanded site will be prepared. Contingency plans to protect groundwater in the event of an unforeseen incident will be developed including:

- The installation of a perimeter barrier system (cut-off wall);
- The installation of perimeter collection systems to protect shallow groundwater; and
- The installation of a purge well system in the aquifer to prevent off-site impacts from occurring.

Given the long timeline for impacts to occur in the basal / bedrock aquifer underlying the landfill (over 3,000 years), the groundwater at that time would still meet drinking water objectives (See **FIGURE 4-9**).

Net Effects – There are no anticipated net effects to groundwater during construction, operation or post closure.

4.1.2.3.3.1.2 Leachate Contaminating Lifespan

Potential Effects – An assessment of the contaminating life span 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).

The calculated contaminating lifespan for Site Development Alternative 1 was approximately 350 years.

[116] Ministry of the Environment, Conservation and Parks (1998a). *Landfilling Sites: Ontario Regulation (O.Reg.) 232/98.* Last Updated: June 2011.

Mitigation – Engineering controls such as a clay liner and leachate collection system will be designed to manage leachate over the long term. A groundwater monitoring plan for the expanded site will be prepared and a report submitted to MECP annually. Contingency plans to protect groundwater in the event of an unforeseen incident will be developed.

Net Effects – There are no net effects on groundwater during construction. Site Development Alternative 1 results in a leachate contaminating lifespan considering engineering controls of approximately 350 years.

4.1.2.3.3.1.3 Groundwater Quantity

Potential Effects – The total footprint area of the design alternative is an indicator of reduction in infiltration with a smaller footprint providing more opportunity for groundwater recharge as the leachate collection system underlying the waste would be smaller and not capture as much water. The footprint for Site Development Alternative 1 is 190 ha. It is noted that regardless of size, there is limited potential for impact to groundwater quantity given that recharge in this area is very low.

Mitigation – No mitigation is required.

Net Effects – There is no anticipated net effect on groundwater quality during construction, operation or post closure for Site Development Alternative 1.

4.1.2.3.3.1.4 Water Supply Wells

Potential Effects – As noted the site is overlain by 30 m of natural clay with additional engineered protection including a leachate collection system. It is estimated to take 3,000 years for leachate to get to the bedrock aquifer by which time the water will meet drinking water quality criteria. As noted, some of the residences and businesses are municipally serviced and 15 private residential wells are currently monitored on an annual basis.

Mitigation – Design of the expansion will include a clay liner and leachate collection system. Residential well monitoring will continue where requested.

Net Effects – There is no anticipated net effect on residential water wells during construction, operation or post closure.

4.1.2.3.3.2 Site Development Alternative 2

4.1.2.3.3.2.1 Groundwater Quality

The groundwater quality potential effects, mitigation and net effects for Site Development Alternative 2 are identical to those described above for Site Development Alternative 1. Although Site Development Alternative 2 includes landfill mining, which would require the removal of waste and associated leachate in the waste mound, this activity is short term and would not specifically result in any impact to groundwater quality.

4.1.2.3.3.2.2 Leachate Contaminating Lifespan

Potential Effect – The calculated contaminating lifespan for Site Development Alternative 2 was approximately 359 years.

Mitigation – Engineering controls such as a clay liner and leachate collection system will be designed to manage leachate over the long term. A groundwater monitoring plan for the expanded site will be prepared and a report submitted to MECP annually. Contingency plans to protect groundwater in the event of an unforeseen incident will be developed.

Net Effects – There are no net effects on groundwater during construction. Site Development Alternative 2 results in a leachate contaminating lifespan considering engineering controls of approximately 359 years.

4.1.2.3.3.2.3 Groundwater Quantity

Potential Effects – Total footprint area of the design alternative is an indicator of reduction in infiltration with a smaller footprint providing more opportunity for groundwater recharge. The footprint for Site Development Alternative 1 is 185 ha. It is noted that regardless of size, there is limited potential for impact to groundwater quantity given that recharge in this area is very low.

Mitigation – No mitigation is required.

Net Effects – There is no anticipated net effect on groundwater quality during construction, operation or post closure for Site Development Alternative 2.

4.1.2.3.3.2.4 Water Supply Wells

The water supply well potential effects, mitigation and net effects for Site Development Alternative 2 are identical to those described above for Site Development Alternative 1.

4.1.2.3.3.3 Site Development Alternative 3

4.1.2.3.3.3.1 Groundwater Quality

The groundwater quality potential effects, mitigation and net effects for Site Development Alternative 3 are the same as described above for Site Development Alternative 1.

4.1.2.3.3.3.2 Leachate Contaminating Lifespan

Potential Effect – The calculated contaminating lifespan for Site Development Alternative 3 was approximately 335 years.

Mitigation – Engineering controls such as a clay liner and leachate collection system will be designed to manage leachate over the long term. A groundwater monitoring plan for the expanded site will be prepared and a report submitted to MECP annually. Contingency plans to protect groundwater in the event of an unforeseen incident will be developed.

Net Effects – There are no net effects on groundwater during construction. Site Development Alternative 3 results in a leachate contaminating lifespan considering engineering controls of approximately 335 years.

4.1.2.3.3.3.3 Groundwater Quantity

Potential Effects – Total footprint area of the design alternative is an indicator of reduction in infiltration with a smaller footprint providing more opportunity for groundwater recharge. The footprint for Site Development Alternative 3 is 214 ha. It is noted that regardless of size, there is limited potential for impact to groundwater quantity given that recharge in this area is very low.

Mitigation – No mitigation is required.

Net Effects – There is no anticipated net effect on groundwater quality during construction, operation or post closure for Site Development Alternative 3.

4.1.2.3.3.3.4 Water Supply Wells

The water supply well potential effects, mitigation and net effects for Site Development Alternative 3 are identical to those described above for Site Development Alternative 1.

4.1.2.4 Natural Environment - Surface Water

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

4.1.2.4.1 Surface Water Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Potential impacts to surface water quantity.	• Changes in peak flows pre- and post-expansion.	• Topographic mapping and aerial imagery. • Climate data. • Soils and land use mapping. • Previous drainage studies. • Existing and proposed facility characteristics. • Field observations. • Aerial photography & GIS mapping. • Past monitoring reports. • Surface water modelling results.	• Differences in site development alternative footprints and heights may result in different quantities of runoff.
Potential impacts to surface water quality.	• Anticipated change in temperature, water quality, benthos and fish habitat.	• MECP published water quality data. • Water quality monitoring data. • Surface water quality program. • Benthic community inventory. • Fish habitat survey.	• Differences in site development alternatives footprints and heights may result in different levels of runoff that could impact surface water quality.

4.1.2.4.2 Overview of Surface Water Considerations and Assumptions

In general, the existing surface water management system is comprised of a network of ditches and culverts, which convey site runoff to one (1) of six (6) stormwater management (SWM) ponds. The existing SWM ponds were designed to provide water quantity and quality control prior to discharging to the municipal drains that transect the site. Additional water quality control is provided in the flood control facility at the confluence of the Howard and Duke Drains.

Flow conditions in the Howard Drain and its tributaries the Duke and Scott Drains are predominantly driven by surface runoff and snow melt with very limited groundwater contributions. During the summer months it is common for the Howard, Duke and Scott Drains to be dry.

At an expanded site, all surface water flows will be directed to stormwater management ponds and tested prior to being released to the local drains. The proposed SWM ponds have been designed as extended detention 'wet' ponds, in accordance with the Stormwater Management Planning and Design Manual[117]. The following summarizes the design criteria that have been adopted for conceptual design of the proposed SWM system:

- Quality control – 'Enhanced' level of water quality protection (i.e., 80% suspended solids removal efficiency). For the purpose of the analysis, a 35% level of imperviousness was applied for the proposed landfill expansion area;
- Erosion control – controlled release of the extended detention volume (40 m^3/ha) to provide protection against streambank erosion; and
- Quantity control – attenuate peak flows from the 2-year through 250-year return period storm events at pre-development levels.

It is noted that for all site development alternatives, stormwater management infrastructure will be constructed as landfill cells are developed over the duration of the expansion to ensure effective surface water management throughout the construction and operation of the site.

Surface water quality monitoring at the site has been ongoing since 1995. A 12-month monitoring 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. This program identified poor surface water quality both upstream and downstream of the existing landfill indicating that the existing landfill is not causing impact to surface water quality. Other key observations from the 2017 monitoring program are as follows:

- ***Temperatures*** upstream and downstream are relatively consistent (slight temperature elevation downstream in summer). In addition, water temperatures in the Howard Drain were found to be consistent with the ambient air temperatures measured at the onsite climate station during the assessment period.

[117] Ministry of the Environment, Conservation and Parks (2003). Stormwater Planning and Design Guidance Manual. Queen's Printer. Toronto, ON.

- The 12-month ***surface water quality*** monitoring program in 2017 involved the collection of water quality 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[118] for several parameters at the three (3) sampling locations located upstream of the landfill, and the one (1) downstream location. 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* ***benthic*** assessment, based on the same sample locations as above, indicated 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).
- The Howard, Scott and Duke Drains are warm water intermittent drains and based on field work have limited ***fish habitat*** potential.

The surface water quantity assessment included an examination of hydrologic conditions under future climate change projections. Future rainfall projections for the year 2050 were determined for the Chatham WWTP climate station using the IDF_CC Tool 3.0 to calculate based on the RCP 4.5 scenario.

The models prepared for the three (3) landfill expansion alternatives were simulated for a range of storm events, including the 2, 5, 10, 25, 50, 100, and 250-year return periods. All of the storm events followed a 24-hour duration with a Soil Conservation Service (SCS) Type II rainfall distribution.

The rainfall data that utilized for the model simulations was obtained from the Short Duration Intensity-Duration-Frequency Data for the Chatham WWTP climate station (ID 6131415). The

[118] Ministry of the Environment, Conservation and Parks (1994c). Water Management Policies, Guidelines, Provincial Water Quality Objectives. PIBS 3303E. Available at: https://www.ontario.ca/page/water-management-policiesguidelines-provincial-water-quality-objectives. Last Updated: March, 2019.

rainfall depth for the 250-year return period was projected through a frequency analysis of annual maximum data recorded at the climate station, using a Gumbel distribution.

Separate model simulations were executed to evaluate hydrologic conditions for the 2- to 250-year return periods under the future climate change projections.

The results of the hydrological analyses undertaken with the HEC-HMS model indicate 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-year) including the current IDF and 2100 future climate conditions. 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 to 3%) for Site Development Alternative 3. The baseline conditions are shown in **Table 4-2**.

Table 4-2: Summary of HEC-HMS Model Results – Baseline Condition

Return Period (Years)	Current IDF					2100 Future Climate Change				
	24 Hour Rainfall (mm)	Site Outlet (Node 1)		Study Area (Node 2)		24 Hour Rainfall (mm)	Site Outlet (Node 1)		Study Area (Node 2)	
		Flow (m^3/s)	Volume (1000 m^3)	Flow (m^3/s)	Volume (1000 m^3)		Flow (m^3/s)	Volume (1000 m^3)	Flow (m^3/s)	Volume (1000 m^3)
2	*51.3*	7.2	256.6	7.5	293.4	*60.1*	11.5	331.6	12.1	337.8
5	*64.4*	14.5	369.8	15.1	420.6	*77.6*	24.2	491	25.6	557.1
10	*73.1*	21.1	448.9	22.1	509.5	*93.1*	29.1	639.1	31.1	723.7
25	*84.1*	26.5	552.8	28.2	626.5	*111.4*	43.9	834.3	47.4	945.6
50	*92.2*	28.8	630.8	30.8	714.3	*125.1*	39.8	953.2	42.6	1077.0
100	*100.3*	31.4	709.5	33.6	802.8	*139.0*	44.5	1091.8	47.7	1232.9
250	*110.9*	34.9	813.2	37.4	919.5	*157.7*	50.9	1277.4	54.6	1441.7

Note:
(1) IDF: Intensity Duration Frequency

4.1.2.4.3 Surface Water Net Effects

4.1.2.4.3.1 Site Development Alternative 1

4.1.2.4.3.1.1 Surface Water Quantity

Potential Effects – Site Development Alternative 1 requires the re-alignment of approximately 1,330 linear m of the Howard Drain. The re-aligned drain will be approximately 1,500 m. Four (4) of the existing stormwater ponds (1, 2, 4 and 5) will remain in operation and will be expanded/retrofitted to provide improved quality/quantity control. Stormwater ponds 3 and 3A will be decommissioned. Two (2) new ponds (6 and 7) will be constructed for the expansion area. Surface water from the Ridge Landfill is received by three (3) municipal drains (Howard, Duke, and Scott).

Changes between pre and post expansion peak flows and runoff volumes will represent the most significant potential impact to surface water quantity for each site development alternative. Further discussion regarding the potential effects is provided below:

- Hydrologic analysis results confirm that peak flows will remain at or below pre-expansion conditions for all storm events (2- to 250-years) for Site Development Alternative 1 (See **Table 4-3**);
- Hydraulic analysis indicates that there will be no impacts to upstream or downstream flood levels;
- Baseflow contributions to the on-site drains are minimal and no impacts are anticipated.
- Peak flows to be maintained at pre-expansion rates and minimal increase in runoff volumes are predicted; and
- Significant erosion impacts to receiving drains are not anticipated.

Overall, pre and post expansion peak flows are maintained at or below the baseline condition.

Table 4-3: Summary of HEC-HMS Model Results – Alternative 1

Return Period (Years)	Current IDF					2100 Future Climate Change				
	24 Hour Rainfall (mm)	Site Outlet (Node 1)		Study Area (Node 2)		24 Hour Rainfall (mm)	Site Outlet (Node 1)		Study Area (Node 2)	
		Flow (m^3/s)	Volume (1000 m^3)	Flow (m^3/s)	Volume (1000 m^3)		Flow (m^3/s)	Volume (1000 m^3)	Flow (m^3/s)	Volume (1000 m^3)
2	*51.3*	7.0	252.8	7.2	289.3	*60.1*	11.1	327.6	11.5	373.4
5	*64.4*	13.5	365.6	14.1	416.1	*77.6*	22.7	486.8	23.8	552.3
10	*73.1*	19.7	444.6	20.6	504.9	*93.1*	28.1	634.8	29.9	718.8
25	*84.1*	25.8	548.2	27.4	621.5	*111.4*	33.6	814.2	35.8	920.5
50	*92.2*	27.9	626.1	29.6	709.0	*125.1*	37.9	948.4	40.5	1071.5
100	*100.3*	30.2	704.8	32.2	797.6	*139.0*	42.5	1087.3	45.4	1227.6
250	*110.9*	33.2	800.5	35.4	905.2	*157.7*	48.9	1273.8	52.4	1437.3

Note:
(1) IDF – Intensity Duration Frequency

Net Effects – There are no anticipated net effects on surface water during construction, operation or post closure.

4.1.2.4.3.1.2 Surface Water Quality

Potential Effects – There is potential for water quality impacts within the receiving drains during landfill construction. During operation, potential effects include:

- Impacted surface water due to leachate seeps and increase suspended sediment levels.
- Potential change in benthic invertebrate species composition due to changes in water quality (i.e., thermal impacts, increased sediment, leachate impacts). The proposed relocation of the Howard Drain will result in a net gain of in-stream habitat area within the on-site study area. The impacts will be temporal in nature as it is anticipated that the drain will recolonize with a benthic community that is similar in composition to the existing drain. There are no impacts anticipated for the benthic community within the off-site study area.
- Potential changes in fish habitat conditions related to thermal impacts, increased suspended sediment and leachate impacts. The Howard and Duke Drains and their tributaries are considered to be intermittent or ephemeral drains containing direct, warm water habitat for tolerant fish species. Given the warm water regime, together with the tolerance of the fish species and the homogeneity of the habitat, the

sensitivity of fish and fish habitat is considered to be low. Furthermore, water quality controls will be implemented to mitigate potential impacts related to suspended sediment and leachate seeps. No significant water quality impacts or thermal impacts are expected from the development of this alternative. There are no impacts anticipated for the fish habitat within the off-site study area due to the controls that will be provided on-site.

Mitigation – Mitigation will include the implementation and maintenance of erosion and sediment control measures during construction; the expansion of stormwater management control measures; the continuation of an expanded surface water monitoring program; and the development and implementation of a spill response plan.

Net Effects – There are no anticipated net effects on surface water quality during construction, operation or post closure. Ongoing monitoring will provide early warning of any surface water quality issues.

4.1.2.4.3.2 Site Development Alternative 2

4.1.2.4.3.2.1 Surface Water Quantity

The surface water quantity potential effects, mitigation and net effects for Site Development Alternative 2 are the same as described above for Site Development Alternative 1. See **Table 4-4**.

Table 4-4: Summary of HEC-HMS Model Results – Alternative 2

Return Period (Years)	Current IDF					2100 Future Climate Change				
	24 Hour Rainfall (mm)	Site Outlet (Node 1)		Study Area (Node 2)		24 Hour Rainfall (mm)	Site Outlet (Node 1)		Study Area (Node 2)	
		Flow (m^3/s)	Volume (1000 m^3)	Flow (m^3/s)	Volume (1000 m^3)		Flow (m^3/s)	Volume (1000 m^3)	Flow (m^3/s)	Volume (1000 m^3)
2	*51.3*	7.0	252.3	7.2	288.7	*60.1*	11.0	326.9	11.5	372.7
5	*64.4*	13.5	365.1	14.0	415.6	*77.6*	22.6	486.1	23.8	551.6
10	*73.1*	19.6	443.9	20.6	504.2	*93.1*	28.1	634.1	29.9	718.2
25	*84.1*	25.8	547.5	27.4	620.8	*111.4*	33.6	813.2	35.8	919.5
50	*92.2*	27.9	625.4	29.6	708.3	*125.1*	37.9	947.8	40.5	1070.9
100	*100.3*	30.2	704.1	32.1	796.1	*139.0*	42.5	1086.5	45.5	1226.9
250	*110.9*	33.2	800.0	35.4	904.7	*157.7*	48.9	1273.0	52.4	1436.5

4.1.2.4.3.2.2 Surface Water Quality

The surface water quality potential effects, mitigation and net effects for Site Development Alternative 2 are the same as described above for Site Development Alternative 1.

4.1.2.4.3.3 Site Development Alternative 3

4.1.2.4.3.3.1 Surface Water Quantity

The surface water quantity potential effects, mitigation and net effects for Site Development Alternative 3 are similar as described above for Site Development Alternative 1. See **Table 4-5**.

Table 4-5: Summary of HEC-HMS Model Results – Alternative 3

Return Period (Years)	Current IDF					2100 Future Climate Change				
	24 Hour Rainfall (mm)	Site Outlet (Node 1)		Study Area (Node 2)		24 Hour Rainfall (mm)	Site Outlet (Node 1)		Study Area (Node 2)	
		Flow (m^3/s)	Volume (1000 m^3)	Flow (m^3/s)	Volume (1000 m^3)		Flow (m^3/s)	Volume (1000 m^3)	Flow (m^3/s)	Volume (1000 m^3)
2	*51.3*	7.3	263.9	7.5	300.3	*60.1*	11.5	342.4	12.1	341.6
5	*64.4*	14.3	380.9	14.9	431.5	*77.6*	23.6	507.3	24.8	572.9
10	*73.1*	20.7	463.6	21.6	523.8	*93.1*	28.5	660.5	30.3	744.5
25	*84.1*	26.1	570.8	28.0	644.1	*111.4*	34.3	846.3	36.5	952.6
50	*92.2*	28.3	651.6	30.0	734.5	*125.1*	38.9	985.9	41.5	1109
100	*100.3*	30.7	733.0	32.7	825.9	*139.0*	43.4	1127.6	46.3	1267.9
250	*110.9*	33.8	832.4	36.0	937.0	*157.7*	50.7	1324.6	54.2	1488.1

The results of the hydrologic analysis indicate that the post expansion peak flows will remain at or below the pre development levels for Alternative 3, with the exception of a nominal increase (approximately 1%) for the 2 year storm event under the current IDF scenario. There is a marginal increase in the calculated runoff volumes at the site outlet and downstream limits of the study area for all of the return periods that were evaluated under the current IDF and 2100 future climate change scenarios. However, the increase in runoff volumes are minimal (less than 4%), and are not expected to result in significant erosion impacts to the receiving drainage system as the drains are low gradient channels with low velocity characteristics. Accordingly, there are no significant impacts associated with this alternative.

4.1.2.4.3.3.2 Surface Water Quality

The surface water quality potential effects, mitigation and net effects for Site Development Alternative 3 are the same as described above for Site Development Alternative 1.

4.1.2.5 Natural Environment - Air Quality

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

4.1.2.5.1 Air Quality Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Potential for dust during construction and operation.	• Relative concentration of dust at discrete receptors.	• Existing and proposed facility characteristics and operational parameter. • MECP local meteorological data. • MECP terrain data. • MECP and ECCC background air quality monitoring data (i.e., NAPS stations, etc.). • U.S. EPA and U.S. EPA AP-42 emission factors. • U.S. EPA LandGEM modelling for the site. • Results of site specific air quality monitoring.	• Construction, landfilling waste and landfill mining has the potential to cause some dust.
Potential for impacts to air quality during construction and operation.	• Relative concentrations of Nitrogen Oxides, Sulphur Dioxide and Carbon Monoxide (together referred to as criteria air contaminants) at discrete receptors. • Relative concentration of	• Existing and proposed facility characteristics and operational parameters. • MECP local meteorological data. • MECP terrain data. • MECP and ECCC background air quality monitoring data (i.e., NAPS stations, etc.). • U.S. EPA AP-42 and MECP	• Construction, landfilling waste and landfill mining has the potential to result in impact to air quality.

Criteria	Indicators	Data Sources	Rationale
	Hydrogen Sulphide, Vinyl Chloride, Chloroform at discrete receptors.	emission factors. • U.S. EPA LandGEM modelling for the site. • Results of site specific air quality.	

4.1.2.5.2 Overview of Air Quality Considerations and Assumptions

Air quality monitoring of particulates and organic compounds was completed at the Ridge Landfill site in 2014 and showed that the Ridge was operating in compliance with MECP air quality criteria.

Vehicle movement and level of vehicular activity is a significant potential source of dust and air quality impacts. The following key considerations were made regarding vehicle activity at an expanded site:

- All alternatives will receive the same number of waste vehicles;
- The number of vehicles associated with construction (approximately 500 to 750/year) are small compared to total waste vehicles and are considered to be the same across all alternatives;
- The level of vehicular activity relates to the amount of fuel consumed and the resulting potential for nitrogen oxides, sulphur dioxide and carbon monoxide; and
- Without expansion the landfill operation would cease in approximately 2021 significantly reducing material movement and vehicular activity.

Landfill gas is the key source of potential air quality impacts related to hydrogen sulphide, vinyl chloride and chloroform. Site specific monitoring conducted during ongoing operations demonstrated compliance with MECP vinyl chloride and chloroform criteria.

Landfill gas will continue to be collected and managed with two (2) flares currently operating and a third flare, included in the existing ECA approval, will be installed on 2020. Additional flares will be added to the operation of the site as required.

All alternatives will have waste deposited at the current rate and for the same duration into the future resulting in an annual landfill gas emissions generation similar to today. Landfill gas will continue to be emitted beyond the operating life of the existing landfill (i.e., beyond 2021). For

the purpose of the air quality Alternatives Methods evaluation, emissions quantification, modelling, and analysis was completed to determine the potential effects of each alternative.

4.1.2.5.2.1 Indicator Compounds

The ten (10) indicator compounds presented in the Atmospheric Scope of Work (SOW) were quantitatively assessed, where possible. The ten (10) compounds are:

1. Total Suspended Particulate (TSP);
2. Particulate Matter with aerodynamic diameter <10µm (PM_{10});
3. Particulate Matter with aerodynamic diameter <2.5µm ($PM_{2.5}$);
4. Nitrogen Oxides (as NO_X and NO_2);
5. Hydrogen Sulphide;
6. Vinyl Chloride;
7. Chloroform;
8. Carbon Monoxide;
9. Sulphur Dioxide; and
10. Odour.

4.1.2.5.2.2 Air Quality Criteria

The criteria for air quality in Ontario are established in *O.Reg. 419/05*[119] and in Ontario's Ambient Air Quality Criteria (AAQC). *O.Reg. 419/05* provide contaminant concentration standards and guidelines to assess impacts for permitting requirements. The AAQCs developed by the MECP are commonly used in environmental assessments, special studies using ambient air monitoring data, and assessment of general air quality in a community and annual reporting on air quality across the province.

Federally, the Canadian Council of Ministers of the Environment have a set of Canadian Ambient Air Quality Standards (CAAQS) that were developed to be outdoor air quality targets for air quality actions across the country.

[119] Ministry of the Environment, Conservation and Parks (2019c). *Environmental Protection Act. Ontario Regulation 419/05 (O.Reg.419/05): Air Pollution – Local Air Quality*. January 2019.

The applicable Ontario and Canada-wide standards and criteria are provided in **Table 4-6** for the most stringent criteria, standard, or guideline for each averaging period (shown in bold) and will be used throughout the alternative methods evaluation.

Table 4-6: Ontario and Canada-Wide Standards and Criteria

Indicator Compound	Averaging Period	Criterion ($\mu g/m^3$)	Regulation/Guideline
TSP	**24 hr**	**120**	***O.Reg 419/05, AAQC***
	Annual	**60**	**AAQC**
PM_{10}	**24 hr**	**50**	**AAQC**
$PM_{2.5}$	24 hr	30	AAQC
	24 hr	28	CAAQS
	24 hr	**27**	**CAAQS 2020**
	Annual	10	CAAQS
	Annual	**8.8**	**CAAQS 2020**
Nitrogen Oxides	**1 hr**	**400**	***O.Reg 419/05***
	24 hr	**200**	***O.Reg 419/05***
Nitrogen Dioxide	**1 hr**	**400**	***AAQC***
	24 hr	**200**	***AAQC***
	1 hr	**112.8**	***CAAQS 2020***
	Annual	**31.96**	***CAAQS 2020***
	1 hr	**78.96**	***CAAQS 2025***
	Annual	**22.56**	***CAAQS 2025***
Hydrogen Sulphide	**24 hr**	**7**	***O.Reg 419/05***
	10 min	**13**	***O.Reg 419/05, AAQC***
Vinyl Chloride	**24 hr**	**1**	***O.Reg 419/05, AAQC***
	Annual	**0.2**	***AAQC***
Chloroform	**24 hr**	**1**	***O.Reg 419/05, AAQC***
	Annual	**0.2**	***AAQC***
Carbon Monoxide	**0.5 hr**	**6000**	***O.Reg 419/05***
	1 hr	**36,200**	***AAQC***
	8 hr	**15,700**	***AAQC***

Indicator Compound	Averaging Period	Criterion (µg/m³)	Regulation/Guideline
Sulphur Dioxide	**24 hr**	**275**	***O.Reg 419/05, AAQC***
	1 hr	690	*O.Reg 419/05, AAQC*
	1 hr	**100**	***O.Reg 419/05* future**
	10-min	**180**	**AAQC**
	Annual	55	*O.Reg 419/05, AAQC*
	Annual	**10**	***O.Reg 419/05* future**
Odour	**10 min**	**1 OU/m³**	***MECP Guidelines***

Notes:
(1) Canadian Ambient Air Quality Standards (CAAQS) future – criteria set for the year 2020.
(2) *O.Reg. 419/05* future – standard effective on July 1, 2023.
(3) Ontario's Ambient Air Quality Criteria (AAQC).

4.1.2.5.2.3 Background Air Quality

Background air quality was quantified by compiling historic monitoring records in the region in addition to a review of on-site air monitoring data performed by Dillon in 2014[120]. The MECP and ECCC National Air Pollution Surveillance Program (NAPS) stations were reviewed for each indicator compound. Ambient monitoring data for hydrogen sulphide is not readily available for the Study Areas. The ECCC documents an overall average concentration measured in urban area presumed to be away from major anthropogenic (originating from human activity) sources in Canada[121] which was used as the background concentration for this assessment.

The calculated background concentrations (µg/m³) for each indicator compound for the Study Area are summarized in **Table 4-7**.

[120] Dillon Consulting Limited (2015). Ridge Landfill 2014 Air Monitoring Report, June 2015.
[121] Environment and Climate Change Canada (2017). Draft Screening Assessment: Hydrogen Sulfide (H_2S), Sodium Sulfide (NA(SH)) and Sodium Sulfide (Na_2S), September 2017.

Table 4-7: Background Air Quality

Indicator Compound	Averaging Period	Background Concentration ($\mu g/m^3$)
TSP	24 hr	41.3 *
	Annual	26.9 *
PM_{10}	24 hr	22.9 *
$PM_{2.5}$	24 hr	12.4
	Annual	8.1
Nitrogen Oxides	1 hr	28.2
	24 hr	26.1
Nitrogen Dioxide	1 hr	20.7
	Annual	12.8
Hydrogen Sulphide	10 min	1.4
	24 hr	1.4
Vinyl Chloride	24 hr	0.004
	Annual	0.002
Chloroform	24 hr	0.17
	Annual	0.13
Carbon Monoxide	0.5 hr	446.8
	1 hr	446.8
	8 hr	426.7
Sulphur Dioxide	10-min	10.5
	1 hr	10.5
	24 hr	8.4
	Annual	4.9
Odour	10 min	--

Note: * Anticipated to be a conservatively high estimate of baseline conditions as site-specific monitoring of TSP (site operations and background levels) measured lower levels.

4.1.2.5.2.4 Emission Rates

The emission rates used in the calculations followed the same methodologies as documented within Appendix D3A - Atmospheric Impact Assessment for the project.

The worst-case emission rates were calculated for each indicator compound across all development phases of the landfill expansion and they were then used in this alternative methods evaluation. The emission calculations included combustion products, particulates, and landfill gas indicator compounds from the following site operations:

- Material handling (active working face, storage piles, active working face);
- Paved and unpaved roads;
- Off-road vehicle emissions;
- On-road vehicle emissions;
- Landfill gas collection system combustion products (nitrogen oxides, carbon monoxide, and particulates); and
- Landfill gas generation rates were determined using U.S. EPA's LandGEM to calculate fugitive and flared emissions landfill gas.

As the daily waste acceptance rate of the landfill will not be increased across the alternatives methods, the greatest variance in potential impact to the air quality for the landfill expansion was associated with the location of on-site operations.

4.1.2.5.2.5 Dispersion Modelling

The emission estimates were incorporated into the air dispersion model AERMOD version 16216r to predict potential contributions to local air quality. As determined through correspondence with the MECP, the Site's emissions were simplified and modelled as an area source encompassing the entire landfill footprint for each alternative method. The area source release height is taken as the weighted average of the halfway point from ground level to the final height of the landfill footprint.

The terrain data that was used in this assessment was obtained from the MECP's available digital elevation data (7.5-minute format). Site-specific meteorological data taken from the ECCC's Ridgetown RCS climate station pre-processed by the Air Modelling and Emissions Unit of the MECP will be used for this assessment.

Receptors were chosen to determine the impact of environmental effects from a grid of discrete receptors identified using satellite imagery. The discrete receptors for the Study Area were residences and businesses located in the vicinity of the landfill as shown on **FIGURE 3-21.**

The AERMOD dispersion model provided results of maximum point-of-impingement concentrations at discrete receptors.

The simplified modelling approach presented for the alternative method evaluation should be considered a screening method only. The predicted concentrations are used to assess the approximate magnitude of change for each of the alternatives compared to a do-nothing scenario based on the changes in landfill footprint. It is noted that the screening level model used for the analysis can be conservative and provide an over-prediction of impacts. Detailed modelling is required to be completed to predict impacts for the preferred alternative.

