GUIDING SOLUTIONS IN THE NATURAL ENVIRONMENT

FINAL DRAFT

Southwestern Landfill Environmental Assessment

Ecological Assessment Report

Prepared For:

Walker Environmental Group

Prepared By:

Beacon Environmental Limited

Date:	*Project:*
January, 2020	**217238**

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Part 1

Southwestern Landfill Environmental Assessment Aquatic and Terrestrial Ecology Baseline Conditions Report

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NATURAL ENVIRONMENT

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1. Introduction

The Walker Environmental Group (WEG or "Walker") is preparing an Individual Environmental Assessment (EA) for the provision of future waste landfill capacity at the Carmeuse Lime (Canada) site in Oxford County for solid, non-hazardous waste generated in the Province of Ontario. **Figure 1** shows the proposed site location.

As part of the EA, Beacon Environmental Limited (Beacon) prepared the *Southwestern Landfill Proposal Environmental Assessment Ecological Assessment Work Plan* (Beacon 2017). This document was prepared in accordance with the *Approved Amended Terms of Reference* (Walker 2016), which has been approved by the Minister of the Environment.

The objectives of the study, which are provided within Section 8.2 of the *Approved Amended Terms of Reference* are as follows:

(a) Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
(b) Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria described in Appendix A of the Work Plan (Beacon 2017);
(c) Carry out an evaluation of any additional impact management actions that may be necessary to prevent, change or mitigate any (negative) environmental effects;
(d) Prepare a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following the application of mitigation measures; and
(e) Prepare monitoring, contingency and impact management plans to remedy the environmental effects of the proposed undertaking.

The purpose of this report is to describe the baseline conditions of the aquatic and terrestrial environments within the prescribed study areas, which will generally satisfy objective (a), as described above. This information will then be used to satisfy the remaining objectives described above.

1.1 Study Areas

Three general study areas were defined within the Southwestern Landfill Proposal Environmental Assessment Ecological Assessment Work Plan (Beacon 2016). They included: "On-Site & Site Vicinity", "Haul Routes" and the "Wider Area".

On-Site includes the proposed waste disposal facility and leachate treatment area, the storm water management outfall plus the associated prescribed buffer zones. Site Vicinity is the area immediately adjacent to the proposed waste disposal facility property that could be directly affected by the on-site activities. Its area is variable to encompass the actual extent of the effects and consists of neighbouring properties and/or communities, where required.

The Haul Routes include the primary route along which waste disposal facility truck traffic will move between major provincial highways and the waste disposal facility site entrance, plus the properties directly adjacent to these roads.

The Wider Area is the area beyond the Site Vicinity. This area will vary depending on the criterion to which it is being applied. It may include neighbourhoods, local municipalities, Oxford County, or the Province. This study area can also be used for some of the general or indirect effects of a landfill that do not result from specific physical activities on the site.

The study areas utilized for the purposes of the environmental assessment and the criteria to be measured through the EA process are described below and shown in **Figure 2**.

On-Site and in the Site Vicinity	Loss or disturbance to aquatic ecosystems Loss or disturbance to terrestrial ecosystems (within 120 m) Disease transmission via insects or vermin Aviation impacts due to gull interference (within 500 m)
Along the Haul Routes	Loss or disturbance to aquatic ecosystems Loss or disturbance to terrestrial ecosystems (either side of the route within 50 m, to the first public road)
Wider Area	Loss or disturbance to aquatic ecosystems Loss or disturbance to terrestrial ecosystems (within 1 km) Aviation impacts due to gull interference (within 20 km and 16-60 km).

The rationale for the selection of these study areas is provided in **Table 1**.

Table 1. Primary Criteria and Associated Study Area

EA Criteria	Associated Study Areas	Rationale
Loss or disturbance to aquatic ecosystems	• On Site and Vicinity • Haul Routes • Wider Area – Thames River and downstream receivers within a to-be-determined proximity downstream of the landfill	• Ecological effects more likely in the immediate vicinity of the project • Construction of haul route crossings may reduce the area of fish habitat and may cause sediment input into watercourses which would compromise habitat quality. Also, salt and sediment input during operation from increased use could impact habitat quality and have effects on aquatic species • The proximity of the proposed landfill to the Thames River may create far-reaching impacts downstream • Includes operational aspects such as fish and wildlife management
Loss or disturbance to	• On Site and Vicinity – within 120 m of the study area	• This will capture the direct effects zone for terrestrial receivers

Site Location	Figure 1

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Environmental Assessment

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Checked by: BH

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Legend

- Site
- Haul Routes (50m)
- Site Vicinity (120m)
- Wider Area (500m)
- Wider Area (1000m)

Study Areas | **Figure 2**

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EA Criteria	Associated Study Areas	Rationale
terrestrial ecosystems	• Haul Routes – within 50 m of the route to the first public road • Wider Area – for connectivity and context, within 1 km of the site	• The haul route (portions on Carmeuse Property) may include natural or semi-natural areas, direct effects can be anticipated within approximately 50 m • Connectivity across the landscape requires a broader context, using existing information and site visits the general natural heritage system will be described within this range to allow the landscape context to be developed, as well as to assess potential effects on connectivity associated with increased traffic
Disease transmission *via* insects or vermin	• On site and Vicinity – the actual waste disposal area is the potential source, the potential receptors are the nearby residential communities and farmland	• Primarily a potential on-site issue, would be adjusted if investigations indicate otherwise
Aviation impacts due to gull interference	• On site and Vicinity - the site and areas within 500 m • Wider Area. All areas within a 20 km radius of the proposed site as the site is located within the air traffic movement patterns of two airports. • Wider Area. A Secondary Study Area, to include the London International Airports, will include lands located 16 to 60-km distant from the airport	• Characteristics and features of the immediate environment are important to how birds might use the site • The proposed landfill site is located in proximity to the Woodstock Airport which is located approximately 6 km to the northeast and the Tillsonburg Regional Airport which is located approximately 18 km to the southwest • This represents an area where birds' movements to and from attractants could result in birds moving through airspace frequented by aircraft after feeding or loafing

1.2 Study Objectives

1.2.1 Aquatic Resources

The objective of the aquatic ecosystem studies is to determine the potential for effects on aquatic species, water resources or aquatic habitats through direct or indirect impacts. The loss or disturbance of aquatic ecosystems was identified as one of the primary environmental assessment criteria and as one of the primary concerns identified through public consultation.

The approach to evaluate/assess aquatic resources for this study followed the information provided within the Southwestern Landfill Proposal Environmental Assessment Ecological Assessment Work Plan (Beacon 2016).

Tasks that were completed as part of the aquatic field program included:

- Aquatic habitat assessments;
- Fish community surveys;
- Benthic invertebrate community surveys; and
- Freshwater mussel community surveys.

The aquatic program, including background review and fieldwork, was completed according to the workplan prepared by Beacon in 2017 and approved by Walker following extensive consultation with government agencies, Aboriginal communities and interested members of the public. One minor change was implemented due to safety concerns. The high-water levels in the South Thames River during the spring of 2018 precluded any aquatic field work at locations 1 and 3 for safety and practical reasons. Both locations on the South Thames River were sampled in the summer of 2018 during baseflow conditions.

Two additional monitoring sites were added to the aquatic program in 2019 following an updated conceptual design of the stormwater management ponds.

1.2.2 Terrestrial Resources

The approach to evaluate/assess terrestrial resources for this study followed the information provided within the Southwestern Landfill Proposal Environmental Assessment Ecological Assessment Work Plan (Beacon 2016).

Tasks that were completed as part of the terrestrial field program included:

- Ecological Land Classification (ELC) and floral surveys;
- Breeding bird surveys;
- Amphibian surveys;
- Dragonfly, damselfly and butterfly surveys;
- Winter wildlife use surveys;
- Incidental wildlife observations; and
- Landscape connectivity assessment.

Qualitative surveys for species-at-risk and rare species, which were informed by correspondence with the MNRF, were also completed as part of this program. Generally, these surveys were completed as part of other surveys. These included monitoring for the endangered Spiny Softshell Turtle (*Apalone spinifera*) and the threatened Blanding's Turtle (*Emydoidea blandingii*) and the assessment and testing of 19 putative Butternut trees (*Juglans cinerea*).

Aviation impacts due to gull interference will be addressed as part of the Bird Hazard Assessment that is being completed by Beacon in a separate report. No data collection was proposed to address disease transmission *via* insects or vermin.

Details of the various surveys for the terrestrial field programs are described below in **Section 3.2**.

2. Background Data Collection

A comprehensive background review was undertaken to gather existing natural heritage information regarding the three study areas. This review included at least the following documents and sources for background data:

- County of Oxford. 2016. Oxford Natural Heritage Study;
- Ingersoll and District Nature Club;
- Oxford Trail Committee;
- Ministry of Natural Resources Fish Dot Mapping;
- Ministry of Natural Resources Natural Heritage Information Centre;
- Upper Thames River Conservation Authority. 2007. Woodstock Natural Heritage Inventory;
- Aquatic Species at Risk in the Thames River Watershed (Cudmore *et* al. 2004);
- The Thames River Watershed Synthesis Report (Taylor *et* al. 2004);
- Fisheries and Oceans Canada Species at Risk (SAR) Mapping;
- Transport Canada Airport Bird Strike Data;
- Christmas Bird Count data;
- Ontario Breeding Bird Atlas Data (and other atlas data as available);
- Upper Thames River Conservation Authority natural heritage data;
- Knowledgeable local naturalists;
- Ministry of Natural Resources District Office; and
- Official Plan policies and mapping related to natural features.

For the Wider Area, background data collection included a detailed review of secondary sources of the Thames River and downstream receivers downstream of the landfill.

Ecological information that was gathered through the consultation process with Indigenous groups and others through other aspects of the EA was also utilized.

Airport Wildlife Management Plans were requested from the airports that were included as part of the Bird Hazard study. They were not available for review.

Key correspondence received from any agencies is attached as **Appendix A**.

2.1 Aquatic Background Review Results

A summary of the background information collected for the aquatic environment is provided below.

2.1.1 Fish Community

Fish community sampling results were received from agencies for five (5) locations in the 1000 m Site Study Area and five (5) locations within 5 km of the Site Study Area. These studies were completed between 1974 and 2015 (**Appendix A**).

Records were received for 12 fish species identified in **Table 11**, which is located in Section 4.2.2.

All recorded species are common and widespread in Southern Ontario except Brown Trout which is less common as spawning is limited to groundwater fed streams. The Brown Trout is native to Europe and was one of the first species introduced into Ontario in the 1800s (Holm *et al.* 2009).

2.1.2 Benthic Invertebrate Community

Benthic monitoring survey data were received for two (2) locations in the 1000 m Study Area and five (5) locations within 5 km of the Wider Area (**Appendix A**). Benthic samples were obtained by the Upper Thames River Conservation Authority (UTRCA) between 1997 and 2016 using a Rapid Bioassessment Protocol developed by the United States Environmental Protection Agency. UTRCA calculated the Hilsenhoff family biotic index for each sampling event. Hilsenhoff family biotic index is a value assigned to benthic invertebrate taxa indicating water quality and degree of organic pollution based on the sensitivity of the species captured. The scale ranges from zero (0) to ten (10). Low numbers indicate pollution sensitivity of the taxa and resulting in high water quality/low level of organic pollution. High numbers indicate tolerance, poor water quality/high level of organic pollution.

Records received for the study area include:

- Patterson and Robbins drain (at Road 67): This location was last sampled in 2003 at which time the Hilsenhoff family biotic index was rated the same as the locations on Foldens Creek, which were 'fairly poor' water quality and 'substantial organic pollution likely' (UTRCA Benthic location 1 on **Figure 3**);
- Foldens Creek west of Mill Line (downstream of Centreville Pond): This location was last sampled in 2016 at which time the Hilsenhoff family biotic index was also 'fairly poor' water quality and 'substantial organic pollution likely' (UTRCA Benthic location 2 on **Figure 3**); and
- Foldens Creek at Karn Road (upstream of Centreville Pond): This location was last sampled in 2016 at which time the Hilsenhoff family biotic index indicated 'fairly poor' water quality and 'substantial organic pollution likely' (UTRCA Benthic location 3 on **Figure 3**).

2.1.3 Freshwater Mussels

Aquatic Species at Risk mapping produced by the Department of Fisheries and Oceans (DFO) and accessed through the DFO website shows that the following two mussel species may be present within the South Thames River 1000 m Wider Area.

- Round Pigtoe (*Pleurobema sintoxia*) – endangered; and
- Rainbow (*Villosa iris*) – endangered.

DFO was contacted through email and confirmation was received that no records of freshwater mussel species at risk within the 1,000 m Site Study Area exist (**Appendix A**). Records received from MNRF and UTRCA also did not include any records of freshwater mussel species at risk.

Aquatic Sampling Locations

Figure 3

Southwestern Landfill
Environmental Assessment

Legend

- Site
- Site Vicinity (120m)
- Haul Routes (50m)
- Wider Area (500m)
- Wider Area (1000m)
- Aquatic Sampling Sites
- UTRCA Historic Benthic Sampling Sites

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2.2 Terrestrial Background Review Results

A background review of known terrestrial data for the Site, its Vicinity and the Wider Area was completed. A summary of the findings is included in **Table 2**. Information collected from background resources covers a broader range than the Wider Area; therefore, it is important to note, the presence of a record within the table below does not necessarily indicate that the record occurred within the Site, its Vicinity or the Wider Area.

Table 2. Background Review – Terrestrial Results

Species at Risk			Potential Significant Wildlife Habitat	Significant Natural Areas
Endangered	**Threatened**	**Special Concern**		
• Spiny Softshell [1,2] • Butternut [1,2] • American Badger [1,2] • Endangered Bat sp. [1] • Loggerhead Shrike [3] • Rapids Clubtail [2]	• Barn Swallow [1,2,4] • Bank Swallow [1,4] • Bobolink [1,2,4] • Eastern Meadowlark [1,4] • Eastern Hognose Snake [3] • Blanding's Turtle [2]	• Common Nighthawk [4] • Red-headed Woodpecker [4] • Eastern Wood-Pewee [2,4] • Canada Warbler [2,4] • Peregrine Falcon [1] • Snapping Turtle [1,2,5] • Northern Map Turtle [1] • Monarch [6] • Wood Thrush [2] • Broad Beech Fern [2]	• Heron Colony [9] Species of Conservation Concern: • Purple Martin [4] • Bald Eagle [7] • Rough-legged Hawk [7] • Ram's Head Lady's Slipper [3]	• Thames River [9] • Significant Valleylands [8]

1 - Ministry of Natural Resources and Forestry
2 - Upper Thames River Conservation Authority 2017, Ingersoll Watershed Report Card
3 - Upper Thames River Conservation Authority 2007, Woodstock Natural Heritage Inventory
4 - Ontario Breeding Bird Atlas
5 - OHA – Ontario Herpetofauna Atlas
6 - Ontario Butterfly Atlas
7 - Woodstock Christmas Bird Count
8 - County of Oxford
9 - Natural Heritage Information Center

2.2.1 Oxford County Official Plan

Schedule C-1 of the Oxford County Official Plan identifies the area adjacent the Patterson & Robbins Drain from the South Thames River to Road 64 as 'Significant Valleylands'. Section 3.2.4.2.4 of the Official Plan states that Significant Valleylands are represented by the outer limits of the following features:

- The lands associated with a Regulatory Flood Plain, or a Floodway and Flood Fringe in the case of a Two Zone Flood Plain; or
- A Fill Zone established by a Conservation Authority with jurisdiction, except in the case of the Upper Thames River Conservation Authority, where erosion hazard lands are used to represent significant valleylands.

It also states that these features, as shown on Schedule C-1 of the Official Plan, may not be a reliable indicator of significant valleylands and that the presence of significant valleylands in a development proposal will be confirmed by the Conservation Authority during the development review process.

2.2.2 Oxford Natural Heritage System Study

The ONHSS (UTRCA 2016) evaluates existing ecologically important terrestrial resources within Oxford County using the scientific method and information provided within the Natural Heritage Reference Manual (NHRM) (MNR 2010), Geographic Information System (GIS) modelling and 2010 aerial photography. Within the appendices of the ONHSS mapping of the various criterion that were used to evaluate vegetation communities and groups.

Appendix I-1. Criterion 1 Map, Significant Valleylands does not identify the area adjacent to the Patterson & Robbins Drain as a significant valleyland. The criteria used to identify significant valleylands were taken from the NHRM and are identified within Section 3.3.1 of the ONHSS.

Appendix I-1-1. Criterion 1 Map, Vegetation Group within or touching a Significant Valleylands identifies the woodlands west of the Site as a vegetation group that is not touching a Significant Valley. Vegetation communities, which are used to identify vegetation groups are defined within Section 2.3 of the ONHSS. These communities are assigned to Vegetation Groups, which include:

1) Wetland (contains woodland, thicket and meadow);
2) Woodland;
3) Thicket;
4) Meadow;
5) Water Feature;
6) Connected Vegetation Features; and
7) Watercourse Bluff and Depositional Areas.

These Groups are comprised of a mosaic of one or more Vegetation Communities within 20 m of each other.

Appendix I-3. Criterion 3 Map, Vegetation Groups within 30 m of an open watercourse identifies a vegetation group that is within 30 m of a watercourse north of the Site within the Haul Route Study area. It also identified the woodlands west of the Site and a vegetation group within the Site as a group that is not within 30 m of an open watercourse. A review of more recent aerial imagery shows that the vegetation group located on the Site has since been removed in accordance with the approved licence and site plan for the aggregate extraction operation.

Appendix I-5. Criterion 5 Map, Woodland Size ≥ 4 ha identifies woodlands that are greater than 4 ha in size. The NHRM recommends that woodlots of 4 ha or more should be considered significant in landscapes with about 5-15% woodland cover. The ONHSS indicates that there is 13.18% woodland cover within Oxford County based on 2010 aerial photography (UTRCA 2016). Woodlands identified in Appendix I-5 as satisfying these criteria include:

- The woodlands located on the property to the west of the Site;
- Both woodlands located adjacent to the Haul Route; and

- A woodland along the southern edge of the Site.

Appendix I-6. Criterion 6 Map, Woodland Proximity shows that all of the woodlands identified in Appendix I-5 are not located within 100 m of another woodland that is greater than 4 ha in area.

Appendix I-7. Criterion 7 Map, Thicket Size ≥ 2 ha identifies a thicket on the Site. A review of more recent aerial imagery shows that the group located on the Site has since been removed in accordance with the approved licence and site plan for the aggregate extraction operation.

Appendix I-10. Criterion 10 Map, Patches that meet a Group Criteria identifies patches within the Site, Site Vicinity and Haul Route that have been identified using the criteria described in the appendices that have been discussed above. These criteria were utilized by the ONHSS to measure the unique aspects of ecological services that natural features can provide. Through the ONHSS, any group or patch that meets at least one criterion is considered "ecologically important" in Oxford County.

Appendix I-11. Criterion 11 Map, Diversity identifies the woodlands west of the Site, and the woodlands along the proposed Haul Route as Patches that Meets Diversity Criteria. It also identifies a patch on the Site as a Patch that does not meet diversity criteria. A review of more recent aerial imagery shows that the group located on the Site has since been removed in accordance with the approved licence and site plan for the aggregate extraction operation.

Appendix I-12. Criterion 12 Map, Patch Proximity identifies that none of the features identified within the Site, Site Vicinity, Haul Route or Wider study areas as Patches that meet the proximity criteria.

Appendix J-2. Map showing Woodlands that contain Woodland Interior identifies the woodlands west of the Site as a Woodland that has Interior habitat.

3. Field Assessment Methodology

3.1 Aquatic Resources

In total, ten study locations were selected within pre-determined study areas. The 1000 m and 500 m study areas fall into the Wider study area for the project, as shown on **Figure 3**. The 120 m and 50 m Study Areas are contained within the Site Vicinity. The aquatic systems in which the study locations are located in is as follows:

- Two locations in the South Thames River;
- One location in Foldens Creek;
- Six locations in Patterson and Robbins drain/ Caddy drain; and
- One location in the Former West Quarry.

Coordinates for the locations are included in **Appendix B**. A record of representative photographs for each location was prepared and is included in **Appendix C**.

Locations 1 and 3 are both located within the Wider study area in the South Thames River. Location 1 is immediately upstream of the bridge at Foldens Line. Location 3 is upstream of the bridge at Pemberton Street. These locations have comparable aquatic habitat characteristics (i.e., channel width, wetted depth and bank angle, canopy cover).

Location 2 is on a tributary of the South Thames River called Foldens Creek. This reference location is approximately 650 m upstream of the confluence of Foldens Creek and the South Thames River. It is approximately 200 m upstream of Centreville Pond, which is an on-line pond that was constructed in the Centreville Conservation Area. The dam at the Centreville Pond and the culvert under Beachville Road are barriers to fish passage. As such, fish in the South Thames River are unable to migrate into Foldens Creek.

Locations 4 and 5 are on a tributary of the South Thames River called the Patterson and Robbins drain. Locations 6 and 7 are on the Caddy drain, which is an upstream branch of the Patterson and Robbins Drain. The confluence of the Patterson and Robbins Drain and the South Thames River has a steep gradient channel which constitutes a barrier to upstream fish migration. Fish in the South Thames River are unable to migrate into this tributary.

Location 4 is approximately 800 m upstream from the confluence of the Patterson and Robbins drain and the South Thames River. It is an exposure location that is within the 1,000 m Study Area limit. At location 4 the channel has a natural meandering course which appears to be relatively undisturbed by anthropogenic influences.

Location 5 is approximately 1 km upstream of location 4. It is also an exposure location and is located at the outer edge of the Site Vicinity study area. At location 5 the channel has been straightened and the banks are uniform as a result of drain maintenance activities.

Location 6 is on the Caddy Drain, approximately 1 km upstream of location 5. This is an exposure location and is located within the 50 m Haul Road study area. The channel at this location has also been straightened and the banks are uniform as a result of drain maintenance activities.

Location 7 is approximately 1 km upstream of location 6. This reference location is outside of the 1000 m Study Area and the 50 m Haul Road Study Area.

Location 8 is the former West Quarry, which is located on the Carmeuse property to the south of the Site study area (**Figure 4**). The former West Quarry was not originally included in the sampling program as interactions between this location and the proposed landfill were not anticipated. However, potential impacts on this feature were raised as a concern by the Community Liaison Committee. Therefore, in order to address these concerns, it was added to the monitoring program.

Location 9 is approximately 300 m upstream of location 5. It is located within the Site Vicinity study area as identified on **Figure 3**. Similar to location 5 this portion of channel has been straightened to accommodate agricultural land use and roads. The banks are uniform as a result of drain maintenance activities. This location was assessed in 2019 following an updated conceptual design of the stormwater management ponds (North Pond).

Location 10 is approximately 400 m downstream of location 4. It is located within the Wider study area as identified on **Figure 3**. As with the other aquatic monitoring locations along the Patterson and

Quarry Lake (Site 8) Aquatic Habitat Assessment

Figure 4

Southwestern Landfill
Environmental Assessment

Legend

- Site
- Site Vicinity (120m)
- Wider Area (500m)
- Wider Area (1000m)
- Littoral Areas
- Water Quality Monitoring Locations

Ontario Hydro Network Watercourse (MNRF LIO 2018)

- Permanent Watercourse

Watercourses (Beacon 2018)

- Permanent

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Robbins Drain the channel has been historically modified to accommodate the former West Quarry immediately to the east. This location was sampled in 2019 following an updated conceptual design of the stormwater management ponds (South Pond).

The methods applied to study the aquatic habitat, fish populations, benthic invertebrate populations and freshwater mussel populations are described below.

3.1.1 Aquatic Habitat

Aquatic Habitat assessments were completed on the dates shown in **Table 3**. This table also shows the air temperature (daily maximum), water temperature, and precipitation during the 24 hours prior to the field work.

Table 3. Aquatic Habitat Sampling Dates and Weather Conditions

Location	Name	Date	Daily Maximum Air Temperature (°C)	Precipitation (mm)	Precipitation/ Past 24 hours (mm)
1	South Thames River	Aug 14 (2018)	23	None	None
2	Foldens Creek	May 8 Sep 18 (2018)	25 26	None None	None None
3	South Thames River	Aug 15 (2018)	18	None	Trace
4	Patterson and Robbins drain	May 10 Sep 19 (2018)	25 23	None None	None None
5	Patterson and Robbins drain	May 11 Sep 19 (2018)	9 23	Trace None	None None
6	Patterson and Robbins drain	May 10 Sep 20 (2018)	25 21	None None	None None
7	Caddy drain	May 9 Oct 3(2018)	30 22	None None	7.7 None
8	Former West Quarry	Oct 4 (2018)	22	<1	None
9	Patterson and Robbins drain	June 19 (2019)	26	None	None
10	Patterson and Robbins drain	June 19 (2019)	26	None	None

3.1.1.1 South Thames River and Tributaries

A representative reach of 40 m was selected at each location. Upstream and downstream waypoints were recorded using a handheld global positioning system (GPS). A modified methodology of the

Ontario Stream Assessment Protocol (OSAP) was used to characterize the aquatic habitat. Water quality measurements were taken using a handheld multi parameter water quality probe (YSI). The following parameters were recorded:

- Water temperature (°C);
- Conductivity (µs/cm);
- Conductance (mS/cm);
- Total dissolved solids (g/l);
- pH;
- Dissolved oxygen (DO%);
- Dissolved oxygen (mg/l); and
- Oxidation reduction potential (ORP).

Measurements were taken along five transects evenly distributed over the length of the reach. The following habitat characteristics were recorded at each transect:

- Bank full width (cm);
- Wetted width (m);
- Bank full depth maximum (cm);
- Water depth maximum (cm);
- Dominant substrate;
- Dominant morphology;
- Velocity (m/s) derived from hydraulic head (mm);
- Left bank angle (degrees);
- Right bank angle (degrees);
- Low canopy closure (%); and
- High canopy closure (%).

Representative photos of the bank and along the centre of the channel were taken and are included in **Appendix C**.

3.1.1.2 Former West Quarry

The former West Quarry was surveyed from a boat and focused on the perimeter of the former West Quarry to identify areas that may provide high quality habitat for fish such as shoals, beaches, macrophyte beds and submerged trees. Water depths were recorded at each water sampling station using a portable sonar unit. Water quality measurements were taken at the five monitoring locations in the former West Quarry using a handheld multi-parameter water quality probe at a depth of 1.8 m below the water surface.

Representative photographs of the former West Quarry are included in **Appendix C**.

3.1.2 Fish Community and Population Assessment

Fish community sampling was completed in the spring and fall at five locations on the tributaries. Two locations on the South Thames River were sampled in the summer. The workplan originally included sampling these locations twice however, due to water levels in the spring field staff were unable to safely access the river until the time of the second sampling. Because of restrictions noted below, the former West Quarry was sampled in the fall using hoop nets and minnow traps only. Other methods of sampling the former West Quarry (i.e. gill nets) were not permitted by the MNRF Wildlife Animal Care Committee (WACC) due to potential harm to wildlife (i.e. turtles and birds). Due to the overall size and depth of the former West Quarry, electrofishing was determined to be an unsuitable method of community sampling as the electrical current generated by the electrofishing equipment extends only to a depth of approximately 2 m, which is insufficient to capture fish within a waterbody of this size.

3.1.2.1 South Thames River

Fish community sampling at locations 1 and 3 was completed as follows. Study reaches were identified, flagged, and GPS coordinates were taken from the upstream and downstream limits. Study reaches were selected to meet the following criteria:

- Minimum length of 40 metres (m);
- Include all different types of morphology within the area (i.e. riffle, run, pool); and
- Limit the occurrence of water deeper than waist height as the electrofisher cannot effectively sample these areas.

Exploratory electrofishing was used to sample representative habitat at these sites. Study reach selection was based on the criteria detailed above and two high-intensity exploratory passes were conducted. All captured fish were processed and catalogued. Fish captured during the first round of electrofishing were kept in large shaded totes with oxygen bubblers in order to ensure they were not captured multiple times.

3.1.2.2 Tributaries

Fish community sampling at locations 2, 4, 5, 6, and 7 was completed as follows. Study reaches were identified, flagged, and GPS coordinates were then taken from the upstream and downstream crossings. Study reaches were selected to meet the following criteria:

- Minimum length of 40 m; and
- *Where applicable*, begin and end at a crossover (not always possible due to the channelization of many tributaries).

The fish community survey was completed by employing the ‘Multiple Pass Survey’ as outlined in the Ontario Stream Assessment Protocol (OSAP 2013). Block nets were used to contain all fish within the selected reach and a minimum of two passes were completed with the backpack electrofisher. Care was taken to ensure a similar level of effort was exerted for each survey pass. The number of fish captured was tallied after each pass and released downstream of the block nets outside the study reach. A third pass was completed if the number of fish caught in the second pass exceed the number of fish caught in the first pass by more than 50%. Where sufficient numbers of fish were captured, the numbers caught during subsequent passes can be used to estimate the total number of fishes of a certain species in the study reach using the "catch depletion method" developed by Zippin (1958). The assumptions that underlie this approach include:

1. Emigration from and immigration to the site must be negligible. Block nets must be used to ensure this condition is met;
2. The probability of capture during a pass is the same for each fish. Applying appropriate sampling effort and sampling all habitats within a site. Attempt to capture all fish observed with equal intensity, regardless or species or size; and
3. The probability of capture remains constant between passes. Using the same effort and crew on each pass will ensure that this condition is met.

The first ten fish of each species captured were measured for length and weight between each pass (**Appendix E**). Any additional fish were recorded using a dot-tally. Photographic vouchers for each species were also collected and are included in **Appendix C**.

3.1.2.3 Former West Quarry

Two hoops nets and fifteen minnow traps were deployed for a total of 15 hours between October 3, 2018, and October 4, 2018.

Minnow traps were baited using dry dog food and secured to rocks and branches along the shoreline of the quarry between 0.5 m and 2m below the surface of the water.

The hoop nets were set on former access roads into the quarry, which are the only locations where there is a shallow gradient beneath the water surface. As per the conditions of the WACC permit (#1089369) issued by the MNRF, the nets were installed so that the top of the hoop net basket would stay above water to prevent turtle mortality. The hoop nets measured 81 cm in diameter, with a 2.7 m basket, 7.3 m lead and 6.1 m wings on either side.

3.1.3 Benthic Invertebrate Assessment

3.1.3.1 Field Methods

Seven benthic invertebrate sampling stations were established at the same monitoring stations utilized for the aquatic habitat and fish community surveys. This included two locations on the South Thames River, which were sampled on August 14 and 15, 2018, and five locations on the tributaries to the South Thames River, which were sampled between May 8 and May 11, 2018.

The kick and sweep method described in the Ontario Benthos Biomonitoring Network (OBBN) was utilized to complete the sampling. This involved the use of an aquatic kick net measuring 45.7 x 22.9 cm that is made of a nylon material with a 500 µm mesh size. The average water depth and water temperature at each sample location were also recorded and are summarized below in **Table 4**.

Table 4. Benthic Survey Effort Summary

Location	Date	Time (start-end)	Water Depth (m)	Water Temperature (°C)
1	August 15, 2018	09:05-09:25	0.2-0.4	21.23
2	May 8, 2018	13:00-13:30	0.2-0.4	7.1
3	August 14, 2018	11:00-11:20	0.2-0.4	22.5
4	May 10, 2018	13:55-14:25	0.2-0.4	12.9
5	May 11, 2018	11:45-12:10	0.2-0.3	9.5
6	May 10, 2018	08:50-09:10	0.2-0.3	11.7
7	May 9, 2018	10:40-11:00	0.2-0.4	11.6

Sediment collected during sampling was rinsed in a wash bucket with a 504 µm mesh screen and the benthic invertebrates were placed in one or two 1L plastic jars depending on the size of the sample. Samples were preserved with buffered formaldehyde (formalin) and submitted to William B. Morton of Guelph Ontario, for sorting and identification.

3.1.3.2 Laboratory Analysis

Each sample was processed for laboratory analysis following OBBN protocols. Before sorting, the samples were placed into a geological sieve with a 500 micron mesh to remove the field preservative then rinsed with tap water. Small amounts of sediment were then placed into sorting trays and the invertebrate specimens were removed with the assistance of 10x dissecting microscope. Extra sub-samples were processed until at least 100 organisms were removed. All the specimens in the last sub-sample were completely sorted. The blot dried wet weight of the sorted material versus that of the total samples was used to calculate the % sub-samples (sorted/total x 100 = %). The sorted sediments were discarded, and any unsorted material was returned to the original container and re-preserved with field preservatives.

Prior to identification, the specimens were sorted into similar groups then identified to the lowest practical level/species possible. Identified specimens were placed into labelled shell vials with neoprene stoppers and preserved with 75% ethanol. The results of the laboratory analysis are included in **Appendix F**.

3.1.3.3 Biotic Index Calculations

Data received from the laboratory were summarized using the following standard biotic indices.

Ephemeroptera, Plecoptera, and Trichoptera (EPT) Index

This EPT index estimates water quality by the relative abundance of three major orders of stream insects that have a low tolerance to water pollution i.e. Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). These three orders of invertebrates are very sensitive to many pollutants that may be present in aquatic environments. The EPT Index can be expressed as a percentage of the sensitive orders to the total taxa found. A large percentage of EPT taxa indicates high water quality and a low percentage of EPT taxa indicates low water quality.

Diversity

Diversity indices provide important information about the rarity and commonness of species in a community. The ability to quantify diversity in this way is an important tool for biologists trying to understand community structure. Two indices for diversity were applied: the Simpson’s Diversity Index (D) and the Shannon Diversity Index.

The Simpson's Diversity Index (D) is a measure of diversity which considers the number of species present, as well as the relative abundance of each species. As species richness and evenness increase, the diversity increases. The value of D ranges between zero and one, with one representing infinite diversity and zero representing no diversity.

The Shannon diversity index is another commonly used index for characterizing species diversity in a community. This index assumes a value between zero and one. Similar to above, one represents infinite diversity and zero represents no diversity.

The Hilsenhoff Biotic Index

The Hilsenhoff Biotic Index (HBI) estimates the overall tolerance of the community to organic pollutants in a sampled area, weighted by the relative abundance of each taxonomic group (e.g., family, genus). Organisms are assigned a tolerance number from zero to ten pertaining to that group's known sensitivity to organic pollutants with zero being the most sensitive and ten being the most tolerant.

3.1.4 Freshwater Mussel Survey

Qualitative surveys within the Study Areas were completed at the request of DFO (email dated March 23, 2018, from Amy Boyko), at the monitoring stations to determine if mussel Species at Risk were present. The methods used are described in the *Protocol for The Detection and Relocation of Freshwater Mussel Species at Risk in Ontario - Great Lakes Area* (Mackie *et al*. 2008).

These surveys consisted of thorough searches of the bottoms and shorelines of the watercourses at the survey stations for live mussels and dead shells for a period of 20 minutes. Two ecologists completed the surveys for stations located on the smaller tributaries. Three ecologists completed the surveys for stations on the South Thames River due to its size.

These surveys were completed in the summer and early fall when mussels are most likely to be detected and water and turbidity levels are typically at their lowest.

3.2 Terrestrial Resources

3.2.1 Vegetation Communities

The standard ELC protocol for southern Ontario (Lee *et al*. 1998) was undertaken for the EA. This protocol involves utilizing the most current orthogonally rectified aerial photographs of the Site, Site Vicinity and Haul Route study areas to approximate vegetation community polygons (discrete areas of similar, contiguous vegetation) through air photo interpretation. These communities were then ground-truthed *via* appropriately timed season surveys to confirm or amend the polygon boundaries. Three-season surveys in May, late June/early July and in September were utilized for the 2018 surveys and a single season survey was utilized for the 2019 surveys. A single season survey for the 2019 period was considered appropriate due to the anthropogenic nature of the areas being surveyed. Survey details and dates are included in **Table 5**. Surveys completed in 2018 focused on the Site, Site Vicinity and Haul Route study areas. Surveys completed in 2019 focused on the proposed Leachate Treatment area and southern Storm Water Management (SWM) outfall area. Ground-truthing involved visiting each of the distinct polygons to assess the vegetation community. ELC Community Description and Classification Data records were completed for each polygon.

Table 5. Vegetation Survey Details

Date	May 8, 2018	June 25, 2018	September 12, 2018	January 24, 2019	June 11, 2019	June 27, 2019
Time	08:00 - 17:00	08:00 - 17:00	08:30 - 14:30	09:00 – 13:00	06:00 – 10:00	06:00 – 09:30
Temperature (˚C)	10 - 22	16 – 25	16 – 24	minus 5	15 – 22	18 – 25
Wind Speed (Beaufort)	1 – 3	1 – 3	0 - 1	0 – 1	1	1
Cloud Cover (%)	<10	0	50 - 100	100%	0	80
Precipitation	None	None	None	Light Snow	None	None

The floral inventories were completed according to the ELC protocol (Lee *et al*. 1998) and communities were identified to vegetation type incorporating four layers of data (i.e., canopy, sub-canopy, shrub and herbaceous layers). Vegetation Types are recurring plant species assemblages that dominate a community based on relative cover. These are generally the species that make up the majority of the canopy cover (Lee *et al*. 1998).

Occasionally, polygons of similar vegetation included small areas of dissimilar form. The ELC system typically does not recognize areas less than 0.5 hectares (ha) in area, therefore, the majority of these areas that were less than 0.5 ha were designated as ‘inclusions’ within a larger vegetation community. The final community boundaries were transferred to GIS-based mapping.

A floral inventory of the Site, Site Vicinity and Haul Route study areas was completed in conjunction with this task. This involved roaming the area to record vascular plant species that are present on the property. The specific locations of plants that are rare in Oxford County, or provincially rare according to the MNRF’s Natural Heritage Information Centre (NHIC) were noted and geo-referenced using GPS.

3.2.2 Breeding Bird Surveys

Roaming breeding bird surveys were undertaken such that the Site, Site Vicinity and Haul Route study areas were surveyed on foot to within 50 m of all locations. The purpose of the surveys was to confirm what species of breeding birds are present in the area and if avian species at risk are present. The first round of surveys took place during late May/first week of June to better capture the temporal variation in breeding birds. Subsequent surveys were repeated at least five days after the first survey.

Breeding bird surveys (**Table 6**) commenced at least 20 minutes after the first light to minimize the effect of frenetic activity associated with the dawn. The surveys took place within acceptable weather and time parameters (Cadman *et al*. 2007). These are:

- No precipitation (except the lightest drizzle which stops shortly after dawn);
- Visibility greater than 200 m;
- Wind less than force five on the Beaufort scale (29 km/hr);
- Temperatures not deviating more than four degrees Celsius from the average for the time of day and date; and
- Counts finished by 10:45 a.m.

Surveys completed in 2018 focused on the Site, Site Vicinity and Haul Route study areas. Surveys completed in 2019 focused on the proposed Leachate Treatment area and southern SWM outfall area.

Table 6. Breeding Bird Survey Details

Date	**May 28, 2018**	**May 30, 2018**	**June 19, 2018**	**June 26, 2018**	**June 11, 2019**	**June 27, 2019**
	Survey 1		**Survey 2**		**Survey 1**	**Survey 2**
Start Time	05:30 - 10:00	06:00 - 08:00	06:00 - 09:00	05:30 - 09:30	06:00 – 10:00	06:00 – 09:30
Temperature (˚C)	20	20	16	11 - 18	15 – 22	18 – 25
Wind Speed (Beaufort)	0 – 2	2 – 3	0	1 - 2	1	1
Cloud Cover (%)	10 – 25	0	25	0 - 5	0	80
Precipitation	None	None	None	None	None	None

Birds were recorded on an orthophotograph in the approximate location that they were observed. All birds in suitable habitat and showing some propensity to breed (e.g., territorial behaviour) were assumed to be breeding.

Since American Woodcock only issue territorial calls to attract females in the evening, surveys for this species were completed during the amphibian breeding surveys using calling males as an index for the local population.

3.2.3 Breeding Amphibian Surveys

A total of 11 amphibian survey stations were established within the Site, Site Vicinity and Haul Route Study areas (**Figure 5**). These stations, which were identified through air photo interpretation and site reconnaissance, were placed near habitats that had potential breeding habitat for amphibians.

A total of three surveys were completed at each of these stations using the methodology provided within the *Marsh Monitoring Program Protocol* (Bird Studies Canada 2009). The timing windows prescribed within this protocol are as follows:

- First Survey: minimum night-time air temperatures of at least 5°C and the first or second warm spring shower;
- Second Survey: night-time air temperatures should be at least 10°C; and
- Third Survey: night-time air temperatures should be at least 17°C.

These conditions generally occur between late April and late June in any given year. However, this can be subject to change and can be influenced by a “late” winter or an “early” spring. Surveys are also completed a minimum of 15 days apart in order to include the short temporal peak for each of the species targeted through these surveys.

Weather conditions under which the surveys are to be completed are low winds, no higher than a 3 (12 – 19 km/h) on the Beaufort Scale, and little or no precipitation.

Survey details, including dates, times and weather conditions are summarized in **Table 7**.

Table 7. Amphibian Survey Details

Date	April 26, 2018	May 17, 2018	June 19, 2018
Start Time	21:02	21:09	21:33
Temperature (°C)	5 – 9	18 - 22	18 - 21
Wind Speed (Beaufort Scale)	2	1 - 2	0 - 1
Cloud Cover (%)	10	30	70 - 80
Precipitation	None	None	None/Drizzle

Calling amphibians, if present, were identified to species and calling activity was assigned a code from the following options, which indicate increasing abundance:

0 No calls;
1 Individuals of one species can be counted, calls not simultaneous;
2 Some calls of one species simultaneous, numbers can be reliably estimated; or
3 Full chorus, calls continuous and overlapping.

Using this code method, areas that support a Code 1 for a species indicate very low population numbers in the local area, and/or low-quality breeding habitat. Code 2 indicates a moderate population and/or lower quality breeding habitat. Code 3 for species indicates a healthy population and high-quality breeding habitat.

Species, calling locations and approximate numbers of calling individuals were recorded and mapped.

3.2.4 Basking Turtle Surveys

Correspondence with the MNRF revealed records for Spiny Softshell Turtle, Blanding's Turtle and Snapping Turtle (*Chelydra serpentina*) in the Site Vicinity or Wider study areas. Consequently, ten basking turtle surveys were completed as per the guidelines provided in the *Survey Protocol for Blanding's Turtle in Ontario* (MNRF 2015).

These surveys focused on watercourses and standing bodies of water in the Site Vicinity and Wider study areas. This included the agricultural drain located along the western edge of the Haul Route study area, wetland pockets north of the Site, the former West Quarry, and the Centreville Pond and Conservation Area (**Figure 6**). The surveys consisted of travelling slowly along the outer edge of these features while using binoculars to scan its perimeter and other potential basking sites within the waterbody.

The South Thames River was also identified as potentially suitable habitat for these species. Surveys of this feature were completed by floating down the river south of the Site, between 37th Line and Pemberton Street, in a canoe and scanning the shoreline, water surface and other potential basking sites for evidence of turtles.

Surveys were completed between 08:00 hrs and 17:00 hrs during sunny periods. When possible, surveys were completed when the air temperature was higher than the water temperature and after inclement weather. Details of these surveys, including weather conditions, are included in **Table 8.**

Table 8. Basking Turtle Survey Details

Date	Time	Temperature (˚C)	Wind speed (Beaufort)	Cloud Cover (%)	Precipitation
May 2, 2018	10:00 - 17:00	20 – 26	4 – 5	15-90	None
May 8, 2018	09:30 - 16:30	14 – 22	0 – 1	<10	None
May 16, 2018	09:15 - 15:15	16 – 22	1 – 2	20	None
May 17, 2018	10:00 - 16:00	24 – 26	1 – 3	<5	None
May 23, 2018	09:30 - 15:45	18	2 – 3	0	None
May 25, 2018	09:15 - 15:45	23 – 28	2 – 3	<5	None
May 29, 2018	08:30 - 12:30 13:00 - 14:45	21 – 28	1 – 3	5-20	None
May 30, 2018	09:15 - 15:00	22 – 30	2 – 3	<5 - 40	None
June 7, 2018	09:20 - 15:45	16 – 27	1 – 2	50	None
June 11, 2018	09:15 – 15:30	18 – 25	3 – 4	0	None

3.2.5 Odonate and Lepidoptera Surveys

Three surveys for lepidoptera (butterflies) and odonates (dragonflies and damselflies) were undertaken during the period from May to September. The roving surveys focused on the Site, Site Vicinity and

Legend

- Site
- Site Vicinity (120m)
- Haul Routes (50m)
- Wider Area (500m)
- Wider Area (1000m)
- Amphibian Survey Stations

Amphibian Call Survey Stations

Figure 5

Southwestern Landfill
Environmental Assessment

BEACON ENVIRONMENTAL

Project: 217238
Last Revised: January 2019

Client: Walker Environmental Group

Prepared by: RA
Checked by: BH

DRAFT

N

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0 200 400 m

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Legend

- Site
- Site Vicinity (120m)
- Haul Routes (50m)
- Wider Area (1000m)
- Wider Area (500m)
- Basking Turtle Survey Areas

Basking Turtle Survey Areas | **Figure 6**

Southwestern Landfill
Environmental Assessment

BEACON ENVIRONMENTAL

Project: 217238
Last Revised: January 2019

Client: Walker Environmental Group

Prepared by: RA
Checked by: BH

DRAFT

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Haul Route study areas. All unusual species were noted as to number and location. Weather conditions on the survey dates are summarized in **Table 9**.