4.1.2.5.2.6 Method of Assessing Significance of Impact

An analysis of the cumulative air quality impact for each indicator compound was used to determine the significance of potential impact for each alternative. Using the criteria listed in **Table 4-6**, an assigned magnitude level is given to predict the potential significance of impact to air quality. The magnitude levels are provided in **Table 4-8**. The following metric has been applied to the criteria to determine the magnitude level definitions:

- High – If the cumulative air quality exceeds the relevant criteria;
- Medium – If the cumulative air quality exceeds half but remains below the relevant criteria; and
- Low – If the cumulative air quality is below half of the relevant criteria.

Table 4-8: Effects Magnitude Levels for Air Quality

Indicator Compound	Averaging Period	Magnitude Level Definition (µg/m³)		
		Low	Medium	High
TSP	24 hr	≤60	≤120	>120
	Annual	≤30	≤60	>60
PM_{10}	24 hr	≤25	≤50	>50
$PM_{2.5}$	24 hr	≤13.5	≤27	>27
	Annual	≤4.4	≤8.8	>8.8
Nitrogen Oxides	24 hr	≤100	≤200	>200
	1 hr	≤200	≤400	>400
Nitrogen Dioxide	1 hr	≤39.5	≤79.0	>79.0
	Annual	≤11.3	≤22.6	>22.6
Hydrogen Sulphide	24 hr	≤3.5	≤7	>7
	10 min	≤6.5	≤13	>13
Vinyl Chloride	24 hr	≤0.5	≤1	>1
	Annual	≤0.1	≤0.2	>0.2
Chloroform	24 hr	≤0.5	≤1	>1
	Annual	≤0.1	≤0.2	>0.2
Carbon Monoxide	0.5 hr	≤3000	≤6000	>6000
	1-hr	≤18,100	≤36,200	>36,200
	8-hr	≤7,850	≤15,700	>15,700
Sulphur Dioxide	24 hr	≤137.5	≤275	>275
	1 hr	≤50	≤100	>100
	≤90	≤180	>180	10-min
	Annual	≤5	≤10	>10

A summary of the significance of each alternative method is provided in **Table 4-9**. The results show that the following indicator compounds had a low significance level across all alternative methods: nitrogen oxides, hydrogen sulphide, vinyl chloride, chloroform, carbon monoxide, and sulphur dioxide. Vinyl chloride and chloroform showed low significance for the 24-hr averaging period and a medium significance over the annual averaging period.

The results showed that the following indicator compounds had at least one (1) high significance level across the alternative methods: total suspended particulates, PM_{10}, and $PM_{2.5}$, and nitrogen dioxide. TSP (annual), and PM_{10}, and $PM_{2.5}$ (annual) were shown to have medium significance for Site Development Alternatives 1 and 2, and high significance for Site Development Alternative 3.

Table 4-9: Significance of Cumulative Air Quality Impact

Indicator Compound	Averaging Period	Criterion (µg/m³)	Alternative 1 (µg/m³)	Alternative 2 (µg/m³)	Alternative 3 (µg/m³)
TSP	24 hr	120	High (145.9)	High (145.9)	High (199.3)
	Annual	60	Medium (42.4)	Medium (42.5)	High (56.0)
PM_{10}	24 hr	50	Medium (43.0)	Medium (43.0)	High (53.3)
$PM_{2.5}$	24 hr	27	Medium (19.3)	Medium (19.3)	Medium (22.8)
	Annual	8.8	Medium (8.3)	Medium (8.3)	High (9.2)
Nitrogen Oxides	24 hr	200	Low (48.8)	Low (48.8)	Low (60.4)
	1 hr	400	Low (133.2)	Low (134.5)	Low (165.8)
Nitrogen Dioxide	Annual	22.6	Low (10.2)	Low (10.2)	Medium (13.2)
	1-hr	79.0	High (125.7)	High (127.0)	High (158.3)
Hydrogen Sulphide	24 hr	7	Low (1.9)	Low (1.9)	Low (2.1)
	10 min	13	Low (3.7)	Low (3.8)	Low (4.5)
Vinyl Chloride	24 hr	1	Low (0.2)	Low (0.2)	Low (0.3)

Chloroform	Annual	0.2	Low (0.03)	Low (0.03)	Medium (0.1)
	24 hr	1	Low (0.2)	Low (0.2)	Low (0.2)
Carbon Monoxide	Annual	0.2	Medium (0.1)	Medium (0.1)	Medium (0.1)
	0.5 hr	6000	Low (511.0)	Low (511.8)	Low (530.9)
	1-hr	36,200	Low (449.2)	Low (500.9)	Low (516.9)
	8-hr	15,700	Low (452.3)	Low (452.4)	Low (466.1)
Sulphur Dioxide	24 hr	275	Low (15.4)	Low (23.0)	Low (15.8)
	1 hr	100	Low (18.6)	Low (15.4)	Low (17.9)
	10-min	180	Low (18.6)	Low (18.6)	Low (22.7)
	Annual	10	Low (4.4)	Low (4.4)	Low (5.0)

Potential for off-property dust impacts for Site Development Alternative 1, 2 and3 are shown in **Table 4-10.**

Table 4-10: Alternative Methods Summary

Criteria	Indicator	Alternative 1	Alternative 2	Alternative 3
Potential for dust during construction and operation.	Relative concentration of dust at discrete receptors.	Conservative screening level modelling identified potential for impacts to ambient air quality as part of regular landfill operations.	Conservative screening level modelling identified potential for impacts to ambient air quality as part of regular landfill operations.	Conservative screening level modelling identified potential for impacts to ambient air quality as part of regular landfill operations.
Potential for impacts to air quality during construction and operation.	Relative concentration of nitrogen oxides sulphur dioxide and carbon monoxide (together referred to as criteria air contaminants) at discrete receptors.	Conservative screening level modelling identified low potential for impacts to ambient air quality as part of regular landfill operations.	Conservative screening level modelling identified low potential for impacts to ambient air quality as part of regular landfill operations.	Conservative screening level modelling identified low potential for impacts to ambient air quality as part of regular landfill operations.
	Relative concentration of hydrogen sulphide, vinyl chloride, chloroform at discrete receptors.	Conservative screening level modelling identified low potential for impacts to ambient air quality as part of regular landfill operations.	Conservative screening level modelling identified low potential for impacts to ambient air quality as part of regular landfill operations.	Conservative screening level modelling identified low potential for impacts to ambient air quality as part of regular landfill operations.

4.1.2.5.3 Air Quality Net Effects

4.1.2.5.3.1 Site Development Alternative 1

4.1.2.5.3.1.1 Dust

Potential Effects – Relative levels of material movement and vehicular activity are indicators of dust and criteria air contaminant emissions. Standard mitigation practices are 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 Site Development Alternative 1 involves material movement and vehicular activity associated with cell construction and closure and ongoing waste receipt and deposition in the landfill. Approximately 500 to 750 trucks/year will be required for construction of the alternative. Approximately 200 waste trucks/day (this includes a combination of tractor trailers and collection vehicles) currently and will continue to access the Ridge Landfill. Conservative screening level modelling identifies a potential for off-property dust impacts for Site Development Alternative 1 as shown in **Table 4-10.** Site specific monitoring conducted during ongoing operations demonstrated compliance with the MECP TSP criterion.

Mitigation – 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. A best management practice plan for fugitive dust will be implemented.

Net Effects – Conservative screening level modelling identified potential for impacts to ambient air quality (dust) as part of regular landfill operations. Potential dust impacts 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. Further assessment will be completed for using a more refined model if this alternative is carried forward. No significant net effects are anticipated post closure.

4.1.2.5.3.1.2 Air Quality

Potential Effects – The level of vehicular activity was used as an indicator for the amount of fuel combusted and the resulting potential for Nitrogen Oxides (as NO_X and NO_2), Sulphur Dioxide and Carbon Monoxide. The anticipated LFG emissions for Site Development Alternative 1 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.

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 Site Development Alternative 1 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 the underground migration of LFG to occur and cause an adverse effect is negligible.

Mitigation – Proper vehicle maintenance will 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.

Net Effects – No off-site net effects are expected during construction or operation. No significant net effects are anticipated post closure. Further assessment will be completed using a more refined model if this alternative is carried forward.

4.1.2.5.3.2 Site Development Alternative 2

4.1.2.5.3.2.1 Dust

The dust potential effects, mitigation and net effects for Site Development Alternative 2 are identical to those described above for Site Development Alternative 1 and are shown on **Table** 4-10. In addition to the dust potential effects, mitigation and net effects identified for Site Development Alternative 1 in **Table 4-10**, landfill mining, which is included as part of Site Development Alternative 2, has the potential to create additional dust during the period when mining occurs.

4.1.2.5.3.2.2 Air Quality

Potential Effects – The level of vehicular activity for was used as an indicator for the amount of fuel combusted and the resulting potential for Nitrogen Oxides (as NO_X and NO_2), Sulphur Dioxide and Carbon Monoxide. The anticipated LFG emissions for Site Development Alternative 2 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, waste will be deposited at the same rate as is currently resulting in similar annual emissions generation as current activities.

Conservative screening level modelling identifies low potential for off-property impacts to air quality for Site Development Alternative 2 during construction and operation as shown in **Table 4-10.**

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., Methane and Hydrogen Sulphide) and therefore there is a greater potential for air quality impacts during landfill mining because of the required exposure and handling of previously buried waste. It is not possible to quantify the amount of gas that would be released as a result of landfill mining as the volume of gas contained in the existing landform is unknown.

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 Site Development Alternative 2 and would be down to low levels of generation by the year 2100. Similar to Site Development Alternative 1, the potential for migration to occur and cause an adverse effect is negligible.

Mitigation – Proper vehicle maintenance will be implemented to help 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. There is no way to prevent or mitigate the release of gases during mining operations; however, odour masking systems can be utilized.

Net Effects – The potential for the release of by-products of waste decomposition related to landfill mining for Site Development Alternative 2 may result in air quality impacts that cannot fully be mitigated. These impacts would extend over the 5- to 10-year period of landfill mining. Further assessment will be completed using a more refined model if this alternative is carried forward. No significant net effects are anticipated post closure.

4.1.2.5.3.3 Site Development Alternative 3

4.1.2.5.3.3.1 Dust

The dust potential effects, mitigation and net effects for Site Development Alternative 3 are the same as described above for Site Development Alternative 1 and are shown on **Table 4-10.**

4.1.2.5.3.3.2 Air Quality

Potential Effects – The level of vehicular activity was used as an indicator for the amount of fuel combusted and the resulting potential for Nitrogen Oxides (as NO_X and NO_2), Sulphur Dioxide and Carbon Monoxide. The anticipated LFG emissions for Site Development Alternative 3 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, waste will be deposited at the same rate as is currently, resulting in similar annual emissions generation as current activities. Conservative screening level modelling identifies low potential for off-property impacts to air quality during construction and operation for Site Development Alternative 3.

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.

Mitigation – Proper vehicle maintenance will be implemented to help 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.

Net Effects – There are no off-site air quality net effects anticipated during construction or operation. No significant net effects are anticipated post closure. Further assessment will be completed using a more refined model if this alternative is carried forward.

4.1.2.6 Natural Environment - Climate Change

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

4.1.2.6.1 Climate Change Criteria and Indicators

Criteria	Indicators	Data Source	Rationale
Potential for greenhouse gas emissions during construction and operation.	• Daily/annual waste volume landfilled. • Anticipated differences in on-site vehicular activity. • Extent of woodlot removal.	• Existing and proposed facility characteristics. • U.S. EPA and U.S. EPA AP-42 emission factors.	• Landfilling waste has the potential to release greenhouse gases that can contribute to climate change.
Resilience of engineered systems.	• Ability to incorporate climate change adaptations within the alternative.	• Existing and proposed facility characteristics. • Climate Change Impact Assessment (Appendix D3B).	• Climate change results in less predictable weather patterns and storms that are larger and more violent. These storms could effects landfill infrastructure which could result in a negative impact on the environment.

4.1.2.6.2 Overview of Climate Change Considerations and Assumptions

Landfilling waste has the potential to release GHG, primarily methane, which can contribute to climate change. All three (3) site development alternatives will have the same amount of waste deposited over the proposed 20-year planning life at the same rate as is done currently. The number of vehicles associated with construction are small (approximately 500 to 750/ per year) compared to total waste vehicles and are considered to be the same across 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. Current greenhouse gas emissions from the Ridge landfill are 391,000 tonnes CO_2e/year. Landfill gas will continue to be emitted and managed beyond the operating life of the existing landfill (i.e., beyond 2021).

Site Development Alternatives 1 and 2 would require removal of a 3.76 ha woodlot. Alternative 3 removes a 3.76 ha and an 8 ha woodlot. The removal of the 3.76 ha and 8 ha woodlot results in an estimated annual CO_2e sequestration of 29 tonnes/year CO_2e and 71 tonnes/year CO_2e, respectively, using methodologies provided in the Tree Canada Afforestation and Reforestation Protocol[122]. As the Landfill is estimated to currently emit 391,000 tonnes/year of CO_2e under the existing conditions, the annual combined carbon sequestration of the woodlots represent well under 0.01% of the annual GHG emissions.

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, and the negligible carbon sequestration rate of the woodlots compared to the total GHG emissions profile of the Landfill, the potential for climate change impacts from on-site woodlot removal is not considered significant.

The landfill mining included in Site Development Alternative 2 is an operational activity that will result in a marginal increase in on-site vehicular activity greater than historical operations and operational vehicular activity during the five (5) to ten (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, mostly methane. There is no way to capture this gas as landfill mining occurs over a large uncontrolled area with trapped pockets of gas being released as the area is excavated.

[122] Tree Canada (2015). Tree Canada Afforestation and Reforestation Protocol. Version 2.0. April 2015.

The landfill gas collection system at the Ridge Landfill has been designed to target a high collection efficiency. The Site will work to make continual improvements to the system to provide long term landfill gas mitigation. Each landfill gas destruction/upgrade system considered will maintain the same target landfill gas collection efficiency.

Landfill systems will be designed in accordance with current regulations and design standards and will also take climate change into consideration.

4.1.2.6.3 Climate Change Net Effects

4.1.2.6.3.1 Site Development Alternative 1

4.1.2.6.3.1.1 Green House Gas Emissions

Potential Effects – Greenhouse gas emissions from Site Development Alternative 1 are estimated to peak at 762,000 tonnes CO_2e/year assuming that:

- Waste will be deposited over the proposed 20-year planning life at the same rate as is done currently (1.3 million tonnes annually);
- On-site vehicular activity associated with standard landfill construction and operation will be relatively consistent with what occurs today; and
- The 3.76 ha woodlot that will be removed will be replanted at a 2:1 ratio in the same ecoregion. The removal of the 3.76 ha woodlot results in an estimated annual loss of CO_2e sequestration of 29 tonnes/year CO_2e until the replacement woodlot matures.

Mitigation – Tree replanting will be completed at a 2:1 ratio to compensate for the loss of the 3.76 ha woodlot. Landfill gas capture and control to minimize GHG emissions will continue.

Net Effects – Landfill gas is currently generated and managed at the site and will continue to be generated and managed into the future even if the site closed in 2021. There are no significant net effects anticipated during construction and operation of the proposed expansion. The expansion would result in a net increase in landfill gas generation extending the period of landfill gas generation however as the gas will continue to be captured and controlled with the same collection efficiency during operations and post-closure no net effect is anticipated post closure.

4.1.2.6.3.1.2 Resilience of Engineered Systems

Potential Effect – The potential for greater frequency and intensity of storms, higher winds, increased rain events and high temperatures can affect the operation of the landfill systems as well as the health and safety of workers. Critical adaptation measures relates to providing sufficiently sized stormwater ponds to accommodate increased storm intensity. Site Development Alternative 1 provides sufficient space on-site for stormwater ponds and ditches that can accommodate storm conditions taking into account projected climate change impacts. Other adaptations that can be incorporated into Site Development Alternative 1 include:

- Design of the landfill mounds to reduce runoff velocity and minimize erosion;
- Design of side slopes to accommodate a rapid increase in leachate mound height within the landfill due to an extreme precipitation event;
- Need for increased litter management resulting from stronger winds;
- Provision of back-up power in the event of outages during severe storms; and
- Climate controlled equipment and safety protocols to protect workers from extreme heat.

Mitigation – Mitigating climate change will involve including the adaptation measures noted above and monitoring landfill systems and adapting as needed. A climate change risk assessment will be completed for the preferred alternative and measures to reduce risk incorporated as appropriate (see Appendix D3B – Climate Change Impact Assessment).

Net Effect – Landfill engineered systems will be designed to perform in potential future climate conditions through the construction, operation or post closure periods.

4.1.2.6.3.2 Site Development Alternative 2

4.1.2.6.3.2.1 Green House Gas Emissions

Potential Effects – Greenhouse gas emissions from Alternative 2 are estimated to peak at 762,000 tonnes CO_2e/year assuming that:

- Waste will be deposited over the proposed 20-year planning life at the same rate as is done currently (1.3 million tonnes annually);
- On-site vehicular activity associated with standard landfill construction will be relatively consistent with what occurs today. There will be a marginal increase in on-site operational vehicle traffic associated with landfill mining and the potential for the

uncontrolled release of the by-products from waste decomposition may result in an increase in GHG emissions impacts that cannot be mitigated. These impacts would extend over the five (5) to ten (10) year period of landfill mining. It is not possible to quantify these GHG emissions as the amount and concentration of gases in the existing Old Landfill is unknown. Only upon excavation of the Old Landfill would it be possible to know the extent of the gases released; and

- The 3.76 ha woodlot that will be removed will be replanted at a 2:1 ratio in the same ecoregion. The removal of the 3.76 ha woodlot results in an estimated annual loss of CO_2e sequestration of 29 tonnes/year CO_2e until the replacement woodlot matures.

In addition to the above GHG emissions associated with standard landfill operation, this alternatives could result in significant release of GHG emissions from the operational activity of landfill mining over the five (5) to ten (10) year mining period.

Mitigation – Tree replanting will be completed at a 2:1 ratio to compensate for the loss of the 3.76 ha woodlot. Landfill gas management will continue for areas not being mined. Mitigation to prevent or capture the release of GHG during landfill mining is not possible.

Net Effects – Landfill gas is currently generated and managed at the site and will continue to be generated and managed into the future even if the site closed in 2021. There are no significant net effects anticipated during construction and operation of the proposed expansion with the exception of landfill mining. There could be significant release of GHG emissions from the operational activity of landfill mining over the five (5) to ten (10) year mining period. The expansion would result in a net increase in landfill gas generation and will continue to be captured and controlled with the same collection efficiency during operations and post closure. The expansion would result in extending the period of landfill gas generation however as the gas will continue to be captured and controlled no net effect is anticipated post closure.

4.1.2.6.3.2.2 Resilience of Engineered Systems

The resilience of the engineered systems' potential effects, mitigation and net effects for Site Development Alternative 2 are the same as described above for Site Development Alternative 1.

4.1.2.6.3.3 Site Development Alternative 3

4.1.2.6.3.3.1 Green House Gas Emissions

Potential Effects – Greenhouse gas emissions from Site Development Alternative 3 are estimated to peak at 762,000 tonnes CO_2e/year assuming that:

- Waste will be deposited over the proposed 20-year planning life at the same rate as is done currently (1.3 million tonnes annually);
- On-site vehicular activity associated with standard landfill construction and operation will be relatively consistent with what occurs today; and
- The 3.76 ha and 8 ha woodlots that will be removed and will be replanted at a 2:1 ratio in the same ecoregion. The removal of the 3.76 ha and 8 ha woodlot results in an estimated annual loss of CO_2e sequestration of 29 tonnes/year CO_2e and 71 tonnes/year CO_2e until the replacement woodlot matures.

Mitigation – Tree replanting will be completed at a 2:1 ratio to compensate for the loss of the woodlots. Landfill gas management will continue.

Net Effects – Landfill gas is currently generated and managed at the site and will continue to be generated and managed into the future even if the site closed in 2021. There are no significant net effects anticipated during construction and operation of the proposed expansion. The expansion would result in a net increase in landfill gas generation and will continue to be captured and controlled with the same collection efficiency during operations and post closure. The expansion would result in extending the period of landfill gas generation however as the gas will continue to be captured and controlled no net effect is anticipated post closure.

4.1.2.6.3.3.2 Resilience of Engineered Systems

Potential Effect: The potential for greater frequency and intensity of storms, higher winds, increased rain events and high temperatures can affect the operation of the landfill systems as well as the health and safety of workers. Critical adaptation measures relate to providing sufficiently sized stormwater ponds to accommodate increased storm intensity. Alternative 3 has limited space on-site to accommodate the size of the stormwater ponds required to adapt to climate change without impacting the area required for other supporting landfill needs. Supporting landfill activities that are required for the day to day operation of the landfill include temporary soil storage, wood storage and concrete crushing. Other adaptations measures that can be incorporated into Site Development Alternative 3 include:

- Design of the landfill mounds to reduce runoff velocity and minimize erosion;

- Design of side slopes to accommodate a rapid increase in leachate mound height within the landfill due to an extreme participate event;
- Need for increased litter management resulting from stronger winds;
- Provision of back-up power in the event of outages during severe storms; and
- Climate controlled equipment and safety protocols to protect workers from extreme heat.

Mitigation – Mitigating climate change will involve including the adaptation measures noted above and monitoring landfill systems and adapting as needed. A climate change risk assessment will be completed for the preferred alternative and measures to reduce risk incorporated as appropriate (see Appendix D3B – Climate Change Impact Assessment).

Net Effect – Landfill engineered systems will be designed to perform in potential future climate conditions through the construction, operation and post closure periods. However the size of the stormwater system required to address climate change will limit the space available for other landfill related activities.

4.1.2.7 Socio-Economic Environment - Social

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

4.1.2.7.1 Social Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
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.	• GIS mapping. • Survey input from local residents as available. • Existing and future facility characteristics. • Public consultation.	• Residents in the vicinity of the site may experience noise impacts that are already familiar, from the current and continued operation of the landfill. This experience may differ depending on the characteristics of the site development alternatives.
Potential for odour during construction and operation.	• Relative concentration of odour at discrete receptors.	• Existing and proposed facility characteristics. • MECP local meteorological data. • MECP terrain data. • MECP emission factor. • Survey input from local residents as available. • Public consultation.	• Landfilling waste has the potential to cause some odour. Landfill mining is a component included in the site development alternatives which has an even greater potential to result in odour.
Potential for visual impacts on residents during site construction and site operation.	• Percent change in view within the Study Area.	• GIS mapping. • Existing and future facility characteristics. • Public consultation. • Survey input from local residents as available.	• Residents in the vicinity of the site may have different views of the landfill based on the site development alternatives.

Criteria	Indicators	Data Sources	Rationale
Potential for landfill traffic effect on residents during construction and operation.	• Number of waste trucks during operation. • Number of trucks for construction.	• Existing and proposed facility characteristics. • Survey input from local residents as available. • Public consultation.	• The annual tonnage and the haul route for a future expanded site will be the same as it is currently. There may be potential for minor additional truck traffic during construction.
Potential for effect on worker safety during construction and operation.	• Likelihood of safety concerns with alternative.	• Existing and proposed facility characteristics.	• The safety of workers is important to Waste Connections. The difference in site development alternatives footprints and heights may result in different potential safety concerns.

4.1.2.7.2 Overview of Social Considerations and Assumptions

The Ridge Landfill has operated since the 1960s. There are 24 residences, two (2) businesses and one (1) institution within the 1 km Study Area. Rental of the two (2) on-site residences will cease at an appropriate time if the proposed expansion is approved. There are 31 residences on the haul route from Highway 401 to the site. No change to the existing haul route is proposed.

Approximately 200 waste trucks/day [123] (this includes a combination of tractor trailers and collection vehicles) currently access the Ridge Landfill. The number of waste trucks is not expected to change as the annual tonnage for the proposed expansion will be the same as it is today. Approximately 500 to 750 additional construction material trucks/year, on average, are anticipated over the 20-year operation of the proposed expansion.

Active fill areas will generally move south with the expansion. This will result in noise causing activities moving away from some residences and closer to others. The construction of new cells and the placement of waste within open cells will occur simultaneously. Berms exist on the west

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

side of the site and will be constructed on the east and south. The landfill height will not be greater than 241.3 masl as dictated by the Chatham Airport Zoning Regulation and will be built no higher than the current elevation of the existing highest landfill mound. The existing landfill is visible from approximately 27% of the area within the 3 km visual Study Area.
The landfill mining included in Site Development Alternative 2 is an operational activity that will result in a marginal increase in on-site vehicular activity greater than historical operations and operational vehicular activity during the five (5) to ten (10) year period of mining.

The landfill will continue to be managed to minimize potential effects on neighbours. Some considerations related to landfill operation include:

- 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;
- Landfill gas will be collected and managed. Tipping face and fugitive landfill gas emissions will continue to be the main potential odour sources;
- Odour complaints have occurred at the site. Waste Connections addresses complaints on a case-by-case basis;
- Concerns have been raised in the past regarding trucks not staying on the haul route and fugitive litter; and
- Landfill operation will continue with ongoing safety training and practices as Waste Connections' #1 core operating value is safety.

It is noted that without the expansion the site would close in approximately 2021 eliminating truck activity, reducing on-site activities that could produce noise and reducing the number of on-site employees. The site would continue to produce landfill gas well beyond the closure date and landfill gas would continue to be managed post closure. Once the site is closed, Waste Connections will cease to pay compensation to the Ridge Landfill Trust and individually to neighbouring residents.

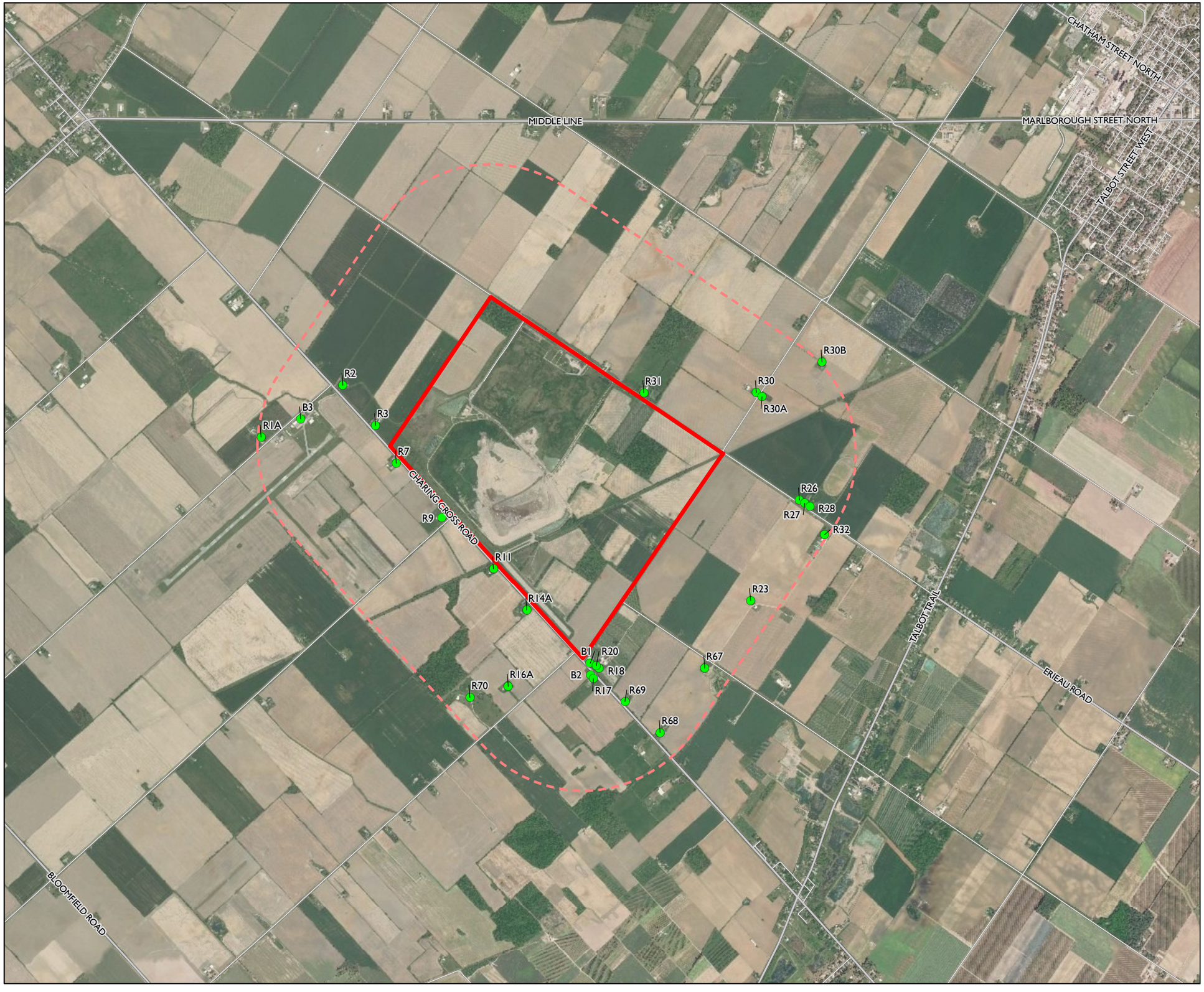
4.1.2.7.2.1.1 Noise

Daily current operations at the landfill are in compliance with the maximum day-time and night-time noise limits established by the MECP, in the publication "Noise Guidelines for Landfills". The

guideline specifies a daytime noise receptor guideline of 55 dBA and a night time receptor noise guideline of 45 dBA. The baseline noise for each receptor in the vicinity of the landfill is shown in **FIGURE 3-23** in **Section 3.2.9**.

Equipment and/or activity sound levels, as well as proximity of noise generating activities to receptors were used to assess and compare the three (3) site development alternatives. As shown in **FIGURE 4-10** there are noise sensitive receptors in all directions from the landfill. The qualitative assessment of noise impact was determined based on anticipated change in receptor noise levels for various alternatives (relative to baseline (2011) noise levels). Screening level noise propagation modelling, using the CANDA modelling software, was completed to determine change in receptor noise levels. Changes to site layout and locations of dominant noise sources (in relation to receptor locations) were used to determine expected noise level change at the receptors. The expected noise impact for individual receptors will be similar for all alternatives; however, due to the difference in locations and orientations of the active cells, the pool of receptors that will be experiencing higher noise levels varies in time over the expansion period between alternatives. In other words, the noise impact is simply shifted from one side of the landfill to another for different periods of time, due to the change in proximity of receptor locations to active landfill areas. A detailed quantitative noise assessment is required to be completed to identify the noise impacts for the preferred alternative (see **Section 6.6.1.4**). There is relatively little difference in impact between the three (3) alternatives with all impacted receptors experiencing at most a medium impact for some period of time over the expansion period compared to the baseline condition (do nothing). The approximate ranges of potential impact are categorized as follows and shown in **Table 4-11**:

- Negligible: < 1 dB;
- Low impact: 1 to 6 dB;
- Medium impact: 7 - 11 dB; and
- Significant: > 11 dB.



WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
NOISE ASSESSMENT

FIGURE 4-10
NOISE RECEPTORS CLOSEST TO THE RIDGE LANDFILL

- Noise Receptor
- On Site Property Boundary
- 1 km Property Boundary Setback

1:28,000

0 0.5 1 2 km

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

DATE: 2019-10-18

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Table 4-11: Potential Change from Baseline Noise Level from Landfill Operations

Receptor Number	Alternative 1	Alternative 2	Alternative 3
B1	Low	Low	Low
B2	Medium	Medium	Medium
B3	Medium	Medium	Medium
R1A	Medium	Medium	Medium
R2	Low	Low	Low
R3	Low	Low	Low
R7	Low	Low	Low
R9	Low	Low	Low
R11	Low	Low	Low
R14	Medium	Medium	Medium
R16A	Medium	Medium	Medium
R17	Medium	Medium	Medium
R18	Low	Low	Low
R20	Low	Low	Low
R23	Low	Low	Low
R26	Low	Low	Medium
R27	Low	Low	Medium
R28	Low	Low	Medium
R30	Low	Low	Medium
R30A	Low	Low	Medium
R30B	Medium	Medium	Medium
R31	Low	Low	Medium
R32	Negligible	Negligible	Low
R67	Negligible	Negligible	Negligible
R68	Negligible	Negligible	Negligible
R69	Negligible	Negligible	Negligible
R70	Negligible	Negligible	Negligible

Note:
(1) Negligible (<1 dB) - - Low (1 - 6 dB) - - Medium (7 – 11dB)

4.1.2.7.2.1.2 Odour

Screening level models were developed to assess the potential for odour for the three (3) alternatives. To accomplish this, the AERMOD model was utilized and the sources of odour from the future landfill areas were input to represent the changing footprint for the different alternatives to give an indication of difference in magnitude of off-site impacts. The following information presents the results of these models. It is noted that these screening level models are conservative and can provide an over prediction of impacts.

The MECP guideline[124] for odour is 1 odour unit (OU)/m^3 over a 10 minute averaging period.

As the environment surrounding the site consists of primarily agricultural land uses it is expected that the ambient odour would be characteristic of a rural agricultural setting with varying odours, odour intensities, and hedonic tones experienced at different receptor locations with varying frequencies. Agricultural operations are not liable for odour nuisance impacts, provided the disturbance is a result of normal farm practices under the *Farming and Food Production Protection Act* (FFPPA)[125].

In addition to the Ridge Landfill operations, odours within the 1 km Study Area can also be generated by normal agricultural operations and the BWTL. The BWTL is located on Lagoon Road approximately 1.5 km east of the site boundary.

As there have not been any odour studies performed within the Study Areas, a baseline value has not been defined for odour.

The following was used to establish the magnitude level of odour impact and the results of the odour assessment are shown in **Table 4-12**:

- Low impact- ≤0.5 OU/m^3;
- Medium impact- ≤1 OU/m^3; and
- High impact - >1 OU/m^3.

[124] Ministry of the Environment, Conservation and Parks (2016b). Technical Bulletin: Methodology for Modelling Assessments of Contaminants with 10-Minute Average Standards and Guidelines for Odour under O. Reg. 419/05. Available at: https://www.ontario.ca/page/methodology-modelling-assessments-contaminants-10-minute-average-standards-and-guidelines-under-o-reg

[125] Ontario Ministry of Agriculture, Food and Rural Affairs (2019). The Farming and Food Production Protection Act (FFPPA) and Nuisance Complaints. Factsheet. Available at:http://www.omafra.gov.on.ca/english/engineer/facts/05-013.htm#4

The magnitude level of odour impact is shown in brackets in OU/m^3 for each receptor for all three (3) alternatives. Development Alternative 1 only has 3 receptors with a medium odour impact while Alternative 3 has 24 receptors with medium impact due to the expansion of the landfill into the southeast corner of the site. Alternative 2 with landfill mining has the potential for severe odour impacts over the landfill mining period of 5 to 10 years.

Table 4-12: Potential for Odour Impact

Receptor Number	Alternative 1	Alternative 2[1]	Alternative 3
B1	Low (0.49)	Medium (0.50)	Medium (0.65)
B2	Medium (0.51)	Medium (0.51)	Medium (0.67)
B3	Low (0.39)	Low (0.38)	Medium (0.55)
R1A	Low (0.39)	Low (0.39)	Medium (0.55)
R2	Low (0.40)	Low (0.40)	Medium (0.52)
R3	Low (0.41)	Low (0.40)	Medium (0.53)
R7	Low (0.39)	Low (0.39)	Medium (0.53)
R9	Low (0.36)	Low (0.36)	Low (0.48)
R11	Low (0.35)	Low (0.35)	Low (0.44)
R14	Low (0.41)	Low (0.42)	Low (0.50)
R16A	Low (0.41)	Low (0.42)	Medium (0.54)
R17	Medium (0.51)	Medium (0.52)	Medium (0.68)
R18	Medium (0.50)	Medium (0.51)	Medium (0.66)
R20	Low (0.50)	Medium (0.50)	Medium (0.65)

Receptor Number	Alternative 1	Alternative 2[1]	Alternative 3
R23	Low (0.45)	Low (0.44)	Medium (0.54)
R26	Low (0.39)	Low (0.39)	Medium (0.60)
R27	Low (0.39)	Low (0.39)	Medium (0.60)
R28	Low (0.40)	Low (0.40)	Medium (0.60)
R30	Low (0.31)	Low (0.32)	Medium (0.55)
R30A	Low (0.31)	Low (0.31)	Medium (0.54)
R30B	Low (0.31)	Low (0.31)	Medium (0.54)
R31	Low (0.31)	Low (0.31)	Low (0.47)
R32	Low (0.41)	Low (0.41)	Medium (0.55)
R67	Low (0.45)	Low (0.46)	Medium (0.58)
R68	Low (0.48)	Low (0.49)	Medium (0.63)
R69	Medium (0.50)	Medium (0.51)	Medium (0.67)
R70	Low (0.38)	Low (0.38)	Medium (0.51)

Notes:

(1) The modelling results do not include increased odour generated from landfill mining. Odour emissions from landfill mining cannot be quantified without site-specific measurements (which are not possible to obtain unless the activity is undertaken). Therefore, odour will be assessed from base operations only, and landfill mining considered qualitatively as a compounding odour source in assessing the ranking of the alternative method that includes this activity.

(2) All values presented in OU/m^3

4.1.2.7.3 Social Net Effects

4.1.2.7.3.1 Site Development Alternative 1

4.1.2.7.3.1.1 Noise and Vibration

Potential Effects – A qualitative noise assessment completed for the 27 receptors within the 1 km Study Area for Site Development Alternative 1 identified that seven (7) receptors may experience a medium noise level increase of 7 to 11 dBA. These receptors are located for the most part west of the landfill, along Charing Cross Road. Based on the completed noise assessments it is anticipated that noise at receptors in the vicinity of the landfill will not exceed the MECP's criterion of 55 dBA for landfills.

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.

Mitigation – No mitigation is anticipated to be required based on past noise studies. However, noise will be modelled for the preferred site development alternative and mitigation recommended if necessary. Continuation of regular communications with neighbours is recommended including the encouragement of local residents to contact Waste Connection with concerns. In addition berms will be constructed and vegetated along the east, south and west boundaries of the site to assist in screening neighbours from noise sources. All complaints are investigated by landfill staff, mitigated as required and discussed with the complainant.

Net Effects – During construction and operation noise will not exceed MECP criteria. There are no anticipated net effects related to noise post closure.

4.1.2.7.3.1.2 Odour

Potential Effects – The conservative screening level modelling identifies an overall low potential for off-site property odour impacts for Site Development Alternative 1 with only 3 receptors that could potentially experience a medium impact.

Mitigation – Waste Connections has historically and will continue to address the potential for odour disruption to residential neighbours as follows:

- Minimizing the size of the working face;
- Application of daily and intermediate cover material;

- Expansion of the landfill gas collection and management system to address the additional waste and the destruction of the LFG (flaring);
- Installing and operating odour neutralizing systems; and
- Regular communications with neighbours.

Net Effects – The conservative screening level modelling identified low potential for odour impacts as part of regular landfill construction and operations. 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. Further assessment will be completed using a more refined model if this alternative is carried forward. No significant net effects related to odour are anticipated post closure.

4.1.2.7.3.1.3 Visual

Potential Effects – 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, Site Development Alternative 1 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 as show in **FIGURE 3-26**.

Mitigation – Mitigation to minimize the visual impact includes:

- Construction of proposed berms;
- Consider localized plantings to minimize views; and
- Regular communications with neighbours.

Net Effects – During construction, operation and post closure, 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.

4.1.2.7.3.1.4 Traffic

Potential Effects – As the number of waste trucks will not change on an annual basis, residents along the haul route will have continued landfill truck traffic very similar to what is experienced today (i.e., 200 waste trucks/day). Residents may experience temporary disruption from

additional trucks required to construct the expansion. The number of trucks may fluctuate but are anticipated to be in the order of 500 to 750/year.

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. 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.

Mitigation – Waste Connections has historically and will continue to address the potential traffic to disrupt residential neighbours as follows:

- Protocols and signage to ensure trucks use the designated haul route, and all loads are properly covered/tarped;
- Road watering for dust suppression;
- Encouraging residents in the site vicinity and along the haul route to raise concerns about traffic or litter directly to Waste Connections to be addressed; and
- Continue regular communication with neighbours.

Net Effects – The potential impact from landfill traffic during construction and operation will be low and similar to what is experienced today. There are no anticipated net effects post closure.

4.1.2.7.3.1.5 Worker Safety

Potential Effects – 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. Site Development Alternative 1 involves the construction of cells and the landfilling of solid non-hazardous waste of which Waste Connections has significant experience at this site. Continued construction and operation of the landfill will not result in any change to worker health and safety training and practice and the ongoing operation would be similar to current with known and manageable safety risks.

Mitigation – Continued implementation of worker health and safety best practices.

Net Effects – No anticipated net effect during construction, operation or post closure.

4.1.2.7.3.2 Site Development Alternative 2

4.1.2.7.3.2.1 Noise and Vibration

The noise and vibration potential effects, mitigation and net effects for Site Development Alternative 2 are identical to those described above for Site Development Alternative 1.

4.1.2.7.3.2.2 Odour

Potential Effects – The conservative screening level modelling identifies a low potential for off-site property odour impacts for the vertical and horizontal expansion areas for Site Development Alternative 2 related to direct landfilling activity. However, landfill mining of the Old Landfill is anticipated to act as a compounding odour source over the five (5) to ten (10) year duration significantly increasing the overall odour emissions.

Mitigation – Waste Connections has historically and will continue to address the potential for odour disruption to residential neighbours as follows:

- Minimizing the size of the working face;
- Application of daily and intermediate cover material;
- Expansion of the landfill gas collection and management system to address the additional waste and the destruction of the LFG (flaring);
- Installing and operating odour neutralizing systems; and
- Regular communications with neighbours, with heightened communications during landfill mining.

Mitigation for landfill mining would include odour masking and suppression systems, it is unknown how successful these measures would be for mitigating the odour.

Net Effects – The conservative screening level modelling identified a low potential for odour impacts as part of regular landfill construction and operations. However, landfill mining could result in significant odour generation over the five (5) to ten (10) year process that would be difficult (and likely unsuccessful) to mitigate. Further assessment will be completed using a more refined model if this alternative is carried forward. No significant net effects related to odour are anticipated post closure.

4.1.2.7.3.2.3 Visual

The visual potential effects, mitigation and net effects for Site Development Alternative 2 are identical to those described above for Site Development Alternative 1.

4.1.2.7.3.2.4 Traffic

In addition to the traffic potential effects, mitigation and net effects identified for Site Development Alternative 1, landfill mining, which is included as part of Site Development Alternative 2, would also increase vehicle use on-site during the mining operation however off-site traffic is not anticipated to increase.

4.1.2.7.3.2.5 Worker Safety

Potential Effects – 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. As with Site Development Alternative 1, this alternative involves the construction of cells and the landfilling of solid non-hazardous waste of which Waste Connections has significant experience at this site. Continued construction and operation of the landfill will not result in any change to worker health and safety training and practice and the ongoing operation would be similar to current with known and manageable safety risks.

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 five (5) to ten (10) years. Additional training and specific worker health and safety practices will be needed related to landfill mining.

Mitigation – Continued implementation of worker health and safety best practices.

Net Effects – Site Development Alternative 2 presents an elevated health and safety risk for workers due to landfill mining during construction and operation. No net effects are anticipated post closure.

4.1.2.7.3.3 Site Development Alternative 3

4.1.2.7.3.3.1 Noise and Vibration

The noise and vibration potential effects, mitigation and net effects for Site Development Alternative 3 are similar to those described above for Site Development Alternative 1, the exception is that about 6 more receptors (total of 13) will be subject to a medium noise impact versus a low impact. These additional receptors that will receive a medium noise impact are located east of the landfill and will be a result of the development of landfill area C. It is important to note that the landfill is still expected to still be in compliance with regulatory criteria.

4.1.2.7.3.3.2 Odour

Potential Effects – The conservative screening level modelling identifies a medium potential for off-site property odour impacts for Site Development Alternative 3 as 24 receptors could experience a medium odour impact. Receptors southeast of the landfill along Erieau Road would be impacted at the medium level due to their proximity to landfill area C.

Mitigation – Waste Connections has historically and will continue to address the potential for odour disruption to residential neighbours as follows:

- Minimizing the size of the working face;
- Application of daily and intermediate cover material;
- Expansion of the landfill gas collection and management system to address the additional waste and the destruction of the LFG (flaring);
- Installing and operating odour neutralizing systems; and
- Regular communications with neighbours.

Net Effects – The conservative screening level modelling identified a medium potential for odour impacts as part of regular landfill construction and operations. There will be periodic instances where fugitive odours are noticeable by residents, regular landfill operation can be expected to result in a medium potential for odour. Further assessment will be completed using a more refined model if this alternative is carried forward. No significant net effects related to odour are anticipated post closure.

4.1.2.7.3.3.3 Visual

The visual potential effects, mitigation and net effects for Site Development Alternative 3 are the same as described above for Site Development Alternative 1.

4.1.2.7.3.3.4 Traffic

The traffic potential effects, mitigation and net effects for Site Development Alternative 3 are the same as described above for Site Development Alternative 1.

4.1.2.7.3.3.5 Worker Safety

Potential Effects – 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. Similar to Site Development Alternatives 1 and 2, this alternative involves the construction of cells and the landfilling of solid non-hazardous waste of which Waste Connections has significant experience at this site. Continued construction and operation of the landfill will not result in any change to worker health and safety training and practice and the ongoing operation would be similar to current with known and manageable safety risks.

Mitigation – Continued implementation of worker health and safety best practices.

Net Effects – No anticipated net effect during construction, operation or post closure.

4.1.2.8 Socio-Economic Environment - Economic

The following documents the economic criteria and indicators, potential effects, proposed mitigation and net effects for each of the alternatives. **Figure 3-21** shows the residences, businesses and institutions in the Study Area and along the haul route.

4.1.2.8.1 Economic Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Potential for effect on businesses during construction and operation.	• Number of businesses in the Study Area and their distance from the fill area. • Loss of revenue for on-site tenant farm businesses.	• GIS mapping. • Existing and proposed facility characteristics.	• There are limited businesses in the vicinity of the landfill (two [2] in the Study Area and two [2] on-site farmers) that may experience different effects to their business depending on the site development alternatives.
Potential for landfill traffic effect on businesses during construction and operation.	• Number of waste trucks during operation. • Number of trucks for construction.	• Existing and proposed facility characteristics. • Survey input from local businesses as available.	• The annual tonnage for a future expanded site will be the same as it is currently. There may be potential for minor additional truck traffic during construction.
Potential for effect on agriculture during construction.	• Area of on-site crop production lost. • Area of Class 1-3 soils lost.	• GIS mapping. • Personal communication. • Soils mapping of Ontario. • Canada Land Inventory. • Official Plan mapping.	• The area around the site is primarily agriculture. The characteristics of the different development alternatives may have minor effect on farmers and farm operations.
Cost of facility.	• Approximate cost of site development alternative.	• Cost estimate.	• The site development alternative characteristics may result in differing capital and operating costs.

4.1.2.8.2 Overview of Economic Considerations and Assumptions

The Ridge Landfill has operated since the 1960s. There are two (2) businesses operating near the site (small equipment dealer, year round market) as well as agricultural operations and one (1) institution (Chatham-Kent airport). Existing businesses are approximately 1.2 km from the existing fill area. There are two (2) businesses and four (4) institutions on the haul route from Highway 401 to the site. No change to the existing haul route is proposed. There are two (2) farmers that operate on-site.

The Municipality of Chatham-Kent is primarily agricultural land. Over the years, tenant farm operators on the Ridge property have planted crops such as soybean, corn and winter wheat. A 6 ha apple orchard is located on the east side of the property. Soils in the on-site area are Class 2 and on-site lands will continue to be used for agriculture for as long as possible.

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. Approximately 200 waste trucks/day (this includes a combination of tractor trailers and collection vehicles) currently access the Ridge Landfill. The number of waste trucks is not expected to change as the annual tonnage for the proposed expansion will be the same as it is today. Approximately 500 to 750 additional construction material trucks/year, on average, are anticipated over the 20-year operation of the proposed expansion. 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.

Active fill areas will generally move south with the expansion. The construction of new cells and the placement of waste within open cells will occur simultaneously. Berms exist on the west side of the site and will be constructed on the east and south providing a screening of businesses.

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.

4.1.2.8.3 Economic Net Effects

4.1.2.8.3.1 Site Development Alternative 1

4.1.2.8.3.1.1 Construction and Operation Effect on Businesses

Potential Effects – With Site Development Alternative 1 tenant farmers harvest approximately 59 ha of soybean on an annual basis which will no longer be available. Based on a value of approximately $430 per tonne for soybean and a yield of 3 tonnes per hectare this represents an economic value of approximately $76,000 per year.

Landfill activities will move closer to the two (2) businesses located south/southwest from the landfill. Businesses can be disrupted by landfill activities (e.g., noise, litter, and odour) that could affect their business activities. The two (2) businesses are approximately 400 m from the proposed Fill Area A at the southwest corner of the site. Businesses may experience minor and short term disruption which is not anticipated to affect their business activities. The type and extent of future activity at the site with the proposed expansion will be similar to what businesses in the site vicinity experience today.

Mitigation –On-site tenant farmers are aware of the impending expansion and will be treated fairly based on the terms of their lease agreement. They will be able to farm until the land is needed for landfill activities.

A berm will be constructed between the fill area and the businesses providing a buffer. The details of the berm construction have been developed considering the potential for impacts on the businesses. Waste Connections has historically and will continue to address the potential for site construction and operation to disrupt business 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;
- 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;
- Plantings and landscaping to reduce visual impact;

- Use of the permanent and temporary litter fences; and
- Regular off-site inspection and litter collection from neighbouring properties and along the haul route.

Net Effects – Businesses may experience minor and short term disruption such as periodic odour and litter as they do today during construction and operation. These disruptions are not anticipated to affect their business activities. For the two (2) farmers; one of the farmers is looking to retire and for the other farmer, the Ridge Landfill leased area represents a very small portion of the land he farms and he has advised that losing it is not an issue. There are no anticipated net effects on businesses during the post closure period.

4.1.2.8.3.1.2 Traffic Effect on Businesses

Potential Effects – As the number of waste trucks will not change on an annual basis, businesses along the haul route will have continued landfill truck traffic very similar to what is experienced today (i.e., 200 waste trucks/day). Businesses along the haul route may experience minor and short-term disruption from additional materials trucks required to construct the expansion (approximately 500 to 750/year). The number of the construction related trucks is considered minimal and not anticipated to have an impact on access to businesses along the haul route. The two (2) businesses located adjacent to the landfill are on the opposite side of the property from the truck entrance and will not be impacted by waste or construction trucks. It is noted that the airport entrance is not located on the haul route.

Mitigation – Protocols to require waste trucks to use the designated haul route and to tarp their vehicles will be put in place. Waste Connections will continue to receive and work to address complaints related to trucks on the haul route. Regular communications with neighbouring businesses will also occur.

Net Effects – The potential impact on businesses from landfill traffic during construction and operation will be low and similar to what is experienced today. There are no anticipated net effects related to traffic on businesses during the post closure period as waste trucks would no longer use the haul route.

4.1.2.8.3.1.3 Removal of Agricultural Lands

Potential Effects – Site Development Alternative 1 includes an expanded fill area footprint over approximately 59 ha. This land is currently being leased to tenant farm operators for crop production. A 6 ha apple orchard located on the east side of the site, south of the landfill entrance

will also be removed. 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. It is noted that this represents a small amount of land within the Chatham-Kent context.

Farming operations will be permitted until the lands are required for landfill operations 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. 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 landfill operations are complete.

Mitigation – On-site tenant farmers are aware of the impending expansion and will be treated fairly based on the terms of their lease agreement. They will be able to farm until the land is needed for landfill activities. Additional mitigation includes:

- Regular communications with neighbours;
- Continuation of farming on-site for as long as possible; and
- Consideration of some form of agricultural use as part of closure plan.

Net Effects – There will be some on-site lands that are removed from agricultural use during site operation. For the two (2) farmers on-site; one of the farmers is looking to retire and for the other farmer, the Ridge Landfill leased area represents a very small portion of the land he farms and he has advised that losing it is not an issue. The extent of removal is minimal in the context of Chatham-Kent. During the post closure period some lands may be able to revert back to agricultural use.

4.1.2.8.3.1.4 Facility Cost

Potential Effects – Using this per hectare unit cost, Site Development Alternative 1 would cost in the order of $60 million. Site Development Alternative 1 represents standard landfill construction costs. The operating cost will be similar for all site development alternatives as the same amount of waste will be landfilled.

Mitigation – No mitigation is required.

Net Effects – Cost of facility is in line with expected per hectare cost for landfill.

4.1.2.8.3.2 Site Development Alternative 2

4.1.2.8.3.2.1 Construction and Operation Effect on Businesses

For Site Development Alternative 2, tenant farmer(s) would harvest approximately 54 ha of soybean on an annual basis which will no longer be available. Based on a value of approximately $430 per tonne for soybean and a yield of 3 tonnes per hectare this represents an economic value of approximately $70,000 per year. The potential effects, mitigation and net effects for off-site businesses Site Development Alternative 2 are identical to those described above for Site Development Alternative 1.

4.1.2.8.3.2.2 Traffic Effect on Businesses

In addition to the traffic potential effects, mitigation and net effects identified for Site Development Alternative 1, landfill mining, which is included as part of Site Development Alternative 2, would also increase vehicle use on-site during the mining operation.

4.1.2.8.3.2.3 Removal of Agricultural Lands

Potential Effects: Site Development Alternative 2 includes an expanded fill area footprint over approximately 54 ha. This land is currently being leased to tenant farm operators for crop production. A 6 ha apple orchard is located on the east side of the site, south of the landfill entrance will also be removed. 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. It is noted that this represents a small amount of land within the Chatham-Kent context.

Farming operations will be permitted until the 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. 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.

Mitigation – On-site tenant farmers are aware of the impending expansion and will be treated fairly based on the terms of their lease agreement. They will be able to farm until the land is needed for landfill activities. Additional mitigation includes:

- Regular communications with neighbours;
- Continuation of farming on-site for as long as possible; and
- Consideration of some form of agricultural use as part of closure plan.

Net Effects – There will be some on-site lands that are removed from agricultural use during site operation. The extent of removal is minimal in the context of Chatham-Kent. For the two (2) farmers on-site; one of the farmers is looking to retire and for the other farmer, the Ridge Landfill leased area represents a very small portion of the land he farms and he has advised that losing it is not an issue. During the post closure period some lands may be able to revert back to agricultural use.

4.1.2.8.3.2.4 Facility Cost

Potential Effects – Using this per hectare unit cost, the construction of the vertical and horizontal expansion for Site Development Alternative 2 would cost in the order of $54 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. Site Development Alternative 2, including the landfill mining would likely cost in excess of $165 million. The operating cost will be similar for all site development alternatives as the same amount of waste will be landfilled.

Mitigation – No mitigation is required.

Net Effects – Cost of facility is in line with expected per hectare cost for landfill with a significant additional cost for landfill mining.

4.1.2.8.3.3 Site Development Alternative 3

4.1.2.8.3.3.1 Construction and Operation Effect on Businesses

For Site Development Alternative 3, tenant farmer(s) would harvest approximately 83 ha of soybean on an annual basis which will no longer be available. Based on a value of approximately $430 per tonne for soybean and a yield of 3 tonnes per hectare this represents an economic value of approximately $107,000 per year.

The potential effects, mitigation and net effects for off-site businesses for Site Development Alternative 3 are the same as described above for Site Development Alternative 1.

4.1.2.8.3.3.2 Traffic Effect on Businesses

The traffic potential effects, mitigation and net effects for Site Development Alternative 3 are identical to those described above for Site Development Alternative 1.

4.1.2.8.3.3.3 Removal of Agricultural Lands

Potential Effects – Site Development Alternative 3 includes an expanded fill area footprint over approximately 83 ha. This land is currently being leased to tenant farm operators for crop production. A 6 ha apple orchard is located on the east side of the site, south of the landfill entrance will also be removed. 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. It is noted that this represents a small amount of land within the Chatham-Kent context.

Farming operations will be permitted until the 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. 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.

Mitigation – On-site tenant farmers are aware of the impending expansion and will be treated fairly based on the terms of their lease agreement. They will be able to farm until the land is needed for landfill activities. Additional mitigation includes:

- Regular communications with neighbours;
- Continuation of farming on-site for as long as possible; and
- Consideration of some form of agricultural use as part of closure plan.

Net Effects – There will be some on-site lands that are removed from agricultural use during site operation. The extent of removal is minimal in the context of Chatham-Kent. For the two (2) farmers on-site; one of the farmers is looking to retire and for the other farmer, the Ridge Landfill leased area represents a very small portion of the land he farms and he has advised that losing it

is not an issue. During the post closure period some lands may be able to revert back to agricultural use.

4.1.2.8.3.3.4 Facility Cost

Potential Effects – Using this per hectare unit cost, Site Development Alternative 3 would cost approximately $80 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 Site Development Alternative 3 that would be about 15% higher than Site Development Alternatives 1 and 2 due to the larger overall area of the alternative.

Mitigation – No mitigation is required.

Net Effects – Cost of facility is in line with expected per hectare cost for landfill.

4.1.2.9 Cultural Environment – Cultural Heritage and Archaeological

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

4.1.2.9.1 Cultural Heritage Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Potential effects to archaeological resources as a result of construction.	• Area of undisturbed land affected by the expansion alternative.	• Stage 1, 2 and partial 3 Archaeological Assessments. • Existing and proposed facility characteristics.	• There is undisturbed land remaining on-site that could have archaeological resources.
Potential effects to cultural heritage resources as a result of construction.	• Number and type of cultural heritage resources affected by expansion alternative.	• Cultural Heritage Resource Assessment. • Existing and proposed facility characteristics.	• There are identified cultural heritage resources on-site that could be impacted by alternatives.

4.1.2.9.2 Overview of Cultural Considerations and Assumptions

Much of the site has been previously disturbed or has been assessed. A Stage 2 Archaeological Assessment has been completed on the site as part of the impact assessment of the preferred site. The Stage 2 results identified three (3) areas that will require a Stage 3 Archaeological Assessment. All three (3) areas are in the southwest corner of the site and would be impacted by

landfill activities for all alternatives. A Stage 3 Assessment was competed on two (2) of the three (3) areas identified and no further assessment is required in those areas. The areas are shown in **FIGURE 3-28**. The remaining Stage 3 work will be completed in the spring of 2020 and prior to use of this area and any resources identified will be removed.

Three (3) properties having cultural heritage value or interest are shown on **FIGURE 6-16** and include:

- 8765 Allison Line – farmstead with a residence, barn and outbuildings;
- 8779 Allison Line – residence; and
- 20323 Charing Cross Road – barn.

All residential buildings, barns and associated cultural landscapes on the site will be removed as part of the proposed expansion.

4.1.2.9.3 Cultural Net Effects

4.1.2.9.3.1 Site Development Alternative 1

4.1.2.9.3.1.1 Archaeological Resources

Potential Effects – Site Development Alternative 1 will impact the three (3) areas requiring a Stage 3 Archaeological Assessment.

Mitigation – The Stage 3 Archaeological Assessment cleared two (2) of the three (3) on-site areas identified, assessment of the remaining area will be completed as soon as weather and ground conditions permit. Any archaeological resources discovered as a result of this further assessment will be removed prior to use of this area. Should archaeological resources be uncovered during construction, Waste Connections will stop work and notify the appropriate agencies/authorities.

Net Effects – There are no anticipated net effects during construction, operation or post closure.

4.1.2.9.3.1.2 Cultural Heritage Features

Potential Effects – On-site cultural resources along Allison Line (residence, barn, and a farmscape with residence) will be removed for the construction of Site Development Alternative 1.

Mitigation – The Heritage Impact Assessment completed for this project (and included in Appendix D2A) considered mitigation as follows:

- Retention - 8675 and 8779 Allison Line and 20323 Charing Cross Road, are proposed to be cleared for use by the landfill. Should the proposed undertaking be redesigned to avoid the residences and barns, consideration of retention in situ would be appropriate. Based on the current site plans, retention in situ was not determined to be a feasible alternative to lessen the impacts identified.
- Relocation - The barns at 8765 Allison Line and 20323 Charing Cross Road were constructed as purpose built agricultural structures representative of rural construction practices in late 19th and early 20th century Ontario. These barns, although once very common, are increasingly rare but not unique from other barns found in the vicinity. Both barns have fallen into disrepair and are no longer used. It was concluded that these barns do not warrant consideration for relocation as a strategy to mitigate the impacts associated with the proposed as the current condition of the barns do not allow for accurate recreation.
- Documentation and Salvage - Detailed documentation and salvage is often the preferred mitigation strategy where retention or relocation is not feasible or warranted. Documentation creates a public record of the resource, or resources, which provides researchers and the general public with a land use history, construction details, and photographic record of the property. Although documentation and salvage does not eliminate the removal of these structures, it does seek to record the cultural heritage value or interest identified making the buildings available for future study and access by the public. When an agricultural building is no longer needed as is the case for the identified barns following the appropriate mitigation such as documenting the properties and completing salvage where possible is recommended.

The Heritage Impact Assessment Report serves as initial documentation of the features. Further documentation completed during demolition will be undertaken. Salvage will also be undertaken where practical during demolition.

Net Effects – No net effect during construction, operation or post closure is anticipated.

4.1.2.9.3.2 Site Development Alternative 2

4.1.2.9.3.2.1 Archaeological Resources

The archaeological potential effects, mitigation and net effects for Site Development Alternative 2 are identical to those described above for Site Development Alternative 1.

4.1.2.9.3.2.2 Cultural Heritage Features

The cultural heritage potential effects, mitigation and net effects for Site Development Alternative 2 are identical to those described above for Site Development Alternative 1.

4.1.2.9.3.3 Site Development Alternative 3

4.1.2.9.3.3.1 Archaeological Resources

The archaeological potential effects, mitigation and net effects for Site Development Alternative 3 are identical to those described above for Site Development Alternative 1.

4.1.2.9.3.3.2 Cultural Heritage Features

The cultural heritage potential effects, mitigation and net effects for Site Development Alternative 3 are identical to those described above for Site Development Alternative 1.

4.1.2.10 Built Environment – Land Use, Transportation, Bird Hazards and Aviation Safety, Design and Operations

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

4.1.2.10.1 Built Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Effects on land use as a result of construction.	• Size of landfill footprint.	• Existing and proposed facility characteristics.	• The site development alternatives involve different footprints resulting in differences in the use of land.
Potential effects on existing transportation infrastructure and transportation operation.	• Number of waste trucks during operation. • Number of trucks for construction. • Anticipated impact on the Chatham-Kent airport.	• Existing and proposed facility characteristics. • Annual tonnage.	• The annual tonnage to the site will not change so the number of landfill trucks will remain approximately the same as they are today. There may be potential for minor additional truck traffic during construction.

Criteria	Indicators	Data Sources	Rationale
			• Continued landfill truck traffic also has the potential to impact safety. • It is noted that the airfield in the vicinity of the site equally dictates the height of landfilling for all alternatives and is not included in the comparative evaluation criteria.
Potential for effects on existing landfill infrastructure as a result of construction.	• Extent and type of change required to existing site facilities.	• Existing and proposed facility characteristics.	• Site development alternative may result in different needs to adjust existing features on-site.
Ease to implement/construct and maintain/operate.	• Anticipated complexity of construction and operation.	• Existing and proposed facility characteristics.	• The alternatives will have different levels of complexity for Waste Connections staff to construct and operate.

4.1.2.10.2 Overview of Built Considerations and Assumptions

The Chatham-Kent Official Plan and Zoning By-law are based on the current Ridge landfill site configuration.

There is an existing designated haul route that waste trucks use to access the site. This haul route will not change and the annual tonnage and anticipated number of trucks to access the site on an annual basis will not change. 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). Approximately 500 to 750 additional construction material trucks/year, on average, are anticipated over the 20-year operation of the proposed expansion. Soil movement will remain on-site.

Without expansion the site would close in approximately 2021 which would reduce the use of the haul route by waste trucks and would reduce some bird activity specific to the site.

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.

Transportation infrastructure includes the Chatham-Kent Municipal Airport. The Ridge Landfill was in existence prior to the Airport Zoning Regulations taking effect. Based on the Airport Zoning Regulations it is the responsibility of Waste Connections to ensure that the landfill does not result in a hazard. Waste Connections liaises with the airport on a continuous basis to support the Airport's wildlife management plan and the Ridge Landfill's bird hazard management plan. Chatham Airport Zoning Regulations define a maximum height of 241.3 masl for construction in the area. Currently 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[126] 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. There is also no ground traffic interference between the landfill and airport users as the airport is not located on the designated haul route.

[126] Transport Canada (1991). Chatham Airport Zoning Regulations, SOR/91-173. Last Updated: January 30, 2019.

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.

4.1.2.10.3 Built Net Effects

4.1.2.10.3.1 Site Development Alternative 1

4.1.2.10.3.1.1 Land Use

Potential Effects – Different landfill footprints 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. The footprint addition for Site Development Alternative 1 is 59 ha. This alternative will result in limited future use for the approximately 190 ha landfill footprint. Lands in the southeast corner of site will have a more flexible use upon closure.

Mitigation – 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. 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.

Net Effects – No anticipated net effects during construction and operation. Post closure of the site, some lands in the southeast corner of the site could have more flexibility for future use.

4.1.2.10.3.1.2 Transportation Operation and Infrastructure

Potential Effects – Continued traffic related to the landfill will result in continued wear and tear on existing roads. This has been addressed by Waste Connections through ongoing funding provided to the Municipality of Chatham-Kent for upkeep of the designated haul route.

Site Development Alternative 1 will result in the active landfilling area moving further from the airport. Impact to the airport is not expected since the height of the alternative, 241 masl, is within the regulated height limitation. The proximity of the Ridge Landfill to the Airport however results in the potential for bird conflicts with aircraft.

Mitigation – Site Development Alternative 1 will be within the height restriction dictated by the airport. Waste Connections will continue to proactively implement bird control measures at the site and will continue to proactively coordinate this effort with the airport.

Net Effects – No anticipated net effects during construction, operation or post closure.

4.1.2.10.3.1.3 Landfill Infrastructure

Potential Effects – While some relocation/expansion of stormwater ponds will be required other infrastructure (e.g., existing berms, stock pile and flood control facilities to the north, the entrance, scale house, and office) will remain as is. The impact of Site Development Alternative 1 on existing landfill infrastructure is considered minimal.

Mitigation – No mitigation required.

Net Effects – No anticipated net effects during construction, operation or post closure.

4.1.2.10.3.1.4 Ease of Construction and Operation

Potential Effects – Site Development Alternative 1 represents a continuation of current landfill construction and operation practices employed by Waste Connections.

Mitigation – No mitigation required.

Net Effects: Site Development Alternative 1 will be straightforward to implement/construct and maintain/operate. No anticipated net effects during construction, operation or post closure.

4.1.2.10.3.2 Site Development Alternative 2

4.1.2.10.3.2.1 Land Use

Potential Effects – Different landfill footprints 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. The footprint addition for Site Development Alternative 2 is 54 ha. This alternative will result in limited future use for the approximately 185 ha landfill footprint. Lands in the southeast corner of site will have a more flexible use upon closure.

Mitigation – 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. 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.

Net Effects – No anticipated net effects during construction and operation. Post closure of the site, some lands in the southeast corner of the site could have more flexibility for future use.

4.1.2.10.3.2.2 Transportation Operation and Infrastructure

The transportation infrastructure and operation potential effects, mitigation and net effects for Site Development Alternative 2 are identical to those described above for Site Development Alternative 1.

4.1.2.10.3.2.3 Landfill Infrastructure

The landfill infrastructure potential effects, mitigation and net effects for Site Development Alternative 2 are identical to those described above for Site Development Alternative 1.

4.1.2.10.3.2.4 Ease of Construction and Operation

Potential Effects – The vertical and horizontal expansion construction and landfill operation activities associated with Site Development Alternative 2 represents a continuation of current landfill construction and operation practices employed by Waste Connections. Alternative 2 includes landfill mining which is a specialized process that adds significant complexity to landfill construction and operation for the vertical expansion of the Old Landfill.

Mitigation – No mitigation required.

Net Effects – The landfill mining component of Site Development Alternative 2 will be complex to implement/construct and maintain/operate. No anticipated net effects during post closure.

4.1.2.10.3.3 Site Development Alternative 3

4.1.2.10.3.3.1 Land Use

Potential Effects – Different landfill footprints 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. The footprint addition for Site Development Alternative 3 is 83 ha. This alternative will result in limited future use for the approximately 214 ha landfill footprint. Lands in the southeast corner of site would be used for landfill and would no longer support a more flexible use upon closure.

Mitigation – 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. 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.

Net Effects – No anticipated net effects during construction and operation. Post closure of the site, none of the lands in the southeast corner of the site would provide for flexibility in future use.

4.1.2.10.3.3.2 Transportation Operation and Infrastructure

The transportation infrastructure and operation potential effects, mitigation and net effects for Site Development Alternative 3 are the identical to those described above for Site Development Alternative 1.

4.1.2.10.3.3.3 Landfill Infrastructure

The transportation infrastructure and operation potential effects, mitigation and net effects for Site Development Alternative 3 are the identical to those described above for Site Development Alternative 1.

4.1.2.10.3.3.4 Ease of Construction and Operation

Potential Effects – Site Development Alternative 3 represents a continuation of current landfill construction and operation practices employed by Waste Connections.

Mitigation – No mitigation required.

Net Effects – Site Development Alternative 3 will be straightforward to implement/construct and maintain/operate. No anticipated net effects during construction, operation or post closure.

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; 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 4-13 provides a summary 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 1**.

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 350 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
- 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 (subject to completion of

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

assessment on one(1) remaining area);
- No effect on existing transportation infrastructure or major existing on-site infrastructure;
- Optimization of land already used as landfill (Old Landfill); and
- Keeps southeast woodlot in place.

Key Disadvantages

- Removes the southwest woodlot. The woodlot will be replanted;
- Temporarily removes eastern meadowlark habitat and removes barn swallow nest(s);
- Requires the realignment of Howard Drain with localized and limited impact to aquatic systems;
- Increase in GHG emissions over lifespan of landfill;
- 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 359 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 (subject to completion of assessment on one(1) remaining area);
- No effect on existing transportation infrastructure or major existing on-site infrastructure;
- Optimization of land already used as landfill (Old Landfill); and
- Keeps 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 five (5) to 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 and removes barn swallow nest(s);
- Requires the relocation of Howard Drain with localized and limited impact to aquatic habitat

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

systems;
- Increase in GHG emissions over lifespan of landfill;
- 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 335 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;
- Noise will be within MECP criteria;
- Regular landfill operation could result in medium odour impact to neighbouring receptors;
- 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;
- Does not remove eastern meadowlark habitat over Old Landfill;
- No potential for effects on cultural or archaeological resources (subject to completion of assessment on one(1) remaining area); 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 and habitat for the eastern wood-pewee and stiff cowbane in the southeast woodlot and removes barn swallow nest(s);
- 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;
- Increase in GHG emissions over lifespan of landfill;
- Requires amendment to the Official Plan and Zoning; and
- Limits the flexibility of the long term use of the largest area of land.

4.1.3.1 Site Development Alternative Conclusion

Based on the work completed, Site Development Alternative 1 is the preferred or equally preferred option over the other site development alternatives for all of the environments considered. Site Development Alternative 1 is considered the preferred alternative overall as follows:

- Natural Environment – Biological – Preferred (equally preferred with Site Development Alternative 2): Site Development Alternative 1 only removes the lower quality southwest woodlot and has no long term impact on endangered/threatened species after mitigation, which also holds true for Site Development Alternative 2. While Alternative 3 does not remove the meadow habitat over the Old Landfill, for both Alternatives 1 and 2, the meadow habitat will be replaced within 3 to 4 years of removal as the area is restored and other habitat is being added. Alternative 3 requires removal of both the southwest and southeast woodlots. Southeast woodlot removal includes removal of potential SAR bat habitat, habitat for the eastern wood-pewee, designated as Special Concern and Rare Wildlife Species as well as the botanical species stiff cowbane which is considered a Species of Conservation Concern. Alternative 3 would require removal of both the southeast woodlot and the smaller southwest woodlot, both deemed *Significant Woodlots* in the Chatham-Kent's Official Plan. For these reasons Alternative 3 is deemed to be Less Preferred.
- Natural Environment – Groundwater – Equally Preferred: All three (3) site development alternatives are underlain by 30 m of clay and will have no impact on groundwater quality or quantity. Leachate would take approximately 3,000 years to reach the bedrock aquifer and at that time would meet drinking water objectives. With the limited groundwater movement there is no impact to residential water supply wells.
- Natural Environment – Surface Water – Equally Preferred: None of the three (3) site development alternatives will significantly impact surface water quality or quantity.
- Natural Environment – Atmospheric – Preferred (equally preferred with Site Development Alternative 3): Site Development Alternative 1 (and Site Development Alternative 3) will have minimal impact on air quality. In comparison Site Development Alternative 2 includes landfill mining which has the potential for air quality impacts that cannot be mitigated, making it a Less Preferred Alternative.
- Natural Environment – Climate Change – Preferred (equally preferred with Site Development Alternative 3): All three (3) alternatives will result in a similar increase in potential for GHGs as a result of additional waste. Site Development Alternative 1

(and Site Development Alternative 3) is preferred as it does not release further GHG through the process of landfill mining which is the case for Site Development Alternative 2.

- Socio-Economic Environment – Social – Preferred: Site Development Alternative 1 and 3 are Preferred over Alternative 2 which is considered Least Preferred because of the fact that landfill mining has the potential for significant odour and worker safety concerns. Alternative 3 has the potential to result in moderate noise level increases for thirteen (13) receptors of 6 to 11 dBA compared to seven (7) receptors for Alternatives 1 and 2 and so is Less Preferred however noise at receptors in the vicinity of the landfill will not exceed the MECP's criterion of 55 dBA for landfills. For these reasons Alternative 3 is deemed to be Less Preferred than Alternative 1 however the mining component of Alternative 2 makes it the Least Preferred overall.
- Socio-Economic Environment – Economic – Preferred: Site Development Alternative 1 represents, by far, the lowest cost to construct and operate (estimated $60 million) compared to $165 million and $80 million for each of Alternatives 2 and 3 respectfully. Loss of revenue from farming is greatest for Alternative 3 (about $25,000 per year more than Alternatives 1 or 2). Alternative 3 is Less Preferred than Alternative 1 both because construction and operating costs are higher and that some additional farmlands are taken out of production (although this represents a very insignificant amount of farmland in Chatham-Kent). Alternative 2 is Least Preferred because of the very significant increase in construction and operating costs.
- Cultural Environment – Archaeology and Cultural Heritage – Equally Preferred: All three Alternatives require the same geographic extent of the Stage 3 Archeological Assessment. For all three Alternatives the assessment would be completed and any archaeological resources that are discovered would be documented and removed prior to construction. For these reasons all three Alternatives are Equally Preferred.
- Built Environment – Preferred: Site Development Alternative 1. The same Built Environment charactistics generally exist for all three Alternatives except Alternative 1 has a relatively small overall footprint (190 ha) and is easier to construct than Alternatives 2 or 3. Alternative 2 has a footprint of only 185 ha but represents the most complex construction and operation of the three because of the landfill mining component. Alternative 3 has the largest footprint (214 ha) which leaves the least amount of flexibility for future use of the southeast corner of the site for the three Alternatives. For these reasons Alternative 1 is Preferred.

Table 4-13: Overview of Comparative Evaluation Rating - Site Development

(Note: green = preferred; blue = less preferred; pink = least preferred; alternatives that are equally preferred are not highlighted in colour)

Environment	Alternative 1	Alternative 2	Alternative 3	Do Nothing
Natural Environment - Biological Ranking	Preferred – Only removes the lower quality southwest woodlot and has no impact on endangered/ threatened species. Removes the lower quality southwest woodlot, and temporarily removes habitat for eastern meadowlark. All alternatives may remove barn swallow nest(s) which will be mitigated.	Preferred – Only removes the lower quality southwest woodlot and has no impact on endangered/ threatened species, and temporarily removes habitat for eastern meadowlark. All alternatives may remove barn swallow nest(s) which will be mitigated.	Less Preferred – Removes both the southwest and southeast woodlots and permanently removes potential SAR bat habitat and habitat for the eastern wood-pewee and stuff cowbane to the southeast woodlot. Does not impact eastern meadowlark habitat. All alternatives may remove barn swallow nest(s) which will be mitigated.	The southwest and southeast woodlots would remain. The eastern meadowlark meadow habitat on the Old Landfill would remain. Barn swallow nest(s) likely removed due to condition of buildings.
Natural Environment - Groundwater Ranking	Equally Preferred – Contaminating lifespan is relatively similar for all alternatives (i.e., approximately 350 years for Alternative 1). Leachate from all Site Development Alternatives would take approximately 3,000 years to reach the bedrock aquifer and at that time would meet drinking water objectives. With the limited groundwater movement there is no impact to residential water supply wells.	Equally Preferred – Contaminating lifespan is relatively similar for all alternatives (i.e., approximately 359 years for Alternative 2). Leachate from all Site Development Alternatives would take approximately 3,000 years to reach the bedrock aquifer and at that time would meet drinking water objectives. With the limited groundwater movement there is no impact to residential water supply wells.	Equally Preferred – Contaminating lifespan is relatively similar for all alternatives (i.e., approximately 335 years for Alternative 3). Leachate from all Site Development Alternatives would take approximately 3,000 years to reach the bedrock aquifer and at that time would meet drinking water objectives. With the limited groundwater movement there is no impact to residential water supply wells.	Contaminating lifespan of the current site is approximately 325 years. Leachate from the current site would take approximately 3,000 years to reach the bedrock aquifer and at that time would meet drinking water objectives. With the limited groundwater movement there is no impact to residential water supply wells.
Natural Environment - Surface Water Ranking	Equally Preferred – None of the three (3) site development alternatives will significantly impact surface water quality or quantity. Hydrologic analysis results confirm that peak flows will remain at or below pre-expansion conditions for all storm events (2 to 250 years) for Site Development Alternative 1. Hydraulic analysis indicates that there will be no impacts to upstream or downstream flood levels. Runoff volumes are maintained at or below the baseline condition.	Equally Preferred – None of the three (3) site development alternatives will significantly impact surface water quality or quantity. Hydrologic analysis results confirm that peak flows will remain at or below pre-expansion conditions for all storm events (2 to 250 years) for Site Development Alternative 2. Hydraulic analysis indicates that there will be no impacts to upstream or downstream flood levels. Runoff volumes are maintained at or below the baseline condition.	Equally Preferred – None of the three (3) site development alternatives will significantly impact surface water quality or quantity. Hydrologic analysis results confirm that peak flows will remain at or below pre-expansion conditions for all storm events (2 to 250 years) for Site Development Alternative 3. Hydraulic analysis indicates that there will be no impacts to upstream or downstream flood levels. There were minor increases in runoff volume (in the order of 1-3%) for Site Development Alternative 3.	The existing site would continue to have minimal to no impact on surface water.
Natural Environment - Atmospheric Ranking	Preferred – The conservative screening level modelling identified potential for off-site dust impact for all alternatives. 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 even after mitigation such as dust suppressants are used. Conservative screening level modelling identified low potential for off-property impacts to air quality during construction and operation for all three (3) Site	Less Preferred – The conservative screening level modelling identified potential for off-site dust impact for all alternatives. 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 even after mitigation such as dust suppressants are used. Conservative screening level modelling identified low potential for off-property impacts to air quality during	Preferred – The conservative screening level modelling identified potential for off-site dust impact for all alternatives. 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 even after mitigation such as dust suppressants are used. Conservative screening level modelling identified low potential for off-property impacts to air quality	Some fugitive dust from the closed landfill as well as the surrounding farming operations would be expected to reach neighbouring properties depending on wind conditions. The site currently complies with MECP air quality criteria. Continued landfill gas capture and control would be required post closure in 2021.

Environment	Alternative 1	Alternative 2	Alternative 3	Do Nothing
	Development Alternatives that can be mitigated through proper vehicle maintenance and continued landfill gas capture and control.	construction and operation for all three (3) Site Development Alternatives that can be mitigated through proper vehicle maintenance and continued landfill gas capture and control. The potential for the release of by-products of waste decomposition related to landfill mining for Site Development Alternative 2 may result in air quality impacts that cannot fully be mitigated. These impacts would extend over the 5 to 10 year period of landfill mining.	during construction and operation for all three (3) Site Development Alternatives that can be mitigated through proper vehicle maintenance and continued landfill gas capture and control.	
Natural Environment - Climate Change Ranking	Preferred - Greenhouse gas emissions from all three (3) alternatives are estimated to peak at 762,000 tonnes CO_2e/year in 2042. The potential for climate change impacts from on-site woodlot removal is not considered significant. Landfill engineered systems can and will be designed to perform in potential future climate conditions.	Less Preferred – Greenhouse gas emissions from all three (3) alternatives are estimated to peak at 762,000 tonnes CO_2e/year in 2042. The Landfill mining for Alternative 2 would result in a greater potential for greenhouse gas emissions when compared to Alternatives 1 and 3 due to the increase in vehicular activity during the 5 to 10 year period of mining and the release of trapped gases during mining that cannot be captured. The potential for climate change impacts from on-site woodlot removal is not considered significant. Landfill engineered systems can and will be designed to perform in potential future climate conditions.	Preferred: Greenhouse gas emissions from all three (3) alternatives are estimated to peak at762,000 tonnes CO_2e/year in 2042. The potential for climate change impacts from on-site woodlot removal is not considered significant. Landfill engineered systems can and will be designed to perform in potential future climate conditions.	Greenhouse gas emissions from the current landfill are estimated to peak at 391,000 tonnes CO_2e/year in 2021. The landfill is anticipated to be closed before there are significant changes related to climate.
Socio-Economic Environment - Social Ranking	Preferred – Overall Alternative 1 is considered preferred primarily as it has less potential for odour and limited safety risk to the community and workers. The following reflects the relative differences between the alternatives related to the social environment: • Off-site noise will meet MECP's criterion of 55 dBA for landfills in all cases. There is potential for a moderate noise increase of 7-11 dB for some receptors. While there is a slight difference between the alternatives in the number of receptors who may experience a change the difference between the alternatives is considered minimal overall. Seven (7) receptors may experience this moderate noise level increase with	Least Preferred – While there are similarities and differences between these alternatives, overall Alternative 2 is considered least preferred primarily due to the fact that landfill mining has the potential for significant odour and worker safety concerns. The following reflects the relative differences between the alternatives related to the social environment: • Off-site noise will meet MECP's criterion of 55 dBA for landfills in all cases. There is a potential a moderate noise increase of 7-11 dB for some receptors. While there is a slight difference between the alternatives in the number of receptors who may experience a change the difference between the alternatives is considered	Less Preferred – While there are similarities and differences between these alternatives, overall Alternative 3 is considered less preferred than Alternative 1 as it has more noise and odour potential. The following reflects the relative differences between the alternatives related to the social environment: • Off-site noise will meet MECP's criterion of 55 dBA for landfills in all cases. There is a potential a moderate noise increase of 7-11 dB for some receptors. While there is a slight difference between the alternatives in the number of receptors who may experience a change the difference between the alternatives is	Operational noise from the site would no longer be present. While there may be periodic instances where fugitive odours are noticeable by residents the LFG control system should capture most of the escaping gas. The current site is visible from approximately 27% of the land within 3 km. There would no longer be trucks transporting waste to the landfill.

Environment	Alternative 1	Alternative 2	Alternative 3	Do Nothing
	Alternative 1 • Low potential for odour impacts as part of regular landfill construction and operations. 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. • May be visible from approximately 43% of the land within 3 km. • Potential impact from landfill traffic during construction and operation will be low and similar to what is experienced today. • Alternative has known and manageable safety risks.	minimal overall. Seven (7) receptors may experience this moderate noise level increase with Alternative 2. • Low potential for odour impacts as part of regular landfill construction and operations. 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. Landfill mining however would result in significant odour over the five (5) to ten (10) year process that would be difficult to mitigate. • May be visible from approximately 43% of the land within 3 km. • Potential impact from landfill traffic during construction and operation will be low and similar to what is experienced today. • Alternative presents elevated health and safety risk for workers due to landfill mining during construction and operation.	considered minimal overall. Thirteen receptors may experience this moderate noise level increase with Alternative 3. • Medium potential for odour impacts as part of regular landfill construction and operations. 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. • May be visible from approximately 43% of the land within 3 km. • Potential impact from landfill traffic during construction and operation will be low and similar to what is experienced today. • Alternative has known and manageable safety risks.	
Socio-Economic Environment - Economic Ranking	Preferred – – Alternative 1 is preferred as it has the lowest impact on businesses and the lowest cost: • Alternatives 1 and 2 have the lowest potential for loss of revenue for tenant farmers. Off-site businesses may experience minor and short term disruption that is not anticipated to impact their business activities. • 59 ha of on-site lands will be removed from agricultural use during site operation. This is considered minimal in the Chatham-Kent context. • The cost of this alternative is approximately $60 million.	Least Preferred – Alternative 2 is the least preferred; while it has the lowest impact on businesses the overall construction cost is very large: • Alternatives 1 and 2 have the lowest potential for loss of revenue for tenant farmers. Off-site businesses may experience minor and short term disruption that is not anticipated to impact their business activities. • 54 ha of on-site lands will be removed from agricultural use during site operation. This is considered minimal in the Chatham-Kent context. • The cost of this alternative is approximately $165 million.	Less Preferred – Alternative 3 is less preferred than Alternative 1 as it involves slightly more removal of agricultural land and associated economic value and is more costly to develop: • Alternative 3 has the highest potential for loss of revenue for tenant farmers. Off-site businesses may experience minor and short term disruption that is not anticipated to impact their business activities. • 83 ha of on-site lands will be removed from agricultural use during site operation. This is considered minimal in the Chatham-Kent context. • The cost of this alternative is approximately $80 million.	Businesses today may experience minor and short term disruptions that do not impact their business activities. Upon closure these disruption impacts would be reduced. The on-site lands that are currently leased for farming could continue to be farmed.
Cultural Environment - Archaeology and Cultural Heritage Ranking	Equally Preferred – This alternative will remove one (1) area requiring a Stage 3 Archaeological Assessment. The work will be completed and any archaeological resources discovered removed prior to use of this area.	Equally Preferred – This alternative will remove one (1) area requiring a Stage 3 Archaeological Assessment. The work will be completed and any archaeological resources discovered removed prior to use of this area.	Equally Preferred – This alternative will remove one (1) area requiring a Stage 3 Archaeological Assessment. The work will be completed and any archaeological resources discovered removed prior to use of this area.	Any archaeological resources will remain undiscovered.

Environment	Alternative 1	Alternative 2	Alternative 3	Do Nothing
	Three (3) properties having cultural heritage value or interest will be removed as part of the proposed expansion. They will be documented and salvaged where possible.	Three (3) properties having cultural heritage value or interest will be removed as part of the proposed expansion. They will be documented and salvaged where possible.	Three (3) properties having cultural heritage value or interest will be removed as part of the proposed expansion. They will be documented and salvaged where possible.	
Built Environment Ranking	Preferred – While there are similarities and differences between the alternatives, overall Alternative 1 is preferred. The following reflects the relative differences between the alternatives related to the built environment: • Alternatives 1 and 2 have the smallest landfill footprint leaving the area in the southeast corner with greater flexiblity for for future use. The footprint of Alternative 1 is 190 ha. • All alternatives will be 241 masl, within the regulated height limitation for the airport and design complies with airport zoning regulations. • The impact on transportation and existing landfill infrastructure is considered minimal. • Alternative 1 is relatively easy to construct and operate.	Less Preferred – While there are similarities and differences between the alternatives, overall Alternatives 2 and 3 are less preferred. The following reflects the relative differences between the alternatives related to the built environment: • Alternatives 1 and 2 have the smallest landfill footprint leaving the area in the southeast corner with greater flexiblity for for future use. The footprint of Alternative 2 is 185 ha. • All alternatives will be 241 masl, within the regulated height limitation for the airport and design complies with airport zoning regulations. • The impact on transporation and existing landfill infrastructure is considered minimal. • Alternative 2 is more complex to construct and operate due to landfill mining.	Less Preferred – While there are similarities and differences between the alternatives, overall Alternatives 2 and 3 are less preferred. The following reflects the relative differences between the alternatives related to the built environment: • Alternative 3 has the largest landfill footprint leaving no land in the southeast corner with flexiblity for future use. The footprint of Alternative 3 is 214 ha. • All alternatives will be 241 masl, within the regulated height limitation for the airport and design complies with airport zoning regulations. • The impact on transportation and existing landfill infrastructure is considered minimal. • Alternative 3 is relatively easy to construct and operate.	Nothing will be constructed.
Overall Ranking	**Preferred Site Development Alternative**			

4.2 Alternative Methods of Landfill Gas Management

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.[127]

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 29 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 63 vertical LFG extraction wells. An additional 23 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.

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;

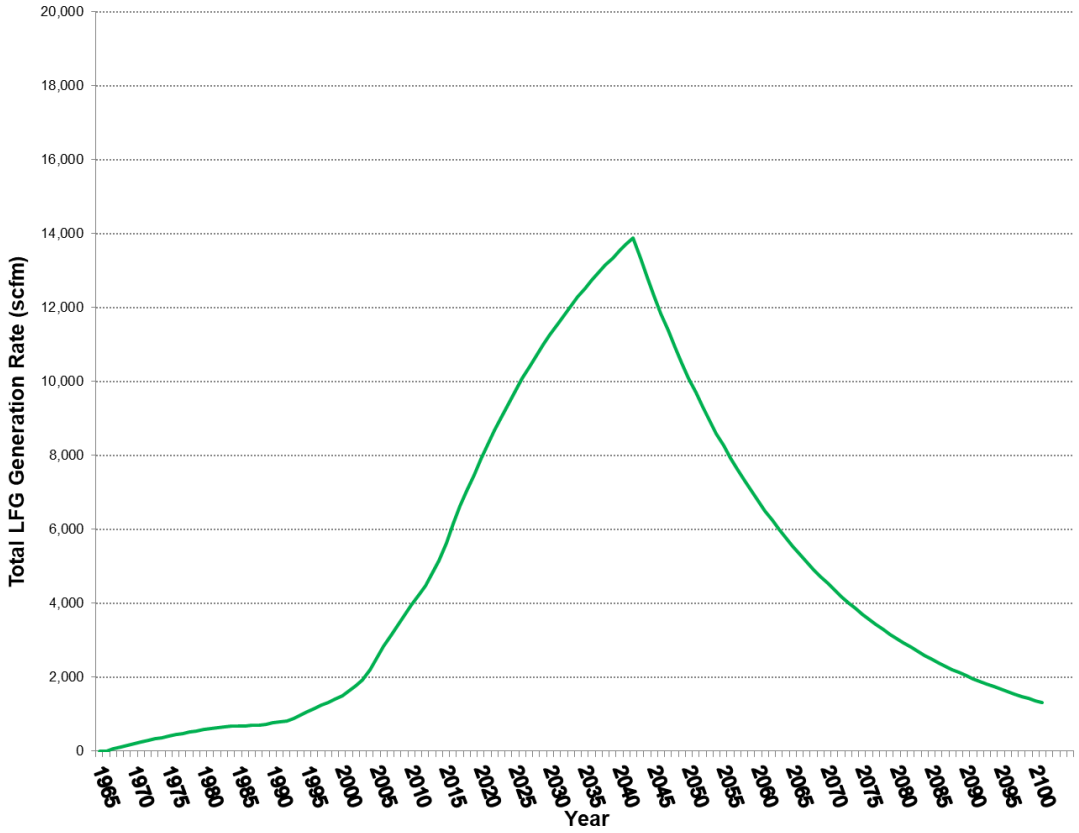
[127] Golder Associates Limited (2019c). Technical Memo: Ridge Landfill Expansion EA: Landfill Gas Contaminating Lifespan & Subsurface Migration, 2019.

- Passive Venting - Passive venting is typically installed at smaller landfills where LFG volumes do not warrant expensive active LFG extraction systems. *O.Reg. 232/98*[128] and *O.Reg. 347* (General Waste Management)[129] 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 4-11**). This number is influenced by a number of factors including rainfall received in the area and climatic conditions.[130]

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.[131]

[128] Ministry of the Environment, Conservation and Parks (1998a). *Landfilling Sites: Ontario Regulation (O.Reg.) 232/98*. Last Updated: June 2011.
[129] Ministry of the Environment, Conservation and Parks (1990). *General - Waste Management: Ontario Regulation (O.Reg.) 347*. Last Updated: December 2013.
[130] Note: See Appendix D6 – Design and Operations Report for technical information relating to landfill gas generation.
[131] Golder Associates Limited (2019a). Ridge Landfill Expansion: Design and Operations Report Draft. July 2019.

FIGURE 4-11: LANDFILL GAS GENERATION



4.2.1 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%.

4.2.2 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 Description of Landfill Gas Management Alternatives

Three (3) LFG management alternative methods were identified for the Ridge Landfill EA.[132] All three (3) alternatives provide responsible management of the LFG produced on-site over 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. As part of this alternative the expected GHG emissions were calculated and compared against existing conditions. The following sources and methodology were applied: • Carbon dioxide collected through the landfill gas system and released through the flares; • Methane collected through the landfill gas system, but not combusted in flares;	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. It should be noted that a full flare system in conjunction with Gas Utilization Alternatives 2 and 3

[132] Note: 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 similar. As such these two (2) alternatives have been combined into one (1) for the EA.