Table 9. Amphibian Survey Details

Date	June 10, 2018	July 12, 2018	July 30, 2018
Temperature (°C)	21	25	25
Wind Speed (Beaufort)	2-3	1	1
Cloud Cover (%)	80	40	30
Precipitation	None	None	Hazy

3.2.6 Winter Wildlife, Mammal Surveys and Incidental Wildlife Observations

Winter habitat use was assessed based primarily on the availability of suitable winter wildlife habitat (using the ELC data) and on all sources of existing information. To support these data, a winter visit was made within 48 hours of a snowfall to document winter use of the Site, Site Vicinity and Haul Route study areas. The survey consisted primarily of tracking and habitat assessment. Stick nests of raptor species or herons were also noted at this time for follow-up in the field season. The site visit was conducted on February 12, 2018, from 10:30 to 16:00, with weather conditions described as -10°C, wind speed at a level 2 on the Beaufort Scale, no cloud cover and no precipitation. Transects completed as part of this survey are included on **Figure 7**.

A site visit specifically for mammals was conducted on October 18, 2018, from 9:15 to 14:30, with weather conditions described as 2 - 7°C, wind speed at levels 0-3 on the Beaufort Scale, 80% cloud cover and no precipitation.

Incidental observations made during other surveys were also documented and reported.

3.2.7 Crow Roost Surveys

Existing information was supplemented with field surveys that were conducted for the Site, Site Vicinity, Haul Route and Wider study areas from February 2018 through January 2019. Early morning monitoring of American Crow movements to the Salford Landfill site, located 8.2 km to the south-southeast of the proposed landfill site, was undertaken in March 2018 and January 2019. Evening surveys of crow movements for the Site and Site Vicinity study areas were conducted in October and November 2018. Night roost surveys in the City of Woodstock, located in the Wider study area, were undertaken in October, November and December 2018. The data collected during these surveys were also used to ascertain the risk of large numbers of crows using the proposed landfill and they assisted in Bird Hazard study.

3.2.8 Bat Exit Surveys

Potential roosting habitat for endangered bats was identified within an abandoned farmhouse and an old barn located within the proposed Leachate Treatment area. Surveys were completed in 2019 to determine if endangered bat species were utilizing this habitat using the methodology provided within the MNRF Guelph District *Use of Buildings and Isolated Trees by Species at Risk Bats: Survey Methodology* (2014). Conditions during the surveys is summarized in **Table 10**.

Table 10. Bat Exit Surveys Details

	Barn		Abandoned Farmhouse
Date	**June 10, 2019**	**June 11, 2019**	**June 25, 2019**
Time	20:31 – 22:01	20:53 – 22:06	20:36 – 22:06
Temperature (°C)	13 - 14	15 - 19	22 - 26
Wind Speed (Beaufort)	3	0	0
Cloud Cover (%)	100	50	5
Precipitation	None	None	None

The second survey of the abandoned farmhouse was not completed as it was demolished between the date of the first survey and June 25.

4. Existing Conditions Assessment

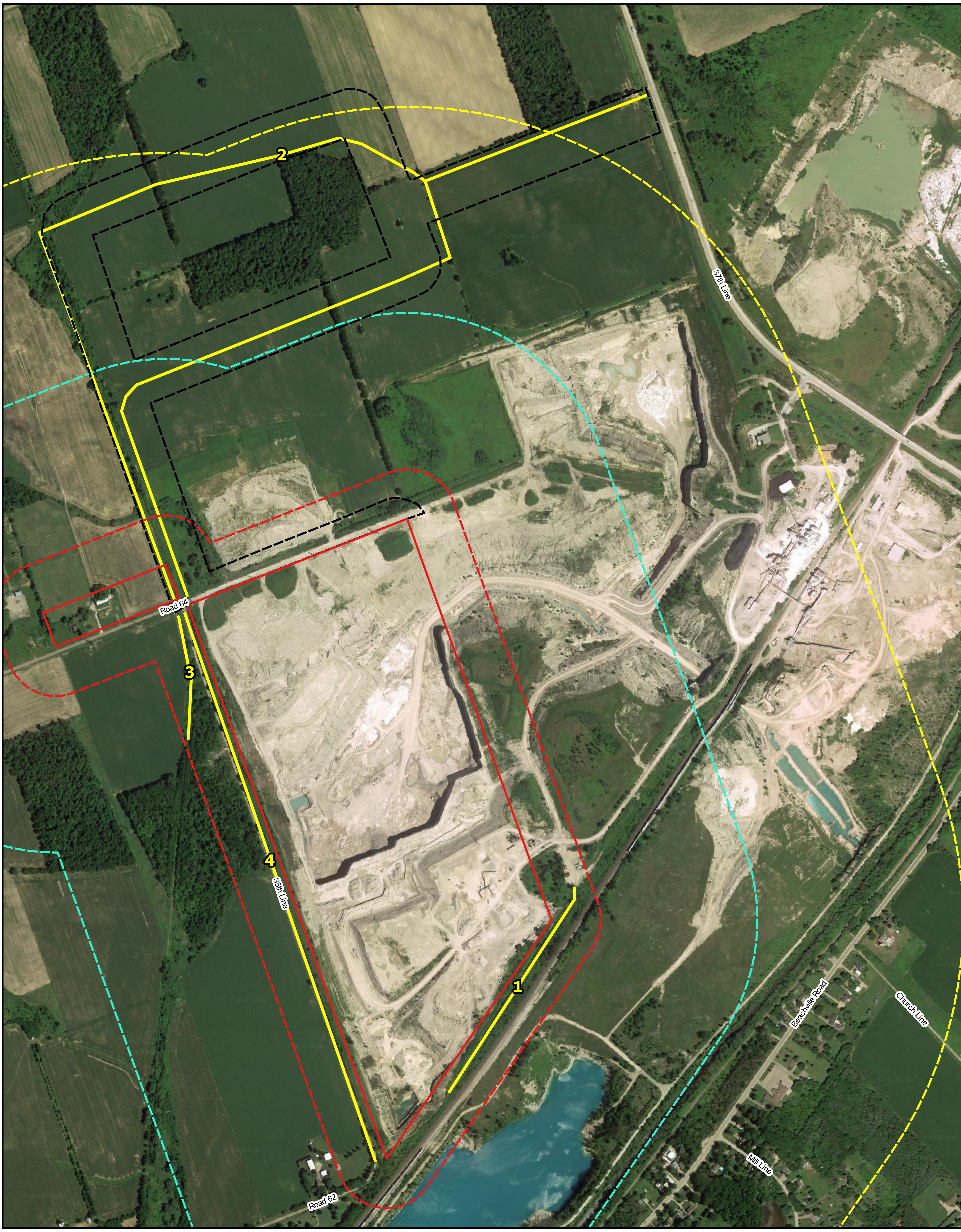
4.1 Overview of Study Area

The Site is located in the Upper Thames River subwatershed which is part of the Thames River watershed. The following description is from the 2017 Upper Thames River Watershed Report Card by the UTRCA (2017):

> *The Upper Thames River watershed is situated in a highly developed and highly agricultural part of southern Ontario. The water and forests in this region face on-going pressure from urban and rural land uses. Despite these pressures, the Thames remains one of the most biologically diverse rivers in Canada, and the upper Thames River watershed is home to 80 species of fish, 30 freshwater mussels species and many species-at-risk.*

A tributary of the Thames called the South Thames River traverses the Wider study area. The South Thames originates west of Tavistock and passes through Woodstock before connecting with the North Thames River at the Forks of the Thames in London. The reach of the South Thames River located to the south of the Site was constructed as a diversion channel based on the following excerpt taken from a report on the Thames River by the Thames River Background Study Research Team (1998):

> *The Ingersoll Diversion Channel, completed in 1949, was the first flood control project and one of the first channel improvements attempted by a conservation authority. The need for a diversion channel was evident when, in 1937, a section of the river was diverted to the south to allow quarrying to take place. This diversion was then extended downstream to increase the excavation area.*



Legend

- Site
- Site Vicinity (120m)
- Haul Routes (50m)
- Wider Area (500m)
- Wider Area (1000m)
- Winter Wildlife Transects

Winter Wildlife Transects

Figure 7

Southwestern Landfill
Environmental Assessment

BEACON ENVIRONMENTAL

Project: 217238
Last Revised: January 2019

Client: Walker Environmental Group

Prepared by: RA
Checked by: BH

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The Site is located within Ecoregion 6E (Lake Simcoe-Rideau), approximately 2.75 km from the northern boundary of Ecoregion 7E (Lake Erie-Lake Ontario). Ecoregion 6 extends from Lake Huron in the west to the Ottawa River in the east and it includes most of the Lake Ontario Shore (Crins *et al*. 2009). The area is dominated by cropland (44.4%), with pasture and abandoned fields covering 12.8% of the land. Deciduous forest cover is 16%, coniferous forest cover is 5.3% and mixed forests cover is 8.8%. The vegetation is relatively diverse. Hardwood forests are dominated by Sugar Maple (*Acer saccharum ssp. saccharum*), American Beech (*Fagus grandifolia*), White Ash (*Fraxinus americana*) and Eastern Hemlock (*Tsuga canadensis*). A variety of other species are found where substrates are well-developed on upland sites. Lowlands, including rich floodplain forests, contain species such as Green Ash (*Fraxinus pennsylvanica*), Silver Maple (*Acer saccharinum*), Red Maple (*Acer rubrum*), Eastern White Cedar (*Thuja occidentalis*), Yellow Birch (*Betula alleghaniensis*), Balsam Fir (*Abies balsamea*), and Black Ash (*Fraxinus nigra*). Peatlands are located along the northern edge and in the eastern portion of the ecoregion, which contains fens, and rarely bogs, with Black Spruce (*Picea mariana*) and Tamarack (*Larix laricina*). Most of Ontario's Alvar communities are found within this Ecoregion and mineral materials greatly dominate this region, comprising more than 95% of the substrates.

Ecoregion 7E (Lake Erie-Lake Ontario) located just to the south of the Site is the most southern Ecoregion of Ontario and extends from Windsor and Sarnia east to the Niagara Peninsula and Toronto (Crins *et al*. 2009). Approximately 78% of this ecoregion has been converted to cropland and pasture. The remnant forests consist of 10.3% dense deciduous forest, 1% sparse deciduous forest and 0.8% mixed forest. The most diverse flora and fauna of Canada are found in this ecoregion. Remnants of Carolinian forests contain species such as the Tulip-tree (*Liriodendron tulipifera*), Black Gum (*Nyssa sylvatica*), Sycamore (*Platanus occidentalis*), Kentucky Coffee-tree (*Gymnocladus dioicus*), Pawpaw (*Asimina triloba*), various Oaks and Hickories, and Common Hackberry (*Celtis occidentalis*). These rarer species are accompanied by more widespread Sugar Maple, American Beech, White Ash, Eastern Hemlock, and Eastern White Pine (*Pinus strobus*). This ecoregion also supports the largest remnants of tall-grass prairie in the province.

4.2 Aquatic Resources Existing Conditions

The existing conditions of the aquatic resources in the Site Vicinity, Haul Route and Wider study areas are detailed in the following sections. They include the results of the aquatic habitat assessment, fish community surveys, benthic invertebrate surveys and freshwater mussel surveys.

4.2.1 Aquatic Habitat

Aquatic habitat was assessed at the ten locations within the Site Vicinity, Haul Route and Wider study areas that are described in Section 3.1. The results of this assessment are discussed in the following sections. A photographic record is provided in **Appendix C** and a complete record of observations is attached to this report as **Appendix D**.

Water temperature monitoring was completed as part of the *Surface Water Assessment Report (Draft), Southwestern Landfill Proposal Environmental Assessment* (Golder 2020). Temperature data were collected at four surface water stations (SW1, SW2, SW3 and SW4) from 2017 into 2019. Golder provided the raw temperature data and Beacon completed a thermal classification analysis of the watercourses (i.e. cold, cool and or warm) at stations SW1 and SW2, as they correspond with fish community sites. According to Chu *et al*. (2009) water temperatures between July 1 and August 31 between the hours of 16:00 and 18:00 hours, when air temperatures are above 24.5°C, can be used to approximate the thermal classification of the watercourse at a particular location.

An assessment was completed to determine the thermal classification of the watercourses based on the results of the temperature data provided by Golder and the thermal preference of the fish species observed in each watercourse (See Section 4.2.2). The assessment of the thermal regime of the watercourses within the 1000 m wider study area is shown on **Figure 8**. This figure also shows the permanency of the watercourses based on the presence of flow observed throughout the 2018 and 2019 field seasons.

A summary of the aquatic habitat measurements and observations discussed in the following subsections is summarized in **Appendix E**.

4.2.1.1 Location 1 - South Thames River

The morphology of the South Thames River at Location 1 consists of a straight run with uniform 45 degree constructed banks. The wetted width of the river at this location on August 14, 2018, was 18 m and the maximum depth was 98 cm. The substrate of the river at this location consisted of mostly gravel with patches of cobble and boulders. The vegetation on the banks at this location consisted primarily of trees and shrubs with smaller groupings of grass directly along the edge of the river. Cover provided to the river by this vegetation was relatively low, covering approximately 20% of the river. In-water cover at this location was also limited, consisting of small amounts of woody debris, patches of cobble and boulders, and small patches of aquatic macrophytes, including Slender Pondweed (*Potamogeton pusillus*) and Coontail (*Ceratophyllum demersum*). There was a small channel located on the south bank of the river at this location from which a small trickle of water was observed flowing into the river during the August 14 survey.

4.2.1.2 Location 2 – Foldens Creek

The morphology of Foldens Creek at Location 2 consists of a meandering channel with steep banks and a variety of riffles, runs and pools. The average wetted width of the creek at this location was 3.5 m however, there was one location (transect 4), where the wetted width exceeded 7 m. The average depth of the deepest parts of the creek at this location was 55 cm. The substrate of the creek at this location consisted mostly of silt with a few areas that were covered in detritus. Vegetation documented along the banks of the creek at this location included trees (Willow (*Salix* sp.) and Manitoba Maple, shrubs (Red-Osier Dogwood (*Cornus stolonifera*) and Alder (*Alnus sp.*) and a mix of graminoids and other herbaceous vegetation such as Skunk Cabbage (*Symplocarpus foetidus*) and Ostrich Fern (*Matteuccia struthiopteris*) in the ground layer. There were also some sections of the creek at this location with exposed soils. Cover provided to the creek by this vegetation was relatively low, ranging from 0% to 30%. In stream cover for fish was low to moderate and generally consisted of small and large woody debris (twigs and branches) and pools (maximum depth: 60 cm). No aquatic macrophytes were observed at this location.

Aquatic Sampling Summary

Figure 8

Southwestern Landfill
Environmental Assessment

Legend

- Site
- Site Vicinity (120m)
- Haul Routes (50m)
- Wider Area (500m)
- Wider Area (1000m)
- Aquatic Sampling Sites

Watercourse (Beacon 2018)

- Permanent Watercourse (Unknown Thermal Regime)
- Intermittent Warm Water Watercourse
- Permanent Warm Water Watercourse
- Permanent Cool / Warm Watercourse
- Intermittent Cool Water Watercourse
- Permanent Cool Water Watercourse
- Permanent Cool / Cold Watercourse

Ontario Hydro Network Watercourse (MNRF LIO 2018)

- Permanent Watercourse
- Intermittent Watercourse

BEACON ENVIRONMENTAL

Project: 217238
Last Revised: January 2019

Client: Walker Environmental Group

Prepared by: RA
Checked by: BH

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0 300 600 m

4.2.1.3 Location 3 - South Thames River

The morphology at Location 3 on the South Thames River consisted of a straight run with uniform 45 degree constructed banks. The wetted width of the river at this location on August 14, 2018 was between 15 m and 17.4 m and the maximum depth was 99 cm. The substrate of the river at this location consisted mostly of cobble with sparse boulders. The vegetation on the banks at this location consisted primarily of trees and shrubs. Cover provided to the river by this vegetation was low, covering only 5% of the river. In-water cover at this location was also limited, consisting of small amounts of woody debris, boulders and small patches of aquatic macrophytes, including Slender Pondweed. Location 3 is an exposure site and is approximately 3.5 km downstream of Location 1, which is a reference site. These locations have comparable aquatic habitat characteristics i.e. wetted width, substrate, bank angles, morphology, and flow.

4.2.1.4 Location 4 – Patterson & Robbins Drain

The morphology of the Patterson & Robbins Drain at Location 4 consisted of a meandering channel with steep banks and a variety of riffles, runs and pools. The wetted width of the watercourse at this location was between 2.1 m to 3.5 m wide. The deepest parts of the watercourse at this location were 46 cm deep. The substrate consisted of mostly boulders with cobble and gravel areas. Vegetation documented along the banks of the watercourse included shrubs (hawthorns (*Crataegus spp.*) and willows). Cover provided to the creek by this vegetation was moderate, ranging from 10 to 50%. In-stream cover for fish was moderate, generally consisting of boulders and cobble. No aquatic macrophytes were observed.

Golder completed temperature monitoring at this location. The results of the nomogram indicate that this reach of Patterson and Robbins Drain is considered to be coolwater.

4.2.1.5 Location 5 – Patterson & Robbins Drain

The morphology of the Patterson & Robbins Drain at Location 5 consists of a straight channel with graded steep banks, a large run and small riffles. The wetted width of the watercourse at this location was between 2.6 m to 3.3 m wide. The deepest part of the watercourse at this location was 22 cm deep. The substrate consisted mostly of sand with pockets of clay. Vegetation documented along the banks of the watercourse included trees (Manitoba Maple (*Acer negundo*) and graminoids. Cover provided to the watercourse by this vegetation was low ranging from 10 to 20%. In-stream cover for fish is low, generally consisting of sparse patches of cobble and some dead organic matter. No aquatic macrophytes were observed.

4.2.1.6 Location 6 – Caddy Drain

The morphology of the Caddy Drain at Location 6 consists of a straight channel with graded steep banks and a variety of riffles and runs. The wetted width of the watercourse at this location was between 1.2 m to 1.6 m. The deepest parts of the watercourse at this location ranged from 12 cm to 39 cm deep. The substrate consisted of sand. Vegetation documented along the banks of the watercourse included trees (apple (*Malus sp.*), Trembling Aspen (*Populus tremuloides*) and White Ash (*Fraxinus Americana*) and graminoids and herbaceous vegetation. In some areas at this location the banks were slumping and exposed soils were present. Cover provided to the watercourse by this vegetation was low, ranging from 0 to 30%. In-stream cover for fish was also low. No aquatic macrophytes were observed.

Golder completed temperature monitoring downstream of this location. The results of the nomogram indicate that this reach of Patterson and Robbins Drain is considered to be coolwater/cool-warmwater.

4.2.1.7 Location 7 – Caddy Drain

The morphology of the Caddy Drain at Location 7 consisted of a large run, in a straight channel with graded steep banks. The wetted width of the watercourse at this location was between 0.8 m to 1.2 m. The deepest parts of the watercourse at this location ranged from 17 cm to 29 cm deep. The substrate consisted of sand and clay with a small area of gravel. Vegetation documented along the banks of the watercourse included shrubs (Red-Osier Dogwood and Willow), graminoids and other herbaceous vegetation. Cover provided to the watercourse by this vegetation was varied ranging from 0 to 60%. In-stream cover for fish is moderate and generally consists of overhanging shrubs, branches and graminoids, dead organic matter (e.g. twigs) and small patches of gravel. Aquatic macrophytes observed included watercress, which is a potential indicator of groundwater contribution to the stream. A seepage area dominated by horsetail (*Equisetum* spp.) was documented along the bank of the watercourse at this location.

4.2.1.8 Location 8 - Former West Quarry

The former West Quarry is located directly south of the Site and consists of a large body of water within an aggregate area in which extraction is no longer occurring. This area is still utilized by Carmeuse Lime as temporary storage for water from the active quarry operation on an as-needed basis.

The waterbody is rectangular in shape with an approximate surface area of 27.4 ha. It is approximately 1.1 km long and 300 m wide, except for the eastern quarter of the waterbody which is only 120 m wide. The waterbody is surrounded by vertical quarry walls and steep banks that are approximately 30 m higher than the surface of the water. The depth of the water ranges from 17 to 20 m throughout the wider parts of the water body and is approximately 4 m deep in the narrower east part of the feature.

There are six small littoral areas in the northeast part of the lake, four of which are associated with former vehicle access ramps into the quarry. Former access ramps (Areas 1, 2, 4 and 6) provide a low gradient shoreline with substrates consisting of silt, sand, gravel and cobble. A variety of macrophytes including Slender Pondweed and stonewort (*Chara* spp.) were observed at these locations. In Areas 4 and 6, submerged fallen trees provide cover for fish. Littoral habitat in Areas 3 and 5 is provided by a shelf along the shoreline of the waterbody. Stonewort was observed growing in Area 3

4.2.1.9 Location 9 – Patterson & Robbins Drain

The morphology of Patterson & Robbins Drain at Location 9 consisted of a large run with a few small riffles, in a straight channel with graded steep banks. The wetted width of the watercourse at this location was between 1.5 m to 2.0 m. The deepest parts of the watercourse at this location were approximately 34 cm deep. The substrate consisted of mostly sand with pockets of clay. Vegetation documented along the banks of the watercourse included young trees (Manitoba Maple, willow and poplar), shrubs (Red-

Osier Dogwood) and graminoids. Cover provided to the watercourse by this vegetation was high ranging from 45 to 60%. In-stream cover for fish is moderate and generally consists of cobbles, boulders and filamentous algae. No aquatic macrophytes were observed.

4.2.1.10 Location 10 – Patterson & Robbins Drain

The morphology of Patterson & Robbins Drain at Location 10 consisted of a large run with a few small riffles, in a straight channel with graded steep banks. The wetted width of the watercourse at this location was between 2.6 m and 3.3 m. The deepest parts of the watercourse at this location were approximately 22 cms deep. The substrate consisted of mostly sand with pockets of clay. Vegetation documented along the banks of the watercourse included trees (Manitoba Maple) and graminoids. Cover provided to the watercourse by this vegetation was low, ranging from 10 to 20%. In-stream cover for fish was also low and generally consisted of sparse patches of cobbles and some dead organic matter. No aquatic macrophytes were observed.

4.2.2 Fish Community

A total of 18 species of fish were captured in the study area and are identified in **Table 11**. The preferred thermal regime, tolerance of a species to adapt to environmental perturbations or anthropogenic stresses and origin are also included in this table. Provincial S-ranks, which are also provided in the table below, are used by the NHIC to set protection priorities for rare species and natural communities. No fish species higher than an S4 ranking were captured through the sampling completed as part of this study. An S4 designation implies apparent security within Ontario; usually with more than 100 occurrences across the province. A record of fishing effort, catch data and fish measurements is included in **Appendix E**.

4.2.2.1 Location 1 - South Thames River

Twelve species of fish were captured at this location. This number of species is typically associated with large, regionally significant, watercourses that provide a variety of habitat types. The minimum and maximum lengths of the fish that were measured indicate a healthy population of adult fish. Since the South Thames River is channelized and experiences rapid flow in this location it is likely that young of the year fish and juveniles utilize more sheltered habitats located upstream and downstream of the study area.

Darters were the most abundant group captured at this location, making up more than 85% of the total fish captured. The number and abundances of the species captured through this survey indicate a cool to cool-warm thermal regime.

4.2.2.2 Location 2 – Foldens Creek

Six species of fish were captured at this location. Only two of the six species were not captured during both Spring and Fall surveys, Fantail Darter, which was captured only during the spring, and Brown Trout, which was only captured during the fall survey. Brown Trout migrate into shallow streams such as these in the fall to spawn along gravel substrate, which could explain their absence from this location during the spring survey. The Brown Trout measured 215 mm total length and weighed 107 grams (g). White Suckers were present in both Spring and Fall. Their average length measured during the spring was 112.5 cm, compared to 194 cm in the fall. Creek Chub was the most commonly occurring fish during both surveys. Utilizing the method of depletion estimation, as described in Section 3.1.2, numbers of Creek Chub were estimated at 67 individuals in the spring, and 112 in the fall. The presence of Brown Trout in combination with the abundance of White Sucker and Creek Chub indicates the thermal class of the watercourse at this location to be cool to cool-cold.

Table 11. Fish Species and Conservation Status

Family	Common Name	Scientific Name	Thermal Regime[1]	Tolerance[1]	Origin[1]	Status			Background Records	Sampling Station and Number Caught							
						S-Rank[1]	SARO[1]	COSEWIC[1]		1	2	3	4	5	6	7	8
Catostomidae	White Sucker	*Catostomus commersonii*	Coolwater	Tolerant	Native	S5	NAR	NAR	X	1	47	1	8	52			
Centrarchidae	Bluegill	*Lepomis macrochirus*	Warmwater	Intermediate	Native	S5	NAR	NAR				1					
	Pumpkinseed	*Lepomis gibbosus*	Warmwater	Intermediate	Native	S5	NAR	NAR				2					
	Rock Bass	*Ambloplites rupestris*	Coolwater	Intermediate	Native	S5	NAR	NAR		4		10					12
	Smallmouth Bass	*Micropterus dolomieu*	Warmwater	Intermediate	Native / Introduced	S5	NAR	NAR		1							
Cyprindae	Blacknose Dace	*Rhinichthys atratulus*	Coolwater	Intermediate	Native	S5	NAR	NAR	X	1	70		146	386	124	21	
	Bluntnose Minnow	*Pimephales notatus*	Warmwater	Intermediate	Native	S5	NAR	NAR	X	3	24	7					
	Brassy Minnow	*Hybognathus hankinsoni*	Coolwater	Intermediate	Native	S5	NAR	NAR		2		2					
	Central Stoneroller	*Campostoma anomalum*	Coolwater	Intermediate	Native / Introduced	S4	NAR	NAR	X	2		2					
	Common Shiner	*Luxilus cornutus*	Coolwater	Intermediate	Native	S5	NAR	NAR				4					
	Creek Chub	*Semotilus atromaculatus*	Coolwater	Intermediate	Native	S5	NAR	NAR	X	2	168	7	123	116	319	96	
	Fathead Minnow	*Pimephales promelas*	Warmwater	Tolerant	Native	S5	NAR	NAR	X								
	Northern Redbelly Dace	*Chrosomus eos*	Coolwater	Intermediate	Native	S5	NAR	NAR	X								
Gasterosteidae	Brook Stickleback	*Culaea inconstans*	Coolwater	Intermediate	Native	S5	NAR	NAR	X				9	21	108	21	
Percidae	Blackside Darter	*Percina maculata*	Coolwater	Intermediate	Native / Introduced	S4	NAR	NAR		3		2					
	Fantail Darter	*Etheostoma flabellare*	Coolwater	Intolerant	Native	S4	NAR	NAR	X		1	6					
	Greenside Darter	*Etheostoma blennioides*	Warmwater	Intermediate	Native / Introduced	S4	NAR	NAR		40		63					
	Johnny Darter	*Etheostoma nigrum*	Coolwater	Tolerant	Native	S5	NAR	NAR	X	31		35	7	3			
	Rainbow Darter	*Etheostoma caeruleum*	Coolwater	Intolerant	Native	S4	NAR	NAR		5		26					
Salmonidae	Brown Trout	*Salmo trutta*	Coldwater	Intolerant	Introduced	SNA	NAR	NAR	X		1						

Notes:
[1] Thermal regime, tolerance origin and status from Ontario Freshwater Fishes Life History Database (Eakins, 2019)
S-Rank (Provincial Status - NHIC): **S4** = apparently secure; **S5** = secure; **SNA** = Not Applicable.
SARO (Committee on the Status of Species at Risk in Ontario): NAR = Not at Risk
COSEWIC (Committee on the Status of Endangered Wildlife in Canada): NAR = Not at Risk

4.2.2.3 Location 3 - South Thames River

Fourteen species were captured at Location 3, which is similar to the number captured at Location 1, which was also on the South Thames River. As previously discussed, the high number of fish caught at this location can be attributed to the South Thames River being a large, regionally significant watercourse that provides a variety of habitat types.

Darters dominated the overall fish population making up for more than 80% of the fish caught. Five different species of darters were collected at this location. Greenside Darter was the most abundant species captured, followed by Johnny Darter and Rainbow Darter.

The number and abundances of the species captured through this survey indicate a cool to cool-warm thermal regime.

4.2.2.4 Location 4 – Patterson & Robbins Drain

Three species were captured at this location in the fall and four species in the spring. Johnny Darter was the only species captured only in the fall. More than double the number of fish were captured during the fall survey compared with the spring survey. Blacknose Dace was the most abundant species captured during the spring and fall. The number of Blacknose Dace (mature only) was estimated at 57 in the spring, and 66 in the fall. A total of 31 additional young of year Blacknose Dace were also captured during the fall survey. The occurrence of three different young of year species during the fall indicates this location provides nursery habitat (i.e. cover and food to young fish as they mature). All species captured at this location have a coolwater thermal preference (Coker 2001). This corresponds with the temperature data collected by Golder.

4.2.2.5 Location 5 - Patterson & Robbins Drain

Four species of fish were captured at this location in the spring and five species were captured in the fall. Like Location 4, Johnny Darter was the only species captured only in the fall. During spring surveys, Blacknose Dace also dominated the fish community, making up 90% of the fish captured. During spring surveys, the population of Blacknose Dace was attributed to only 48% of the total population. The number of Blacknose Dace (mature only) within the study was estimated at 243 in the spring, and 133 in the fall. A total of 61 young of year Blacknose Dace were caught in the fall. A much larger number of both White Sucker and Creek Chub were captured during the fall compared to spring sampling. Most noticeable of these changes was the increase in young of year Creek Chub captured in the fall. This can be expected after spawning has occurred over the course of the summer. All species captured at this location have a coolwater thermal preference (Coker 2001).

4.2.2.6 Location 6 – Caddy Drain

A total of three species of fish were captured at Location 6 in both the spring and fall. Overall numbers of fish were higher in the fall compared to the spring, with nearly double the number captured during fall surveys compared with the spring. Creek Chub were the most abundant species during both surveys, accounting for well over half the fish in both spring and fall. Utilizing the method of depletion estimation, overall populations of mature Creek Chub within the study were estimated to be approximately 122 individuals in the spring, and 128 in the fall. Although these estimates are very close to one another, during the fall survey there were also an additional 80 young of year Creek Chub. All species captured have a coolwater thermal preference (Coker 2001). This corresponds with the temperature data collected by Golder.

4.2.2.7 Location 7 – Caddy Drain

Only three species of fish were captured at location 6 in both the spring and fall. This location had a very low total population of fish during the spring sampling period. Only 13 fish in total were captured during the first round of electrofishing. Catches increased substantially during the fall sampling period, amounting to a total of 125 specimens. Of these species, Creek Chub was the most abundant, accounting for approximately 75% of the total population sampled. All species captured have a coolwater thermal preference (Coker 2001).

4.2.2.8 Location 8 - Former West Quarry

Rock Bass was the only species of fish captured in the former West Quarry. These were captured in the minnow traps. Rock Bass have a coolwater thermal preference (Coker 2001). No fish were captured in the hoop nets. One dead White Sucker was observed floating in the lake. The carcass of the specimen displayed obvious signs of predation, but it is unknown how long it had been there or from where it had originated.

While the total number of species in the former West Quarry is almost certainly not limited to one species, a low diversity within this waterbody is anticipated due to the absence of a surface water connection for fish to migrate into the lake and the limited littoral (shallow shoreline) habitat. Littoral habitat provides many essential functions in the natural life cycle of most fish species such as reproduction, nursery, and foraging. The low number of species detected could also be attributed to the sampling techniques used within the former West Quarry, which were determined through consultation with the MNRF as discussed in **Section 3.1.2**.

4.2.3 Benthic Invertebrate Community

The results of the laboratory analysis and biotic indices are shown in **Table 12**. A record of the laboratory identification results is attached as **Appendix F**. The results are used to characterize the benthic invertebrate communities and to assess water quality and degree of habitat disturbance at each location.

Table 12. Benthic Invertebrate Community Biotic Indices

Location	1	2	3	4	5	6	7
Total Specimens	610	756	813	1467	910	1792	2976
Total Taxa	31	19	29	17	26	16	15
Family/ Sub-Family Richness	19	10	20	15	20	15	13
% EPT	31.25	1.96	31.97	28.18	18.85	58.93	35.20
% Chironomids	0.23	0.88	0.18	0.54	0.35	0.26	0.21
Simpson's Diversity Index	0.90	0.61	0.90	0.85	0.89	0.79	0.78
Shannon diversity index	0.53	0.26	0.50	0.44	0.44	0.31	0.34
Hilsenhoff Biotic Index	5.62	6.37	5.34	4.85	5.90	3.59	4.80

4.2.3.1 Location 1 - South Thames River

The benthic invertebrate community at this location included a relatively high number of taxa (31) and families or sub-families (19). Species diversity was ranked as 'fair' based on both diversity indices which indicates that there is a fair amount of habitat disturbance. Using the Hilsenhoff Biotic Index the water quality at this location was assessed as 'fair' which indicates that there is 'fairly substantial pollution likely'.

4.2.3.2 Location 2 – Foldens Creek

The benthic invertebrate community at this location included a moderate number of taxa (19) and families or sub-families (10). Species diversity was poor based on both diversity indices which indicates a fair amount of habitat disturbance. Using the Hilsenhoff Biotic Index the water quality at this location was assessed as 'fairly poor' which indicates that there is 'substantial pollution likely'. The benthic community at this location also included a relatively low percent of species in the taxa EPT which is also an indicator of poor water quality. The benthic community at this location also included a relatively high percent of Chironomids, which are another indicator of poor water quality.

4.2.3.3 Location 3 - South Thames River

The benthic invertebrate community at this location included a relatively high number of taxa (29) and families or sub-families (20). Species diversity was 'fair' based on both diversity indices which indicates a fair amount of habitat disturbance. Using the Hilsenhoff Biotic Index the water quality at this location was assessed as 'fair' which indicates that there is 'fairly substantial pollution likely'.

4.2.3.4 Location 4 – Patterson & Robbins Drain

The benthic invertebrate community at this location included a moderate number of taxa (17) and a moderate number of families or sub-families (15). Species diversity was 'fair' based on both diversity indices which indicates that a fair amount of habitat disturbance. Using the Hilsenhoff Biotic Index the water quality at this location was assessed as 'good' which indicates that there is 'some organic pollution probable'.

4.2.3.5 Location 5 – Patterson & Robbins Drain

The benthic invertebrate community at this location included a relatively high number of taxa (26) and families or sub-families (20). Species diversity was 'fair' based on both diversity indices which indicates that a fair amount of habitat disturbance. Using the Hilsenhoff Biotic Index the water quality at this location was assessed as 'fairly poor' which indicates that there is 'substantial pollution likely'.

4.2.3.6 Location 6 – Caddy Drain

The benthic invertebrate community at this location included a moderate number of taxa (16) and a moderate number of families or sub-families (15). Species diversity was 'fair' based on both diversity indices which indicates a fair amount of habitat disturbance. Using the Hilsenhoff Biotic Index the water quality at this location was assessed as 'Excellent' which indicates that 'organic pollution is unlikely'. The benthic community at this location also included a relatively high percent of species in the families EPT which is also a possible indicator of good water quality.

4.2.3.7 Location 7 – Caddy Drain

The benthic invertebrate community at this location included a moderate number of taxa (15) and a moderate number of families or sub-families (13). Species diversity was 'fair' based on both diversity indices which indicates a fair amount of habitat disturbance. Using the Hilsenhoff Biotic Index the water quality at this location was assessed as 'Good' which indicates that 'some organic pollution is probable'.

4.2.4 Freshwater Mussel Community

No live freshwater mussels were observed in South Thames River or in any of the tributaries.

The tributaries do not provide ideal habitat for freshwater mussels because they are relatively small with steep gradients. They also lack an upstream migration connection to the South Thames River, due to the steep gradient of the tributaries at the confluence.

The constructed, straight and uniform channel of the South Thames River provides poor quality habitat for freshwater mussel due to its lack of morphological variety. The substrate also lacks variety with coarse rock dominating the substrate in both locations. Dead shells of the species Fluted-shell (*Lasmigona costata*) were observed at both locations 1, and 3, in the South Thames River. Most shells were found embedded in the substrate; some were found on top of the substrate or on the banks. Fluted-shell is locally secure (S5) and this species is not listed as a SAR either federally or provincially.

4.2.5 Aquatic Summary

The aquatic resources surveys consisted of the following assessments:

- Fish community;
- Fish habitat;
- Water quality parameters;

- Benthic invertebrate community; and
- Mussel assessments.

Sources accessed through background review did not reveal any records of fish or mussel SAR within the South Thames River, Wider study area or within 5 km of the study area.

Aquatic Habitat was assessed at two (2) locations in the South Thames River, seven (7) locations in the tributaries, and one location in the former West Quarry. Water quality parameters at all locations were within the range specified for protection of aquatic life in the PWQS (where available). The only exceptions were both locations on the South Thames River where the recorded pH was above 9, which is higher than the recommended range of 6 and 8.5 for the protection of aquatic life in the PWQS.

Fish community sampling was completed in the South Thames River, Patterson & Robbins Drain, Caddy Drain, Foldens Creek and the former West Quarry. A 40 m section of the watercourse was sampled at each location by two staff using a backpack electrofisher and dipnets. At least two and sometimes a third pass was completed to accurately estimate the number fish. In total, 18 fish species were captured as detailed in **Table 11**, with a range of cold to warmwater species.

No rare, threatened or endangered species were captured. Most fish species captured are widespread and common throughout southwestern Ontario. The only exception is Brown Trout. Brown Trout has a cold-coolwater thermal preference was captured at Location 2. This is a non-native species which is widespread as a result of introductions but is not common in Southwestern Ontario. Fishes with warmwater and cool-warmwater thermal preference were captured in the South Thames River (locations 1 and 3). Generally, fishes with coolwater thermal preference were captured in the tributaries (locations 2, 4, 5, 6 and 7)

Rock Bass was the only fish species captured in the former West Quarry (location 8). The quarry provides marginal quality fish habitat because it has relatively little shallow nearshore (littoral) habitat which is required to provide important functions for fishes in lakes.

No freshwater mussels were observed in the river or in the tributaries. Several freshwater mussel shells were found at both locations within the South Thames River.

4.3 Terrestrial Resources

4.3.1 Vegetation

4.3.1.1 Ecological Land Classification

A total of 13 ELC communities were identified for the Site, the Site Vicinity and the Proposed Haul Route. One rare vegetation community was recorded, ELC Unit 7: Moist - Fresh Black Walnut Deciduous Forest This community has an S2S3 ranking. These communities are mapped on **Figures 9a** and **9b**, and described in the following paragraphs.

Unit #	ELC Communities
1	CUM1-1: Dry - Moist Old Field Meadow
2	CUT1: Mineral Cultural Thicket
3	CUM1/CUT1: Mineral Cultural Meadow/Mineral Cultural Thicket Complex
4	HE: Hedgerow
5	CUW1: Mineral Cultural Woodland
6	FOD5: Dry - Fresh Sugar Maple Deciduous Forests
7	FOD7-4: Fresh - Moist Black Walnut Lowland Deciduous Forest
8	MAM2-5: Narrow-leaved Sedge Mineral Meadow Marsh
9	MAM2-2: Reed-canary Grass Mineral Meadow Marsh
10	SWT2-2: Willow Mineral Thicket Swamp
11	SWD4: Mineral Deciduous Swamp
12	SWD4-1: Willow Mineral Deciduous Swamp
13	OAO: Open Aquatic

Legend

- Site
- Site Vicinity (120m)
- Haul Routes (50m)

Ecological Land Classification

- ELC
- ELC - Woodland
- ELC - Wetland

Site Ecological Land Classification

Figure 9a

Southwestern Landfill
Environmental Assessment

BEACON ENVIRONMENTAL

Project: 217238
Last Revised: January 2019

Client: Walker Environmental Group

Prepared by: RA
Checked by: BH

DRAFT

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Haul Route Ecological Land Classification

Figure 9b

Southwestern Landfill
Environmental Assessment

Unit #	ELC Communities
1	CUM1-1: Dry - Moist Old Field Meadow
2	CUT1: Mineral Cultural Thicket
3	CUM1/CUT1: Mineral Cultural Meadow/Mineral Cultural Thicket Complex
4	HE: Hedgerow
5	CUW1: Mineral Cultural Woodland
6	FOD5: Dry - Fresh Sugar Maple Deciduous Forests
7	FOD7-4: Fresh - Moist Black Walnut Lowland Deciduous Forest
8	MAM2-5: Narrow-leaved Sedge Mineral Meadow Marsh
9	MAM2-2: Reed-canary Grass Mineral Meadow Marsh
10	SWT2-2: Willow Mineral Thicket Swamp
11	SWD4: Mineral Deciduous Swamp
12	SWD4-1: Willow Mineral Deciduous Swamp

Legend

- Site
- Site Vicinity (120m)
- Haul Routes (50m)

Ecological Land Classification

- ELC
- ELC - Woodland
- ELC - Wetland

BEACON ENVIRONMENTAL

Project: 217238
Last Revised: January 2019

Client: Walker Environmental Group

Prepared by: RA
Checked by: BH

DRAFT

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1:5000

0 100 200 m

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ELC Unit 1: Cultural Meadow (CUM1)

This community is found throughout the Site, Site Vicinity and Haul Route study areas. Areas classified as cultural meadow are variously dominated by cool season grasses including Kentucky Bluegrass (*Poa pratensis*), Timothy (*Phleum pratensis*), Smooth Brome (*Bromus inermis*), Orchard Grass (*Dacytils glomerata*), and Canada Bluegrass (*Poa compressa*) and forbs such as Tall Goldenrod, Tufted Vetch (*Vicia cracca*), Canada Thistle (*Cirsium canadense*), Hedge Bedstraw (*Gallium mollugo*), Bird's Foot Trefoil, and knapweed (*Centaurea* sp.). Tree and shrub cover is generally sparse (>25% woody cover) but may include Manitoba Maple, Wild Red Raspberry, Staghorn Sumac, Black Locust, Cottonwood and willows.

ELC Unit 2: Cultural Thicket (CUT1)

Unit 2a, 2b, 2f and 2g are located along the Haul Route. These areas are densely vegetated with Gray Dogwood, Staghorn Sumac, Common Buckthorn and shrub willows. Within more open areas dominant ground covers are typical of meadows and disturbed open areas as described within ELC Unit 1 described above.

Unit 2c is located in the south western corner of the site. This area is adjacent an open pool of water and is densely vegetated with Gray Dogwood and shrub willows. Generally, vegetation within the ground layer was sparse as it was located over a shallow soil layer over bedrock within an aggregate extraction area.

Unit 2d and 2j is located in the southwestern corner of the site vicinity. It is densely vegetated with Gray Dogwood and Staghorn Sumac. Within more open areas dominant ground covers are typical of meadows and disturbed open areas as described within ELC Unit 1 described above.

Unit 2e is located along south end of the quarry. This area densely vegetated with Common Buckthorn (*Rhamnus cathartica*), Wild Red Raspberry (*Rubus idaeus* ssp. *strigosus*), Gray Dogwood (*Cornus racemosa*), Staghorn Sumac (*Rhus typhina*), and shrub willows (*Salix* spp.). Tree cover is sparse with occasional Trembling Aspen (*Populus tremuloides*), Black Walnut (*Juglans nigra*), and Black Locust (*Robinia pseudo-acacia*). Ground covers are generally sparse under denser shrubs cover. Within more open areas dominant ground covers are typical of meadows and disturbed open areas such as Canada Bluegrass (*Poa compressa*), Canada Goldenrod (*Solidago canadensis*), Thicket Creeper (*Parthneocissus vitacea*), Bird's Foot Trefoil (*Lotus corniculatus*), and Garlic Mustard (*Alliaria petiolata*).

Unit 2h, located on the west side of 35th Line, is dominated by hawthorns and Common Buckthorn. Groundcovers include Tall Goldenrod, Enchanter's Nightshade (*Circaea lutetiana*), White Avens (*Geum canadensis*), and Yellow Trout Lily (*Erythronium americanum*).

Unit 2i, located on the west side of 35th Line, is a small, dense patch of American Plum (*Prunus americana*).

ELC Unit 3: Cultural Thicket/Cultural Woodland (CUT1/CUW1)

This community is located on the west side of the haul route. This feature has a broken canopy of Eastern Cottonwood (*Populus deltoides*) and a dense understory of Common Buckthorn and Wild Red

Raspberry. Dominant ground covers are Smooth Brome (*Bromus inermis*), Tall Goldenrod, Panicled Aster (*Symphyotrichum lanceolatum*), and Canada Anemone (*Anemone canadensis)*.

ELC Unit 4: Hedgerow (H)

There are various hedgerows within the study area.

Unit 4a, located on the south eastern corner of the Site Vicinity, consist of a mix of Trembling Aspen (*Populus tremuloides*), Black Walnut (*Juglans nigra*) and Black Locust (Robinia pseudo-acacia). The shrub layer consists of a mix of Common Buckthorn (*Rhamnus cathartica*), Gray Dogwood (*Cornus racemosa*) and Staghorn Sumac (*Rhus typhina*). Ground cover is generally sparse.

Unit 4b, located on the west side of 35th Line, consists of mid-aged planted Norway Spruce (*Picea abies*).

Units 4c, 4d, 4e, and 4f are located along the east side of 35th Line is dominated by planted White Spruce (*Picea glauca*).

Unit 4g and 4p are associated with former residences at the northeast corner of 35th Line and Road 64. These hedgerows consist of White Cedar, walnut (*Juglans* sp.), Manitoba Maple, and Sugar Maple.

Unit 4h, located within the haul route consist of hawthorn, apple, Green Ash, and Black Walnut.