Landfill Gas Management Alternative Method	Description	Rationale
	• Carbon dioxide from the combustion of methane; and • The carbon dioxide and methane not collected by the collection system and fugitively released to the atmosphere. The carbon dioxide emissions collected through the landfill gas system are calculated using LandGEM and the landfill gas collection efficiency. The methane collected, but not combusted is calculated from the total landfill gas produced from LandGEM, the collection efficiency for the landfill gas system, and a flare combustion efficiency provided by U.S. EPA AP-42 Chapter 13.5 Industrial Flares. The carbon dioxide created from methane combustion are based on the methane collected and combusted and the molecular ratio of carbon dioxide to methane. Lastly, the GHG emissions from the landfill that were not collected through the LFG system were also included to provide the total GHG emissions. This alternative would be entirely within the control of Waste Connections and would be constructed on-site. The capital construction cost for the flares required for the expansion is about $2.5 million, with an annual maintenance and operating cost of about $125,000 over the life of the expansion.	will be required to manage LFG at times when the gas utilization systems are not operating. As a complete flare back-up system is required for Alternatives 2 and 3, these costs are common for all three (3) alternatives.
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 where 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.	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
	The third party would be responsible for all permits, approvals, construction and operation of any needed off-site facilities. 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 LFG could be treated and injected into the wider natural gas distribution system as RNG.[133] 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 was based on the results of the U.S. EPA spreadsheet tool for a hypothetical RNG scenario. As part of this alternative the expected GHG emissions were calculated and compared against existing conditions. The following sources and methodology were applied: • Carbon dioxide collected through the landfill gas system and released; • Carbon dioxide and methane emissions from combustion of natural gas; • Methane losses in commercial pipelines; and • The carbon dioxide and methane not collected by the collection system and released to the atmosphere. The carbon dioxide emissions collected through the landfill gas system are calculated from LandGEM and the landfill gas collection efficiency. The methane and carbon dioxide emissions from residential and commercial building, were calculated using emission factors provided by U.S. EPA AP-42	

[133] Note: 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
	Chapter 1.4, Table 1.4-2 for natural gas combustion. In addition, 1.4% of the methane was assumed to be lost in distribution and transportation within the natural gas pipeline. Lastly, the GHG emissions from the landfill that were not collected through the system were also included to provide the total GHG emissions for the expansion. 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. As a remote site has not been identified, off-site impacts for conveyance infrastructure cannot be quantified other than to indicate any conveyance infrastructure would likely be constructed within existing road rights-of-way. 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. **FIGURE 4-12** shows the business case for RNG reduction.	
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 the future would need to be undertaken as project specific	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
	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 was based on the results of the U.S. EPA spreadsheet tool for a hypothetical electricity generation scenario. As part of this alternative the expected GHG emissions were calculated and compared against existing conditions. The following sources and methodology were applied: • Carbon dioxide collected through the landfill gas system and released; • Carbon dioxide and methane emissions from combustion of natural gas in a gas generator; and • The carbon dioxide and methane not collected by the collection system and released to the atmosphere. The carbon dioxide emissions collected through the landfill gas system are calculated using LandGEM and the landfill gas collection efficiency. The methane and carbon dioxide emissions from operating a natural gas generator were calculated using emission factors provided under U.S. EPA AP-42 Chapter 3.2, Table 3.2-1. The GHG emissions from the landfill that were not collected through the system were also included to provide the total GHG emissions for the expansion. 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.	

Landfill Gas Management Alternative Method	Description	Rationale
	FIGURE 4-13 shows the business case for electricity generation. Infrastructure in the form of transmission lines would be required to be constructed with this alternative to connect the source of the generation to the provincial grid. As a location for a connection has not been identified it is only possible to indicate that potential transmission lines would be constructed in existing road rights-of-way were possible.	

4.2.4 Detailed Evaluation of RNG and Electricity Generation

For the purposes of this evaluation, site specific hypothetical feasibility and financial assessments were developed for the gas utilization alternatives in order to provide a basis of comparison between the alternatives and to identify the advantages and disadvantages of each alternative. The U.S. EPA has developed a model to evaluate the feasibility and estimate the costs/financial and environmental benefits of landfill gas energy projects in the United States as part of their Landfill Methane Outreach Program (LMOP). The LMOP Landfill Gas Energy Cost Model Version 3.3, August 2019 was used to assist with the assessment of landfill gas management alternatives for the Ridge Landfill EA. The tool utilizes 13 required inputs to characterize the age and size of the landfill, the type of LFG project and other input parameters relating to the project. Although the model is based upon United States data, it is believed that it is relevant for the Ridge Landfill analysis as typical landfill construction and operation techniques are similar between the countries. There are many more examples of these LFG utilization projects in the U.S. to draw upon compared to examples in Canada. The U.S. EPA is a recognized world leader in the development of landfill development and evaluation tools. The results were converted to Canadian dollars and metric units where appropriate. The results of the analysis were used to evaluate LFG gas utilization alternatives and are not meant to establish a business case to move forward with for any of the alternatives. The costs/benefits for budgetary purposes only and are meant to be used on a comparative basis only.

The assessment tool was utilized to assess the feasibility and costs of generating and selling electricity to the local grid and for producing RNG from LFG generated by the waste associated with the expansion project only. Gas currently being generated in the existing parts of the Ridge Landfill was not included in the evaluation in order to focus the evaluation on the expansion only.

Parameters specific to the waste expected to be received at the Ridge Landfill during the expansion period were used. This included using a 20-year fill period of 1.3 million tonnes/year and waste/gas properties of 55% methane in the landfill gas and a collection efficiency of 80%. Financials parameters used included an interest rate of 6% and a loan period of 10 years for borrowing of money to build the facilities, a 15% business tax rate and a discount rate of 8%.

The model generates the business case for each one of the alternatives assessed. This includes the net present value of each alternative, the internal rate of return and the years required to break even. These are all important factors used in the evaluation of the feasibility of a business proposition. The environmental benefits include the calculation of the average annual and lifetime benefits from collecting and destroying methane. **FIGURE 4-12** and **FIGURE 4-13** provide a summary of the inputs and results of the models developed for RNG and Electricity generation respectively

FIGURE 4-12: RENEWABLE ENERGY COST MODEL RESULTS

U.S. EPA Landfill Methane Outreach Program

Landfill Gas Energy Cost Model
LFGcost-Web, Version 3.2
Summary Report

Landfill Name or Identifier: Ridge Landfill Expansion
LFGE Project Type: High Btu Processing Plant
Date: Wednesday, October 02, 2019

Disclaimer:

LFGcost-Web is an LFG energy project cost estimating tool developed for EPA's LMOP. LFGcost-Web estimates landfill gas generation rates using a first-order decay equation. This equation is used to estimate generation potential but cannot be considered an absolute predictor of the rate of landfill gas generation. Variations in the rate and types of incoming waste, site operating conditions, and moisture and temperature conditions may provide substantial variations in the actual rates of generation.

The default inputs and costs estimated by LFGcost-Web are based on typical project designs and for typical landfill situations. The model attempts to include all equipment, site work, permits, operating activities, and maintenance that would normally be required for constructing and operating a typical project. However, individual landfills may require unique design modifications which would add to the cost estimated by LFGcost-Web.

Analyses performed using LFGcost-Web are considered estimates and should be used for guidance only. A detailed final feasibility assessment should be conducted by qualified landfill gas professionals prior to preparing a system design, initiating construction, purchasing materials, or entering into agreements to provide or purchase energy from an LFG energy project.

Summary Results

Project Start Year: 2025
Project End Year: 2039
Project Type: High Btu Processing Plant
Financial Results:
- Net Present Value: $647,512 (at year of construction)
- Internal Rate of Return: 9%
- Years to Breakeven: 15 (years after operation begins)
- Installed Capital Costs:
  - LFG Energy Project: $12,705,213
  - Total Capital Costs (for year of construction): $12,705,213
  - Annual O&M Costs (for initial year of operation): $1,247,783

These financial results DO NOT include the costs associated with the LFG collection and flaring system.

Environmental Benefits

Benefits from Collecting and Destroying Methane (during the life of the project):
- Lifetime
  - (million ft³ methane): 23,820
  - (MMTCO2E): 1.14E+01
- Average Annual
  - (million ft³ methane/yr): 1,588
  - (MMTCO2E/yr): 7.62E-01

Landfill Characteristics

Open Year: 2021
Closure Year: 2041
Waste-In-Place at Closure (tons): 28,660,000
Average Waste Acceptance (tons/yr): 1,433,000
Average Depth of Landfill Waste (ft): 80
Area of LFG Wellfield to Supply Project (acres): 250

Landfill Gas Generation, Collection, and Utilization

Modeling Parameters for First-Order Decay Equation:
- Methane Generation Rate, k (1/yr): 0.040
- Methane Generation Capacity, Lo (ft³/ton): 4,000
- Methane Content of LFG: 55%

Generated During Project Lifetime (ft³/min LFG):
- Minimum: 2,916
- Annual Average: 6,829
- Maximum: 10,122

Collected During Project Lifetime (ft³/min LFG):
- Minimum: 2,333
- Annual Average: 5,464
- Maximum: 8,097

Project Size: Minimum
Design Flow Rate for Project (ft³/min LFG): 2,333
Utilized by Project (ft³/min LFG):
- Annual Average: 2,169.39

LFG Collection Efficiency: 80%

Financial Assumptions

Loan Lifetime (years): 10
Interest Rate: 6.0%
Marginal Tax Rate: 15.0%
Discount Rate: 8.0%

High Btu Production and Sales Summary

Average High Btu Gas Produced (million Btu/yr): 574,304 (during the life of the project)
Initial Year High Btu Production Price ($/mmBtu): 3.3000

FIGURE 4-13: ELECTRICITY GENERATION COST MODEL RESULTS

LANDFILL METHANE OUTREACH PROGRAM

U.S. EPA Landfill Methane Outreach Program

Landfill Gas Energy Cost Model
LFGcost-Web, Version 3.2
Summary Report

Landfill Name or Identifier: Ridge Landfill Expansion
LFGE Project Type: Standard Reciprocating Engine (Electricity Generation)
Date: Wednesday, October 02, 2019

Disclaimer:

LFGcost-Web is an LFG energy project cost estimating tool developed for EPA's LMOP. LFGcost-Web estimates landfill gas generation rates using a first-order decay equation. This equation is used to estimate generation potential but cannot be considered an absolute predictor of the rate of landfill gas generation. Variations in the rate and types of incoming waste, site operating conditions, and moisture and temperature conditions may provide substantial variations in the actual rates of generation.

The default inputs and costs estimated by LFGcost-Web are based on typical project designs and for typical landfill situations. The model attempts to include all equipment, site work, permits, operating activities, and maintenance that would normally be required for constructing and operating a typical project. However, individual landfills may require unique design modifications which would add to the cost estimated by LFGcost-Web.

Analyses performed using LFGcost-Web are considered estimates and should be used for guidance only. A detailed final feasibility assessment should be conducted by qualified landfill gas professionals prior to preparing a system design, initiating construction, purchasing materials, or entering into agreements to provide or purchase energy from an LFG energy project.

Summary Results

Project Start Year: 2025
Project End Year: 2039
Project Type: Standard Reciprocating Engine-Generator Set
Financial Results:
- Net Present Value: ($20,648,142) (at year of construction)
- Internal Rate of Return: Negative
- Years to Breakeven: None (years after operation begins)
- Installed Capital Costs:
- Total Capital Costs (for year of construction): $12,932,502
- Annual O&M Costs (for initial year of operation): $1,907,098

These financial results DO NOT include the costs associated with the LFG collection and flaring system.

Environmental Benefits

Benefits from Collecting and Destroying Methane (during the life of the project):
- Lifetime
  - (million ft³ methane): 23,820
  - (MMTCO2E): 1.14E+01
- Average Annual
  - (million ft³ methane/yr): 1,588
  - (MMTCO2E/yr): 7.62E-01

Landfill Characteristics

Open Year: 2021
Closure Year: 2041
Waste-In-Place at Closure (tons): 28,660,000
Average Waste Acceptance (tons/yr): 1,433,000
Average Depth of Landfill Waste (ft): 80
Area of LFG Wellfield to Supply Project (acres): 250

Landfill Gas Generation, Collection, and Utilization

Modeling Parameters for First-Order Decay Equation:
- Methane Generation Rate, k (1/yr): 0.040
- Methane Generation Capacity, Lo (ft³/ton): 4,000
- Methane Content of LFG: 55%

Generated During Project Lifetime (ft³/min LFG):
- Minimum: 2,916
- Annual Average: 6,829
- Maximum: 10,122

Collected During Project Lifetime (ft³/min LFG):
- Minimum: 2,333
- Annual Average: 5,464
- Maximum: 8,097

Design Flow Rate for Project (ft³/min LFG): 2,333
Utilized by Project (ft³/min LFG):
- Annual Average: 2,169.39

LFG Collection Efficiency: 80%

Financial Assumptions

Loan Lifetime (years): 10
Interest Rate: 6.0%
Marginal Tax Rate: 15.0%
Discount Rate: 8.0%

Electricity Production and Sales Summary

Total Generation Capacity (kW): 6,962.410
Initial Year Electricity Generation Price ($/kWh): 0.0195

4.2.5 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.

4.2.5.1 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.

4.2.5.1.1 Atmospheric and Climate Change Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
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 efficiency of combustion.	• Existing and proposed facility characteristics.	• Construction vehicles and different ways to manage landfill gas management may have different impacts on air quality.
Climate Change			
Potential for reduction of greenhouse gas (GHG) emissions during	• Quantitative assessment of the potential for GHG emissions reduction as a result of landfill gas alternatives.	• Existing and proposed facility characteristics.	• Landfills release greenhouse gases (GHG) that contribute to climate change. Collecting this gas reduces GHGs and additionally the use of landfill gas can also displace the use of

Criteria	Indicators	Data Sources	Rationale
construction and operation.			conventional fuels, further offsetting GHGs. Different methods to manage landfill gas could have different impacts to GHGs.

4.2.5.1.2 Overview of Atmospheric and Climate Change Considerations and Assumptions

Two (2) flares are already operational at the Ridge to manage landfill gas and a third flare is included within the existing approval and will be installed in 2020. The existing flares are effective at managing GHGs and energy use for the existing flares is minimal.

Additional flares will be required over the duration of the expansion to manage additional gas volumes. The effectiveness of flares at managing GHG emissions will remain constant. New flares will require minor construction (e.g., one (1) flare is assumed to require 1 to 2 weeks to construct). Operation of additional flares will not require significantly more energy than is currently used. Flares will still be needed as a contingency to pumping gas to an RNG facility or converting it to electricity.

It is reasonable to assume that the future gas quality will be similar to existing given similar waste characteristics for the expanded landfill. Landfill gas emissions generated for the Site were estimated from the landfill were estimated using the U.S. EPA LandGEM model. Non-road vehicle emissions were estimated using available U.S. EPA non-road engine emission factors[134] and the hours of operation[135]. On-road vehicle emissions were estimated using the U.S. EPA Motor Vehicle Emission Simulator (MOVES) model. MOVES was used to estimate an emission rate per unit distance for tailpipe emissions from the typical on-road vehicles expected at the Site.

Any potential RNG facility to convert landfill gas to a fuel would be located off-site. On-site infrastructure would include equipment needed to pump the gas to the off-site plant. On-site construction for this RNG equipment is anticipated to be in the order of 1 to 2 weeks. On-site equipment to convert gas to electricity would require approximately 4 to 6 weeks of construction. The extent of energy required to operate the on-site equipment to pump the gas to an off-site RNG facility or convert the landfill gas to electricity will be minimal.

[134] United States Environmental Protection Agency (2010). Exhaust and Crankcase Emission Factors for Non-road Engine Modelling – Compression-Ignition NR-009d. July 2010.
[135] Golder Associates Limited (2019a). Ridge Landfill Expansion: Design and Operations Report Draft. July 2019.

4.2.5.1.3 Atmospheric and Climate Change Net Effects

4.2.5.1.3.1 Landfill Gas Management Alternative 1 – Flaring

4.2.5.1.3.1.1 Air Quality & Odour

Potential Effects – Landfill Gas Management Alternative 1 will require minor construction on-site (e.g., brief construction periods approximately 1 to 2 weeks each) to install new flares. Impact to air quality as a result of the operation of construction equipment over this period is expected to be minor.

The indicator compounds and emissions profile will remain identical to the existing conditions with the continued use of flares as the Landfill Gas Management Alternative 1. The landfill gas collection system is designed to maintain the targeted collection efficiency, therefore, as the landfill continues to generate more landfill gas the overall emission rates of all indicator compounds will increase. The flares have a high destruction efficiency (98%[136]) and will provide a sufficient reduction in exhaust concentrations of landfill gas constituents. The emission from the Landfill Gas Management Alternative 1 are not anticipated to contribute significantly to potential off property impacts.

There is low potential for impact to air quality during operation (which includes the post closure period) for Landfill Gas Management Alternative 1 as flares efficiently combust the landfill gas.

There is low potential for odours impacts during operations (which includes the post closure period) as the landfill gas collection system is designed to maintain a high collection efficiency.

Mitigation – 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 construction of Landfill Gas Management Alternative 1.

Net Effects – No significant net effects are anticipated during construction, operation or post closure.

[136] United States Environmental Protection Agency (2008). AP-42 Chapter 2.4 Municipal Solid Waste Landfills. Draft Section. October 2008.

4.2.5.1.3.1.2 GHG Emissions Reduction Potential

Potential Effects – GHG emission from Landfill Gas Management Alternative 1 over the duration of the expansion are estimated to peak at 761,000 tonnes CO_2e/year using methodologies presented in Section 2 of Appendix D3B – Climate Change Impact Assessment, flare specifications, and U.S. EPA emission factors[137]. This represents a 96% increase in GHG emissions from current operations. This increase is not a result of the alternative end use, but more with the increase in waste received. The flaring equipment used for the destruction of captured gas is about 96.5% efficient[138]. Flaring is a very efficient means to destroy the captured gas. No impact to GHG emissions is anticipated as a result of construction given the short window for construction of the flares. As flaring the landfill gas does not result in a beneficial use for the gas there is no potential to offset the use of traditional fuels.

Mitigation – No mitigation is required.

Net Effects – No significant net effects are anticipated during construction, operation or post closure. For Landfill Gas Management Alternative 1, there is no potential to offset the use of GHGs since flaring does not result in a beneficial use for the gas.

4.2.5.1.3.2 Landfill Gas Management Alternative 2 – Renewable Natural Gas

4.2.5.1.3.2.1 Air Quality & Odour

Potential Effects – There is minor construction on-site for infrastructure to pump landfill gas to an off-site facility (approximately 1 to 2 weeks) in addition to the construction for the back-up flares (identical to Landfill Gas Management Alternative 1). Minimal to no impacts anticipated from the construction of this alternative.

The indicator compounds and emissions profile will remain similar to the existing conditions with the continued use of flares and the addition of RNG as the Landfill Gas Management Alternative 2. The landfill gas collection system is designed to maintain the targeted collection efficiency, therefore, as the landfill continues to generate more landfill gas the overall emission rates for all indicator compounds will increase. The RNG system will efficiently remove landfill gas indicator compounds and the use of back up flares will operate with a high destruction efficiency (98%[139]) to provide a sufficient reduction in exhaust concentrations of landfill gas constituents. The

[137] United States Environmental Protection Agency (2008). AP-42 Chapter 2.4 Municipal Solid Waste Landfills. Draft Section. October 2008.
[138] Ibid.
[139] United States Environmental Protection Agency (2008). AP-42 Chapter 2.4 Municipal Solid Waste Landfills. Draft Section. October 2008.

emission from the Landfill Gas Management Alterative 2 are not anticipated to contribute significantly to potential off property impacts.
There is low potential for odour impact during operations (which includes the post closure period) as the landfill gas collection system is designed to maintain a high collection efficiency.

There is low potential for impact to air quality during operation as the conversion to RNG and the burning of that fuel efficiently combusts the landfill gas.

Mitigation – 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.

Net Effects – No significant net effect anticipated during construction, operation or post closure.

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 Landfill Gas Management 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.

4.2.5.1.3.2.2 GHG Emissions Reduction Potential

Potential Effects – GHG emissions from Landfill Gas Management Alternative 2 are estimated to peak at 743,000 tonnes CO_2e/year using methodologies presented in Section 2 of Appendix D3B – Climate Change Impact Assessment, and U.S. EPA emission factors[140]. This represents a 91% increase in GHG emissions from current operations. This increase is not a result of the alternative end use, but more with the increase in waste received. The efficiency of combustion of the landfill gas that is used as RNG is variable depending upon how it is used. However, it generally has a higher efficiency rating than flares/generators because of the broad natural gas emission factors for CO_2 and CH_4 used in the calculations[141]. It is also recognized that there will be some losses of

[140] United States Environmental Protection Agency (2000). Chapter 3.2 Natural Gas-fired Reciprocating Engines. Final Section, 2000.
[141] United States Environmental Protection Agency (1998). U.S. EPA, AP-42 Chapter 1.4 Natural Gas Combustion. Final Section, 1998.

gas from transmission in pipelines that will decrease the efficiency which cannot be quantified. Although it is difficult to quantify the efficiency given the unknown conditions, it can be assumed that RNG conversion of landfill gas will result in the effective destruction of GHG, similar to flaring and electrical conversion. No impact to GHG emissions is anticipated as a result of construction given the short window for construction of the flares. This alternative also has the potential for a positive impact on climate change from the offset of the use of traditional fuels.

Mitigation – No mitigation required

Net Effects – No construction net effects are anticipated. A positive net effect is possible during operation and post closure as this alternative has the potential to offset the use of traditional fuels.

4.2.5.1.3.3 Landfill Gas Management Alternative 3 – Electricity

4.2.5.1.3.3.1 Air Quality and Odour

Potential Effects – There is minor construction (approximately 4 to 6 weeks) on-site for additional flares and infrastructure to convert landfill gas to electricity and no change to air quality is expected from the construction of this alternative.

The indicator compounds and emissions profile will remain similar to the existing conditions with the Landfill Gas Management Alternative 3. The landfill gas collection system is designed to maintain the targeted collection efficiency, therefore, as the landfill continues to generate more landfill gas the overall emission rates of all indicator compounds will increase. Biogas generators have a high destruction efficiency (97.2%[142]) and will provide a sufficient reduction in exhaust concentrations of landfill gas constituents. The emission from the Landfill Gas Management Alternative 3 are not anticipated to contribute significantly to potential off property impacts.

There is low potential for impact to air quality during operation (which includes the post closure period) for Landfill Gas Management Alternative 3 as biogas generators efficiently combust the landfill gas.

There is low potential for odour impact during operations (which includes the post closure period) as the landfill gas collection system is designed to maintain a high collection efficiency.

[142] United States Environmental Protection Agency (2008). AP-42 Chapter 2.4 Municipal Solid Waste Landfills. Draft Section. October 2008.

Mitigation – 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 construction.

Net Effects – No significant net effects are anticipated during construction, operation or post closure. Generating electricity 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 Landfill 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 Landfill Gas Management 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.

4.2.5.1.3.3.2 GHG Emissions Reduction Potential

Potential Effects – GHG emissions from Landfill Gas Management Alternative 3 are estimated to peak at 765,000 tonnes CO_2e/year using methodologies presented in Section 2 of Appendix D3B – Climate Change Impact Assessment, and U.S. EPA emission factors [143]. This represents a 96% increase in GHG emission from current operations. This increase is not a result of the alternative end use, but more with the increase in waste received. The equipment used to generate electricity that will destroy the captured gas is about 96.3% efficient [144]. No impact to GHG emissions is anticipated as a result of construction given the short window for construction of the flares. This alternative has the potential for a positive impact on climate change from the offset of the use of traditional fuels.

Mitigation – No mitigation required

Net Effects – No construction net effects are anticipated. A positive net effect is possible during operation and post closure as this alternative has the potential to offset the use of traditional fuels.

[143] United States Environmental Protection Agency (1998). U.S. EPA, AP-42 Chapter 1.4 Natural Gas Combustion. Final Section, 1998.
[144] United States Environmental Protection Agency (2000). Chapter 3.2 Natural Gas-fired Reciprocating Engines. Final Section, 2000.

4.2.5.2 Socio-Economic Environment - Social

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

4.2.5.2.1 Social Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Social			
Potential for noise as a result of landfill gas management facility construction and operation.	• Number of households in the Study Area who may experience noise or other disturbance.	• GIS mapping. • Existing and proposed facility characteristics.	• The landfill gas management alternatives represent two (2) difference scenarios – maintaining the status quo or actively using the gas. These scenarios will have different degrees of construction and different construction impacts on-site, and in the Study Area.
Potential for odour and air quality impacts during construction and operation.	• Number of potential odour and air quality sources, relative significance of air quality/odour sources (if characterization is possible), distance of air quality/odour sources to discrete receptors.	• GIS mapping. • Feedback from neighbours. • Existing and proposed facility characteristics.	• Different ways to manage landfill gas may have different impacts.

4.2.5.2.2 Overview of Social Considerations and Assumptions

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 familiar with the landfill as the site has been in operation for over 50 years. 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 alternative selected.

No noise complaints related to the operation of the flares are documented in Annual Monitoring Reports from 2007 to 2018. There have been odour complaints at the landfill. Waste Connections works with neighbours to address complaints that are raised.

The site currently has two (2) flares with a third flare approved for construction under the current ECA, which will be installed in 2020. Additional flares will be added to manage additional volume of gas as landfill expands. New flares will be in the same location as the existing flares which are buffered from view by the landfill and berms. Limited construction is involved for the flares (i.e., brief construction period of approximately 1 to 2 weeks for each flare). Flares will still be needed as a contingency to pumping gas to an RNG facility and electricity generation.

In addition to the flares, on-site construction would be required for the infrastructure to pumping gas to an off-site facility and generate electricity. Specific projects for RNG and electricity generation have not been defined however the length of on-site construction is anticipated to be minimal (approximately 1 to 2 weeks for RNG and approximately 3 to 4 weeks for electricity generation).

All on-site equipment will meet operational noise regulations and will not add new odour sources.

4.2.5.2.3 Social Net Effects

4.2.5.2.3.1 Landfill Gas Management Alternative 1 – Flaring

4.2.5.2.3.1.1 Noise

Potential Effects – Flaring has not historically and would be unlikely to disturb households in the future. There have been no complaints related to noise documented in the Annual Monitoring Reports from 2007 to 2018. In addition, construction noise and disturbance is anticipated to be minimal due to limited construction activities (1 to 2 weeks) associated with the flaring alternative. Given this is expected that neighbouring households will not experience noise impacts from flaring similar to the existing conditions. There are no off-site construction impacts associated with this alternative.

Mitigation – 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 use of appropriate equipment.

Net Effects – No significant off-site noise net effects are anticipated during construction, operation or post closure.

4.2.5.2.3.1.2 Odour and Air Quality

Potential Effects – 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. None of the households in the landfill vicinity are expected to experience odour attributed to flaring during regular operation. Construction will not result in odour effects.

With full combustion of the landfill gas by the flares, the significance of any indicator compounds and the potential for impact on residents is minimal. None of the households in the landfill vicinity are anticipated to experience impacts attributed to flaring during regular operation. In addition, construction air quality impacts are anticipated to be minimal due to limited construction activities (1 to 2 weeks) associated with Landfill Gas Management Alternative 1. There are no off-site construction air quality or odour impacts associated with this alternative.

Mitigation – Back-up and contingency plans would be in place to deal with any upset condition to prevent or mitigate the escape of fugitive landfill gas.

Net Effects – During construction, operation and post closure no significant odour or air quality net effects are anticipated.

4.2.5.2.3.2 Landfill Gas Management Alternative 2 – Renewable Natural Gas

4.2.5.2.3.2.1 Noise

Potential Effects – Residents in the site vicinity, particularly those closest to the site may experience some construction noise given the need to construct additional flares and the on-site pumping infrastructure to pump gas to an off-site RNG facility. The construction is short in duration (i.e., approximately 1 to 2 weeks for a flare and approximately 1 to 2 weeks for the pumping infrastructure) with any noise being temporary. The noise level associated with this short duration construction activity is anticipated to be minimal. There is some potential for noise associated with the construction of the pipeline that would be required to convey gas to an off-

site RNG facility. This infrastructure would likely be within the road right of way. The length of time for construction will depend on the location of the RNG facility but it is assumed to be staged construction that is not expected to last more than a day for each potential receptor.

Operation of the standby flares and landfill gas pumps is not anticipated to result in noticeable off-site noise. There would be no off-site noise generated from the conveyance of landfill gas in a pipeline.

Mitigation – Berms, as included in the landfill design, will shield the infrastructure associated with this alternative and minimize noise during construction and operation. The landfill itself will also shield noise. On-site pumping infrastructure will be housed with appropriate noise dampening equipment. Construction best management practices related to equipment maintenance and timing will be employed. Construction best management practices such as turning off machinery when not in use and limiting construction duration to the extent possible will reduce the potential of noise from the construction of the conveyance pipeline to the RNG facility.

Net Effects – During construction, operation and post closure no significant off-site noise net effects are anticipated.

4.2.5.2.3.2.2 Odour and Air Quality

Potential Effects – The RNG alternative will not add any new odour sources to the site. The infrastructure to pipe LFG off-site to a third party RNG facility would be contained and no odour impacts on residents would be expected. Construction will not result in odour effects.

The RNG alternative will not significantly change the emissions profile from the site. Once the landfill gas is collected it is contained within a closed system and no air quality impacts on residents would be expected. In addition, construction air quality impacts are anticipated to be minimal due to limited construction activities (i.e., approximately 1 to 2 weeks for a flare and approximately 1 to 2 weeks for the pumping infrastructure) associated with the Landfill Gas Management Alternative 2.

Mitigation – Back-up and contingency plans including a back-up flare system would be in place to deal with any upset condition to prevent or mitigate the escape of fugitive landfill gas.

Net Effects – During construction, operation and post closure no significant net effects are anticipated.

4.2.5.2.3.3 Landfill Gas Management Alternative 3 – Electricity

4.2.5.2.3.3.1 Noise

Potential Effects – Residences in the site vicinity, particularly those closest to the site may experience some construction noise given need to construct additional flares and the electricity conversion infrastructure. The construction is short in duration (i.e., approximately 1 to 2 weeks for a flare and approximately 3 to 4 weeks for the electrical generation on-site equipment) with any noise being temporary. The noise level associated with this short duration construction activity is anticipated to be minimal. Off-site noise impacts associated with construction of transmission lines in the right of way would be limited to the short time (in the order of less than a day) that construction crews would need to install the poles and string line in front of each receptor.

Operation of the flares and electricity generation are not anticipated to result in noticeable off-site noise.

Mitigation – The landfill and site berms will shield the infrastructure associated with this alternative and minimize noise. The on-site electricity conversion infrastructure will be housed within a structure with appropriate noise dampening equipment. Construction best management practices related to equipment maintenance and timing will be employed. There would be no off-site noise generated from the transmission of electricity from the landfill site to a provincial grid connection.

Net Effects – During construction, operation and post closure no significant off-site noise net effects are anticipated.

4.2.5.2.3.3.2 Odour and Air Quality

Potential Effects – The electricity conversion will not add any new odour sources to the site. The infrastructure to convert landfill gas to electricity would be contained within a building and no odour impacts on residents would be expected. Construction will not result in odour effects.

With full combustion of the landfill gas by the electricity generators and standby flares, the significance of any indicator compounds and the potential for impact on residents is minimal. None of the households in the landfill vicinity are anticipated to experience impacts attributed to flaring and generator combustion during regular operation. In addition, construction air quality impacts are anticipated to be minimal due to limited construction activities (i.e., approximately

1 to 2 weeks for a flare and approximately 3 to 4 weeks for the electrical generation on-site equipment) associated with the Landfill Gas Management Alternative 3.

Mitigation – Back-up and contingency plans including a standby flare system would be in place to deal with any upset condition to prevent or mitigate the escape of fugitive landfill gas.

Net Effects – During construction, operation and post closure no significant net effects are anticipated.

4.2.5.3 Socio-Economic Environment - Economic

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

4.2.5.3.1 Economic Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Economic			
Potential for effect on businesses during construction and operation.	• Number of businesses in the Study Area and their distance from the on-site landfill gas management infrastructure.	• GIS mapping. • Existing and proposed facility characteristics.	• There are limited businesses in the vicinity of the landfill (two [2] in the Study Area) that may experience different effects to their business depending on the LFG management alternative and their proximity.
Cost of facility.	• Approximate cost of landfill gas management facility.	• RNG cost-Web Model version 3.2 U.S. EPA. • Electricity cost-Web Model version 3.2 U.S. EPA.	• The cost of flares will be consistent for all alternatives. While no specific projects for landfill gas utilization have been confirmed, approximate costs have been generated based on hypothetical scenarios.

4.2.5.3.2 Overview of Economic Considerations and Assumptions

Businesses operating within the Study Area include an equipment dealer and a farm market. In addition there are also numerous farmed parcels in the area that are part of agricultural operations.

Two (2) flares currently exist and a third is approved within the existing ECA and will be installed in 2020. The flares will still be needed as a contingency for all alternatives and new flares will be added as needed to manage additional landfill gas. There will be some construction for the new on-site equipment for the alternatives with the maximum window of construction at approximately 3 to 4 weeks. New flares, RNG pumping equipment and the electricity conversion infrastructure will be in the same location as the existing flares. Approximate distance from the businesses to the location of the current flare is 1.85 km.

Waste Connections is familiar with the capital and operating costs associated with flares. The RNG alternative requires an agreement with a third party to purchase the landfill gas. There is currently no agreement in place. Waste Connections would not be able to use the amount of electricity that would be generated on-site. This alternative requires an agreement to sell electricity to the provincial grid or to a third party. There is currently no agreement in place and the provincial government currently has no program to pay for landfill gas generated electricity.

If an agreement was in place for either an RNG facility or electricity generation it is assumed that the cost to build the infrastructure would be offset through the resulting sale of the gas or electricity. A hypothetical business case is presented for both utilization projects in **FIGURE 4-12** and **FIGURE 4-13** in **Section 4.2.1**

4.2.5.3.3 Economic Net Effects

4.2.5.3.3.1 Landfill Gas Management Alternative 1 – Flaring

4.2.5.3.3.1.1 Distance of Businesses to Landfill Activity

Potential Effects – For Alternative 1 construction and operation of the landfill fill gas management infrastructure will occur in the same general area as the current flares. This is approximately 1.85 kilometres from the two (2) businesses on Charing Cross Road immediately south of the landfill. This represents no change to what is currently experienced and is not anticipated to impact business activity.

Mitigation – A berm will be constructed along Allison Line and at the corner of Allison Line and Charing Cross Road. This berm will buffer the existing businesses.

Net Effects – No net effects are anticipated during construction, operation or post closure.

4.2.5.3.3.1.2 Cost of Facility

Potential Effects – The cost that will be incurred for the additional flares is the same for all three (3) alternatives as the flare system is required for all three (3). These costs are a very minimal part of the cost of the expansion and are in the order of $2.5 million for construction and a maintenance and operating annual cost of $125,000 over the life of the expansion.

Mitigation – Waste Connections will effectively manage any on-site construction to minimize costs while meeting regulatory requirements and commitments. No other mitigation is required.

Net Effects – No significant net effect anticipated during construction, operation or post closure.

4.2.5.3.3.2 Landfill Gas Management Alternative 2 – Renewable Natural Gas

4.2.5.3.3.2.1 Distance of Businesses to Landfill Activity

The potential effect on businesses, mitigation and net effects for Landfill Gas Management Alternative 2 are identical to those described above for Landfill Gas Management Alternative 1. Depending on the location of an RNG facility, the construction of the conveyance pipeline could result in temporary disruption in access to businesses. The length of time for this disruption will be minimal as construction of a pipeline is anticipated to be staged and would result in activities being undertaken for less than 1 day (trenchless technologies would result in no impact) in front of any business.

There would be no impact to businesses during operation.

Mitigation – Construction best management practices will be implemented for the off-site conveyance infrastructure

Net Effects – No significant net effect anticipated during construction, operation or post closure.

4.2.5.3.3.2.2 Cost of Facility

Potential Effects – The U.S. EPA Landfill Methane Outreach Program, Landfill Gas Energy Cost Model was used to construct a hypothetical business case for the conversion of landfill gas to RNG to be sold into the natural gas distribution system for the gas to be generated from the expansion waste only - as shown below in **Section 4.2.1** lists the assumptions that were used to develop the business case. The assessment does not include the cost of conveying the gas offsite to the RNG conversion plant or connecting to the gas distribution grid.

As this is a U.S. based model all inputs and outputs are in imperial units. Based on a 15 - year duration for the RNG project, capital costs are projected to be in the order of $17 million (CDN), with a net present value of about $900,000 (CDN) and an internal rate of return of 9%. This is a marginal business case in which to invest as the price for gas sold into the distribution system fluctuates greatly and it has very high upfront capital costs. As indicated this assessment does not include the cost of pipelines to convey the gas off-site which would add to the capital cost and decrease the overall return of investment. The cost of the back-up flare system common to all alternatives would also need to be added to the total cost.

Mitigation – No mitigation required.

Net Effects – The potential net effect depends on the third party agreement reached to purchase landfill gas and invest in the required infrastructure.

4.2.5.3.3.3 Landfill Gas Management Alternative 3 – Electricity

4.2.5.3.3.3.1 Distance of Businesses to Landfill Activity

The potential effect on businesses, mitigation and net effects for Landfill Gas Management Alternative 3 are identical to those described above for Landfill Gas Management Alternative 1. Construction of transmission infrastructure could result in temporary disruption in access to businesses. The length of time for this disruption will be minimal as construction the transmission lines would be staged and activities being undertaken in front of any business would be for a very limited amount of time.

4.2.5.3.3.3.2 Cost of Facility

Potential Effects – The U.S. EPA Landfill Methane Outreach Program, Landfill Gas Energy Cost Model was used to construct a hypothetical business case for the conversion of landfill gas to electricity to be sold into provincial distribution system for the gas to be generated from the expansion waste only. **Section 4.2.1** lists the assumptions that were used to develop the business

case. The assessment does not include the cost of constructing electrical lines to connect to the provincial grid. It should also be noted that there is currently no provincial programs or initiatives that would allow for the sale of electricity generated from landfill gas into the grid.

As this is a U.S. based model all inputs and outputs are in imperial units. Based on a 15 year duration for the electrical generation project, capital costs are projected to be in the order of $17 million (CDN), with a net present value of about negative $28 million (CDN) and a negative internal rate of return. This is a very poor business case in which to invest as the price for electricity sold into the distribution system in Ontario is very low and it has very high upfront capital costs. As indicated this assessment does not include the cost of transmission lines to carry the electricity off-site which would add to the capital cost and further decrease the overall return of investment. The cost of the back-up flare system common to all alternatives would also need to be added to the total cost.

Mitigation – No mitigation required.

Net Effects – The potential net effect depends on the third party agreement reached to purchase electricity. It is reasonable to assume that unless the price that electricity can be sold for changes substantially there is no business case to move forward with this alternative.

4.2.5.4 Cultural Environment

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

4.2.5.4.1 Cultural Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Cultural			
Potential effects to archaeological resources as a result of construction.	• Area of undisturbed land affected by the on-site component of landfill gas management alternative.	• Stage 1, 2 and partial 3 Archaeological Assessments. • Existing and proposed facility characteristics.	• There is undisturbed land remaining on-site that could have archaeological resources.

4.2.5.4.2 Overview of Cultural Considerations and Assumption

All alternatives require the construction of additional on-site infrastructure to manage landfill gas. The additional flares, RNG pumping infrastructure and electricity conversion infrastructure would all be constructed in the vicinity of the existing flares. This area was not identified as an area having archaeological potential in the Archaeological Assessments (see **FIGURE 3-28** for remaining areas requiring Stage 3 Archaeological Assessment). All conveyance infrastructure was assumed to be within existing rights-of-way with limited archaeological potential.

4.2.5.4.3 Cultural Net Effects

4.2.5.4.3.1 Landfill Gas Management Alternative 1 – Flaring

Potential Effects – All work will be undertaken in areas that have been identified as disturbed or have been cleared through Archaeological Assessments. No archaeological effects are anticipated.

Mitigation – No mitigation required. Should archaeological resources unexpectedly be discovered during any construction, Waste Connections will immediately stop work and notify the Ministry of Heritage, Sport, Tourism and Culture Industries (formerly known as the Ministry of Tourism, Culture and Sport).

Net Effects: During construction, operation and post closure no significant net effects are anticipated.

4.2.5.4.3.2 Landfill Gas Management Alternative 2 – Renewable Natural Gas

The cultural potential effects, mitigation and net effects on-site for Landfill Gas Management Alternative 2 are identical to those described above for Landfill Gas Management Alternative 1. For off-site conveyance infrastructure, the pipeline will likely be constructed in a road right of way which would have been previously disturbed during the construction of the original road and no impacts are anticipated.

4.2.5.4.3.3 Landfill Gas Management Alternative 3 – Electricity

The cultural potential effects, mitigation and net effects on-site for Landfill Gas Management Alternative 3 are identical to those described above for Landfill Gas Management Alternative 1. For off-site conveyance infrastructure, the transmission line will likely be constructed in a road right of way which would have been previously disturbed during the construction of the original

road and only the locations where poles will be placed will be disturbed (approximately one (1) 0.5 m diameter hole every 100 m).

4.2.5.5 Built Environment

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

4.2.5.5.1 Built Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Built			
Ease to implement/construct and maintain/operate.	• Anticipated complexity of construction and operation.	• Existing and proposed facility characteristics.	• The alternatives will have different levels of complexity to construct and operate.

4.2.5.5.2 Overview of Built Considerations and Assumptions

Waste Connections is familiar with the construction and operation of flares as two (2) flares are already operational and a third flare is included within the existing approval and will be installed in 2020. Waste Connections has some familiarity with landfill gas utilization as there is a facility at another Waste Connections landfill that utilizes landfill gas. They do not operate any facilities where landfill gas is converted to electricity in Canada.

The RNG alternative has the complexity of working with a third party to establish an agreement associated with the sale of landfill gas.

The electricity conversion alternative has the complexity of adding electricity generating equipment and working with a third party to establish an agreement associated with the sale of electricity.

4.2.5.5.3 Built Net Effects

4.2.5.5.3.1 Landfill Gas Management Alternative 1 - Flaring

Potential Effects – Landfill Gas Management Alternative 1 is easy to implement and maintain/operate as it currently is today. Minimal potential for unexpected complexities related

to implementing/constructing or maintaining/operating the flares is anticipated. Determining the design parameters for Landfill Gas Management Alternative 1 will be technical and regulatory based. The construction and operation of this alternative is entirely within the control of Waste Connections.

Mitigation – No mitigation is required.

Net Effects – Flaring (Landfill Gas Management Alternative 1) is an alternative with lower complexity, is readily implemented and is completely within the control of Waste Connections. During construction, operation and post closure no significant net effects are anticipated.

4.2.5.5.3.2 Landfill Gas Management Alternative 2 – Renewable Natural Gas

Potential Effects – No RNG project is defined at this point. However it is expected that this alternative would involve a complex agreement for the sale of landfill gas to a third party. Landfill gas management operation would also be complex as it would need to be integrated with the RNG facility and include contingency processes to manage LFG in the event that there were problems at the RNG facility. Specialized technology and equipment would be needed. In addition to engineering design and regulation, Landfill Gas Management Alternative 2 will be commercially driven.

Mitigation – Effective communication processes between Waste Connections and the RNG operator would be put in place. Back-up and contingency measures to manage LFG in the event that there is an upset at the RNG facility would also be put in place.

Net Effects – During construction, operation and post closure this alternative would be complex even with the stated mitigation in place.

4.2.5.5.3.3 Landfill Gas Management Alternative 3 – Electricity

Potential Effects – No electricity conversion project is defined at this point. This alternative is expected to involve a complex agreement for the generation of electricity with third party. Landfill gas management operation would also be complex as it would need to be integrated with the generation facility and include contingency processes to manage landfill gas in the event that there were problems at the generation facility. In addition to engineering design and regulation, Landfill Gas Management Alternative 3 will be commercially driven.

Mitigation – Effective communication processes between Waste Connections and the third party purchaser of electricity would be in place. Back-up and contingency measures to manage landfill

gas in the event that there is an upset associated with the conversion of gas to electricity would also be put in place.

Net Effects – During construction, operation and post closure this alternative will be complex even with the stated mitigation in place.

4.2.6 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 4-14 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 1.

The following highlights the key advantages and disadvantages of each of the three (3) 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.
- No off-site construction.

Key Disadvantages

- Does not provide the opportunity to off-set the use of non-renewable 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 potentially off-setting the use of non-renewable fuels.

Key Disadvantages

- Requires complex agreement with a third party for the utilization and/or sale of LFG.
- Commercial assessment indicates that this would be a marginal to poor investment based on current natural gas pricing in Ontario.
- Some off-site construction for conveyance infrastructure in existing road rights-of-way, no impacts are anticipated though.

Alternative 3 – Gas Utilization - Electricity

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 potentially off-setting the use of non-renewable 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.
- Some off-site construction for transmission infrastructure in existing road rights-of-way, no significant impacts are anticipated though.
- Commercial assessment indicates that this is a very poor investment based on current electricity market conditions in Ontario.

4.2.6.1 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 (3) alternatives. Flaring converts the methane in landfill gas, which has a higher global warming potential than CO_2, but still results in CO_2 emissions.

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 viable commercial opportunity, a market and/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. Waste Connections will re-evaluate the commercial opportunities of gas utilization in 4 years after approval of the EA and will report to the MECP the results of the analysis.

Based on the work completed, Alternative 1 - Flaring is preferred or equally over the other landfill gas management alternatives for five (5) of the six (6) environments considered. Landfill Gas Management Alternative 1 is considered the preferred alternative overall as follows:

- Natural Environment - Atmospheric – Equally Preferred: All alternatives involve efficient combustion, and the difference in anticipated construction and energy use is minor for all three (3) alternatives.
- Natural Environment – Climate Change – Less Preferred: All three alternatives landfill gas management alternatives will effectively destroy GHG emissions managing the potential for impact on climate change. However, Alternative 1 is less preferred because it does not provide the opportunity to offset the use of non-renewable fuels further reducing GHG emissions.
- Socio-Economic Environment - Social – Preferred: Alternative 1 - Flaring involves less construction and has less potential for noise impacts on residents. No odour or other off-site impacts are anticipated.
- Socio-Economic Environment Economic – Preferred: As none of the alternatives are anticipated to impact the business activity of neighbouring businesses and Alternative 1 – Flaring is the lowest cost option.
- Cultural Environment – Archaeology – Equally Preferred: All construction for landfill gas management will take place in areas that have been identified as previously disturbed or have been cleared of archaeological resources.
- Built Environment – Preferred: Alternative 1 - Flaring is a straight forward landfill gas management alternative that is completely within Waste Connections control.

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Table 4-14: Comparative Evaluation Overall Ranking Of Landfill Gas Alternatives

(Note: green = preferred; blue = less preferred; pink = least preferred; alternatives that are equally preferred are not highlighted in colour)

Environment	Alternative 1 - Flaring	Alternative 2 – Gas Utilization (RNG)	Alternative 3 – Gas Utilization (Electricity)	Do Nothing
Natural Environment - Atmospheric Ranking	Equally Preferred – Limited construction resulting in no significant air quality impact. Alternative will effciently combust landfill gas during operation with no anticipated odour impacts.	Equally Preferred - Limited construction resulting in no significant air quality impact. Alternative will convert landfill gas to RNG which can be efficiently combusted with no anticipated odour impacts.	Equally Preferred - Limited construction resulting in no significant air quality impact. Alternative will effciently combust landfill gas during operation with no anticipated odour impacts.	After closure in 2021 the flares will continue to efficiently combust the landfill gas.
Natural Environment – Climate Change Ranking	Less Preferred – GHG emission reductions from Alternative 1 over the duration of the expansion are estimated to peak at 761,000 tonnes CO_2e/year at the end of the expansion period. Flaring will effectively destroy GHG emissions but does not provide an opportunity for the potential offset of the use of non-renewable fuels.	Preferred - GHG emission reductions from Alternative 2 over the duration of the expansion are estimated to peak at 743,000 tonnes CO_2e/year at the end of the expansion period. RNG will effectively destroy GHG emissions and this alternative also has the potential for a positive impact on climate change from the potential offset of the use of non-renewable fuels.	Preferred - GHG emission reductions from Alternative 3 over the duration of the expansion are estimated to peak at 765,000 tonnes CO_2e/year at the end of the expansion period. Electricity conversion will effectively destroy GHG emissions and this alternative also has the potential for a positive impact on climate change from the potential offset of the use of non-renewable fuels.	GHG emission from the existing landfill are estimated to peak at 391,000 tonnes CO_2e/year in 2021.
Socio-Economic Environment – Social Ranking	Preferred – Flaring involves minimal construction and potential for noise impacts on residents. There are no off-site odour impacts anticipated.	Less Preferred – Gas utilization involves minimal construction and potential for noise impacts on residents. No off-site odour impacts are anticipated. Off-site construction is anticipated to be of short duration and within existing road rights-of-way resulting in some minimal impacts.	Less Preferred - Gas utilization involves minimal construction and potential for noise impacts on residents. No off-site odour impacts are anticipated. Off-site construction is anticipated to be of short duration and within existing road rights-of-way resulting in some minimal impacts.	After closure in 2021 flaring of LFG will continue and is expected not to have noise or odour impacts to neighbours.
Socio-Economic Environment - Economic Ranking	Preferred – The infrastructure for this LFG management alternative is 1.85 km from the two (2) existing businesses which will be buffered by a berm resulting in no impact on business activity. This alternative involves minimal costs which are relatively low. Capital cost is about $2.5 million (CDN) and annual maintenance and operating costs will be $125,000 (CDN) over life of expansion.	Less Preferred - The infrastructure for this LFG management alternative is 1.85 km from the two existing businesses which will be buffered by a berm resulting in no impact on business activity. Off-site construction is anticipated to be of short duration and within existing road rights-of-way also resulting in minimal impact to business activity. Based on a hypothetical scenario, the business case for this alternative is marginal – capital costs are projected to be in the order of $17 million (CDN), with a net present value of about $900,000 (CDN) and an internal rate of return of 9%. Costs of flare system also need to be added to this cost.	Least Preferred - The infrastructure for this LFG management alternative is 1.85 km from the 2 existing businesses which will be buffered by a berm resulting in no impact on business activity. Off-site construction is anticipated to be of short duration and within existing road rights-of-way also resulting in minimal impact to business activity. Based on a hypothetical scenario, the business case for this alternative is poor – capital costs are projected to be in the order of $17 million (CDN), with a net present value of negative $28 million (CDN) and a negative internal rate of return. Costs of flare system also need to be added to this cost.	Continued flaring of LFG will be 1.85 km from businesses, there is no buffer on the south side of the landfill. However, off-site noise impacts related to current flaring has not been an issue to date. Continued flaring involves minimal costs.

Environment	Alternative 1 - Flaring	Alternative 2 – Gas Utilization (RNG)	Alternative 3 – Gas Utilization (Electricity)	Do Nothing
Cultural Environment - Archaeology Ranking	Equally Preferred – Construction of flares would take place on lands that have been identified as having no archaeological potential or lands that have been cleared of archaeological potential.	Equally Preferred– All construction would take place on lands that have been identified as having no archaeological potential or lands that have been cleared of archaeological potential..	Equally Preferred – All construction would take place on lands that have been identified as having no archaeological potential or lands that have been cleared of archaeological potential.	Existing flares are in an area that has been previously disturbed and cleared of archaeolgical resources. No construction is required.
Built Environment Ranking	Preferred – Flaring is a straight forward landfill gas 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.	Continued flaring 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 existing underground forcemain was completed as part of a 1997 Host Community Agreement with the Municipality of Chatham-Kent.

As it is recognized that leachate will require treatment well beyond the operating life of the landfill, the current agreement requires the BWTL to reserve capacity for leachate generated from the Ridge Landfill for a 100-year period. 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 are 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 Water and Wastewater Master Plan (2012 updated in 2018)[145], and a meeting with the Chatham-Kent Public Utilities Commission (PUC) on July 25th, 2018. A letter was also received from the Chatham-Kent PUC and is included in **FIGURE 4-14**.

The review identified the following:

- The 5-year (2013 to 2017) average volume of leachate treated at BWTL was 170 m^3/day and the maximum future leachate average daily volume is projected to be 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

[145] Chatham-Kent Public Utilities Commission (2012). Water and Wastewater Master Plan. Available at https://drive.google.com/file/d/11Fc-tnSUK4v2yrx1GWw5hSj_bDpH7Enr/view. Last Updated. April 2018.

- 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. The municipality has indicated that it has plans to replace the BWTL with a full mechanical plant sometime in the future. A recent review of the data indicated that until the replacement is completed, 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 through the expansion period.

On-site leachate collection for the proposed landfill expansion would be designed to be consistent with the current leachate collection system 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 produced;
- Treatment Contingency - In the event that BWTL cannot accept the leachate from the Ridge there are no other existing wastewater treatment facilities sufficiently close to the Ridge Landfill to feasibly construct another forcemain. However, this has not occurred in the past 18 years since BWTL started treating the leachate and there is no reason to believe it will occur in the future. As a contingency only, 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 tanker 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 the 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 maximum of approximately 14/day on average (1 to 2 trucks per hour); 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. To access the Chatham Wastewater Treatment Plant, trucks would likely utilize a route following Erieau Road to Middle Line and then Bloomfield Road to the plant, a distance of about 20 km.

FIGURE 4-14: PUC LETTER

Chatham-Kent Public Utilities Commission

Municipality of Chatham-Kent
Public Utilities Commission
325 Grand Avenue East,
PO Box 1191 Chatham, ON N7M 5L8
Tel: (519) 436-0119 Fax: (519) 352-3432
Toll Free: 1.800.714.7497

October 19, 2018

Cathy Smith, Project Manager
Ridge Landfill Expansion EA
Waste Connections

RE: Ridge Landfill EA - Leachate Management Alternatives - Dillion Consulting File: 152456

Dear Cathy:

This letter is in response to our meeting July 25, 2018, regarding Leachate Management Alternate methods.

The Chatham-Kent Public Utilities Commission (CK PUC) has evaluated the leachate flow from the Ridge Landfill to the Blenheim treatment lagoons and have found that, at this time, there is enough capacity to handle the flow generated form the landfill.

According to the Environmental Certificate of Approval (ECA) for the Blenheim Treatment lagoons;

> ***"Average daily flow of leachate into the Blenheim Lagoons shall not exceed 4,045m3/day, and peak flow shall not exceed 12,046m3/day."***

In 2018, May was the highest discharge month with a total discharge from Ridge Landfill of 18,517 m3 per month (597.32 m3 per day). This flow is well below the ECA for this treatment facility. At this time, the Blenheim lagoons have the capacity to handle the current flows of the landfill. The Water and Wastewater Master Plan completed for Chatham Kent identified the need for the upgrade of the Blenheim lagoons to a mechanical plant in the 2023 - 2027 horizon. The population and community growth projections that we have completed for the service area for the Blenheim Treatment Lagoons also indicate that the lagoons will be able to accommodate the anticipated Ridge Landfill leachate flows until the planned upgrade. Once complete, the treatment facility will have ample capacity to manage the flow from the Ridge Landfill over the long term.

Blenheim Treatment Lagoons have been receiving leachate from Ridge Landfill since 1998 and the quality of leachate has been tested and CK PUC has not seen any adverse effects in the lagoon effluent. The lagoons effluent currently meets or exceeds the ECA effluent discharge parameters.

The preferred method for CK PUC is to continue to receive leachate from Ridge Landfill to the Blenheim Lagoons via the forcemain that is in place. The alternative method is to transport leachate from the landfill to the Chatham Wastewater Treatment Plant (100 Irwin St, Chatham) for treatment. Transport by truck is the preferred method to convey leachate to the Chatham plant as the infrastructure is in-place to off-load trucks at the plant and most importantly, it allows PUC staff to control the release of the liquid onto the plant.

Regards,

Tim Sunderland,
General Manager

www.ckpuc.ca

4.3.2 Description of Leachate Treatment Alternatives

The following leachate treatment alternatives were initially identified for consideration.[146]

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.

Information from the Chatham-Kent PUC and the review of the BWTL and forcemain capacities 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 to be 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.

It was considered reasonable to incorporate transportation to another treatment facility as a contingency in the event that the BWTL could no longer accept the Ridge landfill leachate. 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, if required. It should be noted that since the BWTL has been accepting leachate there has never been a shut-down or inability to treat the leachate and there is no

[146] Note: 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 6 km forcemain. Leachate evaporation was not considered feasible due to the large volume of leachate anticipated.

reason to suspect that there will be an issue based on the review of available date and treatment capacity.

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 **FIGURE 4-14** that provides further detail on the treatment of leachate. **Energy Use Requirements:** 96,000 kWh/year in 2021 increasing to 290,000 kWh/year in 2041**.** **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 finalized; a hypothetical system is utilized for this assessment. The pre-treatment system would be designed to treat/remove specific parameters to meet the Chatham-Kent sewer use bylaw. 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 500 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. Operation of the system would continue beyond the operating period of the landfill through the post-closure period. Additional details for the on-site pre-treatment system are included following this table.	Pre-treats the leachate for specific parameters to levels that render it acceptable for final treatment at BWTL and allows for a contingency.

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; • Ultrafiltration (UF) and 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 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. Operation of the treatment system would be required beyond the operating life of the landfill, through the post-closure period. Additional details for the on-site pre-treatment system are included following this table.	Treats leachate to meet surface water discharge criteria which allows direct discharge to environment and allows for a contingency.

4.3.2.1 On-site Leachate Pre-treatment Conceptualized Design

The pre-treatment system proposed for the Ridge Landfill would be a two-tank Sequencing Batch Reactor (SBR) process with associated pumps and blowers. For this system to work efficiently, the leachate will need to be collected in an equalization tank located on the landfill site prior to entering the SBR system. A pumping station will be required to convey the leachate from the equalization tank to the SBR system. The SBR system would provide partial TKN and BOD reduction in concentrations to meet the sewer use bylaw limits.

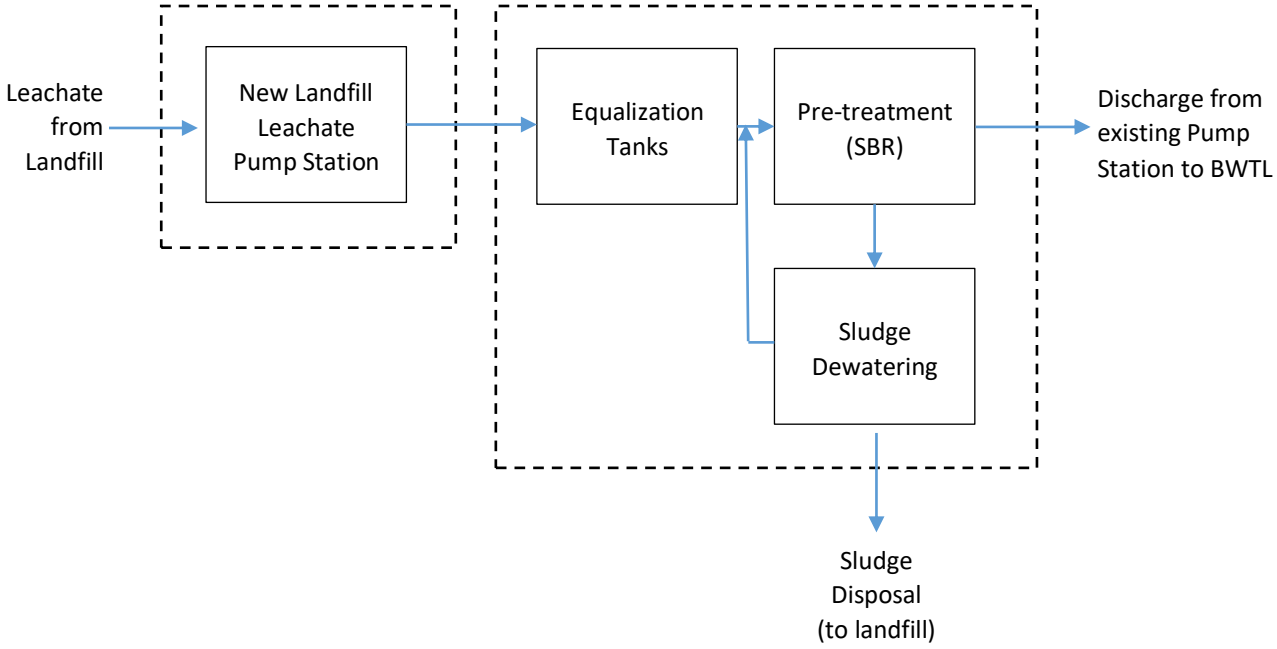
The required effluent quality is governed by Chatham-Kent Sewer By-Law. The by-law limits are listed in **Table 4-15**.

Table 4-15: Limits for Sanitary and Combined Sewers

Group	Parameter	Limit (mg/L)
1a	Biochemical Oxygen Demand	300
4aq	Kjeldahl Nitrogen, Total	100
6	Phosphorus, Total	10
8	Suspended Solids, Total	350

The Chatham-Kent sewer use bylaw does not address the specific contaminant chloride. Chloride is typically stable in leachate and can persist in high concentrations for a long period of time. Other Ontario cities that have included chloride limits into their sewer use bylaws have set their limit to 1500 mg/L. The total chloride concentration going to the BWTL is expected to be less than 1,000 mg/L, this concentration is below the chloride limit set by other Ontario Municipal bylaws and is therefore not considered in the pre-treatment system.

Flow Diagram



The main source of residual from the pre-treatment will be from the waste sludge generated during SBR treatment. It will be dewatered using a geotextile tubing system and the solid will be disposed of at the Ridge Landfill. The estimated capital cost for leachate pre-treatment to meet by-law discharge limits is approximately $5.0 million. It is assumed that the pre-treatment will be located within the existing landfill site. The annual energy consumption will be approximately 2,200 Mwh/year, at a cost of about $220,000. Overall operating and maintenance costs including energy, chemicals, equipment maintenance and labour are projected to be about $450,000/year.

4.3.2.2 On-site Full Treatment

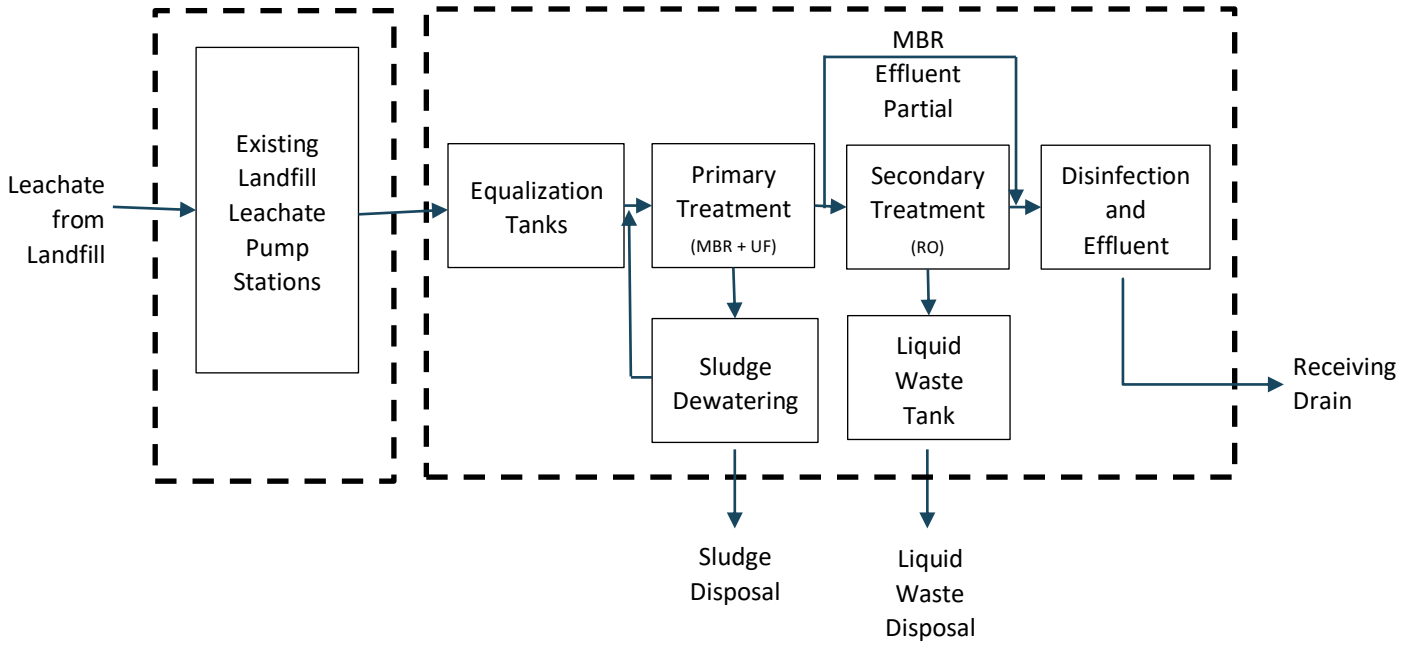
Full on-site treatment would include the use of an equalization tank, a membrane bioreactor (MBR) and ultrafiltration (UF) as preliminary treatment and reverse osmosis (RO) as secondary treatment, and waste disposal. All of the leachate from the landfill would be diverted to equalization tanks. The leachate will then be pumped from equalization tanks to feed the first step of primary treatment, a membrane bioreactor (MBR).