Units 4i and 4q, located within the haul route, consist of mid-aged to mature Black Walnut and Bur Oak (*Quercus macrocarpa*), with lesser amounts of Basswood (*Tilia americana*), Sugar Maple, and Manitoba Maple. The ground layer supports a variety of native ground covers, including spring ephemerals. Dominant ground covers are: Yellow Trout Lily, Garlic Mustard, Virginia Waterleaf (*Hydrophyllum virginiana*), May-Apple (*Podophylum peltatum*), Early Meadow-rue (*Thalictrum dioicum*), Enchanter's Nightshade, and White Avens.

Unit 4j and 4m, also located within the haul route, consist of Bitternut Hickory (*Carya cordiformis*), Black Walnut, Basswood, and Sugar Maple. Dominant groundcovers are Smooth Brome, Tall Goldenrod, Avens, Garlic Mustard, and Enchanter's Nightshade.

Unit 4k and 4l, are both small groupings of hybrid Crack Willow (*Salix* X *fragilis*) and Manitoba Maple adjacent a ditch.

Unit 4n, located on the west side of 35th Line is dominated by mid-aged planted Black Locust (*Robinia pseudo-acacia*).

Unit 4o, also located along the east side of 35th Line, is dominated by Black Walnut, with a few White Ash, Sugar Maple, and Black Locust. The subcanopy consists of apple, Staghorn Sumac, Manitoba Maple, Common Buckthorn, and Black Walnut. Dominant ground cover includes old field grasses and Tall Goldenrod.

Unit 4s, located along the northern edge of the railway tracks at the southern boundary of the Site Study area, is dominated by Trembling Aspen and Manitoba Maple.

ELC Unit 5: Cultural Woodland (CUW1)

Unit 5a is located in the north west corner of the Site Vicinity. It has a sporadic canopy of Manitoba Maple, Green Ash and Black Walnut. The sub-canopy, which is also sporadic, consists of hawthorns, Common Buckthorn, apple and Black Walnut. Within more open areas dominant ground covers are typical of meadows and disturbed open areas as described within ELC Unit 1 described above.

Unit 5b is located on the west side of the haul route has a sporadic canopy of Green Ash, Black Walnut, and hybrid Crack Willow (*Salix* X *fragilis*). The sub canopy is dense and dominated by hawthorns, in association with Common Buckthorn, apple, and Black Walnut. The understory consists of Gray Dogwood, Wild Red Raspberry, Riverbank Grape (*Vitis riparia*), and Thicket Creeper. Dominant ground covers are Thicket Creeper, avens (*Geum* spp.), Tall Goldenrod, and Enchanter's Nightshade.

Unit 5c is located on the south side of quarry. This feature has an open canopy of Eastern Cottonwood and sparse understory of Common Buckthorn, willows, and Gray Dogwood. Dominant ground covers are tall Goldenrod, Kentucky Bluegrass, Bird's Foot Trefoil, and knapweed.

Unit 5d, located on the west side of the haul route, has a canopy of Eastern Cottonwood, Manitoba Maple, and hybrid Crack Willow. The understory consists of Staghorn Sumac, Gray Dogwood, Wild Red Raspberry, and Riverbank Grape. Dominant ground covers are grasses, Tall Goldenrod, avens sp., and Canada Anemone.

Unit 5e, located behind a barn within the proposed Leachate Area, has a canopy of Manitoba Maple with the occasional Black Walnut. The understory consists primarily of a mix of Garlic Mustard, avens and Tall Goldenrod.

Units 5f, 5g, 5h, 5i, 5j and 5k are located in the south west corner of the Site Vicinity study area along the proposed southern SWM outfall. The canopy consists of a mix of Eastern Cottonwood, Manitoba Maple, Black Locust and Black Walnut. The shrub layer consists of a mix of Staghorn Sumac or Common Buckthorn. The ground layer consists of a mix of raspberry, Tall Goldenrod, Garlic Mustard and Dames Rocket.

Unit 6. Dry-Fresh Sugar Maple Deciduous Forest (FOD5)

This community located west of 35th Sideroad has a canopy of Sugar Maple, Black Cherry, American Beech, Black Walnut, and Ironwood (*Ostrya virginiana*). The understory consists of Choke Cherry, Black Raspberry, Tartarian Honeysuckle, and Elderberry (*Sambucus canadensis*). Dominant ground covers are Yellow Trout Lily, Virginia Waterleaf, White Trillium, and False Solomon's Seal.

ELC Unit 7: Black Walnut Lowland Deciduous Forest (FOD7-4)

This mid-aged forest community is located on the west side of 35th Line. The canopy is dominated by Black Walnut, with occurrences of Sugar Maple, Black Maple (*Acer nigrum*), Trembling Aspen, Hybrid Crack Willow, and American Beech. The understory consists of Black Raspberry *(Rubus occidentalis*), Choke Cherry, and Prickly Ash (*Zanthozylum americanum*). There is a good diversity of herbaceous species including many spring ephemerals. Dominant ground covers are White Trillium (*Trillium grandiflorum*), Yellow Trout Lily, Enchanter's Nightshade, and False Solomon's Seal (*Maianthemum* *racemosum*). In some more disturbed areas, the ground layer is dominated by Barnyard Grass, Tall Goldenrod, Dame's Rocket, and White Avens.

The eastern portion of this community closer to 35th Line is more disturbed with a canopy of young to mid-aged Black Walnut and Manitoba Maple and an understory of Wild Red Raspberry, Tartarian Honeysuckle, and Staghorn Sumac. Dominant groundcovers are grasses (*Dactylis glomerata, Poa pratensis, Phleum pratensis*), Tall Goldenrod, Motherwort (*Leonurus cardiaca*), and *Carex spicata*.

ELC Unit 8: Narrow-leaved Sedge Mineral Meadow Marsh (MAM2-5)

This community, which is located along the Haul Route north of the intersection of Road 64 and the 35th Line. This community is dominated by Tussock Sedge (*Carex stricta*), Reed Canary Grass (*Phalaris arundinacea*), Canada Anemone, Stinging Nettle (*Uritica dioica* ssp. *gracilis*), and Spotted Joe-Pye Weed (*Eutrochium maculatum*).

ELC unit 9: Mineral Meadow Marsh (MAM2)

These communities, which are located to the east of the Site within the Site Vicinity and along the ditches and agricultural drains located to the north of the Site and along the Haul Route. They are dominated by the invasive Common Reed (*Phragmites australis*), with sparse amounts of Panicled Aster, Dudley's Rush (*Juncus dudeyi*), and Fox Sedge (*Carex vulpinoidea*) along the edges.

Unit 10: Willow Mineral Thicket Swamp (SWT2)

These communities is located to the north of the Site, within the Site Vicinity study area. They are associated with a drainage ditch and wetland that is located in this area. They are dominated by shrub willows including Sandbar Willow (*Salix exigua*), Heart-leaved Willow (*Salix eriocephala*), Pussy Willow (Salix discolor), and Basket Willow (*Salix purpurea*). Ground covers include Reed Canary Grass, Common Reed, Panicled Aster (*Symphyotrichum lanceolatum*), and Field Horsetail (*Equisetum arvense*).

ELC Unit 11: Mineral Deciduous Swamp (SWD4)

This community is located to the east of the Site, within the Site Vicinity study area. It is dominated by young Eastern Cottonwood. Dominant ground covers are Jointed Rush (*Juncus articulatus*), Panicled Aster, Creeping Bentgrass (*Agrostis stolonifera*), and Bald Spike rush (*Eleocharis erythrypoda*).

ELC Unit 12: Willow Mineral Deciduous Swamp (SWD4-1)

This community occurs along a watercourse along the northern edge of the quarry. The canopy consists of hybrid Crack Willow, Peach-leaf Willow (*Salix amygdaloides*), and Eastern Cottonwood. Common Reed and shrub willows dominate the understory. Dominant ground covers are Field Horsetail, Panicled Aster, Colt's Foot (*Tussilago farfara*), and Scouring Rush (*Equisetum hyemale*).

Unit 13: Open Water (OAO)

These areas consist of open water communities located within former aggregate extraction areas, including an area located in the south western corner of the Site and the Former West Quarry, part of which extends into the outer south western corner of the Site Vicinity.

4.3.1.2 Vascular Plants

An inventory of vascular plants was undertaken within the Site, Site Vicinity and Haul Route study areas in 2018 and 2019. A total of 239 species were identified and are listed in **Appendix G**. Of these vascular species, 88 (37%) are non-native and 138 (58%) are native. All of the plant species recorded in the study area are common to southwestern Ontario, with a provincial rank of S4 (Apparently secure), S5 (Common, secure) or SNA (Non-native).

During the flora surveys, 19 putative Butternut trees were found. A Butternut Health Assessment following MNRF protocols was completed on August 7, 2018 and leaf samples were submitted to the Ontario Forest Research Institute the same day. All 19 samples were tested positive for hybridity, meaning none of the trees were pure Butternut, therefore these trees are not protected under the *Endangered Species Act (*ESA*)*.

No species listed as endangered, threatened or special concern on the provincial SARO List was documented. Additionally, no provincially rare species or regionally rare species were noted either.

4.3.2 Wildlife

4.3.2.1 Breeding Bird Surveys

A total of 55 species of breeding birds thought likely to be breeding, were recorded in the Site, Site Vicinity or Haul Route study areas **Appendix H**).

Species recorded are all common and are frequently found in disturbed rural environments. Bird species observed are generally of two types: forest birds or disturbed habitat/open country birds. The most common disturbed habitat/open country species in decreasing order of abundance were: Song Sparrow (*Melospiza melodia*), European Starling (*Sturnus vulgaris*), American Goldfinch (*Spinus tristis*), Yellow Warbler (*Setophaga petechia*) and Red-winged Blackbird (*Agelaius phoeniceus*).

The most common species found within the forested area west of the Site, in the Site Vicinity study area, were: Downy Woodpecker (*Picoides pubescens*), Red-eyed Vireo (*Vireo olivaceus*), Northern Flicker (*Colaptes auratus*) and Great-crested Flycatcher (*Myiarchus crinitus*).

Species that were observed flying or foraging on or over the Site, Site Vicinity or Haul Route study areas that were not believed to be nesting in the study area included: Canada Goose (*Branta canadensis*), Red-tailed Hawk (*Buteo jamaicensis*), Belted Kingfisher (*Ceryle alcyon*) and Barn Swallow (*Hirundo rustica*).

Two species that are listed as threatened under the *ESA* and federal *Species at Risk Act (SARA) (2002)*, were recorded on the Site or Site Vicinity study area during breeding bird surveys. They were Bank

Swallow (*Riparia riparia*) and Eastern Meadowlark (*Sturnella magna*). These species are discussed further in **Section 4.4.**

Eastern Wood-Pewee (*Contopus* virens), which is listed as special concern both federally and provincially, was recorded in the forest west of the Site, in the Site Vicinity study area, during the 2018 breeding bird surveys. This species breeds in the mid-canopy layer of forest clearings and edges of deciduous and mixed forests. It is most abundant in intermediate-age mature forest stands with little understory vegetation (COSEWIC 2012). Despite being listed as special concern Eastern Wood-Pewee is still abundant within Southern Ontario and is commonly encountered in a wide variety of wooded habitats in southern Ontario.

No species ranked as S1 through S3 (critically imperiled through vulnerable) by the province were present. All species are either S4 (Apparently Secure) or S5 (Secure).

The MNRF classifies birds that require larger tracks of suitable habitat in which to breed, or those that have a higher breeding success in larger areas of suitable habitat as "area-sensitive" species. Area-sensitive species can be further classified into woodland, shrub/early successional and grassland specialists, which typically require large tracts of their respective habitat types to breed and rear young successfully. Forest areas-sensitive species that were recorded were American Redstart (*Setophaga ruticilla*) and Yellow-throated Vireo (*Vireo flavifrons*). One pair of each species was recorded within the forest west of the Site, likely indicating marginal habitat.

Three grassland area-sensitive species were noted during breeding bird surveys. These were Savannah Sparrow (*Passerculus sandwichensis*) (one pair), Eastern Meadowlark (two pairs) and Grasshopper Sparrow (*Ammodramus savannarum*) (two pairs). These were all in the meadow southeast of the Site, within the Site Vicinity study area.

Other notable observations recorded during the breeding bird survey include two colonies adjacent to the former West Quarry in the Site Vicinity study area. One colony consisted of Cliff Swallow (*Petrochelidon pyrrhonota*) nesting in the cliff located on the north shore of the lake. The other was a mixed colony consisting of Great Blue Herons (*Ardea herodias*), Double-crested Cormorants (*Phalacrocorax auritus*) and Turkey Vulture (*Cathartes aura*) that were nesting in a treed area along the south shore of the former quarry. This colony included approximately ten Great Blue Heron nests, 13 Double-crested Cormorant nests and at least one pair of Turkey Vultures using an old heron or cormorant nest.

An active nesting box for Peregrine Falcon is located at the Carmeuse East property, approximately 2.3 km east of the Site (Carmeuse 2016). This species is designated as special concern and this nesting pair will include the study area within its foraging territory.

4.3.2.2 Breeding Amphibian Surveys

A total of five frogs and one toad species were recorded within the Site Vicinity, Wider and Haul Route Study Areas during the nocturnal amphibian call surveys in 2018. Species heard calling included American Toad (*Anaxyrus americanus*), Gray Tree Frog (*Hyla versicolor*), Green Frog (*Rana clamitans*), Northern Leopard Frog (*Lithobates pipiens*), Spring Peeper (*Pseudacris crucifer*), and Wood Frog (*Rana sylvatica*). The findings of the 2018 amphibian surveys are summarized in **Table 13**. The locations of the survey locations are illustrated on **Figure 5**.

Table 13. Breeding Amphibian Survey Results

Location (Figure 5)	Round 1 (April 26, 2018)	Round 2 (May 17, 2018)	Round 3 (June 28, 2018)
1	No Calls	GRTR - 1(3) GRTR - 1(2) (Out of Location Area, but within Site Vicinity)	No Calls
2	No Calls	No Calls	No Calls
3	No Calls	No Calls	GRTR - 1(1)
4	No Calls	No Calls	No Calls
5	No Calls	No Calls	GRTR - 1(1)
6	No Calls	No Calls	No Calls
7	No Calls	No Calls	No Calls
8	SPPE - 2(6)	GRTR - 3 SPPE - 2(10)	GRTR - 2(6) GRTR - 1(1) (Out of Location Area, but within Site Vicinity)
9	AMTO - 1(1) WOFR - 1(1) NLFR - 1(1)	GRTR - 3 (Near Location 8) SPPE - 3 (Near Location 8)	GRTR - 1(3) GRFR - 1(1) (Out of Location Area, but within Site Vicinity)
10	WOFR - 1(1)	No Calls	No Calls
11	WOFR - 1(1)	No Calls	No Calls

AMTO = American Toad, SPPE = Spring Peeper, GRTR = Gray Tree Frog, WOFR = Wood Frog, GRFR = Green Frog, NLFR = Northern Leopard Frog
Code 0 – No calling
Code 1 - Individuals can be counted; calls not simultaneous. Estimated number of individuals indicated in brackets
Code 2 - Calls distinguishable; some simultaneous calling. Estimated number of individuals indicated in brackets
Code 3 - Full chorus; calls continuous and overlapping.

The survey location with the highest level of amphibian activity was recorded during breeding amphibian surveys was location 8. Two wetland pockets, a swamp and a marsh, located outside of the Site Vicinity, were captured by this survey location. During the first survey at this location six Spring Peepers were recorded. During the second survey at this location full choruses of Gray Tree Frog and Spring Peepers were recorded. During the third survey at this location three Gray Tree Frog and one Green Frog were recorded. American Toad was confirmed to be breeding within this wetland during basking turtle surveys. Northern Leopard Frog was also observed within this wetland during basking turtle surveys.

At survey location 9 an individual American Toad, Wood Frog and Northern Leopard Frog were recorded during the first survey. During the second survey at this location a full chorus of Gray Tree Frog and Spring Peepers could be heard calling in the distance from the wetland community near survey location 8. During the third survey three Gray Tree Frog was recorded within the survey area for survey location 9 and one Green Frog was recorded outside of the survey area but within the Site Vicinity.

Five Gray Tree Frog was recorded at survey location 1 during the second survey, three within and two outside of the location survey area for this location. A single Gray Tree Frog was recorded at survey locations 3 and 5 during the third survey.

A single Wood Frog was recorded at survey locations 10 and 11 during the first survey.

No calls were recorded at survey locations 2, 4, 6 and 7 during any of the breeding amphibian surveys.

4.3.2.3 Basking Turtle Surveys

Ten surveys of potential, suitable habitats for SAR turtles (Spiny Softshell, Blanding's Turtle and Snapping Turtle) within the Site Vicinity study area, along the proposed Haul Route study area and at other locations within the Wider study area identified by the MNRF that could potential provide habitat for SAR turtles were completed over the course of the spring of 2018. Two species of turtle, Midland Painted Turtle (*Chrysemys picta*) and Snapping Turtle were identified through these surveys. Results of the basking turtle surveys are shown in **Table 14**; refer to **Figure 6** for the location of survey areas as described in this table.

Table 14. Basking Turtle Survey Summary

Date		Midland Painted Turtle *Chrysemys picta*						Snapping Turtle *Chelydra serpentina*						Unknown
		Survey Area						Survey Area						Survey Area
		1	2	3	4	5	6	1	2	3	4	5	6	6
1	May 02, 2018	-	-	-	8	-	3	1	-	-	6	-	1	-
2	May 08, 2018	-	-	-	13	-	-	-	-	-	11	-	1	2
3	May 16, 2018	-	-	-	18	-	-	-	-	-	18	-	7	1
4	May 17, 2018	-	-	-	12	-	-	-	-	-	8	-	1	2
5	May 23, 2018	-	-	-	6	-	-	-	-	-	16	-	-	-
6	May 25, 2018	-	-	-	2	-	-	-	-	-	13	-	1	-
7	May 29, 2018	-	-	-	2	-	-	-	-	-	12	-	-	1
8	May 30, 2018	-	-	-	1	-	2	-	-	-	9	-	2	-
9	June 07, 2018	-	-	-	11	-	3	1	-	-	34	-	2	-
10	June 11, 2018	-	-	-	11	5	1	-	-	-	28	-	3	-

The majority of these observations were associated with the Centreville Pond Conservation Area and the Thames River. The only observations outside of these areas included three separate observations of a single adult Snapping Turtle that was recorded within a remnant watercourse adjacent to the proposed Haul Route on three separate occasions. Two of these occasions were during the basking turtle surveys (as shown in **Table 14**), while the third observation occurred during the vegetation surveys held on September 12, 2018. Five Midland Painted Turtles were observed within the former West Quarry on one occasion.

Snapping Turtle is listed as a species of special concern under the provincial ESA and nationally under the federal *Species at Risk Act* (SARA**).** Midland Painted Turtle has recently been listed as a Species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (COSEWIC 2018). Snapping Turtle is discussed further in **Section 4.5**.

4.3.2.4 Odonate and Lepidoptera Surveys

A total of 29 butterfly (Lepidoptera) species and 21 dragonfly and damselfly (Odonata) species were recorded within the Site, Site Vicinity and Haul Route study areas during the three surveys in 2018. Odonate and Lepidoptera observations are summarized in **Table 15** and **Table 16**, respectively.

Table 15. Odonate Survey Results

Common Name	Scientific Name	June 10	July 12	July 30	Total	S-Rank
Ebony Jewelwing	*Calopteryx maculata*	8	-	2	10	S5
Slender Spreadwing	*Lestes rectangularis*	-	-	1	1	S5
Lyre-tipped Spreadwing	*Lestes unguiculatus*	-	2	4	6	S5
Emerald Spreadwing	*Lestes dryas*	-	1	-	1	S5
Common/Sweetflag Spreadwing	*Lestes disjunctus/forcipatus*	-	-	1	1	S5/S4
Eastern Red Damsel	*Amphiagrion saucium*	1	2	-	3	S4
River Bluet	*Enallagma anna*	-	4	-	4	S2
Familiar Bluet	*Enallagma civile*	3	40+	15	58	S5
Azure Bluet	*Enallagma aspersum*	-	6	2	8	S3
Eastern Forktail	*Ischnura verticalis*	23	13	20	56	S5
Sedge Sprite	*Nehalennia irene*	-	2	-	2	S5
Green Darner	*Anax junius*	-	1	2	3	S5
American Emerald	*Cordulia shurtleffi*	3	-	-	3	S5
Widow Skimmer	*Libellula luctuosa*	-	4	-	4	S5
Twelve-spotted Skimmer	*Libellula pulchella*	-	11	4	15	S5
Four-spotted Skimmer	*Libellula quadrimaculata*	1	-	-	1	S5
Spot-winged Glider	*Pantala hymenaea*	-	1	1	2	S4
Wandering Glider	*Pantala flavescens*	-	1	9	10	S4
Common Whitetail	*Plathemis lydia*	6	-	-	6	S5
Meadowhawk sp.	*Sympetrum* sp.	-	-	1	1	n/a
Black Saddlebags	*Tramea lacerata*	-	3	-	3	S4
	TOTAL	**45**	**51**	**60**	**198**	

Key Odonata observations included River Bluet (*Enallagma anna*) and Azure Bluet (*Enallagma aspersum*). The general location of these observations is shown on **Figure 10**.

River Bluet is listed as S2 (Imperiled) in Ontario and vulnerable (N3) federally (MNRF 2018). It was first recorded in Ontario in 1998, arriving as an immigrant from the west. This bluet species is expanding its range northeastwards reaching the Minesing Swamp area near Barrie and the Highland Creek watershed in Scarborough in 2018. It prefers slow running waters and can be found in shallow streams in agricultural areas and is often found in muddy-bottomed irrigation ditches (Lam 2004). During the Odonate survey, four River Bluets (including a pair in tandem) were noted using a straight, agricultural drainage ditch adjacent to the proposed Haul Route.

Azure Bluet is listed as S3 (Vulnerable) in Ontario and secure (N5) federally (MNRF 2018). This species utilizes a variety of shallow ponds, lakes and bogs, preferring waterbodies without fish. It can quickly colonize newly-formed habitats such as constructed and/or temporary ponds (Lam 2004). In Ontario, prior to the 1950s, this species was only observed south of the Canadian Shield in bog habitats. However, since that time Azure Bluets have been recorded in constructed ponds and gravel pits in southern Ontario (Ryswyk 2017). Eight individuals were recorded in the Site Vicinity, east of the Site, utilizing a temporary pool that forms within a slight depression in the terrain.

Catling and Brownell (2000) report that, prior to 1953, this species was only known in Ontario from the southern edge of the Canadian Shield, where it inhabited boggy lakes and ponds. Since then, however, it has been found with increasing regularity in artificial ponds and gravel pits in southern Ontario. A race adapted to constructed ponds may have recently spread into Canada (Catling and Pratt 1997) – these would likely be the individuals occurring in Halton, first reported, in 1996, by M. King. (Ryswyk 2017).

No Odonates listed as endangered, threatened or special concern were recorded within the Site, Site Vicinity, Haul Route study areas.

Table 16. Lepidoptera Survey Results

Common Name	*Scientific Name*	June 10	July 12	July 30	Total	S-Rank
Black Swallowtail	*Papilio polyxenes*	1	2	2	5	S5
Giant Swallowtail	*Papilio cresphontes*	3	-	3	6	S4
Clouded Sulphur	*Colias philodice*	-	11	1	12	S5
Orange Sulphur	*Colias eurytheme*	-	3	1	4	S5
Cabbage White	*Pieris rapae*	2	28	53	83	SNA
Acadian Hairstreak	*Satyrium acadica*	-	1	-	1	S5
Banded Hairstreak	*Satyrium calamus*	-	1	-	1	S4
Eastern Tailed Blue	*Cupido comyntas*	-	1	3	4	S5
Summer Azure	*Celastrina neglecta*	-	-	2	2	S5
Monarch	*Danaus plexippus*	1	16	15	32	S2N/ S4B
Red-spotted Purple	*Limenitis arthemis Astyanax*	2	-	3	5	S5

Legend

- Site
- Site Vicinity (120m)
- Haul Routes (50m)
- Wider Area (500m)
- Key Odonate and Lepidoptera Observations

#	Species
1	Giant Swallowtail
2	Acadian Hairstreak
3	Little Glassywing
4	Broad-winged Skipper
5	Black Dash
6	Eastern River Damsel
7	River Bluet
8	Azure Bluet
9	Common/Sweetflag Spreadwing
10	Monarch

Odonate and Lepidoptera Observations

Figure 10

Southwestern Landfill
Environmental Assessment

BEACON ENVIRONMENTAL

Project: 217238
Last Revised: January 2019

Client: Walker Environmental Group

Prepared by: RA
Checked by: BH

DRAFT

N

1:6000

0 100 200 m

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Common Name	*Scientific Name*	June 10	July 12	July 30	Total	S-Rank
Viceroy	*Limenitis archippus*	2	-	1	3	S5
Great Spangled Fritillary	*Speyeria Cybele*	-	2	2	4	S5
Red Admiral	*Vanessa atalanta*	1	1	-	2	S5
Mourning Cloak	*Nymphalis antiopa*	-	-	1	1	S5
Northern Crescent	*Phyciodes cocyta*	-	6	2	8	S5
Northern Pearly-Eye	*Lethe anthedon*	-	1	-	1	S5
Common Ringlet	*Coenonympha tullia*	43	-	-	43	S5
Little Wood-Satyr	*Megisto cymela*	12	1	-	13	S5
Common Wood-Nymph	*Cercyonis pegala*	-	22	6	28	S5
Silver-spotted Skipper	*Epargyreus clarus*	1	-	1	2	S4
Wild Indigo Duskywing	*Erynnis baptisiae*	-	-	1	1	S4
Least Skipper	*Ancyloxypha numitor*	7	-	3	10	S5
Little Glassywing	*Pompeius verna*	-	1	-	1	S5
Hobomok Skipper	*Poanes hobomok*	5	-	-	5	S5
Delaware Skipper	*Anatrytone logan*	-	1	-	1	S4
Broad-winged Skipper	*Poanes viator*	-	-	1	1	S4
Black Dash	*Euphyes conspicua*	-	1	-	1	S4
Dun Skipper	*Euphyes vestris*	-	1	1	2	S5
	TOTAL	**80**	**98**	**102**	**282**	

Key Lepidoptera observations were Giant Swallowtail (*Papilio cresphontes*) (a migrant), Monarch (*Danaus plexippus*), Wild Indigo Duskywing (*Erynnis baptisiae*) and Little Glassywing (*Pompeius verna*). The general locations of these observations are shown on **Figure 10**.

Giant Swallowtail is listed apparently secure provincially (S4) and federally (N4) (MNRF 2018). It is considered an uncommon resident in Ontario. Approximately 20 years ago, it was primarily a Carolinian species, however, it has expanded north and east since that time utilizing Prickly-ash as its foodplant. Its range now extends from the extreme southwest of Ontario to the Ottawa area and below the Canadian Shield (Hall *et al.* 2014). Six individuals were noted during the surveys.

Monarch is listed as special concern federally and provincially; when breeding in Ontario, it is classified as imperiled (S2) and is considered vulnerable (N3) federally (MNRF 2018). Monarch is a common breeding migrant in Ontario, but their numbers fluctuate on a yearly basis likely based on their overwintering success in Mexico (Hall *et al*. 2014). During the Lepidoptera surveys in 2018, 32 Monarchs were recorded within the Site, Site Vicinity and Haul Route study areas. Additional incidental observations were also made during other surveys that were completed as part of this study.

Wild Indigo Duskywing is listed as apparently secure provincially (S4) and federally (N4) (MNRF 2018). At one time, this species was uncommon in Ontario and was originally confined to the extreme southwestern Ontario, however, its range expanded drastically in the late 1990s when it adopted the

Purple Crown-vetch (*Securigera varia*) as a host plant (Hall *et al.* 2014). One Wild Indigo Duskywing was observed within the Site Vicinity on the gravel road west of the Site.

Little Glassywing is classified as apparently secure provincially (S4) and federally (N4) (MNRF 2018). It is an uncommon resident in Ontario that is traditionally found in the Carolinian Zone but has been moving northeast in recent years and is now seen in colonies in the Peterborough and Rideau Lakes areas (Hall *et al*. 2014). One female Little Glassywing was observed within the Site Vicinity on the gravel road west of the Site.

4.3.2.5 Winter Wildlife, Mammal Surveys and Incidental Wildlife Observations

A winter wildlife survey was completed on February 12, 2018. A total of 15 species were identified through this survey, all of which are commonly associated with rural landscapes within southern Ontario. Information collected through these observations informed the analysis of how wildlife utilize/move through the natural heritage features within the study area.

Conditions for the survey were good. The small amount of freezing rain received the day before created a limited crust on the snow but there was a sufficient amount of time between the last snowfall and the freezing rain to allow for a sizable number of tracks. A summary of the results of the winter wildlife surveys is shown in **Table 17** and Transects are mapped on **Figure 7**.

Table 17. Winter Wildlife Survey Summary

Species	Transect			
	One	Two	Three	Four
Deer Mouse (*Peromyscus maniculatus*) / White-footed Mouse (*Peromyscus leucopus*)	2	1	1	-
Eastern Cottontail (*Sylvilagus floridanus*)	7	4	-	3
Eastern Coyote (*Canis latrans*) hybrid Canid	2	3	-	4
Gray Squirrel (*Sciurus carolinensis*)	-	8	-	-
Mink (*Neovison vison*)	-	1	-	-
Red Fox (*Vulpes vulpes*)	1	-	-	-
White-tailed Deer (*Odocoileus virginianus*)	8	7	-	4
Wild Turkey (*Meleagris gallopavo*)	-	22	-	-

Common birds that are generally resident that were observed during the survey included:

- Wild Turkey – observed within the Site Vicinity and Haul Route study areas;
- American Crow (*Corvus brachyrhynchos)* – occasionally observed within the Site, Site Vicinity or Haul Route study areas;
- Canada Goose - flying over the Site, Site Vicinity or Haul Route study areas;
- Red-tailed Hawk (*Buteo jamaicensis*) - flying over the Site Vicinity or Haul Route study areas;
- Black-capped Chickadee (*Poecile atricapillus*) – occasional;

- Dark-eyed Junco (*Junco hyemalis*) – uncommon;
- White-breasted Nuthatch (*Sitta carolinensis*) – uncommon; and
- Downy Woodpecker – occasional.

The number and location of tracks observed during the survey were consistent with that expected in a rural environment in southern Ontario and in habitat conditions prevalent within the study areas. Wildlife movement through the study area is discussed in **Section 4.6.**

A survey specifically for mammals was also completed in October. Incidental observations of all wildlife were also recorded during the completion of all wildlife surveys. In total, 13 mammals and one reptile (excluding turtles) were documented through these surveys/observations. Mammals observed include:

- White-tailed Deer;
- Eastern Coyote;
- Red Fox;
- Eastern Cottontail;
- Deer Mouse /White-footed Mouse;
- Mink;
- Gray Squirrel;
- Northern Short-tailed Shrew (*Blarina brevicauda*);
- Racoon (*Procyon lotor*);
- Striped Skunk (*Mephitis mephitis*);
- Groundhog (*Marmota monax*);
- American Beaver (*Castor canadensis*); and
- Muskrat (*Ondatra zibethicus*).

The single reptile that was documented was Eastern Gartersnake (*Thamnophis sirtalis sirtalis*). All these species are commonly associated with the rural landscapes within southern Ontario. Other common species that are frequently associated with rural landscapes within southern Ontario could also occur within the Site, Site Vicinity, Haul Route and Wider study areas.

These surveys and observations informed the analysis of how wildlife use and move through the natural heritage features within the study area.

4.3.2.6 Bat Exit Surveys

No bats were observed existing the abandoned farmhouse or old barn during exit surveys. Up to two different species of bats were recorded foraging in the vicinity of the old barn and abandoned farmhouse by the handheld detectors during these surveys, Big Brown Bat (*Eptesicus fuscus*) and Silver-haired Bat (*Lasionycteris noctivagans*). Due to similarities between the calls of these species it is difficult to reliably identify them to species using their calls. No endangered bat species were recorded during these surveys.

4.4 Significant Wildlife Habitat

Significant Wildlife Habitat (SWH) consists of a series of natural heritage features that are identified by the Ontario Ministry of Natural Resources (OMNR) in the *SWH Technical Guide* (2000) and the MNRF *SWH Ecoregional Criteria Schedules: Ecoregion 7E (2015)* and regulated under the *Provincial Policy Statement* (*PPS*) (MMAH 2014).

The SWH Technical Guide identifies four categories of SWH, they include:

1. Seasonal Concentration Areas of Animals;
2. Rare Vegetation Communities or Specialized Habitat for Wildlife;
3. Habitat for Species of Conservation Concern; and
4. Animal Movement Corridors.

There are multiple types of SWH within each of these categories that capture a specialized type of habitat that may or may not be captured by other existing features or categories.

To determine if the Site, Site Vicinity or Haul Route study areas support any candidate SWH the data collected from the background review and field investigations was reviewed against the criteria provided within the SWH Technical Guide and SWH Ecoregional Criteria Schedules.

4.4.1 Seasonal Concentration Areas of Animals

One type of SWH that falls within this category was confirmed through the studies that were completed to establish baseline conditions within the approved study areas, Colonially - Nesting Bird Breeding Habitat (Tree/Shrubs). This habitat consists of a colony of Great Blue Heron, Turkey Vulture and Cormorant that are nesting in a treed area located on the southern edge of the Former West Quarry.

Two other types of candidate SWH were identified through studies that were completed to establish baseline conditions. They include:

- Bat maternity roost habitat for non-SAR bats. This type of habitat could potentially be associated with forested ecosites located within the Site Vicinity and Wider study areas; and
- Colonially – Nesting Bird Breeding Habitat (Bank and Cliff). A colony of Cliff Swallows was documented on the north side of the Former West Quarry. The MNRF ecoregional criteria states that habitats located within licensed/permitted mineral aggregate operations are not considered SWH by the MNRF.

4.4.2 Rare Vegetation Communities or Specialized Habitat for Wildlife

One type of SWH that falls within this category was confirmed through the studies that were completed to established baseline conditions within the approved study areas. This Rare Vegetation Community, which is ELC Unit 7: Black Walnut Lowland Deciduous Forest (FOD7-4), was identified within the Site Vicinity study area west of the 35th Line. This ELC community is assigned a subnational rank (SRANK) of S2S3 in Appendix M of the SWH Technical Guide (OMNR 2000).

An SRANK of 2 is assigned to elements that are considered imperilled, which is defined as being at high risk of extirpation in the jurisdiction due to restricted range, few populations occurrences, steep declines, severe threats, or other factors (Master *et al.* 2012). An SRANK of 3 is assigned to elements that are considered vulnerable, which is defined as being at risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors. The combined ranking indicates that the OMNR considered this ELC community to be between imperilled and vulnerable.

4.4.3 Specialized Habitat for Wildlife

One type of SWH that falls within this category was identified through the studies that were completed to establish baseline conditions within the approved study areas, Amphibian Breeding Habitat (Wetlands). This habitat consists of a mix of swamp and marsh habitat located at the outer edge of the Site Vicinity study area northeast of the Site. Species that were observed or heard from this habitat include Spring Peepers, Gray Tree Frog, Green Frog, American Toad and Northern Leopard Frog.

4.4.4 Habitat for Species of Conservation Concern (Not including Endangered or Threatened Species)

One type of SWH that fall within this category was identified through the studies that were completed to establish baseline conditions within the approved study areas. This is the habitat for Species of Special Concern – Snapping Turtle. A large number of Snapping Turtles were documented within the pond and wetland habitat located at the Centreville Conservation Area, with up to 34 individuals being recorded on a single day. A lesser number of Snapping Turtles were also recorded within the Thames River.

4.5 Threatened or Endangered Species

Surveys were conducted in 2018 to determine if endangered or threatened species were present in the Site, Site Vicinity or Haul Route study areas or in nearby features (e.g., ponds and lakes). The types of surveys conducted were based on the screening data gathered from the background review. In total, two species that are listed as SAR under the ESA were recorded on the Site, the Site Vicinity and the Wider Area. These were Bank Swallow and Eastern Meadowlark, which are both classified as threatened provincially and federally.

Bank Swallows nest in burrows in natural and human-made settings where there are vertical faces in silt and sand deposits. Many nests are on banks of rivers and lakes, but they are also found in active sand and gravel pits or former ones where the banks remain suitable. The birds breed in colonies ranging from several to a few thousand pairs (COSEWIC 2013). A Bank Swallow colony was found on site on May 30, 2018 that contained 34 burrows, of which at least ten were occupied. On the next breeding bird survey (June 26, 2018), the aggregate pile that was housing the colonies had slumped, due to heavy rainfall, which is not an uncommon occurrence for colonies of this species. There was no Bank Swallow nesting activity documented subsequently. The habitat is no longer considered suitable (confirmed with K. Buck, Management Biologist with the Aurora District MNRF 2019 3, May, 2019).

Eastern Meadowlarks breed primarily in moderately tall grasslands, such as pastures and hayfields, but are also found in alfalfa fields, weedy borders of croplands, roadsides, orchards, airports, shrubby overgrown fields, or other open areas. Small trees, shrubs or fence posts are used as elevated song perches (COSEWIC 2011). At least two pairs of Eastern Meadowlark were recorded using the meadow southeast of the Site, within the Site Vicinity.

Additionally, the woodlands west of the Site are assumed to contain habitat for bat species that are subject to the ESA.

Although they were not recorded during the turtle basking surveys, a migratory corridor for Spiny Softshell turtle was identified through correspondence with staff from the UTRCA in the Thames River south of the Site within the Wider study area.

No other habitat for endangered or threatened species, including those identified through the background review, was identified as a result of the surveys completed as part of this study.

4.6 Crow Roost

Located between three of the Great Lakes, southwestern Ontario acts as a “funnel” for migrating birds, including hundreds of thousands of crows. As a result, large fall and winter night roosts with thousands of American Crows have become established in and around towns in southwestern Ontario, such as Waterloo, Chatham, and Essex near Windsor. A well-established crow roost occurs in Woodstock, located 13 kms to the north-northwest of the proposed landfill site.

At present, the Woodstock roost is located at Pittock Lake, with annual fall and winter numbers of 10,000 plus birds. For this study, a Pittock Lake night roost survey was undertaken in October, November and December, which confirmed the presence of thousands of crows. Birds were noted to approach the roost site from all directions and flocks of 20 to hundreds of birds were observed flying to the site from tens of kilometres away. Organized Christmas Bird Counts are undertaken each year in December by the Woodstock Field Naturalists. These data show that crow numbers vary from 20,000 to 40,000, with a high of 90,000 in 2011. In 2018, the Christmas Bird Count recorded 21,000 crows for the Woodstock area.

Monitoring of crow numbers at the Salford Landfill, located 8.2 km to the south-southeast of the proposed landfill site, found the greatest number of crows to occur during winter months of January and February, with 1,500 to 2,000 birds. Numbers were found to drop quickly and significantly by March and through the summer and fall, with less than 20 birds noted at any one time. Numbers at the landfill in October were less than 50 birds, even though over 10,000 birds were roosting at Pittock Lake, only 18 kms to the northeast. Monitoring at the landfill found that the crows at the landfill were making flights from the Pittock Lake roost site to feed at the landfill. Yet, only a very small fraction of the Pittock Lake roost birds were found to be feeding at the landfill.

Road surveys for crows in the On-Site and Site Vicinity study areas found very low numbers of birds to occur throughout the year, with less than ten birds noted at one time. Evening surveys of the On-Site and Site Vicinity study areas conducted in October and November did not identify the movements of flocks of crows or the occurrence of roosts, even though at least 100 crows were recorded feeding at the Salford Landfill in November and thousands were roosting at Pittock Lake.

The results of the surveys indicate that even though tens of thousands of crows occur within 20 km of the Salford Landfill, that site does not attract a significantly large number of crows. In addition, the survey found that during the fall and winter months crows at the landfill make morning and evening flights to and from the well-established roost in Woodstock and do use an alternate roost site nearer to the landfill. This site fidelity to an exiting roosting is not uncommon for crows. Therefore, the presence of a new landfill site in the area would not necessarily result in the establishment of a new crow roost.

4.7 Landscape Connectivity

Landscape connectivity and natural linkages have become commonplace when evaluating natural areas. From a planning context, the idea is that variously sized habitat patches, so-called ‘core’ natural areas, and supporting features, are linked by natural corridors in an often-fragmented landscape of land uses.

Corridors can be major river valleys, or smaller in scale such as those associated with creeks and hedgerows. Corridors may serve various ecological functions depending on their size and quality. These functions can include providing shelter from predators and the elements, providing breeding habitat, connecting core natural areas, and facilitating seed dispersal and exchange of genetic material. Wildlife use of corridors likely varies.

In the fragmented landscapes of southern Ontario, corridors are usually discontinuous stepping-stones that act as corridors in concert to provide elements of connectivity. On the other hand, some studies have shown that corridors can have some undesirable effects; for example, on the breeding success of certain bird species through increased nest predation facilitated by edge effects and ease of movement for predators (Weldon 2006). The role of corridors or linkages for maintaining plant populations or dispersal of a species at the larger landscape level is still not well-documented, although it has been identified as a factor for the spread of some invasive species such as Garlic Mustard. There remains a scientific debate surrounding the role of corridors and the importance of connectivity.

Within the Site, Site Vicinity and the Haul Route study areas landscape connectivity was assessed by first identifying potential pathways using background information and aerial photography. This information was then reviewed using data collected through the background review and field surveys to assess these pathways for their likely use.

Within the Wider Area, the Thames River, south of the Site, represents a Regional movement corridor. Within this area the river, and the vegetation growing along its banks provide habitat for and allow for the movement of many aquatic, semi-aquatic species and terrestrial species through the area.

Local movement pathways within and along the hedgerows and watercourses and through agricultural fields between woodlands were identified within the Site, Site Vicinity and Wider Area study areas.

The most common observations along most of these pathways were associated with larger mammals, including White-tailed Deer and Eastern Coyote, whose tracks, and scat was commonly observed in or along these areas. Smaller mammals, i.e. squirrels, Eastern Cottontail as well as birds, were also observed utilizing these pathways.

In addition to acting as a movement corridor for mammals and birds the pathway between the woodland located adjacent to the Haul Route and the wetlands north of the Site could also act as a corridor for breeding amphibians as they move to and from the wetlands and the woodland.

Local movement of aquatic species between the Thames River and its tributaries is limited by the low invert of Thames River relative to the tributaries on the tablelands which is approximately 5 m. As a result, fish species cannot migrate into the tributaries from the Thames River. Upstream migration into tributaries is an essential part of the life cycle of many fishes (i.e. for spawning or as nursey areas). Access to tributaries also plays an important role in the life cycle of freshwater mussels.

Local movement of aquatic species into and from the former West Quarry is restricted as it does not have connecting channels. Connectivity to tributaries and outflow channels is an important factor that contributes to the diversity and size of a fish community in natural lakes.

Representations of the Regional movement corridor associated with the Thames River and the local movement pathways are shown on **Figure 11.**

5. Key Natural Features and Functions

Important or sensitive natural heritage features that were identified within the Site, Site Vicinity, Haul Route or Wider study areas through the work completed as part of this study include:

- Fish habitat;
- Habitats for endangered and threatened species;
- Woodlands;
- Wetlands; and
- Significant Wildlife Habitat.

These features and functions are summarized in **Table 18** and are shown on **Figure 8** and **Figure 12**.

Legend

- Site
- Site Vicinity (120m)
- Haul Routes (50m)
- Wider Area (500m)
- Wider Area (1000m)
- Regional Wildlife Movement Corridor
- Local Wildlife Movement Pathway

Wildlife Movement Cooridors / Pathways

Figure 11

Southwestern Landfill
Environmental Assessment

BEACON ENVIRONMENTAL

Project: 217238
Last Revised: January 2019

Client: Walker Environmental Group

Prepared by: RA
Checked by: BH

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Key Terrestrial & Wildlife Natural Heritage Features | **Figure 12**

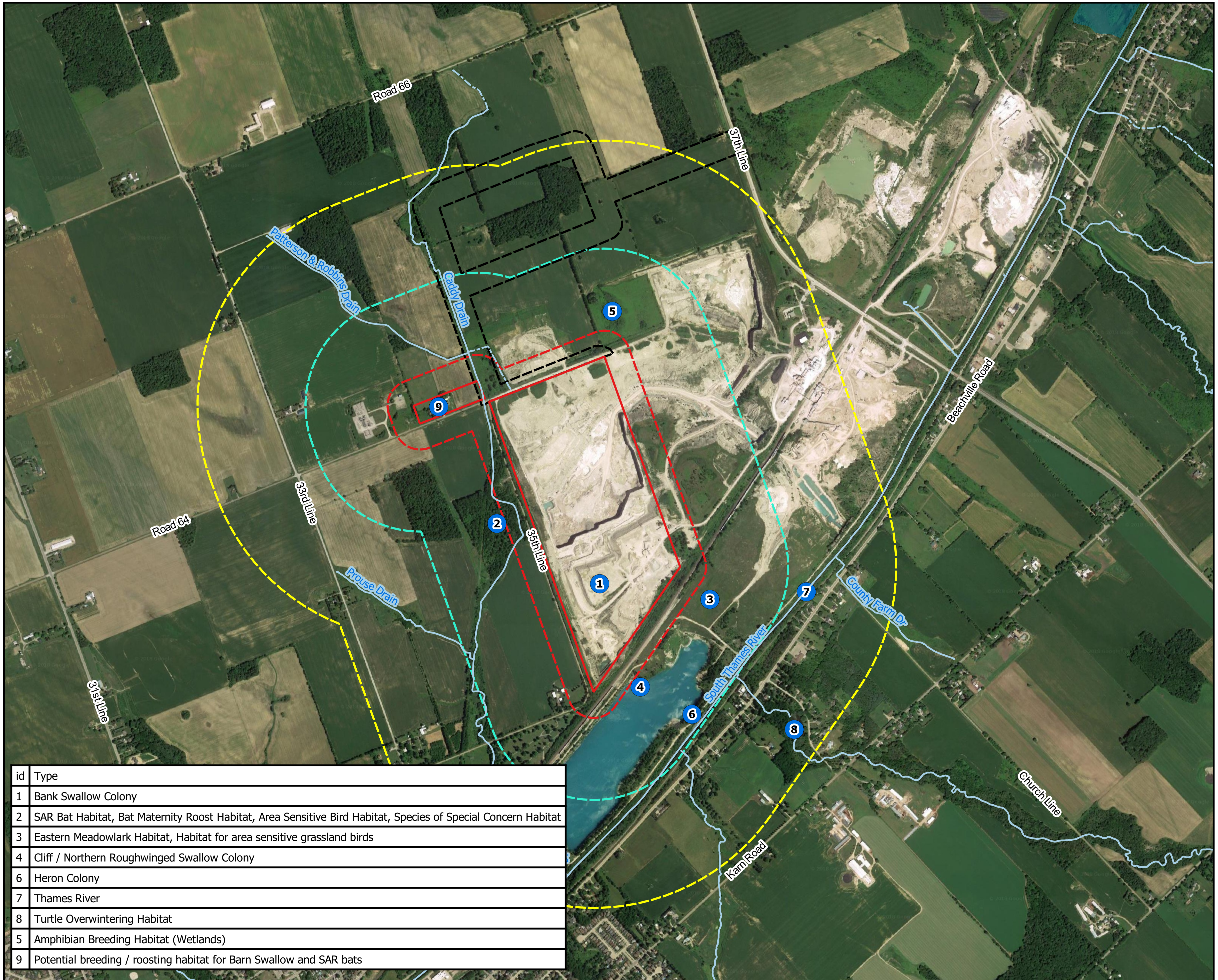
Southwestern Landfill
Environmental Assessment

Legend

- Site
- Site Vicinity (120m)
- Haul Routes (50m)
- Wider Area (500m)
- Wider Area (1000m)
- Key Terrestrial Natural Heritage Features

Watercourse (Beacon 2018 / MNRF LIO 2018)

- Permanent
- Intermittent



id	Type
1	Bank Swallow Colony
2	SAR Bat Habitat, Bat Maternity Roost Habitat, Area Sensitive Bird Habitat, Species of Special Concern Habitat
3	Eastern Meadowlark Habitat, Habitat for area sensitive grassland birds
4	Cliff / Northern Roughwinged Swallow Colony
6	Heron Colony
7	Thames River
8	Turtle Overwintering Habitat
5	Amphibian Breeding Habitat (Wetlands)
9	Potential breeding / roosting habitat for Barn Swallow and SAR bats

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Project: 217238
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Table 18. Summary of Key Natural Heritage Features and Functions

Feature / Function Category	Importance	Sensitivity
Fish Habitat **Regulated under the federal *Fisheries Act* (1985)**		
Patterson & Robbins Drain	This permanent watercourse provides habitat to fishes with a coolwater thermal preference.	The fish community is sensitive to changes in the water supply i.e. volume and temperature.
Caddy Drain	This permanent watercourse provides habitat to fishes with a coolwater thermal preference.	The fish community in this watercourse is sensitive to changes in the water supply i.e. volume and temperature.
Foldens Creek (Upstream of Centreville Pond)	This permanent watercourse provides habitat to fishes with a cool-cold water thermal preference.	The fish community in this watercourse is sensitive to changes in the water supply i.e. volume and temperature.
Thames River	This regionally important river provides habitat to a fish species with a range of water thermal regime preferences.	Fish species with a coolwater thermal habitat in this watercourse are sensitive to changes in the water supply i.e. volume and temperature.
Habitat of Threatened and Endangered Species **Regulated under the *Endangered Species Act* (2007)**		
Eastern Meadowlark	Two pairs recorded using the meadow southeast of the Site, within the Site Vicinity. Listed as a threatened species under the ESA.	Relatively tolerant of disruption such as noise. Nesting areas are subject to destruction from human activities such as mowing or harvesting.
Endangered Bat Species	The woodlands west of the Site are assumed to contain habitat for endangered bat species that are subject to the ESA.	Roosting and maternity habitat for bats can be sensitive to disturbance from noise and light associated with human activities near roosting habitat. The buildings and woodlands in which they roost are subject to destruction from human activities such as building demolition and tree removals.
Woodlands		
Woodlands	The woodland west of the Site and both woodlands adjacent to the proposed Haul Route are identified in the ONHSS as natural features that provide ecologically important services.	These woodlands are sensitive to disturbance from adjacent human activities and destruction from activities such as tree removal.
Wetlands - Regulated under the *Conservation Authorities Act*, O. Reg. 157/06		
Wetlands	Small pockets of meadow marsh and thicket swamp wetlands were identified within the Site, Site Vicinity and Haul Route study areas.	Wetland communities and the wildlife they support can be sensitive to changes in hydrology and destruction from human activities.

Feature / Function Category	Importance	Sensitivity
	Breeding habitat for amphibians was identified with the swamp and marsh habitat located in the northeast corner of the Site Vicinity study area. Given the size and isolated nature of these wetland communities, it is unlikely that they would satisfy the criteria to be considered Provincially Significant, the standard used by the MNRF and PPS to determine the importance of a wetland.	
Significant Wildlife Habitat		
Seasonal Concentration Areas of Animals		
Colonially - Nesting Bird Breeding Habitat - Heronry	A colony of nesting Great Blue Heron is located on the south side of the Former West Quarry. Nesting Double-crested Cormorant and Turkey Vultures were also identified within the heronry.	Heron colonies are generally known to be sensitive to disturbance such as noise and physical presence during their breeding season.
Bat Maternity Colonies	The woodlands west of the Site are assumed to contain bat maternity colonies.	Roosting and maternity habitat for bats can be somewhat sensitive to disturbance from noise and light associated with human activities near roosting habitat. The woodlands in which they roost are sensitive to destruction from human activities such as tree removal.
Colonially - Nesting Bird Breeding Habitat – Cliff Swallow	A colony of Cliff Swallows at the Former West Quarry south of the Site.	During the breeding Swallows can be somewhat sensitive to disruption due to the activity of animals or humans near their colony.
Rare Vegetation Communities or Specialized Habitat for Wildlife		
Other Rare Vegetation Communities – ELC Unit 7: Black Walnut Lowland Deciduous Forest (FOD7-4)	This ELC community is assigned a subnational rank (SRANK) of S2S3 in Appendix M of the SWH Technical Guide (OMNR 2000).	See the description provided for woodlands.
Specialized Habitat for Wildlife		
Amphibian Breeding Habitat (Wetlands)	Spring Peepers, Gray Tree Frog, Green Frog and American Toad were confirmed to be breeding within two wetlands northeast of the Site study area and south of the proposed Haul Route study area. The number of species/individuals recorded as breeding within these features indicate these	Breeding habitat for amphibians can be somewhat sensitive to disturbance from noise and light associated with human activities near the breeding habitat. The wetland communities that support these habitats can be sensitive to changes in hydrology and destruction from human activities.

Feature / Function Category	Importance	Sensitivity
	wetlands are important habitats for breeding amphibians within the wider study area. The lack of other suitable habitats within / adjacent the Site and Haul Route study areas for breeding amphibians further highlights the importance of this habitat.	
Habitat for Species of Conservation Concern (Not including Endangered or Threatened Species)		
Habitat for Species of Special Concern – Snapping Turtle	A relatively large number of Snapping Turtle were documented within the pond and wetland habitat located at the Centreville Conservation Area, with up to 34 individuals being recorded on a single day. A lesser number of Snapping Turtles were also recorded within the Thames River.	Habitat for Snapping Turtles can be somewhat sensitive to disturbance from human activities. They are known to migrate between suitable habitats within the areas in which they live and are also susceptible to habitat fragmentation and mortality due to roads and poaching. The waterbodies that support Snapping Turtle can be sensitive to changes in hydrology and destruction from human activities.

6. Baseline Summary

A background review and field investigations were conducted to identify and evaluate environmental features within the Site, Site Vicinity, Haul Route and Wider study areas identified within the *Southwestern Landfill Proposal Environmental Assessment Ecological Assessment Work Plan* (Beacon 2017). The information collected through these activities was assessed in order to identify and assess key natural heritage features within these study areas. The results of these assessments, grouped by study areas, are summarized below.

No key natural heritage features were identified within the Site study area through the studies that were completed as part of this assessment. This can be attributed to the existing quarry operation within this area, which provides limited opportunities for use by wildlife.

Key natural heritage features identified within the Site Vicinity study area include:

- Fish habitat within the Patterson & Robbins Drain;
- The woodlands west of the Site, which may provide habitat for endangered bat species and roosting habitat for other bat species;
- The meadow south of the Site provides habitat for Eastern Meadowlark, a threatened species under the provincial ESA;
- Amphibian Breeding Habitat (wetlands) within the swamp and marsh located at the northeastern edge of the Site Vicinity study area;
- The northern wall of the former West Quarry is known to provide habitat for a colony of nesting Cliff Swallows; and
- Key natural heritage features identified within the Haul Route study area is limited to fish habitat within the Patterson & Robbins Drain and Caddy Drain, which is located along the western edge of this area.

This can be attributed to the existing agricultural land use within this area, which provides limited opportunities for use by wildlife.

Key natural heritage features identified within the Wider study area include:

- Fish habitat within the Patterson & Robbins Drain, Caddy Drain, Foldens Creek and the South Thames River;
- A Great Blue Heron colony on the south side of the former West Quarry;
- A movement corridor for Spiny Softshell Turtle, which is listed as an endangered species under the ESA, within the South Thames River;
- The presence of a regional movement corridor for aquatic, semi-aquatic and terrestrial wildlife along the South Thames River; and
- Habitat for Species of Special Concern – Snapping Turtle in the pond and wetland habitat within the Centreville Conservation Area and the Thames River.

The purpose of this report is to describe baseline conditions of the aquatic and terrestrial environment within the prescribed study areas which will generally satisfy objective (a) as described in Section 1, which was to:

> *Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking.*

This information will then be used to address the remaining objectives within the EA.

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Appendix A

Correspondence with Regulatory Agency

UTRCA Benthic Sampling Data

Taxonomic Name	Common Name	Life Stage	# in Subsample	Biotic Index

Foster Drain

Karn Road, Centreville

Site code: SO28 UTM X: 511802 UTM Y: 4766798

Sampled - 24/06/1997

REP: 1

Taxonomic Name	Common Name	Life Stage	# in Subsample	Biotic Index
Acariformes	Water Mite	A	1	6
Baetidae	Small Mayfly	N	9	6
Chironomidae	Midge	L	39	6
Chironomidae	Midge	P	2	6
Elmidae	Riffle Beetle	A	4	5
Elmidae	Riffle Beetle	L	8	5
Empididae	Dance Fly	L	2	6
Empididae	Dance Fly	P	1	6
Hydropsychidae	Net-spinning Caddisfly	L	6	5
Oligochaeta	Aquatic Worm	A	34	8

Stream Health **Fairly Poor** **Family Biotic Index** **6.47**

Sampled - 18/06/2003

REP: 1

Taxonomic Name	Common Name	Life Stage	# in Subsample	Biotic Index
Acariformes	Water Mite	A	7	6
Asellidae	Sow Bug	A	7	8
Athericidae	Snipe Fly	L	1	4
Baetidae	Small Mayfly	N	6	6
Ceratopogonidae	Biting Midge	L	1	6
Chironomidae	Midge	L	133	6
Chironomidae	Midge	P	10	6
Elmidae	Riffle Beetle	A	1	5
Elmidae	Riffle Beetle	L	10	5
Empididae	Dance Fly	P	1	6
Gammaridae	Sideswimmer	A	5	6
Gomphidae	Clubtail Dragonfly	N	1	4
Hyalellidae	Sideswimmer	A	5	8
Hydropsychidae	Net-spinning Caddisfly	L	1	5
Lepidostomatidae	Lepistomatid Caddisfly	L	1	1
Nematoda	Thread Worm	A	8	5
Nemouridae	Stonefly	N	1	2
Oligochaeta	Aquatic Worm	A	19	8
Pisidiidae	Fingernail Clam	A	34	6
Simuliidae	Black Fly	L	4	5
Tipulidae	Crane Fly	L	2	4

Stream Health **Fairly Poor** **Family Biotic Index** **6.08**

Sampled - 11/05/2015

REP: 1

Taxonomic Name	Common Name	Life Stage	# in Subsample	Biotic Index
Acariformes	Water Mite	A	2	6
Baetidae	Small Mayfly	N	41	6
Capniidae	Stonefly	N	2	3
Chironomidae	Midge	P	8	6
Chironomidae	Midge	L	150	6
Corydalidae	Dobsonfly	N	1	4
Elmidae	Riffle Beetle	A	2	5
Elmidae	Riffle Beetle	L	49	5
Empididae	Dance Fly	L	11	6
Heptageniidae	Stream Mayfly	N	8	3
Hydropsychidae	Net-spinning Caddisfly	L	17	5
Nematoda	Thread Worm	A	6	5

Taxonomic Name	Common Name	Life Stage	# in Subsample	Biotic Index
Nemouridae	Stonefly	N	18	2
Oligochaeta	Aquatic Worm	A	37	8
Philopotamidae	Finger-net Caddisfly	L	8	4
Pisidiidae	Fingernail Clam	A	1	6
Simuliidae	Black Fly	L	1	5
Simuliidae	Black Fly	P	1	5

Stream Health **Fair** **Family Biotic Index** **5.66**

Sampled - 22/09/2015

REP: 1

Acariformes	Water Mite	A	3	6
Baetidae	Small Mayfly	N	6	6
Caenidae	Crawling Mayfly	N	1	6
Chironomidae	Midge	P	15	6
Chironomidae	Midge	L	129	6
Corydalidae	Dobsonfly	N	2	4
Elmidae	Riffle Beetle	L	39	5
Elmidae	Riffle Beetle	A	8	5
Empididae	Dance Fly	L	1	6
Heptageniidae	Stream Mayfly	N	17	3
Hydropsychidae	Net-spinning Caddisfly	L	63	5
Oligochaeta	Aquatic Worm	A	23	8
Philopotamidae	Finger-net Caddisfly	L	33	4
Pisidiidae	Fingernail Clam	A	1	6
Psychomyiidae	Tube-making Caddisfly	L	2	2
Simuliidae	Black Fly	P	1	5
Simuliidae	Black Fly	L	7	5
Tipulidae	Crane Fly	L	8	4

Stream Health **Fair** **Family Biotic Index** **5.40**

Sampled - 04/05/2016

REP: 1

Acariformes	Water Mite	A	2	6
Baetidae	Small Mayfly	N	20	6
Capniidae	Stonefly	N	1	3
Chironomidae	Midge	L	119	6
Chironomidae	Midge	P	11	6
Corydalidae	Dobsonfly	N	1	4
Elmidae	Riffle Beetle	L	15	5
Elmidae	Riffle Beetle	A	1	5
Empididae	Dance Fly	L	5	6
Heptageniidae	Stream Mayfly	N	2	3
Hydropsychidae	Net-spinning Caddisfly	L	9	5
Nematoda	Thread Worm	A	2	5
Nemouridae	Stonefly	N	25	2
Oligochaeta	Aquatic Worm	A	80	8
Philopotamidae	Finger-net Caddisfly	L	2	4
Psychodidae	Sand Fly	L	1	10
Simuliidae	Black Fly	L	6	5

Stream Health **Fairly Poor** **Family Biotic Index** **6.05**

Patterson-Robbins Drain

East of Ingersoll

Site code: SO35 UTM X: 510093 UTM Y: 4768412

Sampled - 28/10/2003

REP: 1

Acariformes	Water Mite	A	3	6
Capniidae	Stonefly	N	2	3

Taxonomic Name	Common Name	Life Stage	# in Subsample	Biotic Index
Ceratopogonidae	Biting Midge	L	32	6
Chironomidae	Midge	P	2	6
Chironomidae	Midge	L	190	6
Elmidae	Riffle Beetle	A	1	5
Hydropsychidae	Net-spinning Caddisfly	L	4	5
Lymnaeidae	Pond Snail	A	10	6
Physidae	Pouch Snail	A	6	8
Simuliidae	Black Fly	L	2	5
Tipulidae	Crane Fly	L	2	4
	Stream Health	**Fairly Poor**	**Family Biotic Index**	**5.98**

Foldens Creek

downstream of dam, accessed from Mill Line

Site code: SO56 UTM X: 511483 UTM Y: 4766966

Sampled - 05/10/2010

REP: 1

Asellidae	Sow Bug	A	26	8
Capniidae	Stonefly	N	3	3
Chironomidae	Midge	L	21	6
Chironomidae	Midge	P	8	6
Elmidae	Riffle Beetle	A	2	5
Elmidae	Riffle Beetle	L	22	5
Empididae	Dance Fly	L	2	6
Gammaridae	Sideswimmer	A	94	6
Hydropsychidae	Net-spinning Caddisfly	L	48	5
Limnephilidae	Northern Caddisfly	L	1	4
Nematoda	Thread Worm	A	5	5
Oligochaeta	Aquatic Worm	A	2	8
Philopotamidae	Finger-net Caddisfly	L	2	4
Pisidiidae	Fingernail Clam	A	1	6
Planorbidae	Orb Snail	A	1	6
Tipulidae	Crane Fly	L	3	4
Turbellaria	Flatworm	A	3	6
Veliidae	Ripple Bug	A	1	-1
	Stream Health	**Fairly Poor**	**Family Biotic Index**	**5.83**

Sampled - 11/05/2015

REP: 1

Acariformes	Water Mite	A	2	6
Baetidae	Small Mayfly	N	11	6
Capniidae	Stonefly	N	4	3
Chironomidae	Midge	L	81	6
Chironomidae	Midge	P	16	6
Crangonyctidae	Sideswimmer	A	35	6
Elmidae	Riffle Beetle	L	11	5
Elmidae	Riffle Beetle	A	2	5
Empididae	Dance Fly	L	1	6
Heptageniidae	Stream Mayfly	N	1	3
Hydropsychidae	Net-spinning Caddisfly	L	47	5
Limnephilidae	Northern Caddisfly	L	1	4
Nematoda	Thread Worm	A	1	5
Nemouridae	Stonefly	N	2	2
Oligochaeta	Aquatic Worm	A	112	8
Philopotamidae	Finger-net Caddisfly	L	2	4
Simuliidae	Black Fly	L	1	5
	Stream Health	**Fairly Poor**	**Family Biotic Index**	**6.40**

Taxonomic Name	Common Name	Life Stage	# in Subsample	Biotic Index
Sampled - 22/09/2015				
	REP: 1			
Acariformes	Water Mite	A	28	6
Chironomidae	Midge	L	59	6
Chironomidae	Midge	P	4	6
Elmidae	Riffle Beetle	L	14	5
Gammaridae	Sideswimmer	A	3	6
Heptageniidae	Stream Mayfly	N	1	3
Hydropsychidae	Net-spinning Caddisfly	L	190	5
Nematoda	Thread Worm	A	2	5
Oligochaeta	Aquatic Worm	A	7	8
Philopotamidae	Finger-net Caddisfly	L	3	4
Planorbidae	Orb Snail	A	1	6
Pyralidae	Pyralid Moth	L	1	5
Simuliidae	Black Fly	L	2	5
Tipulidae	Crane Fly	L	3	4
Turbellaria	Flatworm	A	34	6
	Stream Health	**Fair**	**Family Biotic Index**	**5.40**
Sampled - 04/05/2016				
	REP: 1			
Acariformes	Water Mite	A	15	6
Asellidae	Sow Bug	A	10	8
Baetidae	Small Mayfly	N	2	6
Cambaridae	Crayfish	A	1	6
Capniidae	Stonefly	N	1	3
Chironomidae	Midge	P	21	6
Chironomidae	Midge	L	167	6
Elmidae	Riffle Beetle	L	4	5
Elmidae	Riffle Beetle	A	1	5
Empididae	Dance Fly	L	3	6
Gammaridae	Sideswimmer	A	25	6
Hydropsychidae	Net-spinning Caddisfly	L	20	5
Nemouridae	Stonefly	N	3	2
Oligochaeta	Aquatic Worm	A	47	8
Pisidiidae	Fingernail Clam	A	2	6
Simuliidae	Black Fly	L	7	5
Tipulidae	Crane Fly	L	1	4
Turbellaria	Flatworm	A	3	6
	Stream Health	**Fairly Poor**	**Family Biotic Index**	**6.20**

Benthic Samples were obtained using a Rapid Bioassessment Protocol developed by the United States Environmental Protection Agency and modified by Dr. Robert Bailey of the University of Western Ontario Zoology Department. A representative section of stream is selected, incorporating a riffle if present, and sampled by moving upstream along a diagonal transect, dislodging and capturing invertebrates with a .5 mm mesh "D"- frame net. Samples are preserved in the field and analyzed in the lab to randomly select a 100 bug subsample which is identified to the Family taxonomic level.

The biotic index is a value assigned to benthic invertebrate taxa indicating their pollution sensitivity and tolerance on a scale from 0 to 10. Lower numbers indicate pollution sensitivity and high numbers tolerance. A value of -1 indicates that no biotic index value has been assigned to these taxa.

The Family Biotic Index is the weighted average of the biotic index and number of bugs in each taxa in the sample. The water quality ranges for the FBI values are as follows: < 4.25 = Excellent; 4.25 - 5.00 = Good; 5.00 - 5.75 = Fair; 5.75 - 6.50 = Fairly Poor; 6.50 - 7.25 = Poor; and > 7.25 = Very Poor.

Report prepared - May-02-18

UTRCA (DFO, ROM, MNRF) Fish Sampling Records

Species (Common Name)	Scientific Name	Species at Risk (SAR) Status: Federal: COSEWIC	SARA	Provincial: ESA 2007	SRank	Thames Status: Abundance	Distribution

Patterson-Robbins Drain

Location Rd 64 & 35th Line **Site Code** SO35 **Sample Date** 28/10/2003

UTM x: 510093 UTM y: 4768412

Brook Stickleback	*Culaea inconstans*				S5	Abundant	Throughout

Location Rd 64 & 35th Line **Site Code** SO35 **Sample Date** 18/07/2012

UTM x: 510093 UTM y: 4768412

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Brook Stickleback	*Culaea inconstans*				S5	Abundant	Throughout
Creek Chub	*Semotilus atromaculatus*				S5	Abundant	Throughout
Fathead Minnow	*Pimephales promelas*				S5	Common	Throughout

Patterson-Robbins Drain

Location Road 62 (North Town Line E) **Site Code** 1583-UT **Sample Date** 16/05/2000

UTM x: 510103 UTM y: 4766823

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Brook Stickleback	*Culaea inconstans*				S5	Abundant	Throughout
Creek Chub	*Semotilus atromaculatus*				S5	Abundant	Throughout
Johnny Darter	*Etheostoma nigrum*				S5	Abundant	Throughout
Northern Redbelly Dace	*Phoxinus eos*				S5	Common	Throughout
White Sucker	*Catostomus commersoni*				S5	Abundant	Throughout

Location Road 62 (North Town Line E) **Site Code** 1583-UT **Sample Date** 02/06/2015

UTM x: 510103 UTM y: 4766823

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Brook Stickleback	*Culaea inconstans*				S5	Abundant	Throughout
Central Stoneroller	*Campostoma anomalum*				S4	Abundant	Throughout
Creek Chub	*Semotilus atromaculatus*				S5	Abundant	Throughout
Johnny Darter	*Etheostoma nigrum*				S5	Abundant	Throughout
White Sucker	*Catostomus commersoni*				S5	Abundant	Throughout

Unknown

Location Ingersoll, beside Stelco Chemical Works **Site Code** R290 **Sample Date** 23/07/1974

UTM x: 510858 UTM y: 4766598

Stonecat	*Noturus flavus*				S4	Common	Throughout

Foldens Creek

Location Beachville Road **Site Code** 7634-UT **Sample Date** 07/06/2012

UTM x: 511319 UTM y: 4767067

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Creek Chub	*Semotilus atromaculatus*				S5	Abundant	Throughout
Fantail Darter	*Etheostoma flabellare*				S4	Abundant	Throughout
White Sucker	*Catostomus commersoni*				S5	Abundant	Throughout

Species (Common Name)	Scientific Name	Species at Risk (SAR) Status Federal COSEWIC	SARA	Provincial ESA 2007	SRank	Thames Status Abundance	Distribution

Foldens Creek

Location accessed from Mill Line below dam **Site Code** SO56 **Sample Date** 02/06/2015

UTM x: 511483 UTM y: 4766966

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Brown Trout	*Salmo trutta*				SNA	Uncommon	Localized
Creek Chub	*Semotilus atromaculatus*				S5	Abundant	Throughout
Fantail Darter	*Etheostoma flabellare*				S4	Abundant	Throughout
White Sucker	*Catostomus commersoni*				S5	Abundant	Throughout

Foldens Creek

Location Mill Line upstream of pond **Site Code** SO24 **Sample Date** 02/06/2015

UTM x: 511653 UTM y: 4766729

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Bluntnose Minnow	*Pimephales notatus*				S5	Abundant	Throughout
Common Shiner	*Luxilus cornutus*				S5	Abundant	Throughout
Creek Chub	*Semotilus atromaculatus*				S5	Abundant	Throughout
White Sucker	*Catostomus commersoni*				S5	Abundant	Throughout

Foldens Creek

Location Karn Road **Site Code** SO28 **Sample Date** 07/07/1993

UTM x: 511802 UTM y: 4766798

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Brook Stickleback	*Culaea inconstans*				S5	Abundant	Throughout
Creek Chub	*Semotilus atromaculatus*				S5	Abundant	Throughout
White Sucker	*Catostomus commersoni*				S5	Abundant	Throughout

Location Karn Road **Site Code** SO28 **Sample Date** 18/06/2003

UTM x: 511802 UTM y: 4766798

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Brook Stickleback	*Culaea inconstans*				S5	Abundant	Throughout

Foldens Creek

Location Clarke Road **Site Code** 6970-UT **Sample Date** 29/08/2002

UTM x: 513461 UTM y: 4766324

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Bluntnose Minnow	*Pimephales notatus*				S5	Abundant	Throughout
Brook Stickleback	*Culaea inconstans*				S5	Abundant	Throughout
Common Shiner	*Luxilus cornutus*				S5	Abundant	Throughout
Creek Chub	*Semotilus atromaculatus*				S5	Abundant	Throughout
White Sucker	*Catostomus commersoni*				S5	Abundant	Throughout

Location Clarke Road **Site Code** 6970-UT **Sample Date** 07/06/2012

UTM x: 513461 UTM y: 4766324

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Bluntnose Minnow	*Pimephales notatus*				S5	Abundant	Throughout
Brook Stickleback	*Culaea inconstans*				S5	Abundant	Throughout
Brown Trout	*Salmo trutta*				SNA	Uncommon	Localized
Creek Chub	*Semotilus atromaculatus*				S5	Abundant	Throughout
White Sucker	*Catostomus commersoni*				S5	Abundant	Throughout

		Species at Risk (SAR) Status				Thames Status	
		Federal		Provincial			
Species (Common Name)	**Scientific Name**	**COSEWIC**	**SARA**	**ESA 2007**	**SRank**	**Abundance**	**Distribution**

Location Clarke Road **Site Code** 6970-UT **Sample Date** 25/07/2014

UTM x: 513461 UTM y: 4766324

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Bluntnose Minnow	*Pimephales notatus*				S5	Abundant	Throughout
Brook Stickleback	*Culaea inconstans*				S5	Abundant	Throughout
Brown Trout	*Salmo trutta*				SNA	Uncommon	Localized
Creek Chub	*Semotilus atromaculatus*				S5	Abundant	Throughout
White Sucker	*Catostomus commersoni*				S5	Abundant	Throughout

Foldens Creek

Location D/S of 401 **Site Code** SO27 **Sample Date** 21/07/2006

UTM x: 514069 UTM y: 4766175

Blacknose Dace	*Rhinichthys atratulus*				S5	Abundant	Throughout
Brook Stickleback	*Culaea inconstans*				S5	Abundant	Throughout
Creek Chub	*Semotilus atromaculatus*				S5	Abundant	Throughout
White Sucker	*Catostomus commersoni*				S5	Abundant	Throughout

		Species at Risk (SAR) Status				Thames Status	
		Federal		Provincial			
Species (Common Name)	**Scientific Name**	**COSEWIC**	**SARA**	**ESA 2007**	**SRank**	**Abundance**	**Distribution**

COSEWIC Status: The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses species for their consideration for legal protection and recovery (or management) under the Species at Risk Act (SARA).

Extinct: A wildlife species that no longer exists.
Extirpated: A wildlife species no longer existing in the wild in Canada, but exists elsewhere.
Endangered: A wildlife species facing imminent extirpation or extinction.
Threatened: A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern: A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk: A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient: A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction.

Reference: www.cosewic.gc.ca (current to November 2011)

SARA Status: The federal at risk designation for species under the Species at Risk Act (SARA)
Reference: www.sararegistry.gc.ca (current to December 2011)

ESA 2007 / SARO Status: Species at Risk in Ontario (SARO) are designated by the Ontario Ministry of Natural Resources (OMNR) in accordance with the provincial Endangered Species Act (ESA) through the Committee on the Status of Species at Risk in Ontario (COSSARO).

Extirpated: A native species that no longer exists in the wild in Ontario but still occurs elsewhere.
Endangered: A native species facing imminent extinction or extirpation in Ontario.
Threatened: A native species that is at risk of becoming endangered in Ontario.
Special Concern: A native species that is sensitive to human activities or natural events which may cause it to become endangered or threatened.

Reference: www.ontario.ca/speciesatrisk (current to January 2012)

Provincial Rank (SRANK): Provincial (or Subnational) ranks are used by the Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities. These ranks are assigned to consider only those factors within the political boundaries of Ontario.

SX Presumed Extirpated: Species or community is believed to be extirpated from the nation or state/province. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
SH Possibly Extirpated (Historical): Species or community occurred historically in the nation or state/province, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20-40 years. A species or community could become NH or SH without such a 20-40 year delay if the only known occurrences in a nation or state/province were destroyed or if it had been extensively and unsuccessfully looked for. The NH or SH rank is reserved for species or communities for which some effort has been made to relocate occurrences, rather than simply using this status for all elements not known from verified extant occurrences.
S1 Critically Imperiled: Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
S2 Imperiled: Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
S3 Vulnerable: Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4 Apparently Secure: Uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5 Secure: Common, widespread, and abundant in the nation or state/province.
SNR Unranked: Nation or state/province conservation status not yet assessed.
SU Unrankable: Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
SNA Not Applicable: A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
S#S# Range Rank: A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).

Reference: http://nhic.mnr.gov.on.ca/MNR/nhic/nhic.cfm (current to March 2012)

Abundance: Refers to the relative abundance of the species found within the waters of the Upper Thames River watershed based on sampling results. Some species may be underrepresented as they are difficult to capture with commonly used sampling methods.
Abundant: Occurred in >25% of the sampling records
Common: Occurred in 10-25% of the samples
Uncommon: Occurred in <10% of the samples

Distribution: Based on the number of Upper Thames Watershed Report Card subwatersheds in which a species has been recorded.
Throughout: Recorded in >20 subwatersheds
Widespread: Recorded in 10-20 subwatersheds
Localized: Recorded in <10 subwatersheds

		Species at Risk (SAR) Status				Thames Status	
		Federal		Provincial			
Species (Common Name)	Scientific Name	COSEWIC	SARA	ESA 2007	SRank	Abundance	Distribution

Prepared - May-02-18

From:	Boyko, Amy
To:	Taco den Haas
Cc:	Jo-Anne Lane; Blair Kimble
Subject:	RE: SAR Freshwater Mussel Consultation - Landfill Project - Walker Environmental Township of Zorra (BEL217238)
Date:	March 23, 2018 1:23:09 PM

Hi Taco,

Apologies for the delay in responding to you. I've had a look at information you sent and compared it to the information we have regarding SAR species in that area. We have records (fishes and mussels) up and downstream of your project area but no records actually in it. As there are no SAR records within the area you will be surveying, you don't need a SARA permit from us. However, if the point of the work is to get baseline data, we strongly recommend that, along with the fish surveys, you do a timed-search for mussels within the project boundaries as well (not a relocation, just a search). Mussels are an important component of the ecosystem and having this information would strengthen your results.

Please let me know if you have any other questions,

Thanks,
Amy

From: Taco den Haas [mailto:tdenhaas@beaconenviro.com]
Sent: March 19, 2018 2:42 PM
To: Boyko, Amy
Cc: Jo-Anne Lane; Blair Kimble
Subject: SAR Freshwater Mussel Consultation - Landfill Project - Walker Environmental Township of Zorra (BEL217238)

Hello Amy:

This is in regards to our telephone discussion a couple weeks ago. For your information I have attached the application we made for a MNRF scientific collection permit as well as the Wildlife Scientific Collectors Authorization application. We are proposing to complete fish community surveys in two tributaries of the Thames River shown in the figures included in the applications.

At this time we want to consult with DFO to determine if you have any concerns with the proposed sampling program in regards to the protection of species at risk freshwater mussels.

Thanks and don't hesitate to contact myself directly if you have any question or if you want to discuss.

Taco den Haas, M.Sc. CISEC 0377 / Aquatic Ecologist
BEACON ENVIRONMENTAL

80 Main St. North, Markham, ON L3P 1X5
T) 905.201.7622 x239 F) 905.201.0639 C) 647.205.5738
www.beaconenviro.com

From: Blair Kimble
Sent: Monday, March 19, 2018 1:56 PM
To: 'MNRF.Ayl.Planners@ontario.ca' <MNRF.Ayl.Planners@ontario.ca>
Cc: Taco den Haas <tdenhaas@beaconenviro.com>
Subject: Fish and Wildlife Scientific Collectors Permit

Good Afternoon Adam,

Attached are PDF packages detailing the applications for scientific collectors permits (both fish and wildlife) on a site in Oxford County. I am reaching out to you as you were the Aylmer MNRF contact who provided our organization (Beacon Environmental) with a SAR inquiry on the Southwestern Landfill EA earlier this year.

I have reached out to the Aylmer Office multiple times through phone but was unable to determine whether you were the appropriate contact to send this application package to. If you are not, please let me know and I can adjust accordingly.

Thanks,

Blair

Blair Kimble / Aquatic Ecologist
Beacon Environmental
80 Main Street North, Markham, ON L3P 1X5
T) 905.201.7622 x247 F) 905.201.0639 C) 647.400.3073
www.beaconenviro.com

Appendix B

Aquatic Sampling Site Coordinates

Appendix B

Southwestern Landfill Environmental Assessment

Aquatic Sampling Sites Coordinates

Site	Upstream (UTM WGS 84)	Downstream (UTM WGS 84)
1	17T 512287 4768589	17T 512206 4768555
2	17T 511637 4766729	17T 511539 4766781
3	17T 510030 4765865	17T 510030 4765869
4	17T 510094 4766862	17T 510095 4766836
5	17T 510128 4767956	17T 510165 4767941
6	17T 509970 4768772	17T 509980 4768737
7	17T 510042 4769716	17T 510017 4769682

Appendix C

Aquatic Habitat and Fish Species Voucher Photos

Appendix C

Southwestern Landfill Environmental Assessment
Aquatic Habitat Photographs

Site 1

Photograph 1.
Transect 2 Upstream View

Photograph 2.
Transect 2 Downstream View

Photograph 3.
Transect 4 Upstream View

Photograph 4.
Transect 4 Downstream View

Site 2

Photograph 5.
Transect 2 Upstream View

Photograph 6.
Transect 2 Downstream View

Photograph 7.
Transect 4 Upstream View

Photograph 8.
Transect 4 Downstream View

Site 3

Photograph 9.
Transect 2 Upstream View

Photograph 10.
Transect 2 Downstream View

Photograph 11.
Transect 4 Upstream View

Photograph 12.
Transect 4 Downstream View

Site 4

Photograph 13.
Transect 2 Upstream View

Photograph 14.
Transect 2 Downstream View

Photograph 15.
Transect 4 Upstream View

Photograph 16.
Transect 4 Downstream View

Site 5

Photograph 17.
Transect 2 Upstream View

Photograph 18.
Transect 2 Downstream View

Photograph 19.
Transect 4 Upstream View

Photograph 20.
Transect 4 Downstream View

Site 6

Photograph 21.
Transcect 2 Upstream View

Photograph 22.
Transect 2 Downstream View

Photograph 23.
Transect 4 Upstream View

Photograph 24.
Transect 4 Downstream View

Site 7

Photograph 25.
Transect 2 Upstream View

Photograph 26.
Transect 2 Downstream View

Photograph 27.
Transect 4 Upstream View

Photograph 28.
Transect 4 Downstream View

Site 8

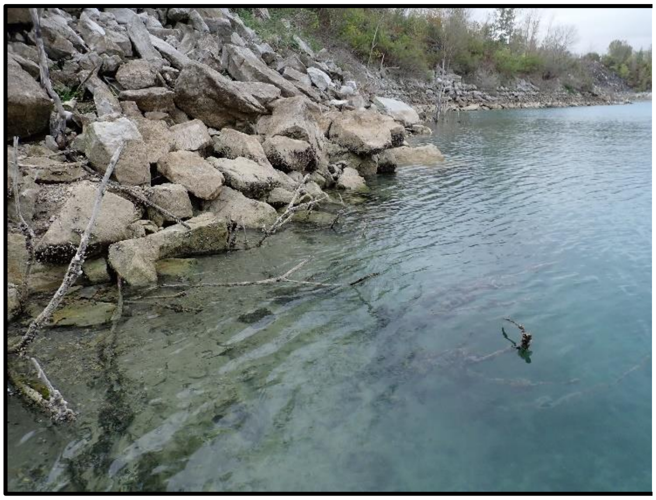
Photograph 29.
View of Northeastern Shoreline

Photograph 30.
View of Northwestern Shoreline

Photograph 31.
View of Southeastern Shoreline

Photograph 32.
View of Southwestern Shoreline

Site 8



Photograph 33.
Representative Characteristics of Northeastern Shoreline

Photograph 34.
Representative Characteristics of Northwestern Shoreline

Photograph 35.
Representative Characteristics of Eastern Shoreline

Photograph 36.
Representative Characteristics of Western Shoreline

Site 8

Photograph 33.
Representative Characteristics of Southeastern Shoreline

Photograph 34.
Representative Characteristics of Southwestern Shoreline

Photograph 35.
Historic Access Road Along Northwestern Shoreline

Photograph 36.
Beach Area Along Northeastern Shoreline

Southwestern Landfill Environmental Assessment
Fish Voucher Photographs

Photograph 1.
Blacknose Dace - *Rhinichthys atratulus*

Photograph 2.
Blackside Darter - *Percina maculate*

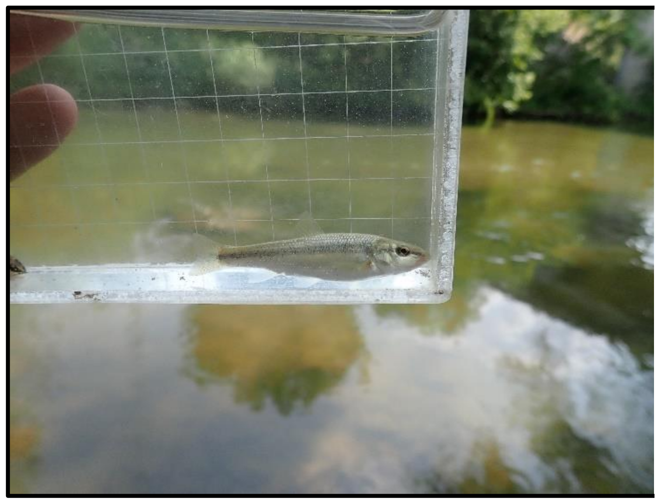
Photograph 3.
Bluegill - *Lepomis macrochirus*

Photograph 4.
Bluntnose Minnow - *Pimephales notatus*

Photograph 5.
Brassy Minnow - *Hybognathus hakinsoni*

Photograph 6.
Brook Stickleback - *Culaea inconstans*

Photograph 7.
Brown Trout - *Salmo trutta*



Photograph 8.
Central Stoneroller - Campostoma anomalum

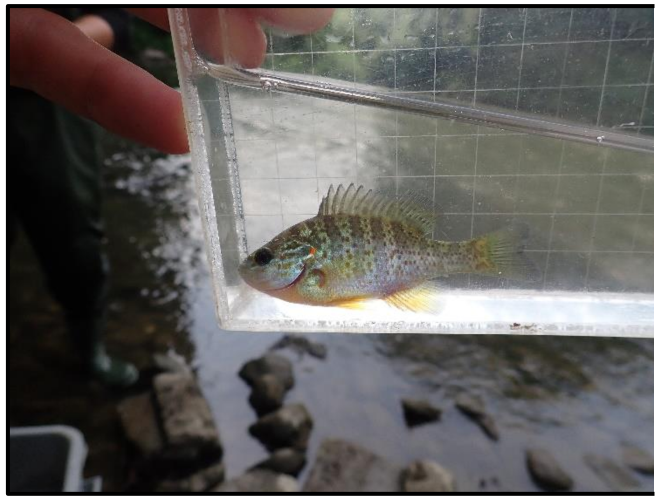
Photograph 9.
Common Shiner – *Luxilus cornutus*

Photograph 10.
Creek Chub - *Semotilus atromaculatus*

Photograph 11.
Fantail Darter - *Etheostoma flabellare*

Photograph 12.
Greenside Darter - *Etheostoma blennioides*

Photograph 13.
Johnny Darter - *Etheostoma nigrum*



Photograph 14.
Pumpkinseed - *Lepomis gibbosus*

Photograph 15.
Greenside Darter - *Etheostoma blennioides*

Photograph 16.
Rainbow Darter - *Etheostoma caeruleum*

Photograph 17.
Rock Bass - *Ambloplites rupestris*

Photograph 18.
Smallmouth Bass - *Micropterus dolomieu*

Appendix D

Aquatic Habitat Observations

Appendix D

Southwestern Landfill Environmental Assessment
Aquatic Habitat Observations

Location / Transect	Bank Full Width (cm)	Wetted Width (m)	Bank Full Depth Maximum (cm)	Wetted Depth Maximum (cm)	Substrate (predominant)	Morphology (predominant)	Hydraulic Head (mm)	Velocity (m/s)[1]	Left Bank Angle (degrees)	Right Bank Angle (degrees)	Low Canopy Closure (%)	High Canopy Closure (%)
1-1	n/a	18	n/a	54	Cobble	Run	-	<1.0	~45	~45	<1	20
1-2	n/a	18	n/a	63	Boulder	Run	-	<1.0	~45	~45	<1	20
1-3	n/a	18	n/a	80	Gravel	Run	-	<1.0	~45	~45	<1	20
1-4	n/a	18	n/a	95	Gravel	Run	-	<1.0	~45	~45	<1	20
1-5	n/a	18	n/a	98	Gravel	Run	-	<1.0	~45	~45	<1	20
2-1	365	282	59	53	Silt	Run	15	0.5	>45	>45	~20	~20
2-2	410	305	95	60	Silt	Run	10	0.4	>45	>45	~10	100
2-3	410	338	77	51	Silt	Run	10	0.4	~45	~45	~15	~10
2-4	800	710	96	55	Silt	Run	10	0.4	~20	>45	~30	~10
2-5	500	395	73	54	Detritus	Run	13	0.5	>45	>45	0	~5
3-1	n/a	16.1	n/a	99	Boulder	Run	35	0.8	~45	~45	<1	5
3-2	n/a	15	n/a	48	Cobble	Run	55	1	~45	~45	<1	5
3-3	n/a	16.7	n/a	59	Cobble	Run	15	0.5	~45	~45	<1	5
3-4	n/a	16.5	n/a	64	Cobble	Run	25	0.7	~45	~45	<1	5
3-5	n/a	17.4	n/a	91	Cobble	Run	0	0	~45	~45	<1	5
4-1	530	350	63	29	Gravel	Run	15	0.5	~45	~45	~5	~50
4-2	540	210	50	24	Boulder	Run	55	1	<30	>45	~5	~50
4-3	360	290	69	46	Boulder	Run	0	0	>60	>60	0	~30
4-4	420	330	50	16	Cobble	Run	20	0.6	>60	>60	0	~10
4-5	500	275	65	25	Gravel	Run	35	0.8	>60	~45	~10	~50
5-1	470	340	60	22	Clay	Run	0	0	~45	~45	0	~10
5-2	540	290	55	15	Sand	Riffle	25	0.7	~45	<30	~10	~20
5-3	485	285	51	15	Sand	Run	10	0.4	<30	<30	0	~20
5-4	400	255	45	19	Sand	Run	5	0.3	~45	<30	10	20
5-5	497	330	57	21	Clay	Run	0	0	~45	~45	~10	~20
6-1	175	150	60	32	Sand	Run	10	0.4	>60	>60	~10	0
6-2	230	120	50	12	Sand	Run	50	1	>60	>60	0	~20
6-3	135	115	70	39	Sand	Run	5	0.3	>60	>60	0	0
6-4	140	135	58	23	Sand	Run	10	0.4	>60	>60	~5	0
6-5	150	130	51	18	Sand	Riffle	30	0.8	>60	>60	~10	~30
7-1	116	88	41	18	Sand	Run	10	0.4	>60	>60	~5	0