The MBR will have an aerobic zone and an anoxic zone to encourage removal of suspended solids, cBOD5, ammonia, nitrate and phosphorus. There will be dedicated phosphoric acid, methanol and ferric pumps to aid with denitrification and to help maintain phosphorous control in the last zone of the MBR. The MBR will result in two (2) main streams: the surface waste and the effluent. The surface waste will have a dedicated waste activated sludge (WAS) and will be dewatered and

the dewatered solid waste will be placed back in the landfill. The liquid waste from the sludge dewatering will be recirculated with new MBR influent. The effluent from the MBR would then continue pre-treatment by way of UF. The UF permeate will flow into RO feed tank and the retained liquid will be recycled back in with the MBR influent.

During secondary treatment, the UF permeate cycles through the RO system twice to remove non-biodegradable contaminants such as chloride and metals as per the effluent discharge limits. The concentrate from RO process will need to be disposed of through a municipal sewage treatment plant off-site. Disinfection of the treated leachate will be required based on the effluent criteria in the ECA for discharge. The effluent quality limits will need to be determined and finalized based on assimilative capacity analysis of the receiving drain to be completed if full on-site treatment is the preferred alternative. For the evaluation of alternatives, it was assumed that the treatment limits for discharge will be the same as for the BWTL.

Flow Diagram



Residual Management

The two (2) main contributors to residual management are the WAS from MBR and RO concentrate. The WAS will be removed from the surface of the MBR at a rate that maintains the target solids retention time. It will be removed using dedicated WAS pumps and dewatered using a geotextile tubing system. Once the WAS is dewatered, the solids will be landfilled. The RO concentrate will have to be conveyed to an off-site wastewater treatment plant for treatment. The most suitable plant for treatment is the Chatham Wastewater Treatment Plant.

The estimated cost of full water treatment onsite for the Ridge Landfill is expected to be $20 and $25 million. Annual power consumption is projected to be 7,000 Mwh/year, at a cost of $700,000/year. Operation and maintenance costs are projected to be about $1.25 million/year including energy, chemicals, equipment maintenance and labour. This estimate does not include the cost of off-site treatment of residual waste streams.

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 - Biological and Natural – Physical, 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. **FIGURE 4-15** shows the potential locations of the leachate management and treatment infrastructure at the Ridge Landfill.

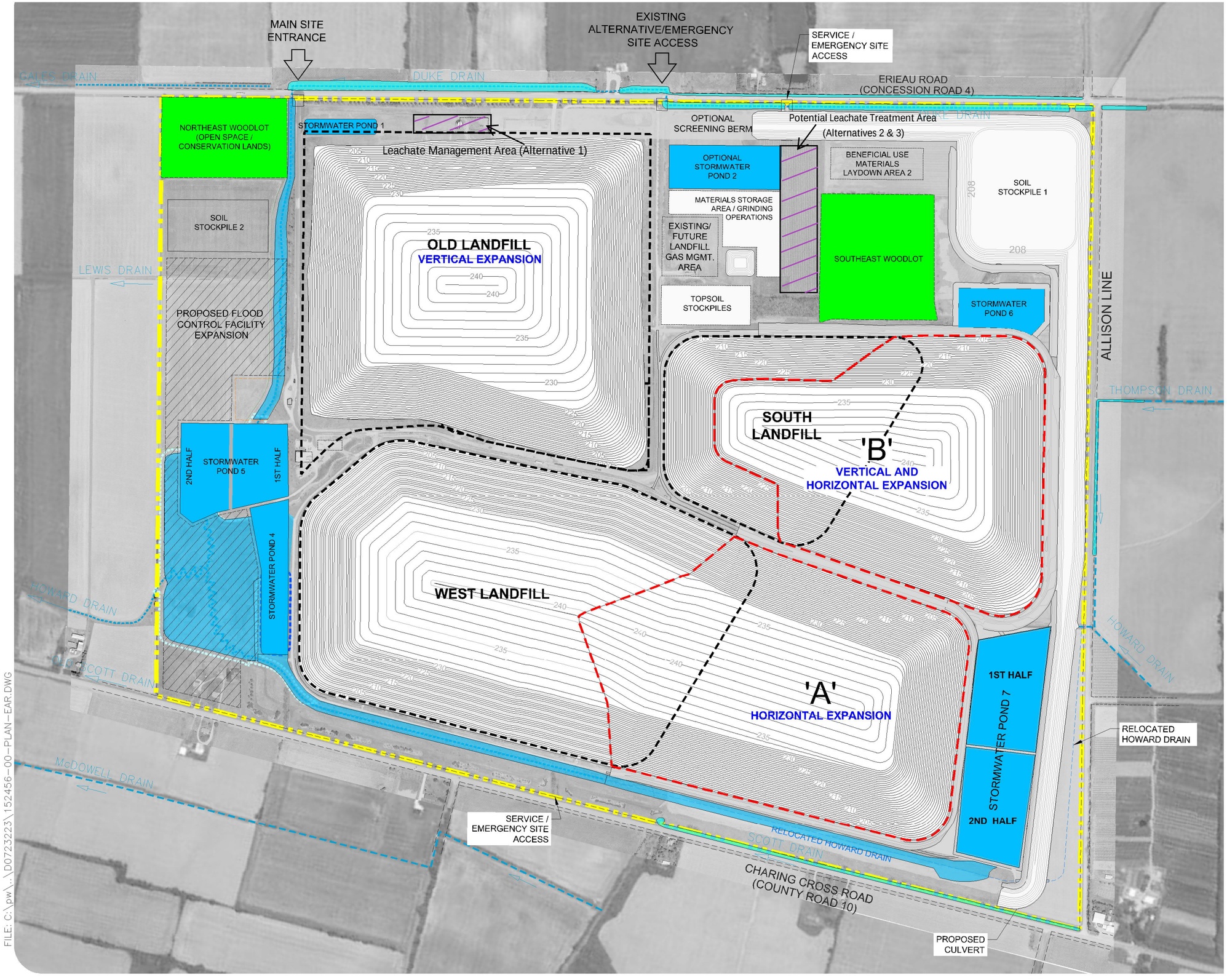
The following sections list the criteria and indicators considered and summarize the potential effects, proposed impact management measures and net effects of each of the alternatives. Potential effects during construction, operation and closure/post closure are identified.

4.3.3.1 Natural Environment – Aquatic

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

4.3.3.1.1 Aquatic Criteria and Indicators

Criteria	Indicators	Data Source	Rationale
Aquatic			
Potential for effect on aquatic systems during construction and operation.	• Proximity of construction and operation to on-site watercourses/aquatic habitat.	• Existing and proposed facility characteristics. • Location of aquatic habitat.	• A treatment facility removed from proximity to aquatic habitat would have minimal to no impact.



WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

Potential Leachate Management and Treatment Areas

Figure 4-15

- PROPERTY BOUNDARY
- APPROVED WASTE LIMIT
- EXISTING WATER COURSE
- PROPOSED WASTE LIMIT FOR EXPANSION AREAS
- PROPOSED STORMWATER POND
- EXISTING WOODLOT AREAS
- EXISTING FLOOD CONTROL FACILITY

0 100 200 400m

TRUE NORTH

PLAN NORTH

MAP/DRAWING INFORMATION
MAPPING FROM THE BASE MAP CO. LTD., MAY 1, 2018

CREATED BY: SKB
CHECKED BY: CO
DESIGNED BY: FG

DILLON CONSULTING

PROJECT: 15 2456

DATE: 07/03/19

FILE: C:\pw\...\D0723223\152456-00-PLAN-EAR.DWG

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4.3.3.1.2 Overview of Aquatic Considerations and Assumptions

Currently leachate is collected at the east side of the site near the site entrance. The current leachate collection system continuously pumps leachate to on-site tanks and then through an existing forcemain to the BWTL where it is treated and tested before being released to the environment. This existing transmission and treatment process has been working effectively for 18 years. Based on the assessment completed for the BWTL and discussions with Chatham-Kent PUC there are no negative effects from the current leachate treatment approach on aquatic habitat. The current system has the capacity to store approximately 1 day of untreated leachate in the on-site tank. The existing tank has a capacity of 605 m^3.

The existing leachate storage tank is approximately 50 m from the nearest ditch which takes stormwater to a stormwater pond. 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 low sensitivity and limited potential for fish habitat. None of the alternatives will result in construction that physically alters the Duke Drain.

All alternatives will continue to collect the leachate as it is done today. All alternatives will have some degree of on-site storage for untreated leachate or leachate undergoing treatment.

4.3.3.1.3 Aquatic Net Effects

4.3.3.1.3.1 Leachate Treatment Alternative 1 – Direct Discharge to Sanitary Sewer

Potential Effects – For Leachate Treatment Alternative 1, there is no construction and no potential construction related impact on aquatic habitat on-site watercourses.

The on-site component of this leachate treatment alternative remains approximately 50 m from the Duke Drain which has limited potential for fish habitat. Given the distance to the drain and the fact that this alternative involves transfer of leachate directly to the BWTL with no on-site treatment, limited on-site storage (maximum 1 day) and no intentional discharge to on-site watercourses there is limited chance for this leachate treatment alternative to impact the Duke Drain and associated aquatic habitat.

All alternatives include the contingency of trucking leachate to the Chatham Wastewater Treatment Plant. While an accident involving a truck hauling leachate poses the potential risk of

a spill on-route that could enter a watercourse, the occurrence of trucking leachate is expected to be rare and the probability of an accident low.

Mitigation – Mitigation to reduce the potential for impact to aquatic habitat includes on-going best management practices similar to those used for the last 18 years of operation. This alternative includes a contingency to use a licensed hauler to truck leachate to the Chatham-Kent Wastewater Treatment Plant. In the contingency situation, where leachate is trucked to a licensed treatment facility, there is some potential for an accidental spill if the truck is involved in an accident. While the occurrence of trucking leachate is expected to be rare, 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. If trucking was required during an extreme adverse weather event, leachate could stop being collected from the landfill avoiding the need for trucks to operate under dangerous conditions.

Net Effects – No negative effects to aquatic habitat are anticipated as there is no construction involved and on-going operations are isolated from the local drain system. Proposed mitigation and available contingency measures will effectively manage leachate during operation and post closure.

4.3.3.1.3.2 Leachate Treatment Alternative 2 – On-Site Pre-Treatment

Potential Effects – Leachate Treatment Alternative 2 involves the addition of an enclosed pre-treatment system. Construction activities will occur over 4 to 6 weeks but will be 50 m or more from the Duke Drain (see **FIGURE 4-15**). Due to the short length of construction and the distance from the watercourse no impacts on aquatic habitat are anticipated from construction.

The on-site component of this leachate treatment alternative remains approximately 50 m from the Duke Drain which has limited potential for fish habitat. While there is some on-site treatment and on-site storage (1 to 3 days), there is no intentional discharge to on-site watercourses and the facility is well removed from the Duke Drain and associated aquatic habitat and expected to have minimal to no impact.

It is noted that given that there is leachate being retained on-site for pre-treatment and storage prior to discharge to the BWTL there is some potential for accidental spills or malfunctions. All alternatives include the contingency of trucking leachate to the Chatham Wastewater Treatment Plant. Trucking leachate has the potential fora spill on-route that could enter a water course if the truck was involved in an accident.

Mitigation – Mitigation to reduce the potential for impact to aquatic habitat 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. Should issues be detected with the treatment system, 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. This alternative includes a contingency to use a licensed hauler to truck leachate to the Chatham-Kent Wastewater Treatment Plant. In the contingency situation, where leachate is trucked to a licensed treatment facility, if the truck was involved in an accident there is some potential for a spill. While the occurrence of trucking leachate is expected to be rare, 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. If trucking was required during an extreme adverse weather event, treated leachate could be recirculated back into the landfill for short periods of time avoiding the need for trucks to operate under dangerous conditions.

Net Effects – No negative effects to aquatic habitat are anticipated during construction. During operation and post closure there is limited potential for impacts to aquatic habitat. There is some potential for an accidental spill of the leachate that is being partially treated on-site, however this potential is minimal with appropriate management and mitigation measures.

4.3.3.1.3.3 Leachate Treatment Alternative 3 – On-Site Full Treatment

Potential Effects - Leachate Treatment Alternative 3 involves construction of an enclosed full treatment system which would outlet directly to a local drain adjacent the site. Construction activities will occur over 6 to 9 months but will be 50 m or more from the Duke Drain (see **FIGURE 4-15**). Even with this longer construction period the construction remains distance from the watercourse and no impacts on aquatic habitat are anticipated from construction.

This on-site full leachate treatment facility will be a minimum of 50 m from the Duke Drain which has limited potential for fish habitat. This will directly discharge treated leachate on-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. As the leachate is treated the potential impact of this discharge on aquatic habitat is minimal.

Given that all leachate is being retained on-site there is potential for accidental spills or malfunctions with Alternative 3.

All alternatives include the contingency of trucking leachate to the Chatham Wastewater Treatment Plant. In the event of a truck accident there is the potential that a spill of leachate could enter the watercourse.

Mitigation – 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. Should issues be detected with the treatment system, 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. This alternative includes a contingency to use a licensed hauler to truck leachate to the Chatham-Kent Wastewater Treatment Plant. In the contingency situation, where leachate is trucked to a licensed treatment facility, there is some potential for an accidental spill if there is a truck accident. 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. If trucking was required during an extreme adverse weather event, treated leachate could be recirculated back into the landfill for short periods of time avoiding the need for trucks to operate under dangerous conditions.

Net Effects – No negative effects to aquatic habitat are anticipated during construction. During operation and post closure there is limited potential for impacts to aquatic habitat. There is some potential for an accidental spill or discharge of the leachate that has not been fully treated on-site, however this potential is minimal with appropriate management and mitigation measures.

4.3.3.2 Natural Environment – Groundwater and Surface Water

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

4.3.3.2.1 Groundwater and Surface Water Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
Groundwater			
Potential impacts to groundwater quality during construction, operation and post closure.	• Ability to effectively treat leachate. • Approximate travel time to bedrock aquifer.	• Existing and proposed facility characteristics. • Groundwater modelling.	• Different ways of leachate treatment may have different impacts on ground water. • In the event of an accidental release of untreated leachate, the distance to the aquifer will influence the potential for that spill to have a negative impact.
Surface Water			
Potential impacts to surface water quantity and quality.	• Anticipated discharge to on-site watercourses.	• Existing and proposed facility characteristics.	• Different ways of leachate treatment may have different impacts on surface water.

4.3.3.2.2 Overview of Groundwater and Surface Water Considerations and Assumptions

The current leachate collection system continuously pumps leachate to on-site tanks and then through an existing forcemain to the BWTL where it is effectively treated meeting MECP discharge criteria. The leachate is tested prior to discharge and Waste Connections works closely with the Chatham-Kent PUC to make sure that the leachate the BWTL will receive is manageable from a quantity and quality perspective.

The current system has the capacity to store approximately 1 day of untreated leachate in the on-site tank. With some leachate stored on-site there is the potential for an accidental spill. The existing site and proposed expansion will include an extensive system to manage surface water which would collect any accidental on-site discharge of leachate from the treatment system. Also, this site affords significant natural protection in the form of 30 m of natural clay under the site

and the approximate travel time to the bedrock aquifer should there be an operational upset, spill or leak is approximately 3,000 years.

4.3.3.2.3 Groundwater and Surface Water Net Effects

4.3.3.2.3.1 Leachate Treatment Alternative 1 – Direct Discharge to Sanitary Sewer

4.3.3.2.3.1.1 Groundwater

Potential Effects – This direct discharge alternative effectively treats the leachate at the BWTL to meet MECP discharge criteria. There is some temporary on-site storage creating potential for accidental spills. Given the significant travel time to the bedrock aquifer (approximately 3,000 years), any accidental leachate spill will be able to be addressed and cleaned up with no impact on groundwater. No construction related effects are anticipated.

Mitigation – Testing of the leachate will continue to be carried out as it leaves the site and Waste Connections will continue to liaise with the PUC. Should issues be detected with leachate quality, the leachate pumps can be cycled off and the landfill can contain leachate for a significant period of time to address the situation. This alternative includes a contingency to use a licensed hauler to truck leachate to the Chatham-Kent Wastewater Treatment Plant.

Net Effects – No significant net effects during construction, operation or post closure are anticipated.

4.3.3.2.3.1.2 Surface Water

Potential Effects –The existing leachate treatment system discharges directly to the sanitary sewer system so there is no anticipated direct discharge on-site and no impact on on-site surface water quality or quantity.

With some temporary leachate storage on-site there is potential for accidental release of untreated leachate; however any accidental spill will be directed to the stormwater management system and is tested before release.

Mitigation – Should issues be detected with the treatment system, leachate pumps can be cycled off and the landfill can contain leachate for a significant period of time to address the situation. This alternative includes a contingency to use a licensed hauler to truck leachate to the Chatham-Kent Wastewater Treatment Plant.

Net Effects – During construction, operation and post closure no significant net effect anticipated.

4.3.3.2.3.2 Leachate Treatment Alternative 2 – On-Site Pre-Treatment

4.3.3.2.3.2.1 Groundwater

Potential Effects – This alternative effectively treats leachate through a combination of the pre-treatment at the Ridge and further treatment at the BWTL to meet MECP discharge criteria. Given that leachate will remain on-site for pre-treatment and some temporary on-site storage is needed, there is a potential for accidental spills. Given the significant travel time to the bedrock aquifer (approximately 3,000 years), any leachate spill would be able to be addressed and cleaned up with no impact on groundwater. A small pre-treatment facility will need to be constructed but no construction related effects on ground water are anticipated.

Mitigation – Testing of the leachate will continue to be carried out at the pre-treatment plant and as it leaves the site and Waste Connections will continue to liaise with the PUC. Should issues be detected with leachate quality, the pumping system or at the BWTL, leachate pumps can be cycled off and the landfill can contain leachate for a significant period of time to address the situation. This alternative includes a contingency to use a licensed hauler to truck leachate to the Chatham-Kent Wastewater Treatment Plant.

Net Effects – No significant net effects during construction, operation or post closure are anticipated.

4.3.3.2.3.2.2 Surface Water

Potential Effects – This alternative does not involve construction in proximity to surface water and the on-site pre-treatment alternative will discharge to the sanitary sewer system so there is no anticipated direct discharge on-site and no impact on on-site surface water quantity or quality.

As leachate will be handled on-site during the pre-treatment process and there is a need for some temporary leachate storage on-site (approximately 2 to 3 days of accumulation of untreated and partially treated leachate) there is some potential for accidental spill of untreated leachate. Any accidental spill would be captured in the stormwater management system which is tested before release.

Mitigation – Best management practices will be implemented during construction to minimize the potential for sedimentation or spills. Should issues be detected with the treatment system, leachate pumps can be cycled off and the landfill can contain leachate for a significant period of

time to address the situation. This alternative includes a contingency to use a licensed hauler to truck leachate to the Chatham-Kent Wastewater Treatment Plant.

Net Effects – No construction related net effects are anticipated. During operation and post closure there is no direct discharge to on-site water courses and no anticipated impact on surface water quality or quantity. As noted any accidental spills will be captured within the stormwater management system which is tested prior to release.

4.3.3.2.3.3 Leachate Treatment Alternative 3 – On-Site Full Treatment

4.3.3.2.3.3.1 Groundwater

Potential Effects – A full treatment facility can be designed on-site to meet MECP discharge criteria. With all leachate treatment occurring on-site there is a potential for accidental spills. Given the significant travel time to the bedrock aquifer (approximately 3,000 years), any leachate spill will be able to be addressed and cleaned up with no impact on groundwater. Construction related effects on ground water are not anticipated from the development of a full treatment facility on-site.

Mitigation – A full treatment plant would involve regular testing of treatment leachate prior to release to the environment. The testing results would be reported to MECP. Should issues be detected with treated leachate quality, the leachate pumps can be cycled off and the landfill can contain leachate for a significant period of time to address the situation. This alternative includes a contingency to use a licensed hauler to truck leachate to the Chatham-Kent Wastewater Treatment Plant.

Net Effects – No significant net effects during construction, operation or post closure are anticipated.

4.3.3.2.3.3.2 Surface Water

Potential Effects – Leachate Treatment Alternative 3 involves the construction of a full treatment plant on-site. Construction will not be in proximity to surface water features and will not result in construction impacts to surface water quality or quantity. The full treatment plant will discharge year round into the Duke Drain and would change the water quantity in this local drain as the result of the direct discharge. The plant will need to meet MECP approved discharge criteria and overall should not negatively affect surface water quality.

Leachate will be handled on-site and there is some potential for accidental spills of untreated or partially treated leachate. Any accidental spill would be captured in the stormwater management system on-site which is tested before release.

Mitigation – Best management practices will be implemented during construction to minimize the potential for sedimentation or spills. Should issues be detected with the treatment system, leachate pumps can be cycled off and the landfill can contain leachate for a significant period of time to address the situation. This alternative includes a contingency to use a licensed hauler to truck leachate to the Chatham-Kent Wastewater Treatment Plant.

Net Effects – No significant construction effects anticipated. This alternative will change the surface water quantity in the local drains as treated leachate will need to be discharged year round.

During operation and post closure any accidental spills will be captured by on-site in the stormwater management system which is tested prior to release.

4.3.3.3 Natural Environment – Atmospheric and Climate Change

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

4.3.3.3.1 Atmospheric and Climate Change Criteria and Indicators

Criteria	Indicators	Data Source	Rationale
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.	• Existing and proposed facility characteristics.	• Different ways of leachate treatment may have different impacts on air quality.

Criteria	Indicators	Data Source	Rationale
Climate Change			
Potential for GHG emissions during construction and operation.	• Relative amount of energy required to operate facility. • Quantity of GHG generated from energy used for treatment processes.	• Existing and proposed facility characteristics.	• Some leachate treatment methods involve trucking which results in GHG and the generation of energy required for treatment processes also produce GHG emissions.

4.3.3.3.2 Overview of Atmospheric and Climate Change Considerations and Assumptions

Construction of the infrastructure for the alternatives ranges from no construction for Leachate Treatment Alternative 1, approximately 4 to 6 weeks of construction for Leachate Treatment Alternative 2 and approximately 6 to 9 months for Leachate Treatment Alternative 3. GHG produced from the energy used to pump and treat the leachate are calculated based upon the Environment and Climate Change Canada's – National Inventory Report (1990 to 2016)[147] which identifies the generation intensity of electrical energy in Ontario to be 17 g CO_2e/kWh.

4.3.3.3.3 Atmospheric and Climate Change Net Effects

4.3.3.3.3.1 Leachate Treatment Alterative 1 – Direct Discharge to Sanitary Sewer

4.3.3.3.3.1.1 Atmospheric

Potential Effects – There is no construction related to Leachate Treatment Alternative 1. The amount of energy current used to pump the leachate to the BWTL and treat it there is estimated to be approximately 96,000 kWh/year which will increase over the expansion period to about 290,000 kWh/year. This estimate includes the energy used to pump leachate to the BWTL and the portion of power required at the BWTL to treat the leachate.

Mitigation – Keeping construction and operation equipment in good working order to minimize emissions.

[147] Environment and Climate Change Canada (2018). National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada. Available at: http://publications.gc.ca/collections/collection_2018/eccc/En81-4-2016-1-eng.pdf

Net Effects - No significant construction, operation or post closure net effects are anticipated.

4.3.3.3.3.1.2 Climate Change

Potential Effects – There is no construction related to Leachate Treatment Alternative 1 and no construction related GHG emissions. During operation, Leachate Treatment Alternative 1 would use minimal energy and have minimal potential to generate GHG emissions from pumping the leachate to the BWTL and treating it at the lagoons. GHG produced from the energy used to pump the leachate to the BWTL and treat it is estimated to be about 5 tonnes of CO_2 equivalent per year at the maximum leachate flow.

There would be minimal change to GHG emissions from what occurs today with this alternative. The landfill expansion will extend the need for energy and associated GHG emissions over time. No construction related effects are anticipated. In the event that BWTL could not accept the leachate, trucking to the Chatham Wastewater Treatment plant, a distance of about 20 kilometers. The volume to be trucked would require between 7 and 14 trucks a day to transport the leachate. It is assumed that trucking would be required only until the BWTL could resolve the issue preventing discharge of leachate. As an event like this has not occurred in the past 15 years of operation, to determine the impacts associated with trucking it is assumed that over the 20 year life of the landfill expansion that the trucking contingency will be required once for a single one (1) month period. The GHG produced from this trucking event is estimated to be about 15 tonnes CO_2 equivalent assuming the maximum number of trucks of 14 per day.

Mitigation – Keeping operation equipment in good working order to minimize emissions.

Net Effects – No significant construction, operation or post closure net effect anticipated.

4.3.3.3.3.2 Leachate Treatment Alternative 2 – On-Site Pre-Treatment

4.3.3.3.3.2.1 Atmospheric

Potential Effects – Leachate Treatment Alternative 2 requires some construction which is anticipated to be approximately 4 to 6 weeks. The minimal amount of construction will not significantly impact in air quality. This alternative will require energy for pre-treatment in the amount of about 2,500,000 kWh/year. The landfill expansion will extend the need for energy and associated air quality impacts over the expansion period.

Mitigation – Keeping construction and operation equipment in good working order to minimize emissions.

Net Effects –No significant construction, operation or post closure net effects are anticipated.

4.3.3.3.3.2.2 Climate Change

Potential Effects – Leachate Treatment Alternative 2 requires construction although it is not anticipated that the short term nature of the construction (4 to 6 weeks) will contribute significantly to GHG emissions. During operation, Leachate Treatment Alternative 2 would use energy to pre-treat the leachate and it is estimated that about 42 tonnes per year of CO_2 equivalent would be produced from the energy used to manage the leachate with this alternative. With the on-site pretreatment, the quality of leachate being conveyed to BWTL would have lower levels of contaminants than the existing leachate quality, making it even less likely that trucking of leachate to the Chatham Wastewater Treatment Plant would be required. However, if trucking was required then the GHG emissions can be assumed to be similar to Alternative 1.

The landfill expansion will extend the need for energy and associated GHG emissions over time.

Mitigation – Keeping construction and operation equipment in good working order to minimize emissions.

Net Effects – No significant construction, operation or post closure net effects are anticipated.

4.3.3.3.3.3 Leachate Treatment Alternative 3 – On-Site Full Treatment

4.3.3.3.3.3.1 Atmospheric

Potential Effects – Leachate Treatment Alternative 3 involves the construction of a full treatment plant over a period of 6 to 9 months. This is a much greater amount of construction activity with a potential to impact air quality as a result of this longer construction period.

There will be significant energy used during operation of a full treatment plant, in the amount of about 7,000,000 kWh/year.

The landfill expansion will extend the need for energy and associated air quality impacts over the expansion period.

Mitigation – Keeping construction and operation equipment in good working order to minimize emissions.

Net Effects – Air quality impacts during construction will be short term. During operation and post closure the operation of a full treatment plant requires significantly energy and has the potential to result in some air quality impact.

4.3.3.3.3.3.2 Climate Change

Potential Effects – Leachate Treatment Alternative 3 requires a much longer construction period (6 to 9 months) which is typical for a complex treatment facility and outfall to a local drain. For Leachate Treatment Alternative 3, significant energy is required to operate a full treatment facility on-site resulting in a higher potential for GHG emissions. GHG produced from the energy required to operate the full treatment facility is estimated to be about 120 tonnes/year of CO_2 equivalent. Trucking to the Chatham Wastewater Treatment Plant of the leachate would be required if the on-site facility could not sufficiently treat it for release to the environment. Given the very complex design requirements for this plant because of the expected stringent discharge criteria and the difficulty in removing leachate contaminants to the regulatory limits, it is reasonable to assume that achieving continuous compliance will be difficult and an alternative discharge contingency will need to be in place. , Off-site trucking of treated leachate that does not meet discharge criteria should be expected during the life of the expansion. In addition, leachate disposal will need to occur during regular plant maintenance activities or shut-downs. For the purpose of this EA it will be assumed that trucking will be required once per year for the 20 years of the landfill expansion for a one (1) month duration each time. This will result in 294 tonnes CO_2 equivalent being generated over the expansion period.

The landfill expansion will extend the need for energy for leachate management and the associated GHG emissions over the expansion period.

Mitigation – Keeping construction and operation equipment in good working order to minimize emissions.

Net Effects – During construction GHG impacts will be short term. During operation and post closure the operation of a full treatment plant requires significant energy and has the potential to result in increased GHG emissions.

4.3.3.4 Socio-Economic Environment - Social

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.

4.3.3.4.1 Social Criteria and Indicators

Criteria	Indicators	Data Sources	Rationale
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.	• GIS mapping. • Existing and proposed facility characteristics.	• Different ways to treat leachate may have different impacts on residents around the landfill during construction.
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 discrete receptors.	• Feedback from neighbours.	• Different ways to treat leachate may have different odour impacts on residents around the landfill during operation.
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.	• Existing and proposed facility characteristics.	• Different ways to treat leachate may have different traffic impacts on residents around the landfill and along the haul route.

4.3.3.4.2 Overview of Social Considerations and Assumptions

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.

Screening berms have been built to control noise generated at the landfill and the existing leachate pumps are enclosed. The site is currently in compliance with respect to noise. There is no vibration as a result of current leachate treatment.

Leachate could be a source of odour. Based on the 2017 Annual Monitoring Report[148], there has been no evidence of leachate seeps since the installation of the leachate collection system in the Old Landfill and no seeps have been observed in the West Landfill, indicating that the leachate collection system is performing as designed. It is noted that should there be any leachate related odour concerns raised associated with the on-site pumps or the pre-treatment and full treatment infrastructure for Leachate Treatment Alternatives1, 2 and 3, leachate pumps can be cycled off and the landfill can contain leachate for a significant period of time to allow for troubleshooting and fixing any issues.

Currently no trucking of leachate is carried out and no chemical delivery or residue disposal is required. There are approximately 200 trucks/day delivering waste to the site and this will continue as long as the site is in operation. 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/day on average.