Location / Transect	Bank Full Width (cm)	Wetted Width (m)	Bank Full Depth Maximum (cm)	Wetted Depth Maximum (cm)	Substrate (predominant)	Morphology (predominant)	Hydraulic Head (mm)	Velocity (m/s)[1]	Left Bank Angle (degrees)	Right Bank Angle (degrees)	Low Canopy Closure (%)	High Canopy Closure (%)
7-2	168	118	57	29	Gravel	Run	5	0.3	>60	>60	0	0
7-3	165	105	47	17	Clay	Run	5	0.3	>60	>60	~50	0
7-4	205	80	47	18	Sand	Run	10	0.5	>60	>60	~20	0
7-5	200	122	41	17	Clay	Run	5	0.3	>60	>60	~60	0

1) Velocity derived from hydraulic head except at Site 1 where velocity was estimated visually

Appendix E

Backpack Electrofishing Effort, Catches and Fish Length and Width

Appendix E

Southwestern Landfill Environmental Assessment
Backpack Electrofishing Effort, Catches and Fish Length and Width

Common Name	Scientific Name	Spring/Summer Sampling		Fall Sampling	
		Number of Fish	Length (mm)/Min-Max	Number of Fish	Length (mm)/Min-Max
Location 1					
Blacknose Dace	*Rhinichthys atratulus*	1	60		
Blackside Darter	*Percina maculate*	3	56-60		
Bluntnose Minnow	*Pimephales notatus*	3	50-55		
Brassy Minnow	*Hybognathus hakinsoni*	2	50-55		
Central Stoneroller	*Campostoma anomalum*	2	50-55		
Creek Chub	*Semotilus atromaculatus*	2	49-55		
Greenside Darter	*Etheostoma blennioides*	40	40-88		
Johnny Darter	*Etheostoma nigrum*	31	39-70		
Rainbow Darter	*Etheostoma caeruleum*	5	39-40		
Rock Bass	*Ambloplites rupestris*	4	23-28		
Smallmouth Bass	*Micropterus dolomieu*	1	88		
White Sucker	*Catostomus commersonii*	1	56		
Location 2					
Blacknose Dace	*Rhinichthys atratulus*	48	38-76	22	60-77
Bluntnose Minnow	*Pimephales notatus*	16	51-81	8	53-80
Brown Trout	*Salmo trutta*	0	-	1	215
Creek Chub	*Semotilus atromaculatus*	63	52-123	105	54-173
Fantail Darter	*Etheostoma flabellare*	1	77	-	-
White Sucker	*Catostomus commersonii*	21	57-227	26	85-268
Location 3					
Blackside Darter	*Percina maculate*	2	55-92		
Bluegill	*Lepomis macrochirus*	1	82		
Bluntnose Minnow	*Pimephales notatus*	7	40-80		
Brassy Minnow	*Hybognathus hakinsoni*	2	50-55		
Central Stoneroller	*Campostoma anomalum*	2	50-55		

Common Name	Scientific Name	Spring/Summer Sampling		Fall Sampling	
		Number of Fish	Length (mm)/Min-Max	Number of Fish	Length (mm)/Min-Max
Common Shiner	*Luxilus cornutus*	4	72-112		
Creek Chub	*Semotilus atromaculatus*	7	40-72		
Fantail Darter	*Etheostoma flabellare*	6	53-88		
Greenside Darter	*Etheostoma blennioides*	63	37-94		
Johnny Darter	*Etheostoma nigrum*	35	38-51		
Pumpkinseed	*Lepomis gibbosus*	2	72-80		
Rainbow Darter	*Etheostoma caeruleum*	26	34-64		
Rock Bass	*Ambloplites rupestris*	10	102-183		
White Sucker	*Catostomus commersonii*	1	55		
Location 4					
Blacknose Dace	*Rhinichthys atratulus*	53	49-76	62	44-128
Blacknose Dace YOY	*Rhinichthys atratulus*	-	-	31	Not Measured
Brook Stickleback	*Culaea inconstans*	3	45-52	6	40-43
Creek Chub	*Semotilus atromaculatus*	18	63-130	48	40-116
Creek Chub YOY	*Semotilus atromaculatus*	-	-	57	Not Measured
Johnny Darter	*Etheostoma nigrum*	-	-	6	36-56
Johnny Darter YOY	*Etheostoma nigrum*	-	-	1	Not Measured
White Sucker	*Catostomus commersonii*	1	50	7	44-109
Location 5					
Blacknose Dace	*Rhinichthys atratulus*	230	44-79	95	44-83
Blacknose Dace YOY	*Rhinichthys atratulus*	-	-	61	-
Brook Stickleback	*Culaea inconstans*	15	37-55	6	38-41
Creek Chub	*Semotilus atromaculatus*	4	39-53	19	36-64
Creek Chub YOY	*Semotilus atromaculatus*	-	-	93	-
Johnny Darter	*Etheostoma nigrum*	-	-	3	40-42
White Sucker	*Catostomus commersonii*	6	44-52	38	37-53
White Sucker YOY	*Catostomus commersonii*	-	-	8	-
Location 6					
Blacknose Dace	*Rhinichthys atratulus*	29	48-80	37	42-56
Blacknose Dace YOY	*Rhinichthys atratulus*	1	-	57	-
Brook Stickleback	*Culaea inconstans*	44	31-56	55	43-54

Common Name	Scientific Name	Spring/Summer Sampling		Fall Sampling	
		Number of Fish	Length (mm)/Min-Max	Number of Fish	Length (mm)/Min-Max
Brook Stickleback YOY	*Culaea inconstans*	-	-	9	-
Creek Chub	*Semotilus atromaculatus*	119	31-127	120	51-96
Creek Chub YOY	*Semotilus atromaculatus*	-	-	80	-
Location 7					
Blacknose Dace	*Rhinichthys atratulus*	5	54-79	4	33-62
Blacknose Dace YOY	*Rhinichthys atratulus*	-	-	12	-
Brook Stickleback	*Culaea inconstans*	6	21-39	10	29-48
Brook Stickleback YOY	*Culaea inconstans*	-	-	5	-
Creek Chub	*Semotilus atromaculatus*	2	27-94	79	34-99
Creek Chub YOY	*Semotilus atromaculatus*	-	-	15	-
Location 8					
Rock Bass	*Ambloplites rupestris*	12	32-91		

Southwestern Landfill Environmental Assessment
Backpack Electrofishing Effort

Location	Pass	Date	Time (Start End)	Seconds	Volts	Frequency	Netters
1	1	August 15	10:20-10:32	1386	200	60	2
1	2	August 15	11:21-11:38	1265	200	60	2
2	1	May 8	09:30-10:00	1030	175	45	1
2	2	May 8	10:30-11:00	830	175	45	1
2	3	May 8	11:30-12:00	786	175	45	1
2	1	September 18	11:10-12:00	1218	125	50	1
2	2	September 18	13:30-14:10	1117	125	50	1
2	3	September 18	14:30-15:00	1046	125	50	1
3	1	August 14	13:57-14:12	431	200	60	2
3	2	August 14	14:50-15:14	904	200	60	2
4	1	May 10	11:00-11:25	1225	160	50	1
4	2	May 10	12:00-12:25	905	160	50	1
4	1	September 19	08:45-09:20	1058	170	70	1
4	2	September 19	10:00-10:30	805	170	70	1
4	3	September 19	10:50-11:10	691	170	70	1
5	1	May 11	09:00-09:30	1135	130	30	1
5	2	May 11	10:06-10:30	1097	130	30	1
5	3	May 11	10:50-11:05	675	130	30	1
5	1	September 19	12:45-13:15	956	170	70	1
5	2	September 19	13:45-14:15	843	170	70	1
6	1	May 9	14:00-14:25	866	180	70	1
6	2	May 9	14:50-15:10	574	180	70	1
6	3	May 9	15:20-15:40	544	180	70	1
6	1	September 20	09:20-09:50	647	170	70	1
6	2	September 20	10:30-10:55	581	170	70	1
7	1	May 9	09:00-09:25	744	130	45	1
7	2	May 9	09:40-10:00	640	130	45	1
7	1	October 3	09:15-10:00	1062	190	60	1
7	2	October 3	10:45-11:00	787	190	60	1
7	3	October 3	11:10-11:30	680	190	60	1

Southwestern Landfill Environmental Assessment
Fish Species Catch Summary

Location	Season	Pass	Blacknose Dace (*Rhinichthys atratulus*)	Blacknose Dace YOY (*Rhinichthys atratulus*)	Blackside Darter (*Percina maculata*)	Bluegill (*Lepomis macrochirus*)	Bluntnose Minnow (*Pimephales notatus*)	Brassy Minnow (*Hybognathus hakinsoni*)	Brook Stickleback (*Culaea inconstans*)	Brook Stickleback YOY (*Culaea inconstans*)	Brown Trout (*Salmo trutta*)	Central Stoneroller (*Campostoma anomalum*)	Common Shiner (*Luxilus cornutus*)	Creek Chub (*Semotilus atromaculatus*)	Creek Chub YOY (*Semotilus atromaculatus*)	Fantail Darter (*Etheostoma flabellare*)	Greenside Darter (*Etheostoma blennioides*)	Johnny Darter (*Etheostoma nigrum*)	Johnny Darter YOY (*Etheostoma nigrum*)	Pumpkinseed (*Lepomis gibbosus*)	Rainbow Darter (*Etheostoma caeruleum*)	Rock Bass (*Ambloplites rupestris*)	Smallmouth Bass (*Micropterus dolomieu*)	White Sucker (*Catostomus Comersonii*)	White Sucker (*Catostomus Comersonii*)
1	AUG	1	1		2		3	1				1		2			30	14			5		1	1	
1	AUG	2			1												10	17				4			
2	MAY	1	23				5							30										12	
2	MAY	2	17				4							24										6	
2	MAY	3	8				7							9		1								3	
2	SEP	1	11											54										14	
2	SEP	2	7								1			31										10	
2	SEP	3	4				8							20										2	
3	AUG	1			2		7	1				1	4	7		6	63	35			26	10		1	
3	AUG	2				1														2					
4	MAY	1	42						3					12										1	
4	MAY	2	11											6											
4	MAY	3																							

Location	Season	Pass	Blacknose Dace (*Rhinichthys atratulus*)	Blacknose Dace YOY (*Rhinichthys atratulus*)	Blackside Darter (*Percina maculata*)	Bluegill (*Lepomis macrochirus*)	Bluntnose Minnow (*Pimephales notatus*)	Brassy Minnow (*Hybognathus hakinsoni*)	Brook Stickleback (*Culaea inconstans*)	Brook Stickleback YOY (*Culaea inconstans*)	Brown Trout (*Salmo trutta*)	Central Stoneroller (*Campostoma anomalum*)	Common Shiner (*Luxilus cornutus*)	Creek Chub (*Semotilus atromaculatus*)	Creek Chub YOY (*Semotilus atromaculatus*)	Fantail Darter (*Etheostoma flabellare*)	Greenside Darter (*Etheostoma blennioides*)	Johnny Darter (*Etheostoma nigrum*)	Johnny Darter YOY (*Etheostoma nigrum*)	Pumpkinseed (*Lepomis gibbosus*)	Rainbow Darter (*Etheostoma caeruleum*)	Rock Bass (*Ambloplites rupestris*)	Smallmouth Bass (*Micropterus dolomieu*)	White Sucker (*Catostomus Comersonii*)	White Sucker (*Catostomus Comersonii*)
4	SEP	1	36	17					2					31	45			4	14					6	
4	SEP	2	13	10					4					9	6			1							
4	SEP	3	13	4										8	6			1						1	
5	MAY	1	124						7					3										2	
5	MAY	2	73						7					1										4	
5	MAY	3	33						1																
5	SEP	1	62	45					3					14	58									26	
5	SEP	2	33	16					3					5	37									12	8
5	SEP	3																							
6	MAY	1	16	1					17					82											
6	MAY	2	6						12					21											
6	MAY	3	7						15					16											
6	SEP	1	28	48					33		3			80	57										
6	SEP	2	9	9					23		6			30	23										
6	SEP	3																							
7	MAY	1	4						5					1											
7	MAY	2	1						1					1											
7	MAY	3																							

Location	Season	Pass	Blacknose Dace (*Rhinichthys atratulus*)	Blacknose Dace YOY (*Rhinichthys atratulus*)	Blackside Darter (*Percina maculata*)	Bluegill (*Lepomis macrochirus*)	Bluntnose Minnow (*Pimephales notatus*)	Brassy Minnow (*Hybognathus hakinsoni*)	Brook Stickleback (*Culaea inconstans*)	Brook Stickleback YOY (*Culaea inconstans*)	Brown Trout (*Salmo trutta*)	Central Stoneroller (*Campostoma anomalum*)	Common Shiner (*Luxilus cornutus*)	Creek Chub (*Semotilus atromaculatus*)	Creek Chub YOY (*Semotilus atromaculatus*)	Fantail Darter (*Etheostoma flabellare*)	Greenside Darter (*Etheostoma blennioides*)	Johnny Darter (*Etheostoma nigrum*)	Johnny Darter YOY (*Etheostoma nigrum*)	Pumpkinseed (*Lepomis gibbosus*)	Rainbow Darter (*Etheostoma caeruleum*)	Rock Bass (*Ambloplites rupestris*)	Smallmouth Bass (*Micropterus dolomieu*)	White Sucker (*Catostomus Comersonii*)	White Sucker (*Catostomus Comersonii*)
7	SEP	1	3	7					7	5				35	9										
7	SEP	2		4					3					30	5										
7	SEP	3	1	1										14	1										
8	SEP	n/a																				12			

Appendix F

Benthic Data

Appendix F

Southwestern Landfill
Benthic Data

Location		1	3	2	4	5	6	7
DATE		**18.08.14**	**18.08.15**	**18.05.08**	**18.05.10**	**18.05.11**	**18.05.10**	**18.05.09**
% Subsampled		21	15	13.5	7.5	13.4	6.25	4.2
TAXA LIST	**HBI**							
ANNELIDA:HIRUDINEA:								
ERPOBDELLIDAE:								
Erpobdella	8	1	5					
ANNELIDA:OLIGOCHAETA								
ENCHYTRAEIDAE:	10			1				
LUMBRICIDAE:								
Eiseniella tetraedra	10			2	8	17	5	1
LUMBRICULIDAE:								
Stylodrilus herringianus	8		8					
TUBIFICIDAE:								
with hairs	10	1		2				
without hairs	10	7	2	4		1		
Branchiura sowerbyi	6	7						
CRUSTACEA:AMPHIPODA:								
CRANGONYCTIDAE:								
Crangonyx	6	1		1	1		1	1
GAMMARIDAE:								
Gammarus pseudolimnaeus	4	8	8					
HYALELLIDAE:								
Hyalella azteca	8	1				3		
CRUSTACEA:DECAPODA:								
CAMBARIDAE:								
Cambarus (juveniles)	6					1		

Location		1	3	2	4	5	6	7
DATE		**18.08.14**	**18.08.15**	**18.05.08**	**18.05.10**	**18.05.11**	**18.05.10**	**18.05.09**
% Subsampled		21	15	13.5	7.5	13.4	6.25	4.2
TAXA LIST	**HBI**							
CRUSTACEA:ISOPODA:								
ASELLIDAE:								
Caecidotea intermedius	8	9	2					2
INSECTA:								
COLEOPTERA:								
ELMIDAE:								
Dubiraphia quadrinotata	5	3				1	2	
Optioservus fastiditus	4		1		5	4	6	
Stenelmis crenata	5	12	26		6	24		
PSEPHENIDAE:								
Psephenus herricki	4		7					
DIPTERA:								
CERATOPOGONIDAE:	6						1	
CHRINOMIDAE:CHIRONOMINAE:								
Chironomus	10			2				
Cryptochironomus	5	3				2		
Dicrotendipes	8	3		2				
Microtendipes	6	5	3	5				
Paracladopelma	7			1				
Paratanytarsus	6	1						
Polypedilum	6	9	6	23	2	6	1	1
Rheotanytarsus	6		1					
Stempellinella	4			2				
Tanytarsus	6	1		21		2		
Tribelos	7			2				
CGIRONOMIDAE:DIAMESINAE:								
Diamesa	5		1		35	2	3	
Pagastia	1		3	1				
CHIRONOMIDAE:ORTHOCLADIINAE:								
Cricotopus	7			12	7	13	3	12
Parametriocnemus	5			13				

Location		1	3	2	4	5	6	7
DATE		18.08.14	18.08.15	18.05.08	18.05.10	18.05.11	18.05.10	18.05.09
% Subsampled		21	15	13.5	7.5	13.4	6.25	4.2
TAXA LIST	HBI							
Tvetenia	5		1					
CHIRONOMIDAE:TANYPODINAE:								
Conchapelopia	6	2	1	6	1			
Labrundinia	7		2					
EMPIDIDAE:								
Chelifera	6		2		2	4		
SIMULIIDAE:								
Simulium	5	5	1		10	1	21	10
TABANIDAE:								
Chrysops	5					11		
TIPULIDAE:								
Antocha	3		1					
Tipula	6				2	2	1	3
EPHEMEROPTERA:								
BAETIDAE:								
Acentrella	4	5	5					
Acerpenna macdunnoughi	5		2					
Baetis brunneicolor	4					1		
Baetis intercalaris	5	11	6					
Procloeon	4					1		
HETAGENIIDAE:								
Heptagenia	4		1					
Stenacron interpunctatum	7		9					
Stenonema femoratum	7				1	3		
Stenonema modestum	1	2						
Stenonema vicarium	2				2	2		
LEPTOPHYPHIDAE:								
Tricroythodes	4	5	6					
PLECOPTERA:								
NEMOURIDAE:								
Amphinemoura	3				7	7	2	

Location		1	3	2	4	5	6	7
DATE		18.08.14	18.08.15	18.05.08	18.05.10	18.05.11	18.05.10	18.05.09
% Subsampled		21	15	13.5	7.5	13.4	6.25	4.2
TAXA LIST	HBI							
PERLODIDAE:								
Isoperla	2				9	7	44	26
TRICHOPTERA:								
GLOSSOSOMATIDAE:								
Glossosoma	0	1						
HELICOPSYCHIDAE:								
Helicopsyche borealis	3	1						
HYDROPSYCHIDAE:								
Cheumatopsyche	5	6	1	1		1		
Hydropsyche	4	7	9				5	
LIMNEPHILIDAE:								
Hesperophylax	3							1
Ironomquia	3							3
Limnephilus	3							2
Pycnopsyche	4			1				
POLYCENTROPODIDAE:								
Polycentropus	6	2						
RYACOPHILIDAE:								
Rhyacophila lobifera	1				2		11	1
UEONIDAE:								
Neophylax	3				10	1	4	11
MOLLUSCA: BIVALVIA:								
SPHAERIIDAE:								
Pisidium	6	2				1		49
Spaherium simile	6	3						
Sphaerium striatinum	6	1						
MOLLUSCA: GASTROPODA:								
ANCYLIDAE:								
Ferrissia parrallella	6		1					
LYMNAEIDAE:								
Fossaria exigua	6							2

Location		1	3	2	4	5	6	7
DATE		**18.08.14**	**18.08.15**	**18.05.08**	**18.05.10**	**18.05.11**	**18.05.10**	**18.05.09**
% Subsampled		21	15	13.5	7.5	13.4	6.25	4.2
TAXA LIST	**HBI**							
PHYSIDAE:								
Physella gyrina	8					4	2	
PLATYHELMINTHES:								
PLANARIIDAE:	6	3	1					
Total Numbers		128	122	102	110	122	112	125
Total Taxa (Richness)		31	29	19	17	26	16	15

Appendix G

Vegetation Communities Plant List

Appendix G

Southwestern Landfill Environmental Assessment
Vegetation Communities Plant List

Family Name	New Scientific Name (FOIBIS 2008)	Common Name (FOIBIS)
Alismataceae	*Sagittaria latifolia*	Broadleaf Arrowhead
Amaranthaceae	*Amaranthus albus*	White Pigweed
Amaranthaceae	*Amaranthus* sp.	Amaranth Species
Anacardiaceae	*Rhus typhina*	Staghorn Sumac
Anacardiaceae	*Toxicodendron rydbergii*	Western Poison Ivy
Apiaceae	*Angelica atropurpurea*	Great Angelica
Apiaceae	*Daucus carota*	Queen Anne's Lace
Apiaceae	*Heracleum maximum*	Cow-parsnip
Apiaceae	*Pastinaca sativa*	Wild Parsnip
Apocynaceae	*Apocynum cannabinum*	Clasping-leaved Indian Hemp
Araceae	*Arisaema triphyllum* ssp. *triphyllum*	Jack-in-the-pulpit
Araceae	*Symplocarpus foetidus*	Skunk Cabbage
Asclepiadaceae	*Asclepias syriaca*	Common Milkweed
Asteraceae	*Achillea millefolium* var. *occidentalis*	Wooly Yarrow
Asteraceae	*Ageratina altissima* var. *altissima*	White Snakeroot
Asteraceae	*Ambrosia artemisiifolia*	Wild Leek
Asteraceae	*Ambrosia trifida*	Great Ragweed
Asteraceae	*Arctium lappa*	Greater Burdock
Asteraceae	*Bidens frondosa*	Devil's Beggar's Ticks
Asteraceae	*Centaurea* sp.	Knapweed Species
Asteraceae	*Cichorium intybus*	Chicory
Asteraceae	*Cirsium arvense*	Creeping Thistle
Asteraceae	*Cirsium vulgare*	Bull Thistle
Asteraceae	*Doellingeria umbellata* var. *umbellata*	Flat-topped White Aster
Asteraceae	*Erigeron annuus*	White-top Fleabane
Asteraceae	*Erigeron philadelphicus* var. *philadelphicus*	Philadelphia Fleabane
Asteraceae	*Euthamia graminifolia*	Grass-leaved Goldenrod
Asteraceae	*Eutrochium maculatum* var. *maculatum*	Spotted Joe-pye Weed
Asteraceae	*Lactuca biennis*	Tall Blue Lettuce
Asteraceae	*Leucanthemum vulgare*	Oxeye Daisy
Asteraceae	*Matricaria discoidea*	Pineapple-weed
Asteraceae	*Pilosella caespitosa*	Field Hawkweed
Asteraceae	*Pilosella piloselloides*	Tall Hawkweed
Asteraceae	*Rudbeckia hirta*	Black-eyed Susan
Asteraceae	*Solidago altissima var. altissima*	Tall Goldenrod
Asteraceae	*Solidago flexicaulis*	Broad-leaved Goldenrod
Asteraceae	*Solidago gigantea*	Smooth Goldenrod

Family Name	New Scientific Name (FOIBIS 2008)	Common Name (FOIBIS)
Asteraceae	*Solidago nemoralis* var. *nemoralis*	Field Goldenrod
Asteraceae	*Sonchus arvensis* ssp. *arvensis*	Field Sowthistle
Asteraceae	*Symphyotrichum ericoides* var. *ericoides*	Heath Aster
Asteraceae	*Symphyotrichum lanceolatum* ssp. *Lanceolatum*	Panicled Aster
Asteraceae	*Symphyotrichum novae-angliae*	New England Aster
Asteraceae	*Symphyotrichum puniceum* var. *puniceum*	Purple-stemmed Aster
Asteraceae	*Symphyotrichum urophyllum*	Arrow-leaved Aster
Asteraceae	*Taraxacum officinale*	Common Dandelion
Asteraceae	*Tussilago farfara*	Colt's Foot
Balsaminaceae	*Impatiens capensis*	Spotted Jewel-weed
Berberidaceae	*Caulophyllum giganteum*	Blue Cohosh
Berberidaceae	*Caulophyllum thalictroides*	Blue Cohosh
Berberidaceae	*Podophyllum peltatum*	May Apple
Betulaceae	*Betula alleghaniensis*	Yellow Birch
Betulaceae	*Ostrya virginiana*	Eastern Hop-hornbeam
Boraginaceae	*Echium vulgare*	Common Viper's-bugloss
Boraginaceae	*Myosotis scorpioides*	True Forget-me-not
Brassicaceae	*Alliaria petiolata*	Garlic Mustard
Brassicaceae	*Brassica rapa*	Bird's Rape
Brassicaceae	*Cardamine diphylla*	Broad-leaved Toothwort
Brassicaceae	*Hesperis matronalis*	Dame's Rocket
Brassicaceae	*Lepidium densiflorum*	Dense-flower Pepper-grass
Campanulaceae	*Lobelia inflata*	Indian-tobacco
Caprifoliaceae	*Lonicera tatarica*	Tartarian Honeysuckle
Caprifoliaceae	*Triosteum aurantiacum*	Horse Gentian
Caprifoliaceae	*Viburnum lentago*	Nannyberry
Caprifoliaceae	*Viburnum opulus*	Guelder-rose Viburnum
Caryophyllaceae	*Dianthus armeria*	Deptford-pink
Caryophyllaceae	*Silene latifolia*	Bladder Campion
Caryophyllaceae	*Silene vulgaris*	Maiden's Tears
Celastraceae	*Euonymus alata*	Winged Spindle-tree
Celastraceae	*Euonymus europaea*	European Spindle-tree
Celastraceae	*Euonymus obovatus*	Running Strawberry-bush
Chenopodiaceae	*Chenopodium album* var. *album*	White Goosefoot
Clusiaceae	*Hypericum perforatum*	St. John's-wort
Convolvulaceae	*Convolvulus arvensis*	Field Bindweed
Cornaceae	*Cornus racemosa*	Gray Dogwood
Cornaceae	*Cornus sericea* ssp. *sericea*	Red-osier Dogwood
Cucurbitaceae	*Echinocystis lobata*	Wild Mock-cucumber
Cupressaceae	*Juniperus communis*	Ground Juniper
Cupressaceae	*Juniperus virginiana*	Eastern Red Cedar
Cupressaceae	*Thuja occidentalis*	Northern White Cedar
Cyperaceae	*Carex gracillima*	Graceful Sedge
Cyperaceae	*Carex granularis*	Meadow Sedge
Cyperaceae	*Carex hirtifolia*	Pubescent Sedge

Family Name	New Scientific Name (FOIBIS 2008)	Common Name (FOIBIS)
Cyperaceae	*Carex pensylvanica*	Pennsylvania Sedge
Cyperaceae	*Carex radiata*	Stellate Sedge
Cyperaceae	*Carex spicata*	Spiked Sedge
Cyperaceae	*Carex stipata*	Stalk-grain Sedge
Cyperaceae	*Carex vulpinoidea*	Fox Sedge
Cyperaceae	*Eleocharis erythropoda*	Bald Spikerush
Cyperaceae	*Schoenoplectus tabernaemontani*	Soft-stemmed Bulrush
Cyperaceae	*Scirpus atrovirens*	Woolgrass Bulrush
Dipsacaceae	*Dipsacus fullonum* ssp. *sylvestris*	Common Teasel
Dryopteridaceae	*Matteuccia struthiopteris* var. *pensylvanica*	Ostrich Fern
Dryopteridaceae	*Polystichum acrostichoides*	Christmas Fern
Equisetaceae	*Equisetum arvense*	Field Horsetail
Equisetaceae	*Equisetum hyemale* var. *affine*	Rough Horsetail
Equisetaceae	*Equisetum variegatum* ssp. *Variegatum*	Variegated Horsetail
Euphorbiaceae	*Euphorbia esula*	Leafy Spurge
Fabaceae	*Coronilla varia*	Crown-vetch
Fabaceae	*Lotus corniculatus*	Bird's-foot Trefoil
Fabaceae	*Medicago lupulina*	Black Medic
Fabaceae	*Medicago sativa* ssp. *Sativa*	Alfalfa
Fabaceae	*Melilotus alba*	White Sweet Clover
Fabaceae	*Melilotus officinalis*	Yellow Sweet Clover
Fabaceae	*Robinia pseudo-acacia*	Black Locust
Fabaceae	*Trifolium hybridum* ssp. *elegans*	Alsike Clover
Fabaceae	*Trifolium pratense*	Red Clover
Fabaceae	*Trifolium repens*	White Clover
Fabaceae	*Vicia cracca*	Tufted Vetch
Fagaceae	*Fagus grandifolia*	American Beech
Fagaceae	*Quercus macrocarpa*	Bur Oak
Geraniaceae	*Geranium maculatum*	Wild Geranium
Geraniaceae	*Geranium robertianum*	Herb-robert
Grossulariaceae	*Ribes americanum*	Wild Black Currant
Grossulariaceae	*Ribes cynosbati*	Prickly Gooseberry
Hydrophyllaceae	*Hydrophyllum virginianum*	Virginia Waterleaf
Juglandaceae	*Carya cordiformis*	Bitternut Hickory
Juglandaceae	*Carya ovata* var. *ovata*	Shagbark Hickory
Juglandaceae	*Juglans ailantifolia*	Japanese Walnut
Juglandaceae	*Juglans nigra*	Black Walnut
Juncaceae	*Juncus articulatus*	Jointed Rush
Juncaceae	*Juncus dudleyi*	Dudley's Rush
Lamiaceae	*Leonurus cardiaca* ssp. *cardiaca*	Common Motherwort
Lamiaceae	*Lycopus uniflorus*	Northern Bugleweed
Lamiaceae	*Prunella vulgaris* ssp. *vulgaris*	Common Heal-all
Liliaceae	*Allium* sp.	Onion Species
Liliaceae	*Allium tricoccum*	Annual Ragweed
Liliaceae	*Asparagus officinalis*	Asparagus

Family Name	New Scientific Name (FOIBIS 2008)	Common Name (FOIBIS)
Liliaceae	*Convallaria majalis*	European Lily-of-the-valley
Liliaceae	*Erythronium americanum* ssp. *Americanum*	Yellow Trout-lily
Liliaceae	*Hemerocallis fulva*	Orange Daylily
Liliaceae	*Lilium michiganense*	Michigan Lily
Liliaceae	*Maianthemum canadense*	Wild-lily-of-the-valley
Liliaceae	*Maianthemum racemosum* ssp. *racemosum*	False Solomon's Seal
Liliaceae	*Maianthemum stellatum*	Starflower False Solomon's Seal
Liliaceae	*Trillium erectum*	Red Trillium
Liliaceae	*Trillium grandiflorum*	White Trillium
Malvaceae	*Abutilon theophrasti*	Velvet-leaf
Moraceae	*Morus alba*	White Mulberry
Oleaceae	*Fraxinus americana*	White Ash
Oleaceae	*Fraxinus pennsylvanica*	Green Ash
Oleaceae	*Ligustrum vulgare*	European Privet
Oleaceae	*Syringa vulgaris*	Common Lilac
Onagraceae	*Circaea lutetiana* ssp. *canadensis*	Enchanter's Nightshade
Onagraceae	*Oenothera biennis*	Common Evening-primrose
Oxalidaceae	*Oxalis stricta*	Upright Yellow Wood Sorrel
Papaveraceae	*Chelidonium majus*	Greater Celadine
Papaveraceae	*Sanguinaria canadensis*	Bloodroot
Phytolaccaceae	*Phytolacca americana*	Common Pokeweed
Pinaceae	*Picea abies*	Norway Spruce
Pinaceae	*Picea glauca*	White Spruce
Pinaceae	*Pinus strobus*	Eastern White Pine
Pinaceae	*Pinus sylvestris*	Scotch Pine
Plantaginaceae	*Plantago lanceolata*	English Plantain
Plantaginaceae	*Plantago major*	Nipple-seed Plantain
Plantaginaceae	*Plantago rugelii*	Black-seed Plantain
Poaceae	*Agrostis gigantea*	Redtop
Poaceae	*Agrostis stolonifera*	Spreading Bentgrass
Poaceae	*Bromus inermis* ssp. *Inermis*	Smooth Brome
Poaceae	*Dactylis glomerata*	Orchard Grass
Poaceae	*Digitaria* sp.	Crabgrass Species
Poaceae	*Echinochloa crusgalli*	Barnyard Grass
Poaceae	*Elymus hystrix*	Bottle-brush Grass
Poaceae	*Elymus repens*	Quack Grass
Poaceae	*Festuca rubra* ssp. *Rubra*	Red Fescue
Poaceae	*Festuca* sp.	Fescue Species
Poaceae	*Lolium perenne*	Perennial Ryegrass
Poaceae	*Phalaris arundinacea*	Reed Canary Grass
Poaceae	*Phleum pratense*	Timothy
Poaceae	*Phragmites australis ssp. australis*	European Common Reed
Poaceae	*Poa compressa*	Canada Bluegrass
Poaceae	*Poa pratensis* ssp. *Pratensis*	Kentucky Bluegrass
Poaceae	*Setaria pumila*	Yellow Foxtail

Family Name	New Scientific Name (FOIBIS 2008)	Common Name (FOIBIS)
Polemoniaceae	*Phlox paniculata*	Fall Phlox
Polygonaceae	*Polygonum persicaria*	Lady's Thumb
Polygonaceae	*Rheum rhabarbarum*	Rubarb
Polygonaceae	*Rumex crispus*	Curly Dock
Portulacaceae	*Claytonia caroliniana*	Carolina Spring Beauty
Portulacaceae	*Claytonia virginica*	Narrow-leaved Spring Beauty
Primulaceae	*Lysimachia ciliata*	Fringed Loosestrife
Ranunculaceae	*Actaea pachypoda*	White Baneberry
Ranunculaceae	*Anemone acutiloba*	Sharp-lobed Hepatica
Ranunculaceae	*Anemone canadensis*	Canada Anemone
Ranunculaceae	*Anemone quinquefolia* var. *quinquefolia*	Wood Anemone
Ranunculaceae	*Ranunculus acris*	Tall Buttercup
Ranunculaceae	*Thalictrum dioicum*	Early Meadowrue
Ranunculaceae	*Thalictrum pubescens*	Tall Meadowrue
Rhamnaceae	*Rhamnus cathartica*	Buckthorn
Rosaceae	*Agrimonia gryposepala*	Tall Hairy Agrimony
Rosaceae	*Aruncus dioicus*	Goatsbeard
Rosaceae	*Crataegus* sp.	Hawthorn Species
Rosaceae	*Fragaria virginiana*	Wild Stawberry
Rosaceae	*Geum aleppicum*	Yellow Avens
Rosaceae	*Geum canadense*	White Avens
Rosaceae	*Geum urbanum*	Clover-root
Rosaceae	*Malus* sp.	Apple Species
Rosaceae	*Physocarpus opulifolius*	Eastern Ninebark
Rosaceae	*Potentilla recta*	Sulphur Cinquefoil
Rosaceae	*Prunus americana*	American Plum
Rosaceae	*Prunus avium*	Sweet Cherry
Rosaceae	*Prunus serotina*	Wild Black Cherry
Rosaceae	*Prunus virginiana* var. *virginiana*	Choke Cherry
Rosaceae	*Rosa multiflora*	Rambler Rose
Rosaceae	*Rubus idaeus* ssp. *strigosus*	Wild Red Raspberry
Rosaceae	*Rubus occidentalis*	Black Raspberry
Rubiaceae	*Galium aparine*	Cleavers
Rubiaceae	*Galium mollugol*	White Bedstraw
Rutaceae	*Zanthoxylum americanum*	Northern Prickly Ash
Salicaceae	*Populus alba*	White Poplar
Salicaceae	*Populus deltoides* ssp. *deltoides*	Eastern Cottonwood
Salicaceae	*Populus tremuloides*	Quaking Aspen
Salicaceae	*Salix alba*	White Willow
Salicaceae	*Salix bebbiana*	Bebb's Willow
Salicaceae	*Salix discolor*	Pussy Willow
Salicaceae	*Salix eriocephala*	Heart-leaved Willow
Salicaceae	*Salix exigua*	Sandbar Willow
Salicaceae	*Salix purpurea*	Basket Willow
Salicaceae	*Salix* x *fragilis*	Crack Willow

Family Name	New Scientific Name (FOIBIS 2008)	Common Name (FOIBIS)
Sapindaceae	*Acer negundo*	Manitoba Maple
Sapindaceae	*Acer nigrum*	Black Maple
Sapindaceae	*Acer platanoides*	Norway Maple
Sapindaceae	*Acer saccharum* var. *saccharum*	Sugar Maple
Sapindaceae	*Acer* x *freemanii*	Freeman's Maple
Scrophulariaceae	*Linaria vulgaris*	Butter-and-eggs
Scrophulariaceae	*Penstemon digitalis*	Foxglove Beardtongue
Scrophulariaceae	*Verbascum thapsus*	Common Mullein
Solanaceae	*Solanum dulcamara*	Climbing Nightshade
Staphyleaceae	*Staphylea trifolia*	American Bladdernut
Tiliaceae	*Tilia americana*	American Basswood
Typhaceae	*Typha latifolia*	Broad-leaf Cattail
Ulmaceae	*Celtis occidentalis*	Common Hackberry
Ulmaceae	*Ulmus pumila*	Siberian Elm
Urticaceae	*Laportea canadensis*	Wood Nettle
Urticaceae	*Pilea pumila*	Canada Clearweed
Urticaceae	*Urtica dioica* ssp. *dioica*	Stinging Nettle
Urticaceae	*Urtica dioica* ssp. *Gracilis*	Slender Stinging Nettle
Violaceae	*Viola pubescens*	Downy Yellow Violet
Violaceae	*Viola sororia*	Woolly Blue Violet
Vitaceae	*Parthenocissus vitacea*	Thicket Creeper
Vitaceae	*Vitis riparia*	Riverbank Grape

Appendix H

Potential Breeding Birds List

Appendix H

Southwest Landfill Environmental Assessment
Breeding Birds List

						2018							2019			
Common Name	Scientific Name	Status				Survey 1			Survey 2			Incidentals in Turtle Surveys (May 29- June 11)	Survey 1		Survey 2	
		COSEWIC[1]	COSSARO[2]	SRANK[3]	Area-sensitive[4]	May-29	May 30	Incidentals	June 19	June-26	Incidentals		June 11	Incidentals	June 27	Incidentals
Double-crested Cormorant	*Phalacrocorax auritus*			S5		13						x				F
Great Blue Heron	*Ardea herodias*			S4		10		F			F	x				
Canada Goose	*Branta canadensis*			S5		F	F	F	F			x	F			
Turkey Vulture	*Cathartes aura*			S5		1		F	1		F	x	3		4	
Osprey	*Pandion haliaetus*			S5										F		
Red-tailed Hawk	*Buteo jamaicensis*			S5				F								
Peregrine Falcon	*Falco peregrinus*	SC	THR	S3								1				
Wild Turkey	*Meleagris gallopavo*			S5						1		x				
Killdeer	*Charadrius vociferus*			S5		3	2		4	1		x	1		1	
Spotted Sandpiper	*Actitis macularia*			S5		2			2	1		x				
American Woodcock	*Scolopax minor*			S4								x				
Rock Pigeon	*Columba livia*			SNA			3									
Mourning Dove	*Zenaida macroura*			S5		2			4			x	1		2	
Black-billed Cuckoo	*Coccyzus erythropthalmus*			S5				x								
Ruby-throated Hummingbird	*Archilochus colubris*			S5											1	
Belted Kingfisher	*Ceryle alcyon*			S4								x				
Downy Woodpecker	*Picoides pubescens*			S5		1				3		x			1	
Northern Flicker	*Colaptes auratus*			S4		1							1			
Eastern Wood-Pewee	*Contopus virens*	SC	SC	S4		1				1		x				

						2018							2019			
Common Name	Scientific Name	Status				Survey 1			Survey 2			Incidentals in Turtle Surveys (May 29- June 11)	Survey 1		Survey 2	
		COSEWIC[1]	COSSARO[2]	SRANK[3]	Area-sensitive[4]	May-29	May 30	Incidentals	June 19	June-26	Incidentals		June 11	Incidentals	June 27	Incidentals
Willow Flycatcher	*Empidonax traillii*			S5		10	2		2	3		x	3		2	
Eastern Phoebe	*Sayornis phoebe*			S5									1		1	
Great Crested Flycatcher	*Myiarchus crinitus*			S4		1						x			1	
Eastern Kingbird	*Tyrannus tyrannus*			S4		3			1	4		x	3		1	
Horned Lark	*Eremophila alpestris*			S5		5			1	3		x				
N. Rough-winged Swallow	*Stelgidopteryx serripennis*			S4				F	1							
Bank Swallow	*Riparia riparia*	THR	THR	S4			F		10					F		
Cliff Swallow	*Petrochelidon pyrrhonota*			S4			3	F	2		F	x	C		C	F
Barn Swallow	*Hirundo rustica*	THR	THR	S4		F		F						F		F
Blue Jay	*Cyanocitta cristata*			S5		3				2		x	1		2	
American Crow	*Corvus brachyrhynchos*			S5		2		F		2	F	x		F		
Black-capped Chickadee	*Poecile atricapillus*			S5		3				6			1		1	
House Wren	*Troglodytes aedon*			S5		6			1	5		x	2		3	
American Robin	*Turdus migratorius*			S5		7			4	8			2		5	
Gray Catbird	*Dumetella carolinensis*			S4		12	1		6	10		x	4		4	
Brown Thrasher	*Toxostoma rufum*			S4					1				1		1	
Cedar Waxwing	*Bombycilla cedrorum*			S5		2			3	5		x	2		1	
European Starling	*Sturnus vulgaris*			SE		7	12	F	36	8		x	3		5	
Yellow-throated Vireo	*Vireo flavifrons*			S4	A	1						x				
Warbling Vireo	*Vireo gilvus*			S5		4						x	3		3	
Red-eyed Vireo	*Vireo olivaceus*			S5		2				2						
Nashville Warbler	*Oreothlypis ruficapilla*			S5		9										
Yellow Warbler	*Setophaga petechia*			S5		24			10	14		x	7		9	
American Redstart	*Setophaga ruticilla*			S5	A					1		x				
Mourning Warbler	*Geothlypis philadelphia*			S4											2	
Common Yellowthroat	*Geothlyphis trichas*			S5		2				1		x				
Northern Cardinal	*Cardinalis cardinalis*			S5		9			1	4		x	6		2	
Rose-breasted Grosbeak	*Pheucticus ludovicianus*			S4								1				

						2018							2019			
		Status				Survey 1			Survey 2			Incidentals in Turtle Surveys (May 29- June 11)	Survey 1		Survey 2	
Common Name	Scientific Name	COSEWIC[1]	COSSARO[2]	SRANK[3]	Area-sensitive[4]	May-29	May 30	Incidentals	June 19	June-26	Incidentals		June 11	Incidentals	June 27	Incidentals
Indigo Bunting	*Passerina cyanea*			S4		7			1	5		x	1		3	
Chipping Sparrow	*Spizella passerina*			S5		2				3			1		1	
Field Sparrow	*Spizella pusilla*			S4		5	2		3	3		x	1		2	
Vesper Sparrow	*Pooecetes gramineus*			S4						1						
Savannah Sparrow	*Passerculus sandwichensis*			S4	A				1	1					1	
Grasshopper Sparrow	*Ammodramus savannarum*			S4	A	2	1			1			1			
Song Sparrow	*Melospiza melodia*			S5		23	3		13	27		x	9		13	
Red-winged Blackbird	*Agelaius phoeniceus*			S4		15	7		10	12		x	5		6	
Eastern Meadowlark	*Sturnella magna*	THR	THR	S4	A	2				2						
Common Grackle	*Quiscalus quiscula*			S5						1			1			
Brown-headed Cowbird	*Molothrus ater*			S4		7			5	8		x	1		5	
Baltimore Oriole	*Icterus galbula*			S4		4						x	3			
American Goldfinch	*Spinus tristis*			S5		18	3		8	21		x	3		3	
House Sparrow	*Passer domesticus*			SNA											3	

KEY

a - COSEWIC = Committee on the Status of Endangered Wildlife in Canada

b - Species at Risk in Ontario List (as applies to ESA) as designated by COSSARO (Committee on the Status of Species at Risk in Ontario) END = Endangered, THR = Threatened, SC = Special Concern

c - SRANK (from Natural Heritage Information Centre) for breeding status if: S1 (Critically Imperiled), S2 (Imperiled),S3 (Vulnerable), S4 (Apparently Secure), S5 (Secure) SNA (Not applicable…'because the species is not a suitable target for conservation activities'; includes non-native species)

d Ontario Ministry of Natural Resources (OMNR). 2000. Significant Wildlife Habitat Technical Guide (Appendix G). 151 p plus appendices.

Beacon Breeding Status classifications:

- # - breeding pair
- F- foraging/flyover

Part 2

Southwestern Landfill Environmental Assessment Aquatic and Terrestrial Ecology Impacts Assessment

GUIDING SOLUTIONS IN THE
NATURAL ENVIRONMENT

FINAL DRAFT

Southwestern Landfill Environmental Assessment Aquatic and Terrestrial Ecology Impacts Assessment

Prepared For:

Walker Environmental Group

Prepared By:

Beacon Environmental Limited

Date:	*Project:*
January 2020	**217238**

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Appendices

1. Introduction

An Environmental Assessment ("EA") is being prepared by Walker Environmental Group Inc. ("Walker") under Ontario's *Environmental Assessment Act* ("Act") for the "provision of future landfill capacity at the Carmeuse Lime (Canada) Ltd. (Carmeuse) site in Oxford County for solid, non-hazardous waste generated in the Province of Ontario".

This is one in a series of technical studies that have been completed by qualified experts to examine the potential effects of the proposed landfill site on the environment, all in accordance with the requirements set out in the Approved Amended Terms of Reference ("ToR") dated May 10, 2016. This report accompanies and supports the Environmental Assessment Report prepared by Walker.

Note that Walker has carried out extensive consultation with government agencies, Indigenous groups and interested members of the public regarding this study; details are provided separately in the EA report.

2. Purpose & Objectives

The purpose of this study is to complete an ecological (terrestrial and aquatic) assessment of the landfill proposed by Walker.

The overall objectives of the study are listed below, in general accordance with the requirements for the assessment of an undertaking as set out in Section 6.1(2)(c) of the *Environmental Assessment Act*, and as specifically detailed in Section 8.1 of the ToR:

a) Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
b) Carry out an evaluation of the environmental effects of the proposed undertaking, using the relevant environmental assessment criteria set out in the ToR (see **Appendix A)**;
c) Carry out an evaluation of any additional impact management actions that may be necessary to prevent, change or mitigate any (negative) environmental effects;
d) Prepare a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
e) Prepare monitoring, contingency and impact management plans to remedy the environmental effects of the proposed undertaking.

3. The Proposed Undertaking

The landfill proposed by Walker is described in detail in the *Environmental Assessment Report*. Following is a brief summary for the benefit of the reader, highlighting aspects of the proposal most relevant to this study.

The landfill is to be located on a portion of Carmeuse's landholdings at its Beachville Quarry Operations in the Township of Zorra, Oxford County. Approximately 17.4 million m^3 of solid, non-hazardous waste and daily/intermediate cover will be deposited within a footprint of about 59 ha. The balance of the 81.6 ha site will be comprised of buffer areas for monitoring, maintenance, environmental controls and other necessary infrastructure. (**Figure 1**).

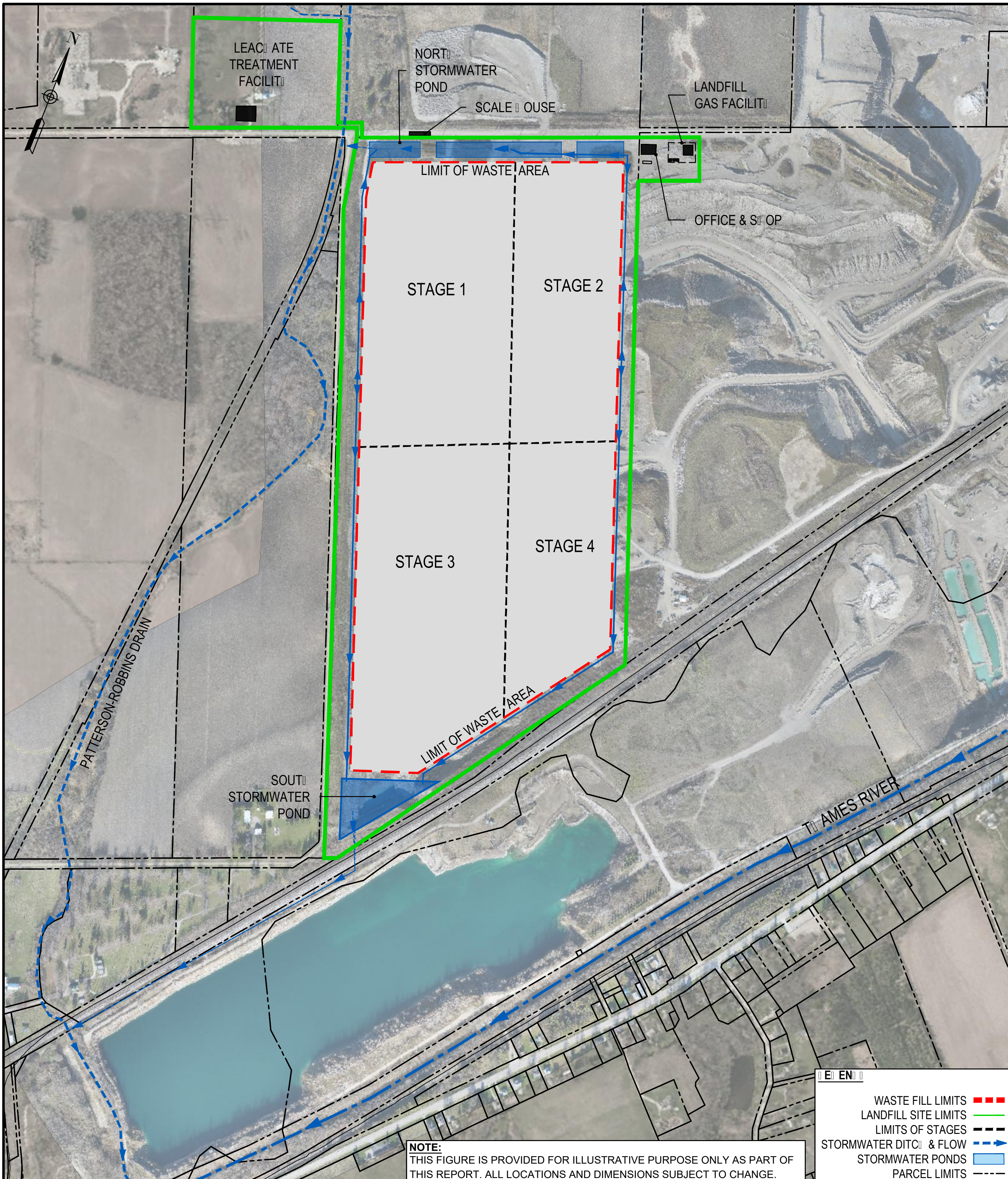
Landfill construction will proceed progressively in a series of cells, generally from north-to-south (**Figure 2**). The former quarry floor will be backfilled to within about 30 to 40 metres below ground surface with engineered fill, and then a *Generic Design Option II – Double Liner* system (as specified by the Ministry of Environment, Conservation & Parks in the *Landfill Standards* under *O. Reg. 232/98;* see **Figure 2**) will be constructed across the bottom and up the sides of the landfill to contain and collect leachate (**Figure 3**). Up to 850,000 tonnes *per* year of solid, non-hazardous waste, and up to 250,000 tonnes per year of daily/intermediate cover soils[1] will then be placed and compacted above the liner in a series of small working areas approximately 0.2 ha in size at any given time, in order to minimize the exposed waste. Waste will be covered with soil on a daily basis, and a final cover with vegetation will be applied as the landfill reaches its final height, which peaks at about 15 m above ground (**Figure 4**). A landfill gas collection system will also be installed as the landfill/cell development progresses.

Most of the supporting infrastructure for the landfill will be located in the buffer area along the northern site perimeter, including the leachate and gas treatment plants. Leachate collected from the liner system will be treated on-site and the clean effluent from the treatment plant will be discharged into the Patterson-Robbins Drain next to the treatment plant. Clean precipitation and groundwater that has not come into contact with waste will be segregated and treated in a stormwater management pond before being discharged from the site (**Figure 1**). Landfill gas will be collected in a network of extraction wells and pipes. Initially, the landfill gas will be flared (combusted), but when the quantities permit the gas will be beneficially utilized as a renewable fuel.

The site will be open for waste deliveries from 07:00 a.m. to 05:00 p.m. on weekdays and from 7:00 a.m. to 1:00 p.m. on Saturdays but closed on Sundays and statutory holidays. On-site construction activities may start-up to one hour before opening and continue up to two hours after closure. The primary designated haul route (i.e., for all waste trucks except deliveries from the local area, if any) is from Hwy. 401 north along County Road #6, then west into the quarry property; trucks will then follow a newly constructed haul route across the quarry site to a landfill site entrance at the northwestern corner of the site **(Figure 5**). Vehicle traffic, including waste trucks as well as construction vehicles and staff, is expected to average approximately 210 trips *per* day.

Nuisance controls will include speed enforcement, regular haul road cleaning (on- and off-site), litter fencing and pick-up, and bird/pest management, with a public complaint reporting and response system.

[1] The daily/intermediate cover soil could consist of acceptable and suitable waste soils, and would be reported as waste, so the total reported waste receipts could be up to 1,100,000 tonnes per year.



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		Approved	Drawing No.	Revision No.
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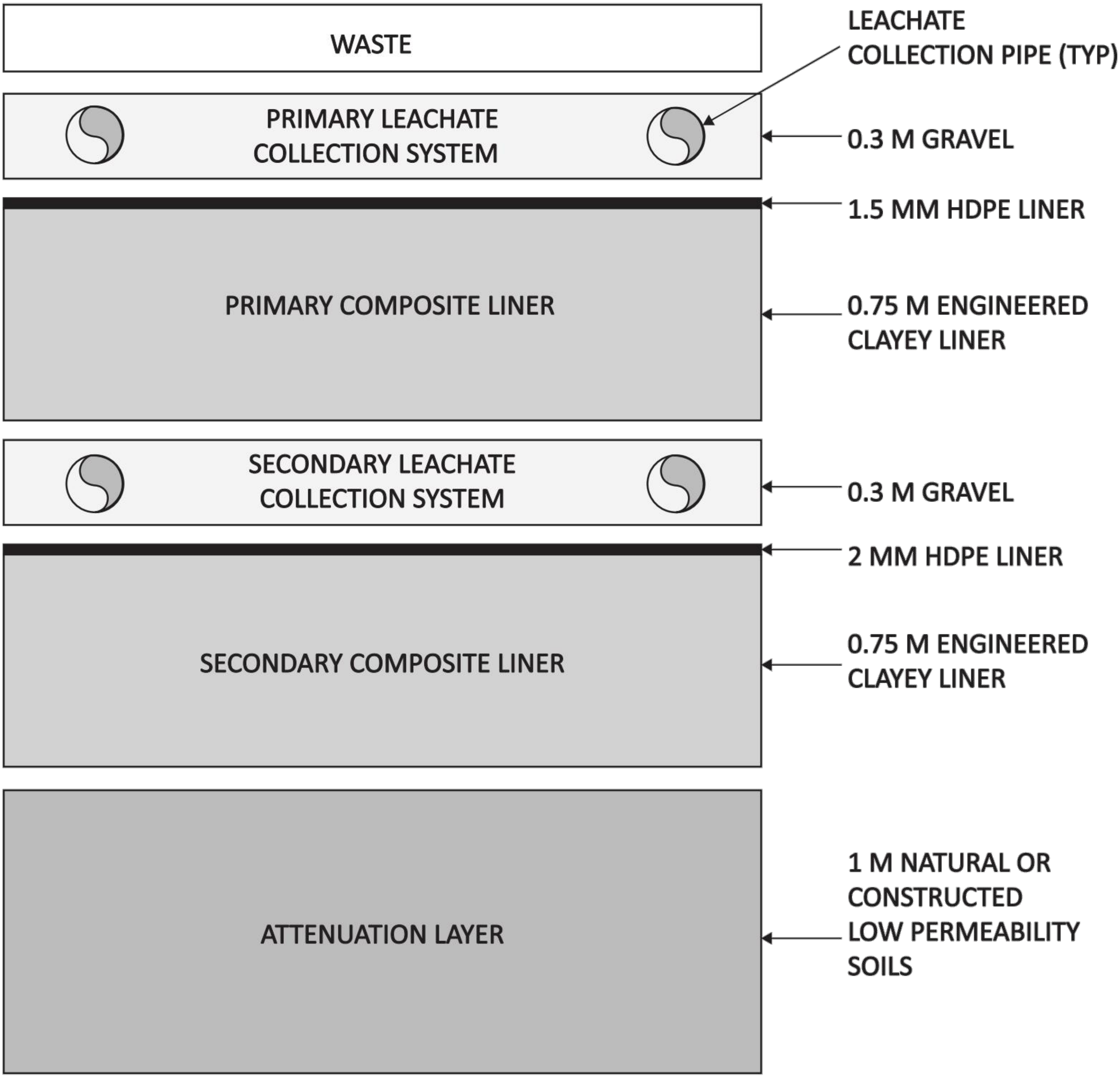

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		Drawn TT□m□□rr□	Scale NTS	Date (D-M-Y) 7JAN19
	Drawing: **LANDFILL LINER S□STEM**	Approved DFry	Drawing No. **Figure □**	Revision No. **C**

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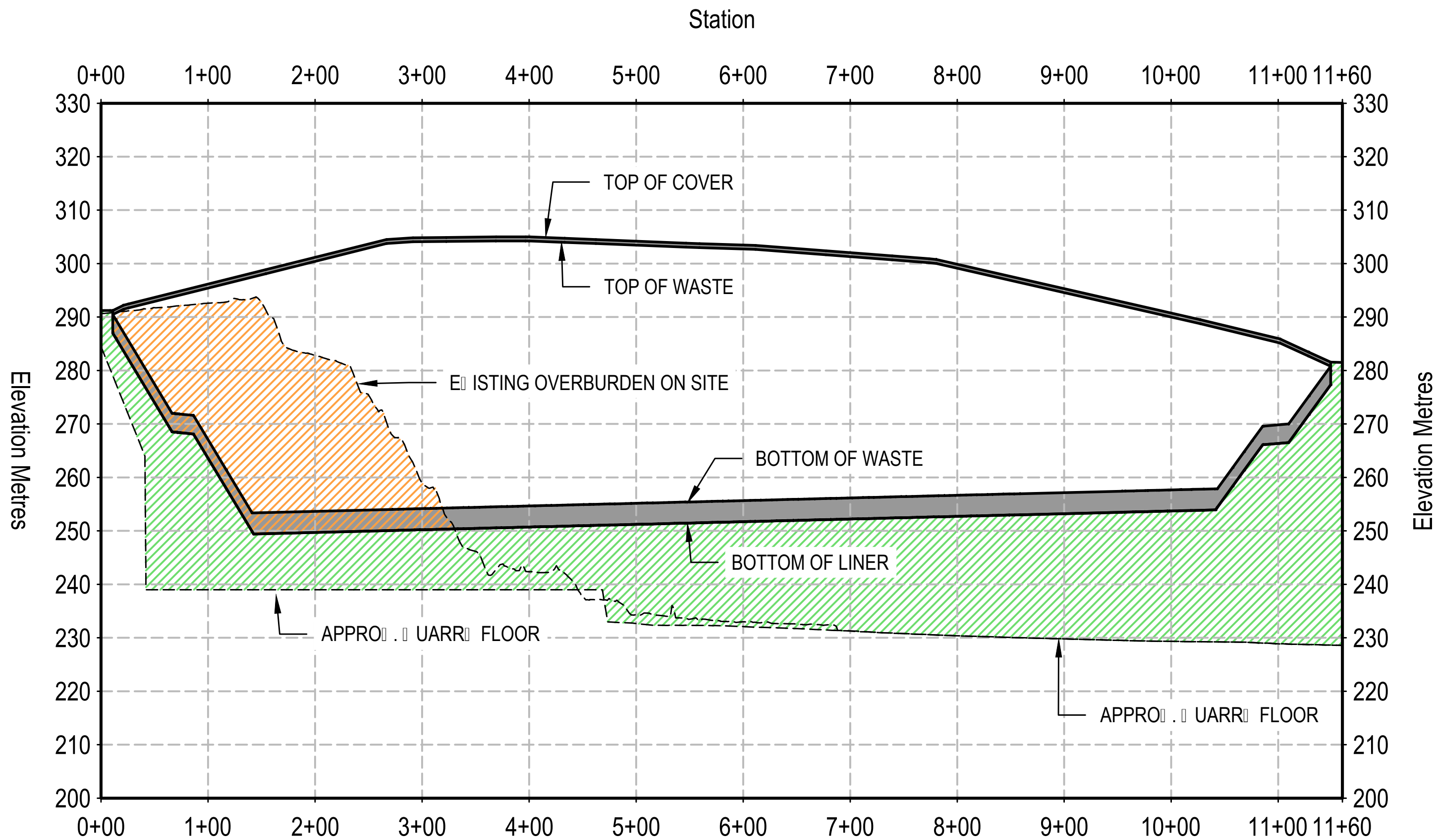
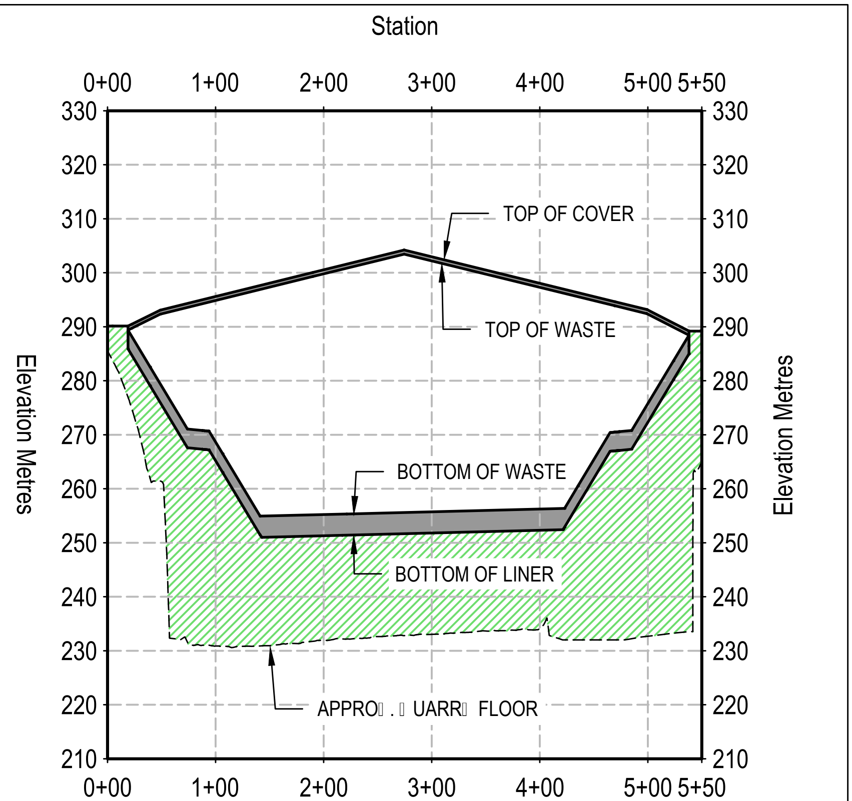


NORTH–SOUTH SECTION VIEW



WEST–EAST SECTION VIEW

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walker environmental	SOUTHWESTERN LANDFILL	967243		
		Drawn: JThompson	Scale: NTS	Date (D-M-Y): 07JAN20
	Drawing: SECTION VIEWS	Approved: DFry	Drawing No.: Figure	Revision No.: E

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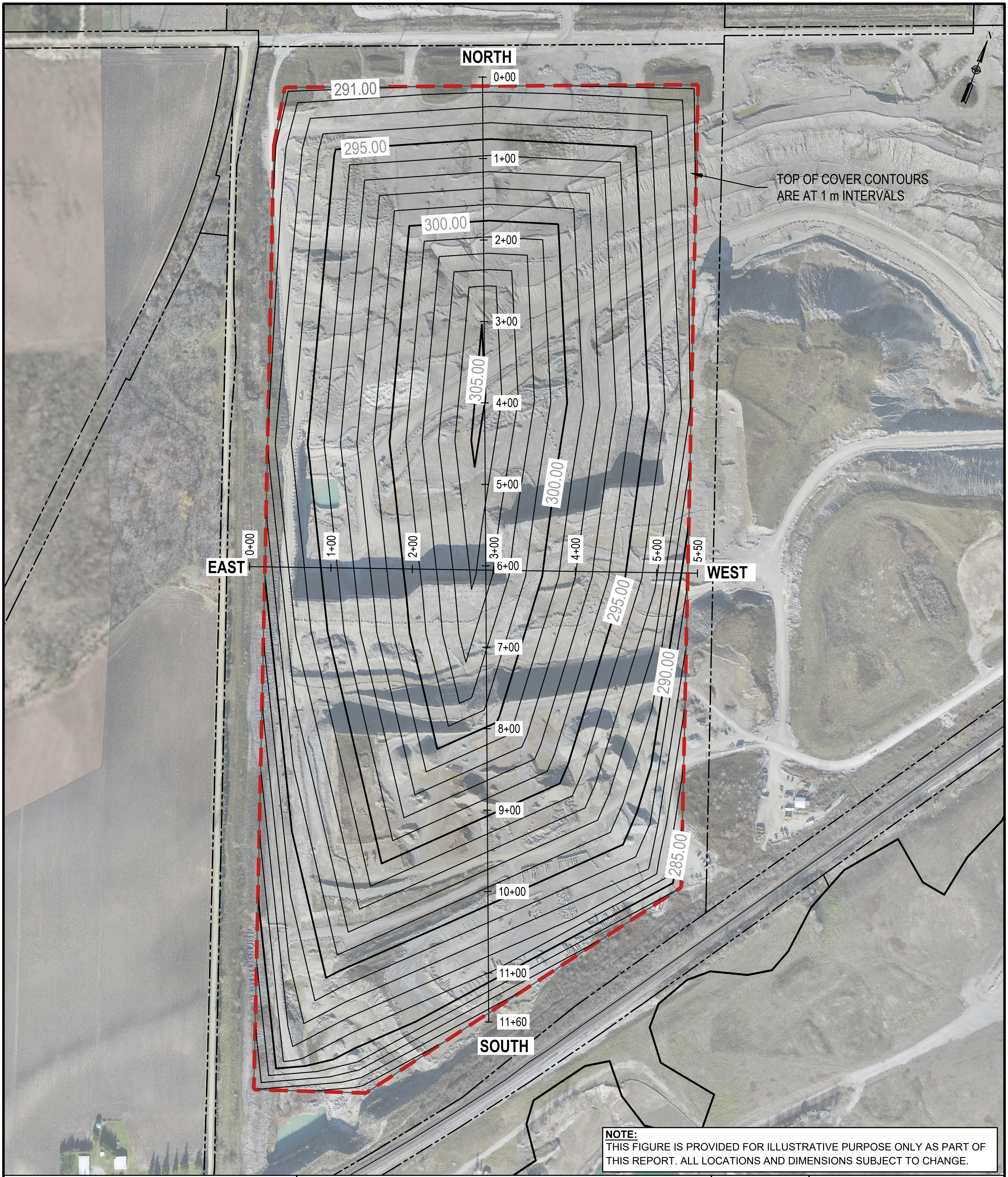

NOTE:
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Owner	Project	Project No.	Scale Bar	
walker environmental	SOUTHWESTERN LANDFILL	967243	0 75 150 Meters	
		Drawn	Scale	Date (D-M-Y)
		JThompson	NTS	07JAN20
	Drawing	Approved	Drawing No.	Revision No.
	PLAN VIEW TOP OF COVER	DFry	Figure 4	E

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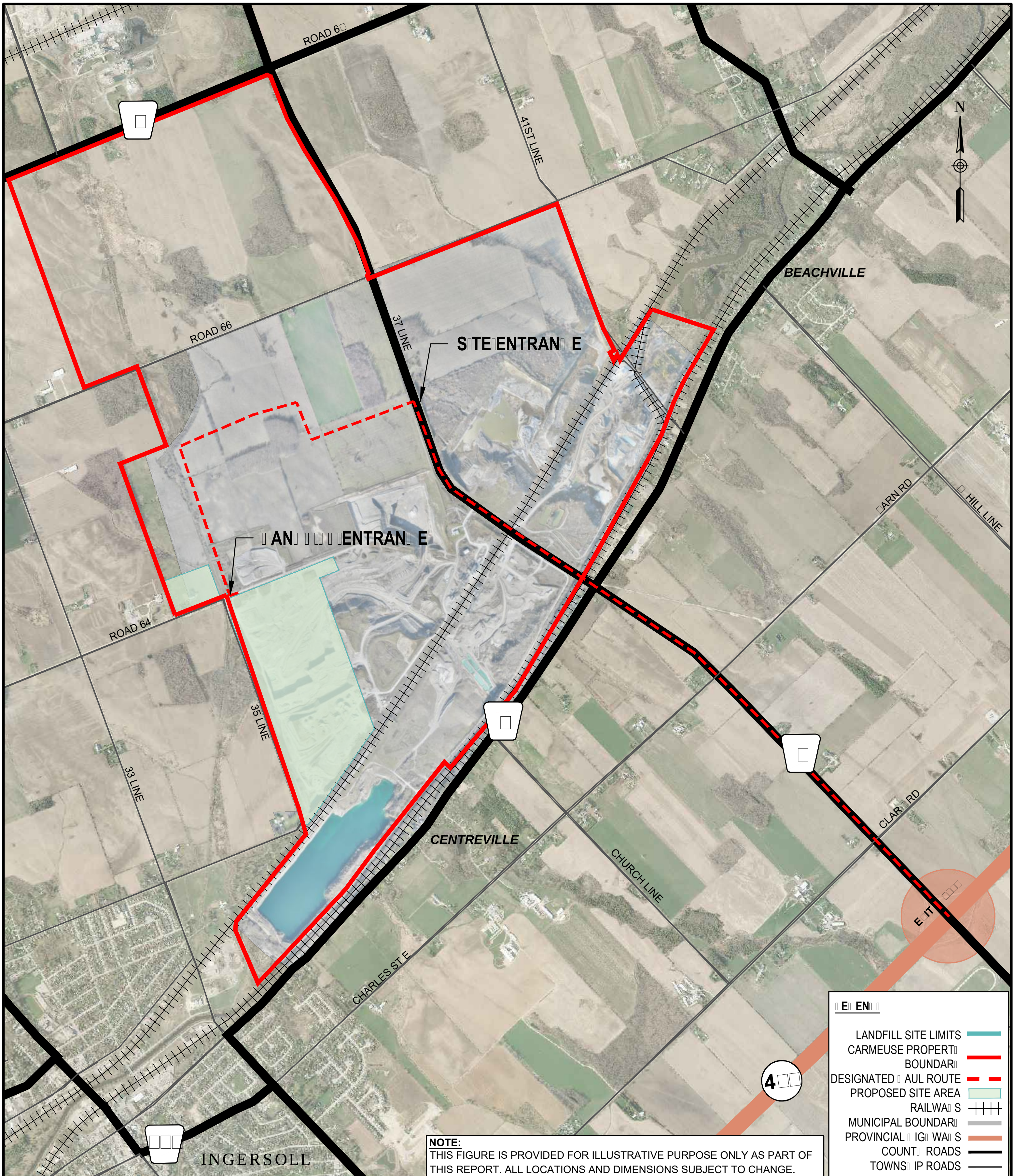

Owner	Project	Project No.	Scale Bar
walker environmental	SOUTHWESTERN LANDFILL	967243	0 500 1000 Meters
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	SITE LOCATION □ HAUL ROUTE	Approved: DFry	Drawing No.: Figure □ / Revision No.: E

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There will be monitoring programs for equipment operations, leachate, groundwater, surface water, air emissions, gas, noise, and particulates (dust).

The landfill is anticipated to receive waste for approximately 20 years commencing in about 2023. After closure, maintenance and operation of the relevant environmental controls and monitoring will carry on during the post-closure period, until there is no further risk of environmental contamination. The end-use is assumed to be passive green space and agriculture, but the design is flexible to accommodate other potential end-uses.

4. Environmental Assessment Criteria & Indicators

The **environmental assessment criteria**, as approved in the ToR, are tabulated in **Appendix A**, Table B-1. In the table, checkmarks indicate which technical studies are assigned primary ("lead") responsibility for assessing each of the criteria. Following are the EA criteria which are assigned to this study:

- Loss or disturbance to aquatic ecosystems;
- Loss or disturbance to terrestrial ecosystems;
- Disease transmission via insects or vermin; and
- Aviation impacts due to gull interference.

Furthermore, the criteria for this EA were designed to be cross-disciplinary to permit an assessment of cumulative effects. Table B-2 in **Appendix A**, from the ToR, illustrates some (though not necessarily all) of the key interconnectivities between the studies. As a result, this study provides input/data to additional environmental criteria that will be addressed through studies conducted by other experts including (but not limited to):

- Criterion 3: Effects due to fine particulate exposure (as it relates to potential effects on aquatic and terrestrial ecosystems);
- Criterion 10: Disruption to use and enjoyment of residential properties (as it relates to the potential effects of noise on aquatic and terrestrial ecosystems);
- Criterion 11: Disruption to use and enjoyment of public facilities and institutions (as it relates to the potential effects of noise on aquatic and terrestrial ecosystems);
- Criterion 32: Loss/displacement of surface water resources (as it relates to potential effects on aquatic and terrestrial ecosystems); and
- Criterion 34: Effects on stream baseflow quantity/quality (as it relates to potential effects on aquatic and terrestrial ecosystems).

Indicators identify how the potential environmental effects will be measured for each criterion. Indicators that were applied to each of the primary EA criteria addressed in this assessment are provided in **Table 1**.

Table 1. Proposed Indicators of EA Criteria

EA Criteria	Proposed Effects Indicators	Potential Unit of Measure	Range and Relevance of Potential Change		Comments
			Negligible	Potentially Meaningful	
Loss or disturbance to aquatic ecosystems*	Benthic Invertebrates	Hilsenhoff Biotic Index (HBI)	<10% decrease in score	≥10% decrease in score	Hilsenhoff is a quantitative measurement that reflects benthic invertebrate species diversity that is often used as a measure of water quality (Mackie 2004).
Loss or disturbance to aquatic ecosystems*	Fish Community	Index of Biotic Integrity (IBI) in lentic systems (creeks, rivers etc.) Nearshore Community Index Netting (NSCIN) in lotic systems (ponds, lakes etc.)	<10% decrease in IBI score	≥10% decrease in IBI score	Index of Biotic Integrity uses up to 12 metrics to determine the health of a fish community (Mackie 2004). Nearshore Community Index Netting evaluates fish species abundance within lake habitats. (MNR 1999)
Loss or disturbance to aquatic ecosystems*	Indicator Species (Rainbow Darter, Iowa Darter, Mottled Sculpin)	Fulton Condition Factor	<10% decrease in score	≥10% decrease in score	Fulton's Condition Factor is a standard measure of fish health (Anderson and Neuman 1996)
Loss or disturbance to aquatic ecosystems*	Fish habitat	Area of fish habitat	<10% decrease in area of fish habitat	≥10% decrease in area of fish habitat	Harmful Alteration, Disruption or Destruction to fish and fish habitat is prohibited under Section 35 of the federal *Fisheries Act.*
Loss or disturbance to aquatic ecosystems*	Species at Risk	Use of habitat and presence, sometimes historical	None present	Presence of habitat where use may be affected now or in the future	Regulated through the provincial *Endangered Species Act* and/or federal *Species at Risk Act* (where applicable)

* Note: A 10% degree of change in aquatic ecosystems may not be appropriate for all effects indicators but is intended as a starting point and will be re-evaluated when meaningful data have been collected.

EA Criteria	Proposed Effects Indicators	Potential Unit of Measure	Range and Relevance of Potential Change		Comments
			Negligible	Potentially Meaningful	
Loss or disturbance to terrestrial ecosystems	Ecological Land Classification (ELC) communities as defined by ELC System for Southern Ontario (other than woodland and wetland which are addressed below)	Presence Area in hectares	<5% loss	Lesser of 10 ha loss or > 5% loss	Loss of habitat for area sensitive species (as defined by MNR 2000) (ha) Intensive vegetation monitoring (using appropriate parameters) may be undertaken in locations where a critical issue is identified (i.e., a rare, sensitive or important vegetation community where a negative effect is possible).
Loss or disturbance to terrestrial ecosystems	Wetlands	Presence Area in hectares	Loss of <10% of a wetland unit that is not PSW	Loss of any PSW or loss of >10% of a wetland unit that is not PSW	Defined by the Ontario Wetland Evaluation System (MNR 1993)
Loss or disturbance to terrestrial ecosystems	Woodlands	Presence, Area in hectares	Loss of cultural woodland types	Loss of woodland that is determined by planning authority to be significant	Significant woodlands are determined in Official Plans using guidelines provided by the Ministry of Natural Resources and Forestry (MNRF) and the Oxford Natural Heritage System Study (ONHSS) (2006)
Loss or disturbance to terrestrial ecosystems	Species at Risk	Use of habitat and presence, sometimes historical	None present	Use of habitat where that use may be affected	Regulated through the *Endangered Species Act* and/or *Species at Risk Act* (where applicable)
Loss or disturbance to terrestrial ecosystems	Rare Communities or Species	Presence of communities or species defined by the provincial S-rank system as S1, S2 or S3 (NHIC, on-line)	Loss of incidental habitat	Loss of regularly used habitat	Rare species and communities are highly valued and are often indicative of high-quality habitat or special habitat conditions
Loss or disturbance to terrestrial ecosystems	Colonial Nesting (birds that nest in colonies)	Presence of multiple pairs	Temporary disturbance	Loss of any breeding habitat	Cliff Swallow and Great Blue Heron colonies are known to occur within the Site Vicinity and Wider study areas.
Loss or disturbance to	Breeding Amphibian Areas	Calling males during the breeding season, (using	Loss of non-breeding habitat	Loss of productive breeding habitat	Breeding amphibians are particularly sensitive to habitat loss or disturbance

EA Criteria	Proposed Effects Indicators	Potential Unit of Measure	Range and Relevance of Potential Change		Comments
			Negligible	Potentially Meaningful	
terrestrial ecosystems		a standardized monitoring scale) And the reduction of the hydroperiod of a breeding pond			
Loss or disturbance to terrestrial ecosystems	Landscape Connectivity	Identified Corridors	Minor impairment on connectivity	Major impact on connectivity	Corridor/landscape criteria from ONHSS (2006) and professional judgment
Disease transmission *via* insects or vermin	Primary vectors (gulls)	Background numbers of gulls	No change in background number of potential vectors (primarily gulls)	Increase beyond pre-determined background level due to landfill	Literature review and professional judgment will be used to confirm the pathway for transfer of pathogens Fieldwork will determine background levels
Aviation impacts due to bird interference	Increased risk of bird strikes	Airport Bird Risk Assessment Process (ABRAP) for the Woodstock, Tillsonburg Regional and London International Airports	Negligible increase in Risk	Unacceptable increase in Risk	Transport Canada guidelines detailed in *Safety Above All* (TP 8240, 2009) and the *Airport Wildlife Management and Planning Regulations* (Canadian Aviation Regulations -*CAR 302.301-306*). Mitigation in the form of an Integrated Gull Management Plan would be required along with a contingency, should the ABRAP determine that the landfill is creating an unacceptable elevated risk to aircraft operating in the vicinity,

Legend

- Site
- South SWM Outfall
- Haul Routes (50 m)
- Site Vicinity (120 m)
- Wider Area (500 m)
- Wider Area (1,000 m)

Study Areas	**Figure 6**
Southwestern Landfill Environmental Assessment	
BEACON ENVIRONMENTAL	Project: 217238 Last Revised: November 2019
Client: Walker Environmental Group	Prepared by: RA Checked by: BH **DRAFT**
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5. Study Duration

Two main **study durations** (or time frames) for this proposed landfill have been identified in the ToR:

Operational Period	The time during which the waste disposal facility is constructed, filled with waste, and capped. These activities are combined since they occur progressively (i.e., overlap) on a cell-by-cell basis, and they have a similar range of potential effects (e.g., there is heavy equipment active on the site).
Post-Closure Period	The time after the site is closed to waste receipt. Activities are normally limited to the operation of control systems, routine property maintenance and monitoring, and thus have a more limited range of potential effects.

The approved EA Criteria in **Table B-1**, **Appendix A** indicate the relevant study duration(s) associated with each of the criteria used in this assessment.

In addition, **common reference periods** or milestone dates were also defined for the operational period of the landfill:

Start of Construction	Est. 2022	Just prior to the start of landfill construction and operation, representing the existing baseline conditions.
Mid-Point	Est. 2034	Approximately midway through the landfill construction and operation.
Closure	Est. 2044	At the completion of the landfill construction and operation, representing the full operating size of the proposed landfill.

6. Study Areas

For the purposes of this EA, three general **study areas** were established in the ToR:

On-Site and in the Site Vicinity:	*On-site* includes the proposed waste disposal facility plus the associated buffer zones. *Site vicinity* is the area immediately adjacent to the waste disposal facility property that is directly affected by the on-site activities. Its size is variable depending on the particular criteria being addressed.
Along the Haul Routes:	The primary route along which the waste disposal facility truck traffic would move between a major provincial highway and the proposed waste disposal facility site entrance, plus the properties directly adjacent to these roads.

Wider Area:	The broader community, generally beyond the immediate site vicinity. Depending on the particular criteria this may include neighbourhoods, local municipalities, Oxford County, or the Province of Ontario.

The tables of approved EA Criteria in **Appendix A** indicate the relevant study duration(s) associated with each of the criteria in this assessment.

Although these three general study areas were common across all of the studies, their actual physical boundaries were not necessarily identical for every study or criterion; a flexible approach was used and the study area boundaries were adjusted as the work progressed to ensure that they adequately encompassed any potential significant effects of the proposed landfill.

The study areas utilized for the purposes of the ecological assessment and the criteria and the criteria to be measured through the EA process are described below and shown in **Figure 6**.

On-Site and in the Site Vicinity	Loss or disturbance to aquatic ecosystems Loss or disturbance to terrestrial ecosystems (within 120 m) Disease transmission via insects or vermin Aviation impacts due to gull interference (within 500 m)
Along the Haul Routes	Loss or disturbance to aquatic ecosystems Loss or disturbance to terrestrial ecosystems (either side of the route within 50 m, to the first public road)
Wider Area	Loss or disturbance to aquatic ecosystems Loss or disturbance to terrestrial ecosystems (within 1 km) Aviation impacts due to gull interference (within 20 km and 16-60 km).

The rationale for the selection of these study areas is provided in **Table 2**.

Table 2. Primary Criteria and Associated Study Areas

EA Criteria	Associated Study Areas	Rationale
Loss or disturbance to Aquatic ecosystems	• On-Site and Vicinity • Haul Route • Wider Area – Thames River and downstream receivers within a to-be-determined area downstream of the landfill	• Ecological effects more likely in the immediate vicinity of the project • Construction of haul route crossings may reduce the area of fish habitat and may cause sediment input into watercourses which would compromise habitat quality. Also, salt and sediment input during operation from increased use could impact habitat quality and have effects on aquatic species • The proximity of the proposed landfill to the Thames River may create far-reaching impacts downstream • Includes operational aspects such as fish & wildlife management

EA Criteria	Associated Study Areas	Rationale
Loss or disturbance to terrestrial ecosystems	• On-Site and Vicinity – within 120 m of the study area • Haul Route – within 50 m of the route to the first public road • Wider Area – for connectivity and context, within 1 km of the site	• This will capture the direct effects zone for terrestrial receivers • The haul route (portions on Carmeuse Property) may include natural or semi-natural areas, direct effects can be anticipated within approx. 50 m • Connectivity across the landscape requires a broader context, using existing information and site visits the general natural heritage system will be described within this range to allow the landscape context to be developed, as well as to assess potential effects on connectivity associated with increased traffic
Disease transmission *via* insects or vermin	• On-site and Vicinity – the actual waste disposal area is the potential source; the potential receptors are the nearby residential communities and farmland	• Primarily a potential on-site issue; would be adjusted if investigations indicate otherwise
Aviation impacts due to gull interference	• On-site and Vicinity - the site and areas within 500 m • Wider Area. All areas within a 20 km radius of the proposed site as the site is located within the air traffic movement patterns of two airports. • Wider Area. A Secondary Study Area, to include the London International Airports, will include lands located 16 to 60-km distant from the airport	• Characteristics and features of the immediate environment are important to how birds might use the site • The proposed landfill site is located in proximity to the Woodstock Airport which is located approximately 6 km to the northeast and the Tillsonburg Regional Airport which is located approximately 18 km to the southwest • This represents an area where birds' movements to and from attractants could result in birds moving through airspace frequented by aircraft after feeding or loafing

Where appropriate and relevant, **common receptor points** were also selected collaboratively by the technical experts so that the potential overlapping or cumulative effects of the proposed landfill could be assessed at these common receptor points. The common receptor points used in this study are described below in **Table 3** and shown in **Figure 7**.

Table 3. Ecological Receptors and Descriptions

Receptor ID	Description
Township of Zora	
ZOR-11	This receptor is associated with the nearest residence and agricultural operation to the project site. It is the closest ecological receptor to Significant Wildlife Habitat (SWH) – Colonially – Nesting Bird Breeding Habitat (Cliff Swallow).
ZOR-12	Location of the Ingersoll Rural Cemetery within 500m to 1000m of the project site and ecological receptors in the former West Quarry.
ZOR-14	Grassland habitat represents an ecological receptor that provides habitat for a threatened species (Eastern Meadowlark).
ZOR-16	Woodland habitat that represents an ecological receptor that provides habitat for endangered species (endangered bats) / SWH – Bat Maternity Roost Habitat / ONHSS that provides ecologically important services).
ZOR-17	This receptor is located on the Patterson & Robbins Drain, a tributary of the Thames River.
ZOR-18	This receptor is located at the northeast corner of the Site study area, It is the closest receptor to wetland habitat that has been identified as SWH – Amphibian Breeding Habitat (Wetlands).
Town of Ingersoll	
ING-4	This receptor is located at the confluence of the Patterson & Robbins Drain and the Thames River. It represents the Thames River at the surface water discharge location and multiple residences and businesses in the easternmost portions of Ingersoll.
ING-11	This receptor is located on the Thames River where it is crossed by Pemberton Street. It represents an ecological receptor (Thames River Aquatic Habitat, habitat for fish species targeted by anglers).
Township of South-West Oxford	
SWO-3	This receptor is located south of the Thames River. It represents multiple residences and agricultural operations along Beachville Road within 1000m southeast of the project site as well as ecological receptors along the Thames River.
SWO-13	This receptor is located within the Centreville Conservation Area. It represents multiple residences along Beachville Road within 1000m of the project site (closest residences south of the project site), and ecological receptors (SWH – Colonially – Nesting Bird Breeding Habitat (Tree/Shrubs) – Great Blue Heron and SWH – Turtle Overwintering Habitat / SWH – Habitat for Species of Conservation Concern (Snapping Turtle)).

7. Methodologies

7.1 Background Data

A comprehensive background review was undertaken to gather existing natural heritage information regarding the three study areas. This review included at least the following documents and sources for background data:

- County of Oxford. 2016. Oxford Natural Heritage Study;
- Ingersoll and District Nature Club;
- Oxford Trail Committee;
- Ministry of Natural Resources (MNR) Fish Dot Mapping;

Legend

- Site
- South SWM Outfall
- Haul Routes (50 m)
- Site Vicinity (120 m)
- Wider Area (500 m)
- Wider Area (1,000 m)
- Watercourse

Receptors

- Town of Ingersoll
- Township of South-West Oxford
- Township of Zorra

Receptors | **Figure 7**

Southwestern Landfill Environmental Assessment

BEACON ENVIRONMENTAL

Project: 217238
Last Revised: December

Client: Walker Environmental Group

Prepared by: RA
Checked by: BH

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- MNR Natural Heritage Information Centre (NHIC);
- Upper Thames River Conservation Authority (UTRCA). 2007. Woodstock Natural Heritage Inventory;
- Cudmore, B., C.A. MacKinnon and S.E. Madzia. 2004. Aquatic species at risk in the Thames River watershed, Ontario. Can. MS Rpt. Fish. Aquat. Sci.;
- Taylor, I., B. Cudmore, C.A. MacKinnon, S.E. Madzia and S. Hohn. 2004. The Thames River Watershed Synthesis Report;
- Department of Fisheries and Oceans (DFO) Canada Species at Risk Mapping;
- Transport Canada Airport Bird Strike Data;
- Christmas Bird Count data;
- Ontario Breeding Bird Atlas Data (and other atlas data as available);
- UTRCA natural heritage data;
- Knowledgeable local naturalists;
- MNR District Office; and
- Official Plan policies and mapping related to natural features.

For the Wider Area, background data collection included a detailed review of secondary sources of the Thames River and downstream receivers within a to-be-determined proximity downstream of the landfill.

Information gathered through the consultation process from Indigenous groups, the Community Liaison Committee, and other sources as part of the EA was also utilized as part of the background review.

Airport Wildlife Management Plans were requested from the airports that were included as part of the *Bird Hazard and Risk to Aviation* Assessment study, which is included in **Part 3** of this report. They were not available for review.

7.2 Aquatic Resources

The objective of the aquatic ecosystem studies is to determine the potential for effects on aquatic species, water resources or aquatic habitats through direct or indirect impacts associated with the construction and operation of the proposed landfill. The loss or disturbance of aquatic ecosystems was identified as one of the primary environmental assessment criteria.

The aquatic ecosystems were studied by means of the following four specialized disciplines:

- Aquatic habitat assessments;
- Fish community surveys;
- Benthic invertebrate community surveys; and
- Freshwater mussel community surveys.

The aquatic program including background review and fieldwork was completed according to the work plan prepared by Beacon in 2017 and approved by Walker. Detailed methodologies for each of these studies are included within the *Southwestern Landfill Environmental Assessment Aquatic and Terrestrial Ecology Baseline Report*, which is located in **Part 1** of this report.

7.3 Terrestrial Resources

The approach used in evaluating and assessing terrestrial resources for this study followed the information provided within the *Southwestern Landfill Proposal Environmental Assessment Ecological Assessment Work Plan* (Beacon 2017). Tasks that were completed as part of the terrestrial field program included:

- Ecological Land Classification (ELC) and floral surveys;
- Breeding bird surveys;
- Amphibian surveys;
- Dragonfly, damselfly and butterfly surveys;
- Winter wildlife use surveys;
- Incidental wildlife observations; and
- Landscape connectivity assessment.

Qualitative surveys for species-at-risk and rare species were also completed as part of this program. Generally, these surveys were completed as part of other surveys. They were also informed by correspondence with the MNRF. These included additional monitoring for the endangered Spiny Softshell Turtle (*Apalone spinifera*) and the threatened Blanding's Turtle (*Emydoidea blandingii*), the assessment and testing of 19 putative Butternut trees (*Juglans cinerea*), and surveys for endangered bat species were completed as part of the terrestrial field program based on correspondence with the MNRF during the background review and observations made during field surveys.

Aviation impacts due to gull interference have been addressed as part of the Bird Hazard Assessment that has been completed by Beacon in the *Bird Hazard and Risk to Aviation Assessment*, which is included in **Part 3** of this report.

No data collection was proposed to address disease transmission *via* insects or vermin.

Detailed methodologies for each of these studies are included within the *Southwestern Landfill Environmental Assessment Aquatic and Terrestrial Ecology Baseline Report*, which is located in **Part 1** of this report.