Specific assumptions for each Alternative are as follows:

- Alternative 1 - No construction is required. Operation of the existing pump and forcemain will continue.
- Alternative 2 - Construction will be required for approximately 4 to 6 weeks for equipment installation. Operation of the existing pump and forcemain would continue. The leachate pump and pre-treatment infrastructure will be enclosed.
- Alternative 3 - The full treatment facility would be enclosed within a building. Construction will be required for approximately 6 to 9 months for a building approximately of 1,500 m^2; including storage tanks. Fully treated leachate would be pumped to a local drain for discharge to the natural environment and the forcemain would be no longer be used.

[148] Dillon Consulting Limited (2001 to 2017). Annual site Development, Operation and Monitoring Reports.

4.3.3.4.3 Social Net Effects

4.3.3.4.3.1 Leachate Treatment Alternative 1 – Direct Discharge to Sanitary Sewer

4.3.3.4.3.1.1 Noise

Potential Effects – Leachate Treatment Alternative 1 involves no change in the leachate treatment system so there would be no additional noise sources during construction or operation. Operational noise is expected to be minimal and as experienced since the forcemain connection was completed in 2002. There will be no off-site impact from construction or operation as the forcemain is already in operation and is buried below ground. If the leachate trucking contingency is needed then noise from the trucks would be limited to 1 to 2 trucks per hour following designated truck routes during daytime hours for a short period of time. No significant effect is anticipated.

Mitigation – Mitigation includes extension of the landfill berms and regular maintenance of the equipment.

Net Effects - During construction, operation and post closure no significant net effect on residents as a result of noise and vibration are anticipated.

4.3.3.4.3.1.2 Odour

Potential Effects – No construction is required so no odour would occur specific to construction. Leachate odour sources during operation could include seeps, and the storage tank/overflow. Leachate Treatment Alternative 1 represents no change to the current operation and based on operating experience, the continued pumping of leachate to the forcemain and direct discharge to the sanitary sewer does not result in any significant odour impacts. Conveying the leachate through the forcemain will also not generate any odours as the system is sealed and there is no opportunity for odour to escape.

Mitigation – No mitigation required.

Net Effects – During construction, operation and post closure no significant net effect on residents as a result of odour are anticipated.

4.3.3.4.3.1.3 Traffic

Potential Effects – There is no construction related to Leachate Treatment Alternative 1 and no chemical delivery is required, so there is no additional trucking for facility construction or operation. Trucking of leachate is identified should a contingency for leachate treatment be required. In the unlikely event that it is required this would result in approximately 14 tanker truck trips/day which is not anticipated to be significant in the context of the 200 waste trucks/day.

Mitigation – No mitigation is required for regular operation. Should contingency trucking be required, only licensed haulers would be used and they would be required to use identified truck routes.

Net Effects – During construction, operation and post closure no significant net effects on residents as result of traffic are anticipated.

4.3.3.4.3.2 Leachate Treatment Alternative 2 – On-Site Pre-Treatment

4.3.3.4.3.2.1 Noise

Potential Effects – Leachate Treatment Alternative 2 involves minor construction of a pre-treatment facility over 4-weeks likely in the area of the existing leachate storage tank, which could result in temporary construction related noise. However it is anticipated that any construction noise would be intermittent during this time as much of the pre-treatment infrastructure to be constructed is pre-assembled and delivered to the site. Similar to Alternative 1, no off-site impacts are anticipated from conveying the leachate to the BWTL or if trucking of the leachate off-site is required.

Operational noise from the pump and pre-treatment is expected to be minimal as they will be enclosed within a structure. There are no vibration effects as a result of this alternative.

Mitigation – Mitigation to reduce noise includes: extension of the landfill berms; enclosure of the pump and pre-treatment equipment; maintenance of equipment; and limiting construction activity to work days and normal business hours.

Net Effects – During construction, operation and post closure no significant net effects on residents as a result of noise and vibration are anticipated.

4.3.3.4.3.2.2 Odour

Potential Effects – Odour is not anticipated during construction. The operation of an on-site pre-treatment facility adds a potential new source of odour to the site. However, given that pre-treatment will be in a fully contained system, odour during normal operation is not anticipated. There is some potential 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). Similar to Alternative 1, no off-site odour impacts are anticipated.

Mitigation – Mitigation would include odour control on pre-treatment building as required.

Net Effects – No odour effects are anticipated during construction. During operation and post closure there is some potential for odour effects in the event of an upset as leachate will remain on-site for longer to be pre-treated.

4.3.3.4.3.2.3 Traffic

Potential Effects – There will be minimal trucking for facility construction or operation and up to two (2) trucks/day for operation for chemical delivery and residue removal. This number is negligible given the approximately 200 trucks/day that would continue to bring waste to the site.

Pretreated leachate will be pumped via the existing forcemain to the BWTL and trucking of leachate would not be required during normal operations. Leachate Treatment Alternative 2 includes a contingency to truck leachate to the Chatham-Kent Wastewater Treatment Plant licensed wastewater facility should it be required for short periods of time.
In the unlikely event that trucking of leachate should be required, the addition of 14 tanker trucks/day is not anticipated to be significant in the context of the 200 waste trucks/day. The liquid haul trucks would be MECP licensed and use appropriate truck routes.

Mitigation – During construction, traffic will be required to follow designated truck routes. For the delivery of chemicals and removal of residue and contingency trucking should it be required, only licensed haulers would be used and they would be required to use identified truck routes.

Net Effects – No significant net effects on residents as result of traffic are anticipated during construction, operation and post closure.

4.3.3.4.3.3 Leachate Treatment Alternative 3 – On-Site Full Treatment

4.3.3.4.3.3.1 Noise

Potential Effects – Leachate Treatment Alternative 3 would require significant on-site construction (approximately 6 to 9 months) to build a full treatment plant, and would have a longer duration of potential noise associated with construction activity. Operational noise is expected to be minimal as the treatment processes will be fully contained within a building. There are no vibration effects as a result of this alternative. Trucking of leachate to the Chatham WWTP is likely to occur as previously stated on a regular basis given the difficulty anticipated in treating leachate to discharge criteria and during periods of plant maintenance and shut-down.

Mitigation – Mitigation for noise includes an extension of the landfill berms; enclosure of the treatment processes in a building; maintenance of equipment and limiting construction and truck activity to work days and normal business hours, where possible.

Net Effects – The extended construction period of 6 to 9 months has the potential for temporary noise impacts to residents. There is no significant noise effects from operation anticipated.

4.3.3.4.3.4 Odour

Potential Effects – Odour is not anticipated during construction for this alternative. The operation of a full treatment facility adds a potential new source of odour to the site. During normal operating conditions, this facility is not expected to emit odour as it will be fully contained within a building. However, there is potential 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). As the plant will operate during the post-closure period, these impacts would extend past 2041.

Mitigation – Odour control will be installed on the treatment building.

Net Effects – No significant net effects are anticipated during construction. During operation and post closure there is potential for odour effects in the event of an upset or abnormal conditions as leachate treatment will be undertaken on-site.

4.3.3.4.3.4.1 Traffic

Potential Effects – Leachate Treatment Alternative 3 includes the most construction and will result in approximately five (5) to ten (10) construction trucks/day over a 6 to 9 month period and two (2) to five (5) trucks/day during operation for chemical delivery and residue removal.

Traffic effects associated with leachate treatment are minimal especially in the context of continued operation of the site and the typical 200 waste trucks/day.

Leachate Treatment Alternative 3 includes 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/day on average. The liquid haul trucks would use appropriate truck routes. It is likely that some trucking will be required given the difficulty in operating a small plant and the need for shut downs during routine maintenance activities.

Mitigation – Construction traffic will be required to follow designated routes. For the delivery of chemicals and removal of residue and contingency trucking should it be required, only licensed haulers would be used and they would be required to use identified truck routes.

Net Effects – No significant net effects on residents as result of traffic related to full on-site treatment of leachate are anticipated during construction, operation and post closure periods.

4.3.3.5 Socio-Economic Environment - Economic

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

4.3.3.5.1 Economic Criteria and Indicators

Criteria	Indicators	Data Source	Rationale
Economic			
Potential for effect on businesses during construction and operation.	• Number of businesses and their distance from the on-site leachate treatment infrastructure.	• GIS mapping. • Existing and proposed facility characteristics.	• Disruption from leachate treatment may have different impacts on the activities of businesses around the landfill.
Cost of facility.	• Approximate cost of leachate treatment facility alternative.	• Existing and proposed facility characteristics.	• Different leachate treatment methods may have different costs.

4.3.3.5.2 Overview of Economic Considerations and Assumptions

Businesses operating within the Study Area include an equipment dealer and a farm market southwest of the site as well as numerous farmed parcels that are part of agricultural operations. The existing leachate storage tanks are along Erieau Road approximately 2.4 km from these two (2) businesses.

Waste Connections currently pays the Municipality of Chatham-Kent for the treatment of landfill leachate.

4.3.3.5.3 Economic Potential Effects

4.3.3.5.3.1 Leachate Treatment Alternative 1 – Direct Discharge to Sanitary Sewer

4.3.3.5.3.1.1 Impact on Business

Potential Effects – For Leachate Treatment Alternative 1 leachate treatment would remain in its current location with continued use of the forcemain to the BWTL. These activities are well separated from the existing businesses and would have no impact on their activities. Any required trucking of leachate would not be on Charing Cross or Allison Line and would not affect the business operations located on those roads.

Mitigation – No mitigation required.

Net Effect – No significant net effects on businesses are anticipated during construction, operation and post closure.

4.3.3.5.3.1.2 Cost of Facility

Potential Effects – No facility construction required and no construction cost to be incurred.

Mitigation – No mitigation required.

Net Effects –No significant net effect related to cost is anticipated during construction, operation and post closure.

4.3.3.5.3.2 Leachate Treatment Alternative 2 – On-Site Pre-Treatment

4.3.3.5.3.2.1 Impact on Business

Potential Effects – For Leachate Treatment Alternative 2 a leachate pre-treatment facility would likely be constructed near the existing leachate storage tank. There would be continued use of the forcemain to the BWTL. This alternative brings the treatment activity slightly closer to the existing businesses however it is still considered to be well separated and would have no impact on their activities. Any required trucking of leachate would not be south of the landfill on Charing Cross or Allison Line and would not affect the business operations located on those roads.

Mitigation – Mitigation to reduce the potential from disruption to business activities as a result of pre-treatment includes enclosing the pre-treatment facilities, adding odour control as required and requiring construction and operation traffic to follow designated truck routes.

Net Effects – No significant net effect on business activity is anticipated during construction, operation and post closure.

4.3.3.5.3.2.2 Cost of Facility

Potential Effects – Construction costs for a pre-treatment facility would be in the order of $5 million with annual operating costs in the order of $450,000/year including the operating staff time commitment. This alternative results in significant additional costs to Waste Connections.

Mitigation – No mitigation available.

Net Effects – Significant net effect related to cost is anticipated during construction, operation and post closure.

4.3.3.5.3.3 Leachate Treatment Alternative 3 – On-Site Full Treatment

4.3.3.5.3.3.1 Impact of Business

Potential Effects – For Leachate Treatment Alternative 3, the full leachate treatment facility would likely be constructed in the southeast corner of the site as there is insufficient space adjacent the existing leachate storage tank. This alternative locates the treatment activity slightly closer to the existing businesses however it is still considered to be well separated and would have no impact on their activities. Any required trucking of leachate would be towards the Chatham Wastewater Treatment Plant, away from the business operations located in the area.

Mitigation – Mitigation to reduce the potential from disruption to business activities as a result of on-site treatment includes enclosing the treatment facilities, adding odour control as required and requiring construction and operation traffic to follow designated truck routes.

Net Effects – No significant net effect on business activity is anticipated during construction, operation or post closure periods.

4.3.3.5.3.3.2 Cost of Facility

Potential Effects – Leachate Treatment Alternative 3 would require a very significant expenditure for construction of a full wastewater treatment plant and associated infrastructure (estimated in $20 to $25 million range), a very high annual operating cost of $1.25 million and a full time staff compliment. This alternative results in very significant additional capital and operating costs to Waste Connections.

Mitigation – No mitigation available.

Net effects – The additional cost associated with this facility is a very significant effect during construction, operation and post closure periods.

4.3.3.6 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.

4.3.3.6.1 Cultural Criteria and Indicators

Criteria	Indicators	Data Source	Rationale
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.	• Stage 1 and 2 Archaeological Assessment. • Existing and proposed facility characteristics.	• There is undisturbed land remaining on-site that could have archaeological resources.

4.3.3.6.2 Overview of Cultural Considerations and Assumptions

The lands in the vicinity of the current leachate storage and pump location have been identified as having no archaeological potential and the land has been cleared by the Ministry of Heritage, Sport, Tourism and Culture Industries.

Any additional facilities would be built in the same area as the current leachate storage or in the south eastern corner of the site. Leachate Treatment Alternative 1 involves no construction; Leachate Treatment Alternative 2 involves some construction for a pre-treatment facility; Leachate Treatment Alternative 3 will require construction of an approximately 1,500 m^2 building as well as additional storage.

4.3.3.6.3 Cultural Net Effects

4.3.3.6.3.1 Leachate Treatment Alternative 1 – Direct Discharge to Sanitary Sewer

4.3.3.6.3.1.1 Archaeological Resources

Potential Effects – Leachate Treatment Alternative 1 involves no construction or change in location for leachate storage or pumping. There is no potential effect.

Mitigation – No mitigation required. Should unexpected archaeological finds be discovered, Waste Connections will stop work and the Ministry of Heritage, Sport, Tourism and Culture Industries will be notified.

Net Effects – No significant net effect on archaeological resources is anticipated during construction, operation and post closure periods.

4.3.3.6.3.2 Leachate Treatment Alternative 2 – On-Site Pre-Treatment

4.3.3.6.3.2.1 Archaeological Resources

The cultural potential effects, mitigation and net effects for Leachate Treatment Alternative 2 are identical to those described above for Alternative 1.

4.3.3.6.3.3 Leachate Treatment Alternative 3 – On-Site Full Treatment

4.3.3.6.3.3.1 Archaeological Resources

A full facility would be constructed in an area that has been cleared of archaeological potential. The cultural potential effects, mitigation and net effects for Leachate Treatment Alternative 3 are identical to those described above for Leachate Treatment Leachate Treatment Alternative 1.

4.3.3.7 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.

4.3.3.7.1 Built Criteria and Indicators

Criteria	Indicators	Data Source	Rationale
Built			
Potential effects on existing transportation infrastructure and transportation operation.	• Anticipated number of trucks required.	• Existing and proposed facility characteristics.	• Some leachate treatment methods involve trucking which could have transportation impacts.
Ease to implement/construct and maintain/operate.	• Anticipated complexity of construction and operation.	• Existing and proposed facility characteristics.	• The alternatives will have different levels of complexity to construct and operate.

4.3.3.7.2 Overview of Built Considerations and Assumptions

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 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/day on average. The liquid haul trucks would use approved truck routes and the same contingency would apply to all alternatives.

Since 2002 the on-site leachate collection system has been connected to a forcemain which takes the untreated leachate to the BWTLs. This system is straightforward to operation and has been working successfully for 18 years.

No construction is required for Alternative 1. This alternative continues to convey untreated leachate via the existing forcemain to the BWTL. Trucking of leachate is identified should a contingency for leachate treatment be required. If required this would result in approximately 14 tanker truck trips/day, on average when leachate collection peaks during the expansion period.

Leachate Treatment Alternative 2 will require a construction duration of 4 to 6 weeks which will require two (2) trucks/day during the construction period. It is assumed that pre-treatment could require up to two (2) trucks/day for the delivery of chemicals and the removal of residue. Trucking of leachate is identified should a contingency for leachate treatment be required. If required this would result in approximately 14 tanker truck trips/day, on average when leachate collection peaks during the expansion period.

Alternative 3 will require a construction duration of 6 to 9 months for an approximately 1,500 m^2 building as well as additional storage. A full treatment facility is not something that Waste Connections currently has experience with and will require a full staff compliment of licensed operators to maintain/operate. Extensive studies and permitting will be required to discharge treated effluent to the environment. This alternative will require a construction duration of 6 to 9 months which will require five (5) to ten (10) trucks per day on average over the construction duration. It is assumed that full treatment could require two (2) to five (5) trucks/day for the delivery of chemicals and the removal of residue. Trucking of leachate is identified should a contingency leachate treatment be required. If required this would result in approximately 14 tanker truck trips/day.

4.3.3.7.3 Built Net Effects

4.3.3.7.3.1 Leachate Treatment Alternative 1 – Direct Discharge to Sanitary Sewer

4.3.3.7.3.1.1 Transportation Infrastructure

Potential Effects – Leachate Treatment Alternative 1 would have no impact to existing transportation operations or infrastructure as there will be no trucking for facility construction or operation. Should trucking of leachate be required the addition of 14 tanker trucks/day is not anticipated to be significant in the context of the 200 waste trucks/day.

Mitigation – 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.

Net Effects – No significant net effects on infrastructure are anticipated during construction, operation and post closure.

4.3.3.7.3.1.2 Ease of Implementation

Potential Effects – Leachate Treatment Alternative 1 is the 'status quo' and as such is easily implemented, maintained and operated. There is no potential effect.

Mitigation – Ongoing maintenance of the collection system, storage and pumps as required. Ongoing liaison with the Municipality of Chatham-Kent is also required.

Net Effects – No significant net effects are anticipated during construction, operation and post closure.

4.3.3.7.3.2 Leachate Treatment Alternative 2 – On-Site Pre-Treatment

4.3.3.7.3.2.1 Transportation Infrastructure

Potential Effects – There would be some additional traffic associated with facility construction for Leachate Treatment Alternative 2 (two (2) trucks/day for 4 to 6 weeks). Leachate Treatment Alternative 2 would also require some delivery of treatment chemicals and some disposal of treatment waste e.g., liquid waste (up to two (2) trucks/day). This number is negligible given the approximately 200 trucks/day that would continue to bringing waste to the site. This number of trucks utilizing the transportation network for construction and operation will not have a noticeable impact on the transportation infrastructure or operation.

Should trucking of leachate be required the addition of 14 tanker trucks/day is not anticipated to be significant in the context of the 200 waste trucks/day.

Mitigation – During construction traffic will be required to follow designated routes. For the delivery of chemicals and removal of residue and contingency trucking should it be required, only licensed haulers would be used and they would be required to use identified truck routes.

Net Effects – No significant net effect on infrastructure is anticipated during construction, operation and post closure.

4.3.3.7.3.2.2 Ease of Implementation

Potential Effects – This alternative will require installation of pre-treatment equipment. The type of pre-treatment processes will need to be finalized depending upon future conditions and regulations. This alternative will continue to use the existing forcemain to pump pre-treated leachate to the BWTL. A pre-treatment system would be a new operation on-site outside of the current expertise of Waste Connections staff although it would likely be relatively straightforward to operate, it will require licensed operators.

Mitigation – Ongoing maintenance of the collection system, storage and pumps as required. Operator training and certification would be required. Ongoing liaison with the Municipality of Chatham-Kent would be undertaken.

Net Effects – There are no significant net effects associated with construction. During operation and post closure this alternative adds some complexity to Waste Connections' operations.

4.3.3.7.3.3 Leachate Treatment Alternative 3 – On-Site Full Treatment

4.3.3.7.3.3.1 Transportation Infrastructure

Potential Effects – There would be additional traffic associated with facility construction for Alternative 3 (five (5) to 10 trucks/day for 6 to 9 months). Leachate Treatment Alternative 3 also requires some delivery of treatment chemicals and some disposal of treatment waste e.g., liquid waste (two (2) to five (5) trucks/day). However, this number is negligible given the approximately 200 trucks/day bringing waste to the site. This number of trucks utilizing the transportation network for construction and operation will not have a noticeable impact on the transportation infrastructure or operation.

Should trucking of leachate be required the addition of 14 tanker trucks/day is not anticipated to be significant in the context of the 200 waste trucks/day.

Mitigation – Construction traffic will be required to follow designated routes. For the delivery of chemicals and removal of residue and contingency trucking should it be required, only licensed haulers would be used and they would be required to use identified truck routes.

Net Effects – During construction, operation and post closure no significant net effect on infrastructure is anticipated.

4.3.3.7.3.3.2 Ease of Implementation

Potential Effects – This alternative will require a construction duration of 6 to 9 months for an approximately 1,500 m^2 building to house the full treatment facility as well as additional storage.

Extensive studies and permitting will be required to discharge treated effluent to the natural environment. 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). Discharge restrictions could be imposed as part of the treatment plant approval process.

A full treatment facility is not something that Waste Connections currently has experience operating and it will require a full staff compliment of licensed operators to maintain/operate. Alternative 3 would include the construction of a complex leachate treatment facility and an outfall to a local drain. The full-time staff complement would be required to be certified and licensed in order to operate the facility, handle chemicals required for treatment and manage the waste streams from the treatment.

Mitigation – Ongoing maintenance of the collection system, storage and pumps as required. An extensive training program will be required to train new staff in the operation of this complex facility.

Net Effects – This alternative is complex and will result in a significant effect to Waste Connections operations.

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 4-16 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 1**.

The following highlights the key advantages and disadvantages of each of the three (3) 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 operation or post-closure;
- Minimal change to air quality or GHG emissions as a result of 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; and
- 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

- Would remove key contaminants prior to final treatment at BWTL.

Key Disadvantages

- Adds an additional process step, increasing complexity;
- Results in a capital cost in order of $5 million and O & M annual costs of $450,000 per year; and
- Creates additional GHG emissions from energy usage.

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);

- Creates significant GHG emissions from energy usage;
- Results in a cost of $20 to 25 million plus significant annual operating costs of $1.25 million/year;
- Adds a very complex process at the landfill requiring a full complement of trained staff that would need to be operated during the post-closure period; and
- Anticipated challenge to obtain permitting related to direct discharge to the environment.

4.3.4.1 Leachate Treatment Alternatives Conclusion

Based on the work completed, Leachate Treatment Alternative 1 - Direct Discharge to Sanitary Sewer and treatment at the BWTL is preferred or equally preferred over the other leachate treatment alternatives for all the environments considered. Leachate Management Alternative 1 is considered the preferred alternative overall as follows:

- Natural Environment – Biological – Preferred: Alternative 1 has the least potential to impact aquatic systems. There is no construction and the pumping station that discharges leachate to the existing sanitary sewer is 50 m from any aquatic habitat. In comparison, Alternatives 2 and 3 have on-site construction with a minimal potential to impact habitat.
- Natural Environment – Groundwater – Equally Preferred: For all three (3) alternatives, leachate will be effectively collected and treated and any accidental leachate spill would take approximately 3,000 years to reach the bedrock aquifer.
- Natural Environment – Surface Water – Preferred (equal to Alternative 2): Alternative 1 discharges leachate to the existing sanitary sewer and has therefore the least potential to impact surface water. Similarly Alternative 2 discharges to the existing sanitary sewer after some on-site pre-treatment. In comparison, Alternative 3 discharges year round to the on-site watercourse resulting in changes to water quantity.
- Natural Environment – Atmospheric – Preferred: Alternative 1 has no construction related air quality impacts and the energy required for operation is minimal. In comparison, Alternatives 2 and 3 require greater amounts of energy for long term operation.
- Natural Environment – Climate Change – Preferred: Alternative 1 has the smallest GHG impact of the three (3) alternatives. In comparison, Alternatives 2 and 3 have the potential for more significant GHG contributions over the life of the expansion.
- Socio-Economic Environment – Social – Preferred: Alternative 1 involves minimal noise or odour similar to that experienced today. In comparison, Alternatives 2 and 3 results in some potential for short term construction noise and Alternative 3 also has

greater potential for odour from leachate treatment during upset conditions due to the complex on-site treatment processes.

- Socio-Economic Environment – Economic – Preferred: None of the alternatives will impact businesses and business activity and Alternative 1 involves no cost to implement. In comparison, Alternative 2 involves a construction cost of $5 million and Alternative 3 a construction cost of $20 to $25 million plus a significant annual operating cost.
- Cultural Environment – Archaeology – Equally Preferred: Alternatives either involve no construction or are on land that has no potential for archaeological impacts.

Table 4-16: Overview of Comparative Evaluation Ranking of Leachate Treatment Alternatives

(Note: green = preferred; blue = less preferred; pink = least preferred; alternatives that are equally preferred are not highlighted in colour)

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 – Construction and operation will be removed (50 m away) from any on-site aquatic habitat minimizing potential for impact. With leachate being retained longer on-site there is some potential for accidental spills. If leachate is accidently released it will be captured by the stormwater system which is tested prior to being released.	Less Preferred – Construction and operation will be removed (50 m away) from any on-site aquatic habitat minimizing potential for impact. With leachate being retained longer on-site there is some potential for accidental spills. If leachate is accidently released it will be directed to the stormwater system which is tested prior to being released.	Continues with the existing discharge to forcemain with limited potential for aquatic impact.
Natural Environment - Groundwater Ranking	Equally Preferred – This alternative effectively treats the leachate at the BWTL. This alternative involves some temporary on-site storage and there is a potential for accidental spills. Any leachate spill would take approximately 3,000 years to reach the aquifer.	Equally Preferred – This alternative effectively treats leachate through a combination of the pre-treatment at the Ridge Landfill and further treatment at the BWTL. The leachate will remain on-site for pre-treatment and some temporary on-site storage and there is a potential for accidental spills. Any leachate spill would take approximately 3,000 years to reach the aquifer.	Equally Preferred – A full treatment facility can be constructed and operated on-site. With all leachate treatment occurring on-site and with the associated storage there is a potential for accidental spills. Any leachate spill would take approximately 3,000 years to reach the aquifer.	Any accidental spill o fleachate would take approximately 3,000 years to reach the aquifer.
Natural Environment - Surface Water Ranking	Preferred – No construction activities. The existing leachate treatment system discharges directly to the sanitary sewer and will not impact quality or quantity of on-site surface water.	Preferred – Construction will be removed from surface water (50 m away) and no construction related effects are anticipated. This alternative discharges to the sanitary sewer after pre-treatment and will not impact the quality or quantity of on-site surface waters.	Less Preferred – Construction will be removed (50 m away) from surface water and no construction related effects are anticipated. This alternative discharges year round to the Duke Drain impacting the quantity of water in the drain,	The existing system does not impact on-site surface water.
Natural Environment - Atmospheric Ranking	Preferred – This alternative has no construction related air quality impacts and the energy required for operation is minimal.	Less Preferred – This alternative involes very short term construction (4 to 6 weeks) with minimal potential for air quality impacts. The energy used for operation is moderate.	Least Preferred – This alternative involves short term construction (6 to 9 months) with potential for air quality impacts. Significant energy is required for long term operation with resulting air quality impacts.	No construction and requires minimal energy for operation.
Natural Environment - Climate Change Ranking	Preferred – There is no construction associated with this alternative. Uses minimal energy and has minimal potential to generate GHG emissions (about 5 tonnes CO_2e/year).	Less Preferred – This alternative requires short term construction (4 to 6 weeks) resulting in minimal GHG emissions. Uses moderate amount of energy and has minimal potential to GHG emissions (about 42 tonnes CO_2e/year).	Least Preferred – This alternative requires a much longer construction period (6 to 9 months). The full treatement uses significant energy which results in higher GHG emissions about 150 tonnes CO_2e/year).	The existing leachate treatment system uses minimal energy and has minimal potential to generate GHG emissions.
Socio-Economic Environment - Social Ranking	Preferred: No construction; no significant noise or odour during operation. No trucking involved for normal operation. Seven (7) to 14 trucks/day on average would be required to truck leachate if needed for contingency which is not considered significant in the context of the 200 waste trucks/day.	Less Preferred: Potential for some temporary noise during short (4 to 6 week) construction period; no noise expected during operation. No odour expected during normal operation but some potential for odour should there be upset conditions as some leachate remains on-site.	Least Preferred: Significant on-site construction (approximately 6 to 9 months) could result in temporary noise; no noise expected during operation. No odour expected during normal operating conditions but there is potential to generate odours under upset conditions as all leachate will remain on-site.	No construction; no significant noise or odour during operation. No trucking involved for normal operation. Seven (7) trucks/day on average would be required to truck leachate if needed for contingency.

Environment	Alternative 1	Alternative 2	Alternative 3	Do Nothing
		There will be minimal trucking for facility construction or operation and up to two (2) trucks/day for operation for chemical delivery and residue removal. Seven (7) to 14 trucks/day on average would be required to truck leachate if needed for contingency which is not considered significant in the context of the 200 waste trucks/day.	Expected trucking includes approximately five (5) to ten (10) construction trucks/day over a 6 to 9 month period and two (2) to five (5) trucks/day during operation for chemical delivery and residue removal. Seven (7) to 14 trucks/day on averagewould be required to truck leachate if needed for contingency which is not considered significant in the context of the 200 waste trucks/day, however more likely to occur on a regular basis than Alternatives 1 or 2.	
Socio-Economic Environment - Economic Ranking	Preferred – Leachate pumping activity is well separated from the existing businesses and would have no impact on their activities. There is no cost to implement. Annual energy costs are currently about $9,600 per year to pump the leachate to the BWTL and treat it there which would increase to $29,000 at the end of the expansion period.	Less Preferred – Leachate treatment activity is well separated from the existing businesses and would have no impact on their activities. Significant construction cost of $5 million and annual O & M of $450,000.	Least Preferred – Leachate treatment activity is well separated from the existing businesses and would have no impact on their activities. Very significant construction cost of $20 to 25 million; and O & M costs of $1.25 million per year,requires a full time operations staff compliment.	Leachate treatment activity is well separated from the existing businesses and does not have an impact on their activities. Waste Connections currently pays the Municipality of Chatham-Kent for treatment of the leachate and would continue to do so following closure in 2021.
Cultural Environment – Archaeology Ranking	Equally Preferred – Alternative 1 involves no construction or disturbance to land and has no archaeological impact.	Equally Preferred – Alternative 2 would be constructed in an area that has been cleared of archaeological potential.	Equally Preferred – Alternative 3 would be constructed in an area that has been cleared of archaeological potential.	No construction or disturbance to land and has no archaeological impact.
Built Environment Ranking	Preferred – No trucking for facility construction or operation. Seven (7) to14 trucks/day on average would be required to truck leachate if needed for contingency which is not considered significant in the context of the 200 waste trucks/day. This alternative represents a continuation of existing operation and is considered straightforward to operate.	Less Preferred – Some additional traffic associated with facility construction (Two (2) trucks/day for 4 to 6 weeks). Requires some delivery of treatment chemicals and some disposal of treatment waste (up to two (2) trucks/day). Seven (7) to 14 trucks/day on average would be required to truck leachate if needed for contingency which is not considered significant in the context of the 200 waste trucks/day. This alternative involves a new process step at the landfill and is more complex than the current leachate management.	Least Preferred – Additional traffic associated with facility construction (Two (2) trucks per day for 4 to 6 weeks). Requires some delivery of treatment chemicals and some disposal of treatment waste (up to two (2) trucks/day). 7 to 14 trucks/day on avarage would be required to truck leachate if needed for contingency which is not considered significant in the context of the 200 waste trucks per day. Full treatment on-site is the most complex requiring a full compliment of trained staff. 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.	Facility is in place and there is no trucking for facility construction or operation. Seven (7) trucks/day would be required to truck leachate if needed for contingency. This alternative represents a continuation of existing operation and is considered straightforward to operate.
Overall Leachate Ranking	**Preferred Leachate Treatment Alternative**			

4.4 Alternative 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 for site development, landfill gas management and leachate treatment to ensure that the evaluation results were still valid. It is confirmed that the minor changes identified while refining the design of the preferred alternative (**Section 5.0**) did not change the outcome of any of the evaluations in this section of the EA.

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