8. Data Collection

8.1 Background Data

8.1.1 Aquatic

The DFO, MNRF Aylmer District, and UTRCA were contacted for background information. Through this, it was determined that there are no records of fish or mussel species at risk within the Site, Site Vicinity, Haul Route or Wider study areas. Fish community survey data received as a result of this request included:

- Fish community sampling results for ten (10) locations within the Wider study area, including five (5) sampling locations within 1,000 m of the Site, and five (5) locations within 5 km of the Site study area, which were completed between 1974 and 2015; and
- Benthic monitoring survey results for seven (7) locations within the Wider study area, including two (2) locations within 1,000 m of the Site and five (5) locations within 5 km of the Site study area.

Records for 12 species of fish were obtained through the background review. These are identified in **Table 5**, in **Section 8.2.1**. All of these species are common and widespread in southern Ontario, except Brown Trout (*Salmo trutta*), which is less common as it is limited to groundwater-fed watercourses. Brown Trout is native to Europe and was one of the first species introduced into Ontario in the 1800s (Holm *et al*. 2009).

Sources accessed through background review did not reveal any records of fish or mussel SAR within the South Thames River, Wider study area or within 5 km of the study area.

Detailed information from the background review is included within the *Aquatic and Terrestrial Ecology Baseline Report Assessment*, which is provided within **Part 1** of this report.

8.1.2 Terrestrial

A background review of known terrestrial data for the Site, Site Vicinity and Wider study areas was completed. A summary of the findings is included in **Table 4**. Information collected from background resources covers a broader range than the Wider study area; therefore, the presence of a record within the source does not necessarily indicate that the record occurred within the Site, Site Vicinity or Wider study areas.

Table 4. Background Review – Terrestrial Results

Species at Risk			Potential Significant Wildlife Habitat	Significant Natural Areas
Endangered	**Threatened**	**Special Concern**		
• Spiny Softshell [1,2] • Butternut [1,2] • American Badger [1,2] • Endangered Bat sp. [1] • Loggerhead Shrike [3] • Rapids Clubtail [2]	• Barn Swallow [1,2,4] • Bank Swallow [1,4] • Bobolink [1,2,4] • E. Meadowlark [1,4] • Eastern Hognose Snake [3] • Blanding's Turtle [2]	• Common Nighthawk [4] • Red-headed Woodpecker [4] • Eastern Wood-Pewee [2,4] • Canada Warbler [2,4] • Peregrine Falcon [1] • Snapping Turtle [1,2,5] • Northern Map Turtle [1] • Monarch [6] • Wood Thrush [2] • Broad Beech Fern [2]	• Heron Colony [9] Species of Conservation Concern: • Purple Martin [4] • Bald Eagle [7] • Rough-legged Hawk [7] • Ram's Head Lady's Slipper [3]	• Thames River [9] • Significant Valleylands [8]

1 - Ministry of Natural Resources and Forestry
2 - Upper Thames River Conservation Authority 2017, Ingersoll Watershed Report Card
3 - Upper Thames River Conservation Authority 2007, Woodstock Natural Heritage Inventory
4 - Ontario Breeding Bird Atlas
5 - OHA – Ontario Herpetofauna Atlas
6 - Ontario Butterfly Atlas
7 - Woodstock Christmas Bird Count
8 - County of Oxford
9 - Natural Heritage Information Center

8.1.3 Oxford County Official Plan

Schedule C-1 of the *Oxford County Official Plan* identifies the area adjacent the Patterson & Robbins Drain from the South Thames River to Road 64 as 'Significant Valleylands'. Section 3.2.4.2.4 of the Official Plan states that Significant Valleylands are represented by the outer limits of the following features:

- The lands associated with a Regulatory Flood Plain, or a Floodway and Flood Fringe in the case of a Two-Zone Flood Plain; or
- A Fill Zone established by a Conservation Authority with jurisdiction, except in the case of the UTRCA, where erosion hazard lands are used to represent significant valley lands.

It also states that these features, as shown on Schedule C-1 of the Official Plan, may not be a reliable indicator of significant valleylands and that the presence of significant valleylands in a development proposal will be confirmed by the Conservation Authority during the development review process.

8.1.4 Oxford Natural Heritage System Study

The UTRCA (2016) *Oxford Natural Heritage Systems Study* (ONHSS) evaluates existing ecologically important terrestrial resources within Oxford County using the scientific method and information provided within the *Natural Heritage Reference Manual* (NHRM) (MNR 2010), Geographic Information System (GIS) modelling, and 2010 aerial photography. Mapping of the various criterion that were used to evaluate vegetation communities and groups is provided within the appendices of the ONHSS.

Appendix I-1. Criterion 1 Map, Significant Valleylands does not identify the area adjacent to the Patterson & Robbins Drain as a significant valleyland. The criteria used to identify significant valley lands were taken from the NHRM and are identified within Section 3.3.1 of the ONHSS.

Appendix I-1-1. Criterion 1 Map, Vegetation Group within or touching a Significant Valleylands identifies the woodlands west of the Site as a vegetation group that is not touching a Significant Valley. Vegetation communities, which are used to identify vegetation groups are defined within Section 2.3 of the ONHSS. These communities are assigned to Vegetation Groups, which include:

1) Wetland (contains woodland, thicket and meadow);
2) Woodland;
3) Thicket;
4) Meadow;
5) Water Feature;
6) Connected Vegetation Features; and
7) Watercourse Bluff and Depositional Areas.

These Groups are comprised of a mosaic of one or more Vegetation Communities within 20 m of each other.

Appendix I-3. Criterion 3 Map, Vegetation Groups within 30 m of an open watercourse identifies a vegetation group that is within 30 m of a watercourse north of the Site within the Haul Route Study area. It also identified the woodlands west of the Site as a group that is not within 30 m of an open watercourse. It also identified a vegetation group within the Site as a group that is not within 30 m of an open watercourse. A review of more recent aerial imagery shows that the vegetation group located on the Site has since been removed and is now an aggregate extraction area.

Appendix I-5. Criterion 5 Map, Woodland Size ≥ 4 ha identifies the woodlands west of the Site, the woodlands located south of the Haul Route, and woodland north of the Haul Route study area near where it ends at the 37th Line. It also identifies a woodland group < 4 ha along the southern edge of the Site. The NHRM recommends that woodlots of 4 ha or more should be considered significant in landscapes with about 5-15% woodland cover. The ONHSS indicates that there is 13.18% woodland cover within Oxford County based on 2010 aerial photography (UTRCA 2016).

Appendix I-7. Criterion 7 Map, Thicket Size ≥ 2 ha identifies a thicket on the Site. A review of more recent aerial imagery shows that the group located on the Site has since been removed and is now an aggregate extraction area.

Appendix I-10. Criterion 10 Map, Patches that meet a Group Criteria identifies patches within the Site, Site Vicinity and Haul Route that have been described above. These criteria were utilized by the ONHSS to measure the unique aspects of ecological services that natural features can provide. Through the ONHSS, any group or patch that meets at least one criterion is considered “ecologically important” in Oxford County.

Appendix I-11. Criterion 11 Map, Diversity identifies the woodlands west of the Site, the woodland south of the proposed Haul Route and the woodland north of the Haul Route study area near where it ends at the 37th Line as Patches that Meets Diversity Criteria. It also identifies a patch on the Site as a Patch that does not meet diversity criteria. A review of more recent aerial imagery shows that the group located on the Site has since been removed and is now an aggregate extraction area.

Appendix J-2. Map showing Woodlands that contain Woodland Interior identifies the woodlands west of the Site as a Woodland that has Interior habitat.

8.2 Field Data

8.2.1 Aquatic Resources

The aquatic resources surveys consisted of the following assessments:

- Fish community;
- Fish habitat;
- Benthic invertebrate community; and
- Mussel assessments.

Aquatic Habitat was assessed at two (2) locations in the South Thames River, seven (7) locations in the tributaries, and one (1) location in the former West Quarry.

Fish community sampling was completed in the South Thames River, Patterson & Robbins Drain, Caddy Drain, Foldens Creek and the former West Quarry. A 40 m section of the watercourse was sampled at each location by two staff using a backpack electrofisher and dipnets. At least two and sometimes a third pass were completed to accurately estimate the number fish. In total, 18 fish species were captured as detailed in **Table 5**, with a range of cold to warmwater species.

No rare, threatened or endangered species were captured. Most fish species captured are widespread and common throughout southwestern Ontario. The only exception is Brown Trout, which was captured at Location 2 and has a cold-coolwater thermal preference. This is a non-native species that is widespread as a result of introductions but is not common in Southwestern Ontario. Fishes with warmwater and a cool-warmwater thermal preference were captured in the South Thames River (locations 1 and 3). Generally, fishes with coolwater thermal preference were captured in the tributaries (locations 2, 4, 5, 6 and 7). Rock Bass was the only fish species captured in the former West Quarry (location 8). The quarry provides marginal quality fish habitat because it has minimal shallow nearshore (littoral) habitat which is required to provide important functions for fishes in lakes.

No freshwater mussels were observed in the river or in the tributaries, however, several freshwater mussel shells were found at both locations within the South Thames River. The detailed findings of these studies are included within the *Aquatic and Terrestrial Ecology Baseline Assessment*, which is provided within **Part 1** of this report.

Table 5. Fish Species and Conservation Status

Family	Common Name	Scientific Name	Thermal Regime[1]	Tolerance[1]	Origin[1]	Status			Background Records	Sampling Station and Number Caught							
						S-Rank[1]	SARO[1]	COSEWIC[1]		1	2	3	4	5	6	7	8
Catostomidae	White Sucker	*Catostomus commersonii*	Coolwater	Tolerant	Native	S5	NAR	NAR	X	1	47	1	8	52			
Centrarchidae	Bluegill	*Lepomis macrochirus*	Warmwater	Intermediate	Native	S5	NAR	NAR				1					
	Pumpkinseed	*Lepomis gibbosus*	Warmwater	Intermediate	Native	S5	NAR	NAR				2					
	Rock Bass	*Ambloplites rupestris*	Coolwater	Intermediate	Native	S5	NAR	NAR		4		10					12
	Smallmouth Bass	*Micropterus dolomieu*	Warmwater	Intermediate	Native / Introduced	S5	NAR	NAR		1							
Cyprindae	Blacknose Dace	*Rhinichthys atratulus*	Coolwater	Intermediate	Native	S5	NAR	NAR	X	1	70		146	386	124	21	
	Bluntnose Minnow	*Pimephales notatus*	Warmwater	Intermediate	Native	S5	NAR	NAR	X	3	24	7					
	Brassy Minnow	*Hybognathus hankinsoni*	Coolwater	Intermediate	Native	S5	NAR	NAR		2		2					
	Central Stoneroller	*Campostoma anomalum*	Coolwater	Intermediate	Native / Introduced	S4	NAR	NAR	X	2		2					
	Common Shiner	*Luxilus cornutus*	Coolwater	Intermediate	Native	S5	NAR	NAR				4					
	Creek Chub	*Semotilus atromaculatus*	Coolwater	Intermediate	Native	S5	NAR	NAR	X	2	168	7	123	116	319	96	
	Fathead Minnow	*Pimephales promelas*	Warmwater	Tolerant	Native	S5	NAR	NAR	X								
	Northern Redbelly Dace	*Chrosomus eos*	Coolwater	Intermediate	Native	S5	NAR	NAR	X								
Gasterosteidae	Brook Stickleback	*Culaea inconstans*	Coolwater	Intermediate	Native	S5	NAR	NAR	X				9	21	108	21	
Percidae	Blackside Darter	*Percina maculata*	Coolwater	Intermediate	Native / Introduced	S4	NAR	NAR		3		2					
	Fantail Darter	*Etheostoma flabellare*	Coolwater	Intolerant	Native	S4	NAR	NAR	X		1	6					
	Greenside Darter	*Etheostoma blennioides*	Warmwater	Intermediate	Native / Introduced	S4	NAR	NAR		40		63					
	Johnny Darter	*Etheostoma nigrum*	Coolwater	Tolerant	Native	S5	NAR	NAR	X	31		35	7	3			
	Rainbow Darter	*Etheostoma caeruleum*	Coolwater	Intolerant	Native	S4	NAR	NAR		5		26					
Salmonidae	Brown Trout	*Salmo trutta*	Coldwater	Intolerant	Introduced	SNA	NAR	NAR	X		1						

Notes:
[1] Thermal regime, tolerance origin and status from Ontario Freshwater Fishes Life History Database (Eakins, 2019)
S-Rank (Provincial Status - NHIC): **S4** = apparently secure; **S5** = secure; **SNA** = Not Applicable.
SARO (Committee on the Status of Species at Risk in Ontario): NAR = Not at Risk
COSEWIC (Committee on the Status of Endangered Wildlife in Canada): NAR = Not at Risk

8.2.2 Terrestrial Resources

A summary of the findings of the various surveys that were completed as part of the terrestrial field program is provided below. Detailed findings of these studies are included within the *Aquatic and Terrestrial Ecology Baseline Assessment*, located in **Part 1** of this report..

8.2.2.1 Vegetation

Ecological Land Classification

A total of 13 ELC communities were identified for the Site, the Site Vicinity and the Proposed Haul Route. They included:

- Cultural Meadow (CUM1);
- Cultural Thicket (CUT1);
- Cultural Thicket (CUT1) / Cultural Woodland (CUW1) Complex;
- Hedgerow (H);
- Cultural Woodland (CUW1);
- Dry-Fresh Sugar Maple Deciduous Forest (FOD5);
- Black Walnut Lowland Deciduous Forest (FOD7-4);
- Narrow-leaved Sedge Mineral Meadow Marsh (MAM2-5);
- Mineral Meadow Marsh (MAM2);
- Willow Mineral Thicket Swamp (SWT2);
- Mineral Deciduous Swamp (SWD4);
- Willow Mineral Deciduous Swamp (SWD4-1); and
- Open Water (OAO).

The Moist - Fresh Black Walnut Deciduous Forest Type (FOD7-4) has an S2S3 ranking and is considered rare.

Vascular Plants

An inventory of vascular plants was undertaken within the Site, Site Vicinity and Haul Route study areas in 2018 and 2019. A total of 239 species were identified. Of these 88 (37%) are non-native and 138 (58%) are native. All the plant species recorded in the study area are common to southwestern Ontario, with a provincial rank of S4 (Apparently secure), S5 (Common, secure) or SNA (Non-native).

8.2.2.2 Wildlife

Breeding Bird Surveys

A total of 55 species of breeding birds thought likely to be breeding were recorded on the Site, Site Vicinity and Haul Route study areas. Key species that were recorded included:

- Two species listed as threatened under the ESA and federal Species at Risk Act (SARA) (2002): Bank Swallow (Riparia riparia) and Eastern Meadowlark (Sturnella magna). Over the course of the breeding bird season, the aggregate pile that the Bank Swallow was utilizing slumped as the result of heavy rainfall. Following this, no Bank Swallows were documented utilizing this habitat. Correspondence with K. Buck, Management Biologist with the Aurora District MNRF (2019, pers. comm., 3, May), confirmed the aggregate pile no longer provides suitable for Bank Swallow;

- One species listed as special concern under the ESA and SARA: Eastern Wood-Pewee (Contopus virens). Which, despite being listed as special concern, is a common occurrence within wooded habitats throughout southern Ontario;
- Two species considered by the MNRF to be forest area-sensitive species in the Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E (2015): American Redstart (*Setophaga ruticilla*) and Yellow-throated Vireo (*Vireo flavifrons*). Despite the presence of bird species considered by the MNRF to be area-sensitive, the woodlands west of the Site, within the Site Vicinity study area, in which these species were recorded are not considered Woodland Area Sensitive Bird Breeding Habitat based on the criteria provided by the MNRF. Species considered to be area sensitive sometimes utilize smaller patches of habitats in fragmented landscapes, such as those present within the Wider study area;
- Three species considered by the MNRF to be grassland area-sensitive species in the Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E (2015): Savannah Sparrow (*Passerculus sandwichensis*), Eastern Meadowlark and Grasshopper Sparrow (*Ammodramus savannarum*). Despite being identified as a grassland area-sensitive species Savannah Sparrow is a common occurrence in rural areas in and along the edges of agricultural fields. Eastern Meadowlark and Grasshopper Sparrow tend to only occur in larger patches of intact habitat;
- A Cliff Swallow (*Petrochelidon pyrrhonota*) colony; and
- A Great Blue Heron (*Ardea herodias*), Double-crested Cormorant (*Phalacrocorax auritus*) and Turkey Vulture (*Cathartes aura*) colony.

<u>Breeding Amphibian Surveys</u>

A total of five frogs and one toad species were recorded within the Site Vicinity, Wider and Haul Route study areas during nocturnal amphibian call surveys in 2018. Species heard calling included American Toad (*Anaxyrus americanus*), Gray Tree Frog (*Hyla versicolor*), Green Frog (*Rana clamitans*), Northern Leopard Frog (*Lithobates pipiens*), Spring Peeper (*Pseudacris crucifer*), and Wood Frog (*Rana sylvatica*).

<u>Basking Turtles Surveys</u>

Two species of turtle, Midland Painted Turtle (*Chrysemys picta*) and Snapping Turtle (*Chelydra serpentina*) were identified through the completion of basking turtle surveys. Snapping Turtle was observed within a remnant drainage feature within the Haul Route study area. Both Midland Painted Turtle and Snapping Turtle were identified within the Thames River and the Centreville Pond Conservation Authority within the Wider study area.

Odonate and Lepidoptera Surveys

A total of 29 butterfly (Lepidoptera) species and 21 dragonfly and damselfly (Odonata) species were recorded on the Site, in the Site Vicinity and along the Haul Routes during the three surveys in 2018.

Key Odonata observations included River Bluet (*Enallagma anna*) and Azure Bluet (*Enallagma aspersum*). The known range for these species is expanding in Ontario and both have been recorded in man made habitats such as dug ponds and agricultural drains. No Odonates listed as endangered, threatened or special concern were recorded within the Site, the Site Vicinity or Haul Route study areas.

Key Lepidoptera observations were Giant Swallowtail (*Papilio cresphontes*) (migrant), Wild Indigo Duskywing (*Erynnis baptisiae*) and Little Glassywing (*Pompeius verna*). The range in which these species are known to occur has been expanding in recent years as a result of them adopting other food or host plants that are common throughout southern Ontario.

Monarch (*Danaus plexippus*) was observed within meadow habitats within the Haul Route and Site Vicinity study areas. It is listed as Special Concern under the ESA. Monarch is a common breeding migrant in Ontario.

No other lepidoptera listed as endangered, threatened or special concern were recorded within the Site, Site Vicinity or Haul Route study areas.

Winter Wildlife, Mammal Surveys and Incidental Wildlife Observations

Through the completion of the winter wildlife survey, a mammal survey and incidental observations of wildlife during the completion of other surveys a total of 13 mammals were recorded within the Site, Site Vicinity, Haul Route and Wider study areas. They include:

- White-tailed Deer (*Odocoileus virginianus*);
- Eastern Coyote (*Canis* X *latrans*);
- Red Fox (*Vulpes vulpes*);
- Eastern Cottontail (*Sylvilagus floridanus*);
- Deer Mouse (*Peromyscus maniculatus*) / White-footed Mouse (*Peromyscus leucopus*);
- Gray Squirrel (*Sciurus carolinensis*);
- Mink (*Neovison vison*);
- Northern Short-tailed Shrew (*Blarina brevicauda*);
- Racoon (*Procyon lotor*);
- Striped Skunk (*Mephitis mephitis*);
- Groundhog (*Marmota monax*);
- American Beaver (*Castor canadensis*); and
- Muskrat (*Ondatra zibethicus*).

Crow Roost

Located between three of the Great Lakes, southwestern Ontario acts as a “funnel” for migrating birds, including hundreds of thousands of Crows. As a result, large fall and winter night roosts with thousands of Crows have become established in and around towns in southwestern Ontario, such as Waterloo, Chatham, Windsor and Woodstock, which is located 13 km to the north-northwest of the proposed landfill site. The Woodstock roost is currently located at Pittock Lake, with annual fall and winter numbers of 10,000 plus birds. Christmas bird count data undertaken each year in December by the Woodstock Field Naturalists shows that Crow numbers typically vary from 20,000 to 40,000. The highest number of Crows recorded at Pittock Lake during the Christmas bird count was 90,000 in 2011. In 2018 the Christmas bird count recorded 21,000 Crows for the Woodstock area.

The results of the crow roost surveys indicate that even though tens of thousands of Crows occur within 20 km of the Salford Landfill, the site does not attract a significantly large number of Crows. In addition, the survey found that during the fall and winter months Crows at the landfill make morning and evening flights to and from the well-established roost in Woodstock and do use an alternate roost site nearer to the landfill. This site fidelity to an existing roost is not uncommon for Crows.

8.2.3 Landscape Connectivity

Within the Site, Site Vicinity and the Haul Route study areas landscape connectivity was assessed by first identifying potential pathways using background information and aerial photography. This information was then reviewed using data collected through the background review and field surveys to assess these pathways for their likely use.

Local movement pathways within and along the hedgerows and watercourses and through agricultural fields between woodlands were identified within the Site, Site Vicinity and Wider Area. The most common observations along most of these pathways were associated with larger mammals, including White-tailed Deer and Coyote, whose tracks, and scat was commonly observed in or along these areas. Smaller mammals, i.e. squirrels, Eastern Cottontail as well as birds, were also observed utilizing these pathways.

The Thames River, located to the south of the Site within the Wider study area, represents a regional movement corridor. Within this area the river, and the vegetation growing along its banks provide habitat for, and allow for the movement of many aquatic, semi-aquatic species and terrestrial species through the area.

9. Environment Potentially Affected by the Undertaking

Section 6.1(2)(c)(i) of the Act requires a: "*description of the environment that will be affected or might reasonably be expected to be affected, directly or indirectly*". Section 8.2 of the ToR describes the methodology by which the environment potentially affected by the proposed landfill is to be developed, notably including both the existing environment as well as the environment that would be expected to exist in the future without the proposed undertaking (i.e., the environmental baseline conditions, or the "*do nothing*" alternative).

9.1 Baseline Assumptions

9.1.1 Land Use Forecast

A common set of assumptions was provided by MHBC Planning on behalf of Walker regarding the forecast land uses in the area, so that this study could reflect any reasonably foreseeable changes in the uses of the land on and around the proposed landfill site (including the expected ongoing operation of the quarries and lime plants in the vicinity of the site). These assumptions are detailed in Walker's *Environmental Assessment Report*, while a brief summary of the aspects relevant to this study follows.

Land-use changes within the Site, Site Vicinity, Haul Route and Wider study areas identified through the land use forecast that will impact natural heritage features within these areas are limited to the removal of wetland habitat that will occur as part of the approved expansion of the quarry operation to the northeast of Site and Site Vicinity study area and within the Wider study area.

By 2043, the quarry operation will have expanded northward and will be approaching the southern boundary of the Haul Route study area.

9.1.2 Climate Change Forecast

Another set of common assumptions that were established for the purpose of this EA is the potential for climate change so that these could be considered in the individual studies of the potential effects of the proposed landfill. These assumptions are detailed in Walker's *Environmental Assessment Report* and basically adopt the guidance in the MNRF *Climate change projections for Ontario: An updated synthesis for policymakers and planners.*

9.2 Environmental Baseline Conditions

Important or sensitive natural heritage features that were identified within the Site, Site Vicinity, Haul Routes or Wider areas through the work completed as part of this study include:

- Fish habitat;
- Habitats for endangered or threatened species;
- Woodlands;
- Wetlands; and
- Significant Wildlife Habitat.

These features are summarized in **Table 6** and are shown in and **Figure 8**. Detailed descriptions of these features and habitats are provided within the *Aquatic and Terrestrial Ecology Baseline Assessment*, which is provided within **Part 1** of this report.

Key Natural Heritage Features

Figure 2

Southwestern Landfill Environmental Assessment

Legend

- Site
- South SWM Outfall
- Haul Routes (50 m)
- Site Vicinity (120 m)
- Wider Area (500 m)
- Wider Area (1,000 m)
- Watercourse
- Key Terrestrial Natural Heritage Features

	Type
1	Habitat for Endangered Species (Endangered Bats) / SWH - Bat Maternity Roost Habitat / ONHSS Natural Feature That Provides Ecologically Important Services
2	SWH - Turtle Overwintering Habitat / SWH - Habitat for Species of Conservation Concern (Snapping Turtle)
3	SWH - Amphibian Breeding Habitat (Wetlands)
4	SWH - Colonially - Nesting Bird Breeding Habitat (Tree/Shrubs) - Great Blue Heron
5	Habitat for Endangered Species (Spiny Softshell Turtle) / SWH - Regional Movement Corridor
6	Habitat for Threatened Species (Eastern Meadowlark)
7	SWH - Colonially - Nesting Bird Breeding Habitat (Bank and Cliff) - Cliff Swallow
8	ONHSS Natural Feature That Provides Ecologically Important Services
9	ONHSS Natural Feature That Provides Ecologically Important Services

BEACON ENVIRONMENTAL

Project: 217238
Last Revised: November 2019

Client: Walker Environmental Group

Prepared by: RA
Checked by: BH

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9.2.1 Future Baseline Conditions

Anticipated future baseline conditions as they relate to the natural environment within the Site, Site Vicinity, and Haul Route study areas will be similar to existing conditions as there are few natural features within these areas.

Anticipated changes to natural heritage features within the Wider study area will be due to the approved expansion of the quarry operation to the northeast of the Site and Site Vicinity study areas. These include the removal of wetland habitat located in this area and changes to local animal movement pathways.

Table 6. Summary of Key Natural Heritage Features and Functions

Feature / Function Category	Importance	Sensitivity
Fish Habitat **Regulated under the federal *Fisheries Act* (1985)**		
Patterson & Robbins Drain	This permanent watercourse provides habitat to fishes with a cool water thermal preference	The fish community is sensitive to changes in the water supply i.e. volume and temperature
Caddy Drain	This permanent watercourse provides habitat to fishes with a cool water thermal preference	The fish community in this watercourse is sensitive to changes in the water supply i.e. volume and temperature
Foldens Creek (Upstream of Centreville Pond)	This permanent watercourse provides habitat to fishes with a cool-cold water thermal preference	The fish community in this watercourse is sensitive to changes in the water supply (i.e. volume and temperature)
Thames River	This regionally important river provides habitat to a fish species with a range of water thermal regime preferences	Fish species with a cool water thermal habitat in this watercourse are sensitive to changes in the water supply i.e. volume and temperature
Habitat of Threatened or Endangered Species **Regulated under the *Endangered Species Act* (2007)**		
Eastern Meadowlark	Two pairs recorded using the meadow southeast of the Site, within the Site Vicinity Listed as a threatened species under the ESA	Relatively tolerant of disruption such as noise Nesting areas are subject to destruction from human activities such as mowing or harvesting
Endangered Bat Species	The woodlands west of the Site are assumed to contain habitat for endangered bat species that are subject to the ESA	Roosting and maternity habitat for bats can be sensitive to disturbance from noise and light associated with human activities near roosting habitat The buildings and woodlands in which they roost are subject to destruction from human activities such as building demolition and tree removals
Woodlands		
Woodlands	The woodland west of the Site and both woodlands along the proposed Haul Route are identified in the ONHSS as natural features that provide ecologically important services	These woodlands are sensitive to disturbance from adjacent human activities and destruction from activities such as tree removal

Feature / Function Category	Importance	Sensitivity
Wetlands - Regulated under the *Conservation Authorities Act*, O. Reg. 157/06		
Wetlands	Small pockets of meadow marsh and thicket swamp wetlands were identified within the Site, Site Vicinity and Haul Route study areas Breeding habitat for amphibians was identified with the swamp and marsh habitat located in the northeast corner of the Site Vicinity study area Given the size and isolated nature of these wetland communities, it is unlikely that they would satisfy the criteria to be considered Provincially Significant, the standard used by the MNRF and PPS to determine the importance of a wetland	Wetland communities and the wildlife they support can be sensitive to changes in hydrology and destruction from human activities
Significant Wildlife Habitat		
Seasonal Concentration Areas of Animals		
Colonially - Nesting Bird Breeding Habitat – Heron Colony	A colony of nesting Great Blue Heron is located on the south side of the Former West Quarry; nesting Double-crested Cormorant and Turkey Vultures were also identified within the heronry	Heron colonies are generally known to be sensitive to disturbance such as unexpected noise and physical presence during their breeding season
Bat Maternity Colonies	The woodlands west of the Site are assumed to contain bat maternity colonies	Roosting and maternity habitat for bats can be somewhat sensitive to disturbance from noise and light associated with human activities near roosting habitat; the woodlands in which they roost are sensitive to destruction from human activities such as tree removal
Colonially - Nesting Bird Breeding Habitat – Cliff Swallow	A colony of Cliff Swallows at the Former West Quarry south of the Site	During the breeding Swallows can be somewhat sensitive to disruption due to the activity of animals or humans near their colony;
Rare Vegetation Communities or Specialized Habitat for Wildlife		
Other Rare Vegetation Communities – ELC Unit 7: Black Walnut Lowland Deciduous Forest (FOD7-4)	This ELC community is assigned a subnational rank (SRANK) of S2S3 in Appendix M of the SWH Technical Guide (OMNR 2000)	See the description provided for woodlands

Feature / Function Category	Importance	Sensitivity
Specialized Habitat for Wildlife		
Amphibian Breeding Habitat (Wetlands)	Spring Peepers, Gray Tree Frog, Green Frog and American Toad were confirmed to be breeding within two wetlands northeast of the Site study area and south of the proposed Haul Route study area The number of species/individuals recorded as breeding within these features indicate these wetlands are important habitats for breeding amphibians within the wider study area The lack of other suitable habitats within / adjacent the Site and Haul Route study areas for breeding amphibians further highlights the importance of this habitat	Breeding habitat for amphibians can be somewhat sensitive to disturbance from noise and light associated with human activities near the breeding habitat The wetland communities that support these habitats can be sensitive to changes in hydrology and destruction from human activities
Habitat for Species of Conservation Concern (Not including Endangered or Threatened Species)		
Habitat for Species of Special Concern – Snapping Turtle	A relatively large number of Snapping Turtle were documented within the pond and wetland habitat located at the Centreville Conservation Area, with up to 34 individuals being recorded on a single day; a lesser number of Snapping Turtles were also recorded within the Thames River	Habitat for Snapping Turtles can be somewhat sensitive to disturbance from human activities. They are known to migrate between suitable habitats within the areas in which they live and are also susceptible to habitat fragmentation and mortality due to road kill and poaching The waterbodies that support Snapping Turtle can be sensitive to changes in hydrology and destruction from human activities

10. Evaluation of the Proposed Landfill

Section 6.1 (2)(c) and (d) of the Act, and the ToR require an evaluation of:

- The effects that will be caused on the environment;
- The actions necessary to prevent, change, mitigate or remedy the effects on the environment; and
- An evaluation of the advantages and disadvantages (net effects) to the environment.

This section presents the assessment of these matters as it relates to ecological assessment, and for each of the EA criteria related to this study.

10.1 Criterion 6: Disease Transmission *via* Insects or Vermin

The potential for disease transmission *via* insects or vermin during and following the operation of the landfill is associated with the increased abundance of insects and animals, like gulls, which are known to carry zoonotic diseases (disease that can be passed from wildlife to humans) such as: salmonella, campylobacter and histoplasmosis. Climate change has also been linked with the establishment and geographical expansions of zoonotic diseases, such as Lyme disease (Germain *et al.* 2019).

While an increase in the abundance of these types of animals and insects represents a potential increase in the risk in the spread of disease to humans and domestic animals, even without mitigation that reduces the presence of potential vectors, this risk is considered to be very low due to the limited interactions between insects or vermin from the landfill and humans and the tenuous pathways through which transmission to occur.

10.1.1 Potential for Cumulative Effects

Activities identified within the *Land Use Assessment* (MHBC 2020) within the Site, Haul Route, Site Vicinity or Wider study areas should not lead to an increase in the abundance of insects or vermin that could spread disease. There are also no planned developments identified that would lead to a significant increase in the human population within these areas. Therefore, there are no anticipated potential cumulative effects associated with the proposed undertaking and other activates that are anticipated to occur close to the Site, Haul Route, Site Vicinity and Wider study areas.

10.1.2 Additional Mitigation Recommendations

No additional mitigation measures beyond those provided in the *Potential Bird Hazard and Risk to Aviation Assessment*, located in **Part 3** of this report, are recommended to control disease transmission *via* insects or vermin.

10.1.3 Net Effects

No significant net effects are anticipated on disease transmission *via* insects or vermin as a result of the proposed landfill.

10.1.4 Summary

The pathway for disease transmission *via* insects or vermin that could potentially be associated with the landfill directly or indirectly to humans is tenuous due to the limited opportunity for interaction between vectors and humans within the Site, Haul Route, Site Vicinity and Wider study areas.

This limited potential is further reduced through the implementation of the mitigation measures provided in the *Potential Bird Hazard and Risk to Aviation Assessment*, located in **Part 3** of this report.

Accordingly, the proposed landfill is not expected to have any significant effects relating to disease transmission to humans *via* insects or vermin.

10.2 Criterion 8: Aviation Impacts due to Bird Interference

Potential effects associated with the operation of the landfill associated with aviation impacts due to bird interference are discussed within the *Potential Bird Hazard and Risk to Aviation Assessment*, located in **Part 3** of this report.

Potential hazards identified through this study included the attraction of large numbers of gulls, crows and starlings with lesser numbers of raptors and vultures on a seasonal basis.

The assessment found that operation of the proposed landfill would not be anticipated to result in a High risk. Due to their location in relation to the proposed landfill site with no bird hazard mitigation, a Moderate risk was identified for Tillsonburg Airport and Low risk was identified for the Woodstock Airport.

10.2.1 Potential for Cumulative Effects

There are no other activities identified within the *Land Use Assessment* (MHBC 2020) within the Site, Haul Route, Site Vicinity or Wider study areas that have the potential to attract birds that could impact aviation.

10.2.2 Additional Mitigation Recommendations

To mitigate the identified risk, the implementation of an Integrated Bird Management Program (IBMP) is required. The key elements of the IBMP that are to be implemented have been detailed within the *Potential Bird Hazard and Risk to Aviation Assessment*, located in **Part 3** of this report.

10.2.3 Net Effects

With the successful and effective implementation of the IBMP (**Part 3** of this report), it is anticipated that the net effect of the risk to aircraft during the operation of the proposed landfill will be reduced to a low level (Tillsonburg) or very low/background level (other airports or operations).

10.2.4 Summary

Hazardous bird species that have the potential to occur at the landfill include Ring-billed Gull, Herring Gull, European Starling, American Crown, Turkey Vultures. Through the implementation of the measures provided within the IBMP the net effect of the risk to aircraft during the operation of the proposed landfill will be reduced to low or very low/background levels.

10.3 Criterion 35: Loss or Disturbance to Terrestrial Ecosystems

Proposed effects indicators that were selected to evaluate the loss or disturbance to terrestrial ecosystems associated with the proposed landfill within the *Southwestern Landfill Proposal, Environmental Assessment Ecological (Terrestrial/Aquatic) Work Plan* (Beacon 2017) were:

- ELC communities (other than woodland and wetlands);
- Wetlands;
- Woodlands;
- Species at Risk;
- Rare communities or species;
- Colonial nesting birds;
- Breeding amphibian areas; and
- Landscape connectivity.

The range and relevance of potential changes to these indicators are also defined within the Work Plan. These were:

- Removal thresholds for ELC units, wetlands and woodlands;
- Loss of use of habitat for species at risk and rare communities or species;
- Loss of breeding habitat for colonial nesting birds;
- Loss of productive breeding habitat for breeding amphibians; and
- A major impact of landscape connectivity.

Aside from the removal of habitat during construction, dust and noise are two variables associated with the proposed landfill that have the potential to cause the potential changes described above. These are discussed further under the headings below.

Dust

Dust can create effects to vegetation communities and species. During the growing season or year-round for evergreen species, dust can physically coat vegetation limiting photosynthesis and other growth processes. Certain types of dust can also result in concomitant chemical changes or reactions on leaf surfaces. This in turn, can affect associated wildlife communities. These effects are most likely to influence vegetation communities and species, but could, if of a sufficiently high level of effect, cascade into other wildlife sub-components. This interaction is being advanced for further consideration.

A review of dust effects (Farmer 1991) showed that evidence for dust effects on vegetation was poorly studied and did not conclude with a determination of appropriate thresholds. A Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions (New Zealand Ministry of the Environment 2001) also discusses the effect of dust on vegetation and provides recommended triggers. The triggers are, however, largely based on sensitivity that is defined by human interactions (i.e. they are based on nuisance effects related to soiling), deeming rural areas relatively insensitive to some discharges. In the Farmer (1991) review, a number of studies cited demonstrated that daily deposition rates of around 14 g/m^2/day did not result in loss of vegetation (although some other effects such as reduced or increased growth were noted).

Dust will be generated during various activities associated with the construction and operation of the landfill such as on-site vehicle traffic, wind erosion of exposed areas, handling of waste soil and daily cover material and construction activities (RWDI 2020a). Sources of dust from the existing and proposed Carmeuse operation include on-site vehicle traffic, material handling, crushing, screening, loading and other processing activities, blasting and wind erosion of storage piles.

The *Air Quality Assessment Report* (RWDI 2020a) assessed total suspended particulate matter (TSP), inhalable particulate matter (PM_{10}), respirable particulate matter ($PM_{2.5}$) and dustfall against their applicable criteria over various averaging periods for existing, Stage 1 and Stage 3 operational periods. It considered operation in the worst-case scenario for each stage. It also considered the combined effects from the proposed landfill operations, future Carmeuse operations, future traffic levels and background concentrations from the ambient monitoring program.

The results of the dust modeling assessment identified exceedances of PM_{10} – 24 hour and TSP – 24 hour at off-site residential receptors. It is important to note that these exceedances are based on human-based standards. The frequency of these exceedances is very low. For example, at receptor SWO-4 the landfill contribution is predicted to increase the frequency of exceeding the TSP criteria by 1%. At other residential receptors the landfill is predicted to result in one or two additional exceedances over the five-year modelled period. These frequencies are based on a conservative model that assumes maximum operations and dry conditions for each day of the modelled period (RWDI 2020a).

The results of the dust modeling assessment as it relates to the environmental sub-components and natural heritage features is discussed in **Table 7** and **Section 10.3.1**.

Noise and Vibration

Studies on the effects of noise from traffic on breeding birds in grassland and woodland habitat adjacent to roadways have found that higher levels of cars per day on roads can lead to reduced breeding success or densities adjacent the roads (Forman 2000, Reijnen *et al*. 1996 and Reijnan *ei al.* 1997). These studies have also documented a correlation in the number of cars per day on a road and the distance at which reduced breeding success occurs. Acoustic masking has been identified as a possible mechanism through which traffic noise can negatively affect songbird density (Rheindt 2003). Birds with higher-pitched songs at frequencies above those of traffic noise may be less susceptible to the disturbance effects of noise.

While these studies have demonstrated that the noise associated with traffic can affect breeding birds in habitats adjacent roadways detailed information regarding the levels of noise that cause effects to breeding birds (and other wildlife) is scant. A few studies detected declines in breeding bird densities at thresholds between 20 and 56 decibels (dBA) (A) (USDT 2008). However other studies reviewed by the USDT (2008) report waterfowl showed no effects at Leq. 24 hr. 63 dB (A). (This value refers to the maximum value within a period of 24 hours, acknowledging the constant fluctuations of noise, whereby 63 dBA is equivalent to an average value described as a constant level, and also adjusted for how a human ear (A), with its frequency capabilities, would actually hear the noise.)

Under existing conditions there are several sources of constant and intermittent noises associated with the site. This includes existing activity associated with the Carmeuse aggregate operation, rail activity associated with the CN and Ontario Southland railway lines south of the site and noise associated with the roads that surround the site (RWDI 2020b). This is an important part of the assessment of effects as the wildlife communities in and around the site are already adapted to a relatively noisy environment. Wildlife in general and birds in particular, often habituate to noise and vibration that they do not perceive as a clear and present danger. This is why colonies of birds are often be found in industrial sites (such as pits/quarries, landfills and power generation stations).

In order to assess the potential effects of noise associated with the proposed landfill operation a noise and vibration assessment was completed, the results of which are discussed within the *Noise and Vibration Assessment Report* (RWDI 2020b).

Four scenarios were considered as part of the noise and vibration assessment. These are baseline or existing conditions and operational stages 1, 3 and 4 for the proposed landfill. Each of these scenarios captures the worst-case operating locations for both the Carmeuse quarry and the proposed landfill using ten points of reception that are located within 5 km of the project (RWDI 2020b).

Five criteria were considered as a part of noise and vibration assessment. They were:

- Stationary sources;
- Landfilling operations;
- Pest control devices;
- Haul routes on public roads;
- Cumulative noise effects; and
- Landfilling vibration.

Absent specific wildlife guidelines for noise and vibration the guidelines for the individual criteria for human receptors were utilized to compare existing noise and vibration levels to proposed noise and vibration levels. The rationale utilized for this comparison is that wildlife occupying the habitats adjacent to the Site study area have adapted to the background noise levels therefore any changes from these levels can be assessed to determine if they have the potential to affect wildlife. For the cumulative effects assessment completed as part of the *Noise and Vibration Assessment* (RWDI 2020b) a cumulative change greater than 3 dB was considered to be “noticeable”. Only one receptor, ZOR-11, had an increase in the cumulative sound level that was beyond this threshold. An 11 m berm along the southwestern boundary of the landfill at this location was proposed to mitigate this increase (RWDI 2020b).

The results of the *Noise and Vibration Assessment* (RWDI 2020b) as it relates to the environmental sub-components and natural heritage features is discussed in **Table 7** and **Section 10.3.1**

Table 7. Terrestrial Ecosystems Evaluation of Potential Effect Pathway

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for further consideration	Rationale
Loss or disturbance to terrestrial ecosystems - Ecological Land Classification (ELC) communities as defined by ELC System for Southern Ontario (other than woodland and wetland which are addressed below)	ELC Unit 1: Dry – Moist Old Field Meadow (CUM1-1)	• Removal of up to 9.53 ha of this habitat type to accommodate landfill, haul route or leachate area • Dust and debris from landfill and haul route construction and operation.	• No	• The area of removal is less than the threshold considered to be potentially meaningful within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan*
	ELC Unit 2: Mineral Cultural Thicket (CUT1)	• Removal of up to 1.00 ha of this habitat type to accommodate landfill or haul route • Dust and debris from the landfill or haul route construction and operation	• No	• The area of removal is less than the threshold considered to be potentially meaningful within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan*
	ELC Unit 3: Mineral Cultural Meadow / Mineral Cultural Thicket Complex CUM1/CUT1)	• Removal of up to 1.00 ha of this habitat type to accommodate the haul route • Dust and debris from haul route construction and operation	• No	• The area of removal is less than the threshold considered to be potentially meaningful within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan*
	ELC Unit 4: Hedgerow (HE)	• Removal of up to 0.72 ha of this habitat type to	• No	• The area of removal is less than the threshold considered to be potentially meaningful within Table 5 of the *Southwestern Land Fill Proposal,*

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for further consideration	Rationale
		accommodate haul route or leachate area • Dust and debris from haul route and leachate area construction and operation		*Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan*
Loss / Disturbance of Terrestrial Ecosystems – Wetlands	ELC Unit 8a: Narrow-leaved Sedge Mineral Meadow Marsh (MAM2-5)	• Removal of up to 0.08 ha of this habitat type to accommodate the haul route • Dust and debris from haul route construction and operation	• No	• While the area of removal is greater than the threshold considered to be potentially meaningful within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan* the land on which the Haul Route is to be located on is already licensed for extraction by Carmeuse under Licence #2136 and License #2129. Therefore, the removal of this feature has been approved
	ELC Unit 9b: Reed-canary Grass Mineral Meadow Marsh (MAM2-2)	• Removal of up to 0.08 ha of this habitat type to accommodate the haul route • Dust and debris from haul route construction and operation	• No	• While the area of removal is greater than the threshold considered to be potentially meaningful within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan* the land on which the Haul Route is to be located on is already licensed for extraction by Carmeuse under Licence #2136 and License #2129. Therefore the removal of this feature has been approved
Loss / Disturbance of Terrestrial Ecosystems – Woodlands	ELC Unit 5: Mineral Cultural Woodland (CUW1)	• Removal of up to 0.44 ha of this habitat type to accommodate haul route or leachate area	• No	• Loss of cultural woodland types is identified as negligible change within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan*

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for further consideration	Rationale
	ELC Unit 6: Dry – Fresh Sugar Maple Deciduous Forest (FOD5)	• Dust and debris from landfill construction and operation	• No	• Due to the separation of this natural heritage feature from the Site by another woodland no loss or disturbance to this natural heritage feature is anticipated due to dust and debris from the construction and operation of the landfill
	ELC Unit 7: Fresh – Moist Black Walnut Lowland Deciduous Forest (FOD7-4)	• Dust and debris from landfill construction and operation	• Yes	• As this natural heritage feature is located within 15 m of the Site dust and debris from landfill construction and operation has the potential to disturb this natural heritage feature. It has therefore been advanced for further consideration and is discussed in **Section 10.3.1.1**
Loss or disturbance to terrestrial ecosystems – Species at Risk	Habitat for Eastern Meadowlark (Threatened) Location: ELC Unit 1l: Dry – Moist Old Field Meadow (CUM1-1) Receptor ID: ZOR-14	• Dust and debris from landfill construction and operation • Noise from landfill construction and operatio	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan* is use of habitat where that use may be affected As this natural heritage feature is located within 50 m of the Site dust and debris and noise from landfill construction and operation have the potential to affect this natural heritage feature. It has therefore been advanced for further consideration and is discussed in **Section 10.3.1.2**
	Habitat for Endangered Bat species. Location:	• Dust and debris from landfill construction and operation	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan* is use of habitat where that use may be affected

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for further consideration	Rationale
	ELC Unit 6a: Dry – Fresh Sugar Maple Deciduous Forest (FOD5) and ELC Unit 7a: Fresh – Moist Black Walnut Lowland Deciduous Forest (FOD7-4) Receptor ID: ZOR- 16	• Noise from landfill construction and operation		As this natural heritage feature is located within 15 m of the Site dust, debris and noise from landfill construction and operation have the potential to affect this natural heritage feature. It has therefore been advanced for further consideration and is discussed in **Section 10.3.1.3**
	Migratory habitat for Spiny Softshell Turtle (Endangered) Location: Thames River Receptor ID: ING-4	• Treated leachate discharge	• No	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan* is use of habitat where that use may be affected. Thames River is located approximately 500 m south of the Site within the Wider study area No changes to the use of habitat within the Thames River by turtles are anticipated as a result of the proposed landfill due to the distance between the river and the Site and a lack of an the effect pathway
Loss or disturbance to terrestrial ecosystems – Rare Communities or Species	ELC Unit 7: Fresh – Moist Black Walnut Lowland Deciduous Forest (FOD7-4) Receptor ID: ZOR- 16	• Dust and debris from landfill construction and operation	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan* is the loss of regularly used habitats As this natural heritage feature is located within 15 m of the Site dust and debris from landfill

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for further consideration	Rationale
				construction and operation have the potential to affect this natural heritage feature. It has therefore been advanced for further consideration and is discussed in **Section 10.3.1.1**
Loss or disturbance to terrestrial ecosystems - Colonial Nesting (birds that nest in colonies)	Cliff Swallow Colony Receptor ID: ZOR-11	• Noise from landfill construction and operation	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan* is the loss of any breeding habitat As this natural heritage feature is located within 120 m of the Site noise from landfill construction and operation have the potential to affect this natural heritage feature. It has therefore been advanced for further consideration and is discussed in **Section 10.3.1.4**
	Heronry A colony of nesting Great Blue Heron is located on the south side of the former West Quarry. Receptor ID: SWO-01	• Dust and debris from landfill construction and operation • Noise from landfill construction and operation	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan* is the loss of any breeding habitat As heronries can be sensitive to disturbance from anthropogenic sources this natural heritage feature has been advanced for further consideration and is discussed in **Section 10.3.1.5**.

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for further consideration	Rationale
Loss or disturbance to terrestrial ecosystems – Breeding Amphibian Areas	Amphibian Breeding Habitat (Wetlands) Receptor ID: ZOR-18	• Noise, dust and debris from landfill and haul route construction and operation	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan* the loss of productive breeding habitat As this natural heritage feature is located within 90 m of the Site dust, debris and noise from landfill construction and operation have the potential to affect this natural heritage feature. It has therefore been advanced for further consideration and is discussed in **Section 10.3.1.6**
Loss or disturbance to terrestrial ecosystems - Landscape Connectivity	Thames River Regional Movement Corridor Receptor ID: ING-4	• No interaction with the project	• No	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan* is a major impact to connectivity. No changes to the Thames River, or the wooded habitats adjacent to it south of the Site are anticipated as a result of the proposed landfill due to the distance between the river and the site and a lack of an effects pathway
	Local Movement Pathways (e.g. hedgerows, watercourses)	• Removal of parts of habitats utilized by wildlife to move about the study area to accommodate landfill, haul route or leachate area	• No	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan* is a major impact to connectivity

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for further consideration	Rationale
		• Noise, dust and debris from landfill and haul route operation		The movement of wildlife through the Haul Route and Wider study area to the north of the site will be affected by the construction and operation of the Haul Route. These affects are not considered to be a major impact to connectivity as they will be limited to species of wildlife that are common throughout southwestern Ontario and have adapted to the fragmented landscape that is prevalent in this area This area is also licensed under Licence #2136 and License #2129 and part of it will be subject to removal as part of the quarry expansion (MHBC 2020)

10.3.1 Terrestrial Features Advanced for Further Consideration

10.3.1.1 Loss / Disturbance of Terrestrial Ecosystems – Woodlands / Rare Communities or Species - ELC Unit 7: Fresh – Moist Black Walnut Lowland Deciduous Forest (FOD7-4)

This natural heritage feature is associated with the woodlands located on the farm west of the Site, within the Site Vicinity study area. The results of the *Air Quality Assessment* (RWDI 2020b) indicate that the following contaminants exceed the applicable MECP criteria at receptor ZOR-16, which is the receptor associated with this feature:

- 24-hour PM2.5 - Phase 1;
- 24-hour PM10 – Existing conditions and Phase 1 (with and without landfill); and
- 24-hour TSP – Existing conditions and Phase 1 (with and without landfill).

Under existing conditions, the maximum 30 day and annual dustfall levels were determined to be 1.84 ug/m3. Under proposed conditions the maximum 30 day and annual dustfall levels ranged from 0.38 to 4.41 ug/m3. The MECP AAQC maximum 30 day and annual dustfall levels are 7 and 4.6 ug/m3 respectively (RWDI 2020a). These values are well below that which would be expected to result in a response by vegetation communities.

As discussed in **Section 10.3.1** the landfill is predicted to result in one or two additional exceedances over the five-year modelled period. These frequencies are based on a conservative model that assumes maximum operations and dry conditions for each day of the modelled period (RWDI 2020b).

Based on this no loss or disturbance of woodland habitat is anticipated due to the dustfall associated with the proposed landfill. Therefore, additional mitigation measures beyond those already proposed are not required.

10.3.1.2 Loss or Disturbance to Terrestrial Ecosystems – Species at Risk - Habitat for Eastern Meadowlark (Threatened)

This natural heritage feature is associated with meadow habitat located to the south of the site, within the Site Vicinity study area.

Modelled existing sound levels during Phase 1, Phase 2 and Phase 3 at Receptor SWO-3, which is the closest receptor to this habitat for which noise modelling was completed, ranged from 49 to 50 dBA during the day, 45 dBA during the evening and 41 dBA at night (RWDI 2020b). The projected cumulative sound level at receptor SWO-3 increased by no more than 1 or 2 dBA during any of the operational Phases associated with the proposed landfill (RWDI 2020b). The literature indicates that birds are unlikely to respond in a negative manner to this magnitude of change, and as the species is currently present, the existing conditions are not limiting occupancy.

Based on this, no loss of use of habitat by Eastern Meadowlark is anticipated due to the noise associated with the proposed landfill.

The results of the *Air Quality Assessment* (RWDI 2020a) indicate that the following contaminants exceed the applicable MECP criteria at receptor ZOR-14:

- 24-hour PM2.5 – Phase 1;
- 24-hour PM10 – Phase 1; and
- 24-hour TSP – Phase 1 (with and without landfill).

Under existing conditions, the maximum 30 day and annual dustfall levels were determined to be 0.36 ug/m^3. Under proposed conditions the maximum 30 day and annual dustfall levels ranged from 0.46 to 1.74 ug/m^3. The MECP Ambient Air Quality Criteria (AAQC) maximum 30 day and annual dustfall levels are 7 and 4.6 ug/m^3 respectively (RWDI 2020a). These values are well below that which would be expected to result in a response by vegetation communities and by extension the habitat of meadowlarks.

No loss of use of habitat by Eastern Meadowlark is anticipated due to the dustfall associated with the proposed landfill. Therefore, additional mitigation measures beyond those already proposed are not required.

10.3.1.3 Loss or Disturbance to Terrestrial Ecosystems – Species at Risk - Habitat for Endangered Bat species

This natural heritage feature is associated with the woodlands located on the farm west of the Site, within the Site Vicinity study area.

Modelled existing noise levels during Phase 1, Phase 2 and Phase 3 at Receptor ZOR-11, which is the closest receptor to this natural heritage feature for which noise modelling was completed, ranged from 45 to 46 dBA during the day, 40 to 43 dBA during the evening and 40 dBA at night (RWDI 2020b).

The projected cumulative sound level at receptor ZOR-11 increased from by 2 to 1 decibel during Phase 1 and 3 respectively and by 7 dBA during Phase 2. The additional noise at this location during this period was to occur during landfilling operations in daytime hours. Noise levels during the evening and night are to be the same under existing and proposed conditions.

The small increase in daytime noise is not expected to disturb roosting bats and no changes in noise levels are anticipated during darkness when bats are active. Therefore, no loss of use of habitat by endangered bat species is anticipated due to noise associated with the proposed landfill.

The results of the *Air Quality Assessment* (RWDI 2020a) indicate that the following contaminants exceed the applicable MECP criteria at receptor ZOR-16:

- 24-hour PM2.5 - Phase 1;
- 24-hour PM10 – Existing conditions and Phase 1 (with and without landfill); and
- 24-hour TSP – Existing conditions and Phase 1 (with and without landfill);

Under existing conditions, the maximum 30 day and annual dustfall levels were determined to be 1,84 ug/m^3. Under proposed conditions the maximum 30 day and annual dustfall levels ranged from 0.38 to 4.41 ug/m^3. The MECP AAQC maximum 30 day and annual dustfall levels are 7 and 4.6 ug/m^3 respectively (RWDI 2020a). These values are well below that which would be expected to result in a response by vegetation communities and by extension the habitat of bats.

Based on this, no loss of use of habitat by endangered bat species is anticipated due to the dustfall associated with the proposed landfill. Therefore, additional mitigation measures beyond those already proposed are not required.

10.3.1.4 Loss or Disturbance to Terrestrial Ecosystems - Colonial Nesting - Cliff Swallow Colony

This natural heritage feature is located on the northern edge of the former West Quarry in a rock wall that is south facing. It is not located on the Site and will not be removed as a result of the proposed landfill. In addition, the colony is located on a south facing rock wall, so the colony will be partially sheltered from direct exposure to noise from the landfill.

Modelled existing noise levels during Phase 1, Phase 2 and Phase 3 at Receptor ZOR-11, which is the closest receptor to this natural heritage feature for which noise modelling was completed, ranged from 45 to 46 dBA during the day, 40 to 43 dBA during the evening and 40 dBA at night (RWDI 2020b).

A sound level increase of 7 dBA was identified in the *Noise and Vibration Assessment* (RWDI 2020a) during the daytime operation of the Landfill in Phase 3 at receptor ZOR-11. This is still at a level that is unlikely to disturb birds in what is already a “noisy” environment.

Modeling completed for pest control devices at ZOR-11 did not show any exceedances of the MECP noise guideline limit of 70 dBAI. However, the potential for an exceedance was identified during the use of Shotgun Pest Control Devices. This level could also be expected to disturb birds, indeed some of these devices are specifically designed to do so. To mitigate this effect on the colony, an area where such devices will not be permitted has been identified in the southernmost portion of the landfill area.

Based on this assessment, and the relatively high tolerance of swallows to noise (Gorenzel and Salmon 1994), no loss of breeding habitat for Cliff Swallow is anticipated due to due to noise associated with the proposed landfill.

10.3.1.5 Loss or Disturbance to Terrestrial Ecosystems - Colonial Nesting - Heronry

This natural heritage feature is located in a treed area that is located on the southern edge of the former West Quarry. It is not located on the Site and will not be removed as a result of the proposed landfill.

Modelled existing sound levels during Phase 1, Phase 2 and Phase 3 at Receptor SWO-3, which is the closest receptor to this habitat for which noise modelling was completed, ranged from 49 to 50 dBA during the day, 45 dBA during the evening and 41 dBA at night (RWDI 2020b). The projected cumulative sound level at receptor SWO-3 increased by no more than 1 or 2 dBA during any of the operational Phases associated with the proposed landfill (RWDI 2020b). This is well below the level that would be expected to affect birds.

A study of impulsive noises at the heronry was also completed as part of *Noise and Vibration Assessment* (RWDI 2020b). Impulsive noises are sharp and almost instantaneous sounds. For the purposes of this assessment impulses at or above 65 dBAI were measured. This value was selected as impulses from pest management devices are expected to produce levels less than 65 dBAI. An impulse was considered to be an increase of 10 dBA within 100 milliseconds, above the average level of the preceding second. Under existing conditions, 29 to 59 impulsive events already occur at this location on an average day at or above the sound level that a pest control device would produce. These findings demonstrate a soundscape influenced by the industry and the transportation corridors that surround it. Based on the number and magnitude of impulsive events at the heronry under existing conditions no loss of breeding habitat (i.e., disturbance) is anticipated due to the noise associated with the proposed landfill.

In order to assess the potential effects of impulsive pest control devices, a worst-case noise model was also completed as part of the *Noise and Vibration Assessment* (RWDI 2020b). This involved modelling an overall sound power level of 144 dBAI, which was selected to model the primary pest control device, the shotgun. Noise predictions at SWO-3 ranged from 61 to 71 dBAI. This would represent an increase of 12 to 21 dBA over proposed daily noise levels. This level could be expected to disturb nesting herons. To mitigate this effect on the colony, an area where such devices will not be used will be identified in the southernmost portion of the landfill area.

The results of the *Air Quality Assessment* (RWDI 2020a) did not identify any exceedance of the applicable MECP criteria at receptor SWO-1, which is the closest receptor to this natural heritage feature for which dust modelling was completed.

Under existing conditions, the maximum 30 day and annual dustfall levels were determined to be 0.01 ug/m3. Under proposed conditions the maximum 30 day and annual dustfall levels ranged from 0.18 to 0.87 ug/m3. The MECP AAQC maximum 30 day and annual dustfall levels are 7 and 4.6 ug/m3 respectively (RWDI 2020a). These levels are not anticipated to cause any difficulties for the nesting herons.

Based on this, no loss of breeding habitat at the heronry is anticipated due to dust associated with the proposed landfill. Therefore, additional mitigation measures beyond those already proposed are not required.

10.3.1.6 Loss or Disturbance to Terrestrial Ecosystems – Breeding Amphibian Areas

This natural heritage feature is located in wetland habitat that is located north east of the Site. As it is not located on the Site, it will not be removed as a result of the proposed landfill. However, it is located on land that is licensed for extraction by Carmeuse under License #2129. Extraction will occur within this area at some point between 2023 and 2044 as part of the aggregate extraction process (MHBC 2020).

Modelled noise levels during Phase 1, Phase 2 and Phase 3 at Receptor ZOR-3, which is the closest receptor to this natural heritage feature for which noise modelling was 45 dBA during the day, 40 dBA during the evening and at night (RWDI 2020b).

There was no projected cumulative sound increase at ZOR-3. Based on this, the loss of productive habitat is not anticipated due to the noise associated with the proposed landfill.

The results of the *Air Quality Assessment* (RWDI 2020a) indicate that the following contaminants exceed the applicable MECP criteria at receptor ZOR-18:

- 24-hour PM10 –Phase 1 (with landfill) and Phase 3 (with and without landfill); and
- 24-hour TSP – Phase 3 (with and without landfill).

Under existing conditions, the maximum 30 day and annual dustfall levels were determined to be 0.45 ug/m3. Under proposed conditions the maximum 30 day and annual dustfall levels ranged from 2.47 to 2.66 ug/m3. This relatively low level of dustfall is not anticipated to interact with amphibian habitat use, which is already mitigated by their affinity for water.

Based on this, the loss of productive habitat is not anticipated due to dust associated with the proposed landfill. Therefore, additional mitigation measures beyond those already proposed are not required.

10.3.2 Potential for Cumulative Effects

Cumulative effects associated within the proposed undertaking and other activates that are anticipated to occur in close proximity to the Site, Haul Route, Site Vicinity and Wider study areas are associated with the planned expansion of the aggregate operations as identified within the *Land Use Assessment* (MHBC 2020).

By 2043 the active quarry associated with License 2129 and 2136 will have expanded to the north and east of the Site. This expansion will result in the removal of wetland habitat that provides amphibian breeding habitat and the wetland habitats located in the ditches along Road 64. It will also affect the east to west movement of wildlife north of the site within the Wider study areas. While these affects are part of any cumulative assessment, they are already certain to occur as per the approved extraction limits for the quarry.

10.3.3 Additional Mitigation Recommendations

Only one additional mitigation recommendation has been identified to address potential effects associated with the landfill, the creation of a shotgun exclusion zone on the southernmost portion of the landfill. This zone was created so that noise from the operation of these devices do not negatively affect nesting herons.

Other general best management practices that should be considered during construction to further, minimize or offset the effects of the development of the landfill and haul route on terrestrial ecosystems are provided below.

- Review opportunities for vegetation preservation in conjunction with the refinement of the development and grading plan where and if feasible;
- Design and implement Erosion and Sediment Control Plan;
- Stabilize and/or re-vegetate all areas of disturbed soils using native topsoil and native, self-sustaining vegetation; and
- Direct lighting along the western side of the site away from natural heritage features where feasible.

10.3.4 Net Effects

With the mitigation measures recommended above (i.e., the shotgun exclusion zone), no significant or potentially meaningful effects on terrestrial ecosystems as a result of the proposed landfill have been identified.

10.3.5 Summary

The proposed landfill and haul route are to be situated in an area where there is an existing aggregate operation and agricultural fields. On this basis, the terrestrial ecosystems are generally limited to small patches of isolated, early stage successional habitat such as meadow or thicket or hedgerows that are located along roads, fence lines and watercourses. Furthermore, meaningful effects to the terrestrial ecosystem and components within it are not anticipated to occur due to activities associated with the construction and operation of the proposed landfill.

10.4 Criterion 36: Loss/Disturbance of Aquatic Ecosystems

Proposed effects indicators that were selected to evaluate the loss or disturbance to aquatic ecosystems associated with the proposed landfill within the *Southwestern Landfill Proposal, Environmental Assessment Ecological (Terrestrial/Aquatic) Work Plan* (Beacon 2017) are:

- Benthic Invertebrates;
- Fish Community;
- Indicator Species (Rainbow Darter, Iowa Darter and Mottled Sculpin);
- Fish Habitat; and
- Species at Risk.

The range and relevance of potential changes to these indicators are also defined within the Work Plan as:

- Loss or disturbance to aquatic ecosystems.

No loss of aquatic habitat is anticipated during the construction of the proposed landfill. However, three (3) variables are associated with the proposed landfill that have the potential to cause impacts as detailed above:

- Water quality impacts from the stormwater management pond;
- Changes in drainage area; and
- Dust and debris from the haul road.

A *Surface Water Assessment* (Golder 2020) was completed to evaluate the effects of the landfill on surface water quality. The analysis included flows and constituent concentrations in a mass balance to estimate final concentrations in the Patterson & Robbins Drain and the Thames River (Golder 2020). Discharge concentrations were estimated for the stormwater management pond and leachate treatment plant effluent. The results indicate that potential effects on the Patterson & Robbins Drain and the South Thames River include elevated levels of certain water quality parameters primarily due to one of three reasons:

1. Site contact with surface water runoff from the landfill final cover areas, which are discharged through the stormwater management ponds;
2. Treated effluent discharge into the Patterson & Robbins Drain from the leachate treatment plant; or
3. Baseline exceedances of guideline criteria found during background monitoring.

The *Surface Water Assessment* (Golder 2020) indicated that the exceedances were mainly attributable to the SWM pond discharge, which is projected to have elevated concentrations of common stormwater constituents. The assessment results were compared against several guidelines including the Provincial Water Quality Objectives (PWQO) and the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME). As indicated in the *Surface Water Assessment* (Golder 2020), the leachate plant will be designed so that leachate effluent discharge will meet PWQO standards. Based on this no affects on the aquatic ecology in the Patterson & Robbins Drain and the Thames River are anticipated. Therefore, this impact assessment evaluates the SWM pond discharge results (provided by Golder) on the aquatic ecosystem.

Based on the results of the *Surface Water Assessment* (Golder 2020), a total of fourteen (14) constituents are anticipated to exceed PWQO and CCME guidelines from the SWM pond discharge. The assessment modelled data under low flow (exceedances occur for a few days, every several years), average flow (typical concentrations in the watercourse) and high flow events (exceedances occur for a few days as often as each year or two) for Operational, Post-Operational 1 (2014-2070) and Post-Operational 2 (2071-2100).

The results of the *Surface Water Assessment* (Golder 2020) as they relate to the environmental sub-components and natural heritage features identified within the *Southwestern Landfill Proposal, Environmental Assessment Ecological (Terrestrial/Aquatic) Work Plan* (Beacon 2017) are discussed in **Table 8**.

The *Surface Water Assessment* (Golder 2020) assessed Flood and Erosion Hazards (Criterion 5), Loss/Displacement of Surface Water Resources (Criterion 32) and Effects on Stream Baseflow Quantity/Quality (Criterion 34). The results for Golder sites SW1a, SW2 and SW6 are discussed in the following paragraphs.

Patterson & Robbins Drain

The proposed landfill will eventually increase the catchment area of Patterson & Robbins Drain[2] by approximately 7.5% at the point of confluence with the Thames River (Golder 2020). The increased runoff will be managed by the two stormwater management ponds. As expected, the potential risk of flooding and erosion would be highest under high flow conditions. To determine potential impacts, storm events were evaluated under the different project scenarios at the discharge locations and at the receiving watercourses. Surface water resources are not expected to be lost or displaced (Golder 2020). Further, the *Surface Water Assessment* (Golder 2020) states that the proposed landfill will have no effect on groundwater contributions to stream baseflow, however, there is a potential effect on the baseflow quantity from surface water contributions. The additional contribution will be from the leachate treatment plant that discharges to the Patterson & Robbins Drain.

SW1a – Beacon Sampling Station 4

- For the 1:2 year peak flows, increase in flows from the landfill would range from 0.684 m3/s to 0.754 m3/s.

[2] The quarry dewatering is currently pumped directly to the South Thames River, whereas the runoff from the landfill final cover will be directed into the Patterson & Robbins Drain.

- Average flows are expected to increase between 10-11%.
- Increases to the stream baseflow quantity by 5.77 L/s during operational period, 6.44 L/s (post-closure period 1) and 6.63 L/s (post closure period 2) from the proposed landfill.

SW2 – Beacon Sampling Station 9

- For the 1:2 year peak flows, increase in flows from the landfill would range from 0.266 m3/s to 0.284 m3/s.
- Average flows are expected to increase between 8-10%.

Thames River

SW6 – Beacon Sampling Station 3

- For the 1:2 year peak flows, increase in flows from the landfill would range from 0.1 m3/s to 0.103 m3/s.
- Average flows are expected to increase between 0.13%-0.14%.

The peak flows from the landfill site will be managed by the SWM ponds. The discharge of effluent from the leachate treatment plant will also contribute to baseflow and will maintain some baseflow even under low flow conditions (Golder 2020).

The assessment indicates that peak flows in the receiving watercourse will be increasing, however this would occur gradually as a result of the catchment areas of the SWM ponds increasing slowly over the operating life of the landfill. Therefore, the peak flow increase will occur over many years and is not expected to affect the risk of flooding and erosion in the receiving watercourse. Post-closure catchment conditions are expected to decrease by 3.9% (2041-2070) and 8.2% (2071-2021) for the Patterson & Robbins Drain, as the quarry gradually expands to the north and de-waters directly to the South Thames, decreasing the risk of flooding and erosion during these periods.

As detailed in Section 10.3, dust will be generated during various activities associated with the construction and operation of the landfill such as on-site vehicle traffic, wind erosion of exposed areas, handling of waste soil and daily cover material and construction activities (RWDI 2020a). Dust will be generated from the existing and proposed Carmeuse operation include on-site vehicle traffic, material handling, crushing, screening, loading and other processing activities, blasting and wind erosion of storage piles.

Potential impacts to aquatic ecology include increased particulate matter within the water column, sedimentation of the streambed, smothering of benthic invertebrate and fish eggs, damage to fish gills through abrasion and alteration of pH in watercourse.

The results of the dust modeling assessment as it relates to the environmental sub-components and natural heritage features identified within the *Southwestern Landfill Proposal, Environmental Assessment Ecological (Terrestrial/Aquatic) Work Plan* (Beacon 2017) are discussed in **Table 8**.

A summary of aquatic ecosystems identified and evaluated as part of the baseline conditions report is included in **Table 8**. An evaluation of potential effect pathways and rationale as to why further consideration of potential effects and mitigation is or is not required.

Table 8. Potential Effects on Aquatic Ecosystems

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for Further Consideration	Rationale
Loss or Disturbance to Aquatic Ecosystems – Benthic Invertebrates	Caddy Drain	• Dust and debris from the landfill and haul route construction and operation	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan is ≥10% decrease of the HBI score • As this natural heritage feature is located adjacent to the proposed Haul Route dust and debris from the haul route construction and operation have the potential to affect this natural heritage feature. It has therefore been advanced for further consideration and is discussed in **Section 10.4.1**
	Foldens Creek	• No interaction with the project	• No	• Foldens Creek is located on the eastern side of the South Thames River. Foldens Creek will not be negatively affected by the proposed landfill activities and will not receive any discharge from the stormwater management pond or leachate facility
	Patterson & Robbins Drain Receptor ID: ZOR-17	• Treated leachate discharge • Treated stormwater discharge • Dust and debris from the haul road operation • Change to drainage area	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan is ≥10% decrease of the HBI score As this natural heritage feature is located adjacent to the proposed Haul Route dust and debris from the haul route construction and operation have the potential to affect this natural heritage feature. In addition, this feature will receive discharge from the leachate plant and stormwater management ponds. It has therefore been advanced for further consideration and is discussed in **Section 10.4.1**

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for Further Consideration	Rationale
	Former West Quarry	• No interaction with the project • Dust and debris from the landfill construction and operation	• No	• No interaction with the project
	South Thames River (downstream of proposed landfill) Receptor ID: ING-4	• Treated leachate discharge • Treated stormwater discharge	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan is ≥10% decrease of the HBI score As this natural heritage feature is the ultimate receiving waterbody, there is the potential to affect this natural heritage feature. It has therefore been advanced for further consideration and is discussed in **Section 10.4.1**
	South Thames River (upstream of proposed landfill) Receptor ID: ING-4	• No interaction with the project	• No	• No impacts to the South Thames River upstream of the proposed landfill are anticipated. All discharge will be located approximately 3 km downstream of this receptor
Loss or Disturbance to Aquatic Ecosystems – Fish Community	Caddy Drain	• Dust and debris from the landfill and haul route construction and operation	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan is ≥10% decrease in the IBI score • As this natural heritage feature is located adjacent to the proposed Haul Route dust and debris from the haul route construction and operation have the potential to affect this natural heritage feature. It has therefore been

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for Further Consideration	Rationale
				advanced for further consideration and is discussed in **Section 10.4.1.1**
	Foldens Creek	• No interaction with the project	• No	• Foldens Creek is located on the eastern side of the South Thames River. Foldens Creek will not be negatively affected by the proposed landfill activities and will not receive any discharge from the stormwater management pond or leachate facility
	Patterson & Robbins Drain ZOR-17	• Treated leachate discharge • Treated stormwater discharge • Dust and debris from the haul road operation • Change to drainage area	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan is ≥10% decrease of the IBI score As this natural heritage feature is located adjacent to the proposed Haul Route dust and debris from the haul route construction and operation have the potential to affect this natural heritage feature. In addition, this feature will receive discharge from the leachate plant and stormwater management ponds. It has therefore been advanced for further consideration and is discussed in **Section 10.4.1**
	Former West Quarry	• No interaction with the project	• No	• No interaction with the project
	South Thames River (downstream of proposed landfill) ING-4	• Treated leachate discharge • Treated stormwater discharge	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan is ≥10% decrease of the IBI score • As this natural heritage feature is the ultimate receiving waterbody, there is the potential to affect this natural heritage feature. It has therefore been advanced for further consideration and is discussed in **Section 10.4.1**

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for Further Consideration	Rationale
	South Thames River (upstream of proposed landfill) Receptor ID: ING-4	• No interaction with the project	• No	• No impacts to the South Thames River upstream of the proposed landfill are anticipated
Loss or Disturbance to Aquatic Ecosystems – Indicator Species (Rainbow Darter, Iowa Darter, Mottled Sculpin)	Caddy Drain	• Dust and debris from the landfill and haul route construction and operation	• No	• No indicator species were captured in the Caddy Drain
	Foldens Creek	• No interaction with the project	• No	• No indicator species were captured in Foldens Creek
	Patterson & Robbins Drain Receptor ID: ZOR-17	• Treated leachate discharge • Treated stormwater discharge • Dust and debris from the haul road operation • Change to drainage area	• No	• No indicator species were captured in the Patterson & Robbins Drain
	Former West Quarry	• No interaction with the project • Dust and debris from the landfill construction and operation	• No	• No indicator species were captured in the former West Quarry

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for Further Consideration	Rationale
	South Thames River (downstream of proposed landfill) Receptor ID: ING-4	• Treated leachate discharge • Treated stormwater discharge	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan is ≥10% decrease in the Fulton's Conditions Factor • Indicator species were captured in the South Thames River • As this natural heritage feature is the ultimate receiving waterbody, there is the potential to affect this natural heritage feature. It has therefore been advanced for further consideration and is discussed in **Section 10.4.1**
	South Thames River (upstream of proposed landfill) Receptor ID: ING-4	• No interaction with the project	• No	• Indicator species were captured at this location, however, no impacts to the South Thames River upstream of the proposed landfill are anticipated
Loss or Disturbance to Aquatic Ecosystems – Fish Habitat	Caddy Drain	• Dust and debris from the landfill and haul route construction and operation	• Yes	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan is ≥10% decrease in area of fish habitat • As this natural heritage feature is located adjacent to the proposed Haul Route dust and debris from the haul route construction and operation have the potential to affect this natural heritage feature. It has therefore been advanced for further consideration and is discussed in **Section 10.4.1**

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for Further Consideration	Rationale
	Foldens Creek	• No interaction with the project	• No	• Foldens Creek is located on the eastern side of the South Thames River. Foldens Creek will not be negatively affected by the proposed landfill activities and will not receive any discharge from the stormwater management pond or leachate facility
	Patterson & Robbins Drain Receptor ID: ZOR-17	• Treated leachate discharge • Treated stormwater discharge • Dust and debris from the haul road operation • Change to drainage area	• No	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan is ≥10% decrease in area of fish habitat There will not be any area of fish habitat removed, therefore, it has not been advanced for further consideration
	Former West Quarry	• No interaction with the project • Dust and debris from the landfill construction and operation	• No	• No interaction with the project
	South Thames River (downstream of the proposed landfill) Receptor ID: ING-4	• Treated leachate discharge • Treated stormwater discharge	• No	• The threshold used to identify a potentially meaningful change within this effect indicator within Table 5 of the Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan is ≥10% decrease in area of fish habitat There will not be any area of fish habitat removed, therefore, it has not been advanced for further consideration

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for Further Consideration	Rationale
	South Thames River (upstream of the proposed landfill) Receptor ID: ING-4	• No interaction with the project	• No	• No interaction with the project is anticipated
Loss or Disturbance to Aquatic Ecosystems – Species at Risk	Caddy Drain	• Dust and salt from the haul road operation	• No	• Species at Risk were not captured, and no suitable habitat is present within Caddy Drain
	Foldens Creek	• No interaction with the project	• No	• Species at Risk were not captured and no suitable habitat is present within Foldens Creek
	Patterson & Robbins Drain Receptor ID: ZOR-17	• Treated leachate discharge • Dust and salt from the haul road operation	• No	• No Species at Risk were captured as part of this project and have not been identified through historic sampling in the Patterson & Robbins Drain
	Former West Quarry	• No interaction with the project	• No	• Species at Risk were not captured as part of this project and no suitable habitat is present in the former West Quarry
	South Thames River (downstream of proposed landfill) Receptor ID: ING-4	• Treated leachate discharge	• No	• No Species at Risk were captured as part of this project and have not been identified through historic sampling in the South Thames River

Effects Indicators	Natural Heritage Feature	Effect Pathways	Advanced for Further Consideration	Rationale
	South Thames River (upstream of the proposed landfill) Receptor ID: ING-4	• No interaction with the project	• No	• No Species at Risk were captured as part of this project and have not been identified through historic sampling in the South Thames River

As detailed in **Table 8**, there is potential for water quality impacts to the benthic and fish community located in the Patterson & Robbins Drain from the SWM pond discharge based on the water quality modeling results. It is important to note, though, that most of the parameters that are predicted to be elevated above PWQO and CCME guidelines in the SWM discharge similarly exceed PWQO and CCME guidelines already in the Patterson & Robbins Drain. Therefore, based on the background results, the fish and benthic communities found in Patterson & Robbins Drain are either tolerant of and/or have acclimated to these elevated parameters. As detailed in the Ecology Baseline Report (**Part 1**) tolerant fish species were captured and identified in the Patterson & Robbins Drain. The benthic invertebrates collected in Patterson & Robbins Drain were assessed as ‘good’ to ‘fairly poor’ which indicates there is some organic pollution probable and substantial pollution likely, as might be expected in an agricultural drain. Both the fish and benthic community results in Patterson & Robbins Drain are reflective of the background water quality collected.

10.4.1 Aquatic Features Advanced for Further Consideration

10.4.1.1 Caddy Drain

The Caddy Drain was advanced for further consideration due to the potential for dust and debris from the construction and operation of the haul route to affect the benthic and fish community with this feature, which is located parallel to the proposed haul route. The data collected at receptor ZOR-17 was used to assess for potential impacts.

The results of the *Air Quality Assessment* (RWDI 2020a) indicate that the following contaminants exceed the applicable MECP criteria at receptor ZOR-17:

- 24-hour PM2.5 – Phase 1;
- 24-hour PM10 – Phase 1 and Phase 3; and
- 24-hour TSP – Phase 1 and Phase 3 (with and without landfill).

Under existing conditions, the maximum 30 day and annual dustfall levels were determined to be 0.36 ug/m^3. Under proposed conditions the maximum 30 day and annual dustfall levels ranged from 0.95 to 1.78 ug/m^3. The MECP Ambient Air Quality Criteria (AAQC) maximum 30 day and annual dustfall levels are 7 and 4.6 ug/m^3 respectively (RWDI 2020a).

As discussed in **Section 10.3.1** the landfill is predicted to result in one or two additional exceedances over the 5-year modelled period. These frequencies are based on a conservative model that assumes maximum operations and dry conditions for each day of the modelled period (RWDI 2020a).

Based on the low frequency in which these events are projected to occur, there are no impacts to benthic invertebrates or the fish community anticipated.

10.4.1.2 Patterson & Robbins Drain

The Patterson & Robbins Drain was advanced for further consideration due to the potential for dust and debris from the construction and operation of the haul route, discharge from the leachate and stormwater management ponds and changes to the drainage area that may affect the benthic and fish community with this feature.

Water quality impacts from the leachate discharge are not anticipated as effluent levels will be designed to meet PWQO criteria. This will not be advanced for further consideration.

Potential water quality impacts from the SWM pond discharge, could potentially impact benthic invertebrates and fish community. Water quality results from the *Surface Water Assessment* (Golder 2020) indicate that there will be exceedance of several water quality parameters.

SW2 is the furthest upstream station in the Patterson & Robbins Drain and will receive discharge from the leachate treatment facility and one (1) SWM pond. The *Surface Water Assessment* (Golder 2020) identified eleven (11) water quality constituents that may exceed the PWQO and CCME guidelines at this location based on the SWM discharge modelled water quality results see **Appendix B**.

SW1a is the furthest downstream station in the Patterson & Robbins Drain and will receive discharge from the leachate treatment facility and two (2) SWM ponds. The *Surface Water Assessment* (Golder 2020) identified fourteen (14) water quality constituents that may exceed the PWQO and CCME guidelines at this location based on the SWM discharge modelled water quality results see **Appendix B**.

Water quality parameters at the downstream station were noticeably higher than levels modelled upstream at SW2a. This is likely a cumulative effect given that SW1a is downstream and will receive additional discharge from the second SWM pond.

As noted previously, the SWM pond will discharge into the Patterson & Robbins Drain where the background water quality already shows exceedances of PWQO and CCME guidelines for most of these same parameters, and where the fish and benthic communities are likely already tolerant and/or acclimated to this water quality. As a result, it is unlikely that the SWM discharge will have a significant effect on these communities. Nevertheless, it would be prudent to confirm this assessment through a program of benthic invertebrate, fish community and water quality monitoring during site operations, which will permit further refinement of the SWM pond operation, if necessary.

Patterson & Robbins Drain, will receive discharge from both the leachate and stormwater pond, increasing drainage to the watercourse. Based on the Surface Water Assessment Report no net effects are anticipated on the receiving watercourse or the aquatic biota from the increase in catchment area.

The results of the *Air Quality Assessment* (RWDI 2020a) indicate that the following contaminants exceed the applicable MECP criteria at receptor ZOR-17:

- 24-hour PM2.5 – Phase 1;
- 24-hour PM10 – Phase 1 and Phase 3; and
- 24-hour TSP – Phase 1 and Phase 3 (with and without landfill).

Under existing conditions, the maximum 30 day and annual dustfall levels were determined to be 0.36 ug/m^3. Under proposed conditions the maximum 30 day and annual dustfall levels ranged from 0.95 to 1.78 ug/m^3. The MECP Ambient Air Quality Criteria (AAQC) maximum 30 day and annual dustfall levels are 7 and 4.6 ug/m^3 respectively (RWDI 2020a).

As discussed in **Section 10.3,** the landfill is predicted to result in one or two additional exceedances over the 5-year modelled period. These frequencies are based on a conservative model that assumes maximum operations and dry conditions for each day of the modelled period (RWDI 2020a).

Based on the low frequency in which these events are projected to occur, there are no impacts to benthic invertebrates or the fish community anticipated.

10.4.1.3 South Thames River (Downstream of Proposed Landfill)

Potential water quality impacts from the SWM pond discharge, which may impact benthic invertebrates and the fish community were identified at this location. In addition, Rainbow Darter, which is identified as an indicator species in Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan*, were captured in the South Thames River.

Water quality results from the Surface Water Assessment report (Golder 2020) indicate that two (2) water quality parameters will exceed the CCME guidelines. Water quality results at SW6 indicate that Fluoride and Nitrite will exceed the CCME long-term guidelines during all flow scenarios and operation stages. Fluoride is only slightly above (0.188-0.19 mg/L) the CCME guidelines (0.12 mg/L), therefore based on the frequency and duration, no impacts to benthic invertebrates or the fish community are anticipated.

Nitrite concentrations were elevated (0.202-0.205 mg/L) above the CCME guidelines (0.06 mg/L). However, these levels are similar to those experienced by the benthic invertebrate and fish community (including River Darter) under existing conditions as background nitrite levels were 0.2 mg/L as detailed in the Surface Water Report (Golder 2020). Water quality impacts from treated leachate effluent are not anticipated.

10.4.2 Potential for Cumulative Effects

Based on review of the *Land Use Assessment* (MHBC 2020) there is minimal development proposed within lands adjacent to the Patterson & Robbins Drain. Future plans to expand currently operating quarries will not affect water quality, stream baseflow or surface water resources as detailed in the Surface Water Assessment report (Golder 2020).

10.4.3 Additional Mitigation Recommendations

There are no further mitigation measures required as a result of impacts expected to aquatic resources on or in the vicinity of the site.

Best management practices that should be considered to be implemented during construction to further minimize or offset the effects of the development of the landfill and haul route on aquatic ecosystems are provided below.

- Periodic review of the stormwater pond discharge monitoring data with respect to PWQO and CCME guidelines, and adjustments to the SWM design or operation if the water quality significantly exceeds respective baseline quality in the Patterson & Robbins Drain;
- Design and implement an Erosion and Sediment Control Plan – including silt fences where drainage from any construction activities could leave the site; and
- Stabilize and/or re-vegetate all areas of disturbed soils using native topsoil and native, self-sustaining vegetation.

10.4.4 Net Effects

Based on the results of the *Surface Water Assessment* (Golder 2020) and the analysis of the field program results, no significant or potentially meaningful effects on aquatic ecosystems are anticipated from the landfill operation. There are no removals of fish habitat required, and the Surface Water Assessment report states that there are no net effects anticipated from the discharge from the leachate treatment facility, stormwater management ponds, and no net effects related to the increase in catchment area to the Patterson & Robbins Drain.

10.4.5 Summary

The proposed landfill and haul route are to be situated in an area where there is an existing aggregate operation and agricultural fields.

Understanding that the results of the *Surface Water Assessment* (Golder 2020) are modelled results, potential for meaningful effects to benthic invertebrates and the fish community should still be considered during the operation of the landfill. As noted previously, the SWM pond will discharge into the Patterson & Robbins Drain where the background water quality already shows exceedances of PWQO and CCME guidelines for most of these same parameters, and where the fish and benthic communities are likely already tolerant and/or acclimated to this water quality. As a result, it is unlikely that the SWM discharge will have a significant effect on these communities. As these potential effects cannot be identified until the landfill is operational based on the Range and Relevance of Potential Change detailed in Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan*, it would be prudent to confirm this assessment through a program of benthic invertebrate, fish community and water quality monitoring during site operations, which will permit further refinement of the SWM pond operation, if necessary.

11. Monitoring, Contingency & Impact Management Recommendations

11.1 Monitoring & Contingency Plans

11.1.1 Criterion 6: Disease Transmission via Insects or Vermin

The proposed operation for the Southwestern Landfill already includes daily inspection of bird and vermin populations at the site by landfill management staff. This should be sufficient to identify and correct any issues that are identified, including the implementation of the various elements of the IBMP.

Periodic monitoring of gull populations is recommended in order to confirm that control measures are being effective. Thresholds should be established to determine a background level of gulls that is acceptable.

11.1.2 Criterion 8: Aviation impacts due to bird interference

The primary active bird control and deterrent method provided within the IBMP includes the implementation of a full-time falconry program. Other contingency measures, which will be triggered by thresholds that will be established for key hazardous species as discussed within the IBMP. This will include gull monitoring to determine if the bird control measures are effective.

11.1.3 Criterion 35: Loss or Disturbance to Terrestrial Ecosystems

As no potentially meaningful or significant effects on terrestrial ecosystems were identified as a result of this assessment no additional monitoring or contingency plans are required for this criterion.

11.1.4 Criterion 36: Loss/disturbance of Aquatic Ecosystems

Monitoring of water quality, benthic invertebrates and fish community in the Patterson & Robbins Drain are recommended in order to confirm that these communities are not affected by the leachate treatment facility and stormwater management pond discharges. Results will be analyzed to determine if there are any potentially meaningful changes to aquatic ecosystems as defined in Table 5 of the *Southwestern Land Fill Proposal, Environmental Assessment, Ecological (Terrestrial/Aquatic) Work Plan*.

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Appendix A

Environmental Assessment Criteria and Studies (from Approved Amended Terms of Reference)

Appendix A

Table B-1 - EA Criteria Table

	Criteria	Definition/ Rationale	Studies Addressing the Criteria													Study Areas			Duration	
			Agriculture	Air Quality	Archaeology	Cultural Heritage	Ecology	Economic/ Financial	Groundwater/ Surface Water	Human Health	Land Use	Noise/ Vibration	Social	Traffic	Visual/ Landscape	On-Site & Site Vicinity	Along the Haul Routes	Wider Area	Operational Period	Post-Closure Period
	Public Health & Safety																			
1	Explosive hazard due to combustible gas accumulation in confined spaces.	Gas produced within a waste disposal facility (e.g., methane) can move through the ground and accumulate in confined spaces (e.g., manholes, basements, etc.) on or immediately adjacent to the waste disposal facility. There is potential for the gas to combust, creating an explosion and fire hazard.							☑							✓			✓	✓
2	Effects due to exposure to air emissions.	Waste disposal facilities can produce gases containing contaminants that degrade air quality if they are emitted to the atmosphere. Other operations, such as leachate collection facilities, can also produce emissions that could degrade air quality in the vicinity of the site. Air quality in the vicinity of the site should meet regulated air quality standards in order to protect public health.		☑						☑						✓			✓	✓
3	Effects due to fine particulate exposure.	Construction, operation, and truck haulage activities at a waste disposal facility can lead to increased levels of particulate (dust) in the air. Airbourne fine particulate is a health concern in certain size ranges exposure durations.		☑						☑						✓	✓		✓	
4	Effects due to contact with contaminated groundwater or surface water.	Contaminants associated with a waste disposal site have the potential to seep into the groundwater or surface water. This could pose a public health concern if it enters local drinking water supplies, or if it mixes with surface water.							☑	☑						✓			✓	✓
5	Flood hazard.	The construction of a waste disposal facility can disrupt natural surface water drainage patterns, causing a potential for increased flooding.							☑							✓			✓	✓
6	Disease transmission *via* insects or vermin.	Insects and vermin drawn to a waste disposal facility may have the potential to transmit diseases.					☑									✓			✓	✓
Public Health & Safety (continued)																				
7	Potential for traffic collisions.	The risk of traffic collisions may increase along the haul routes to the waste disposal facility. This includes the risk to pedestrian, bicycle and farm machinery.												☑			✓		✓	
8	Aviation impacts due to bird interference.	Birds may be attracted to waste disposal facilities. This can pose a risk of bird strikes on aircraft in the vicinity of the site, especially during take-off and landing altitudes.					☑									✓			✓	
Social and Cultural																				
9	Displacement of residents from houses.	Any residents living on a future waste disposal site will have to relocate, which can cause inconvenience and stress to the residents.											☑			✓			✓	✓

	Criteria	Definition/ Rationale	Studies Addressing the Criteria: Agriculture	Air Quality	Archaeology	Cultural Heritage	Ecology	Economic/ Financial	Groundwater/ Surface Water	Human Health	Land Use	Noise/ Vibration	Social	Traffic	Visual/ Landscape	Study Areas: On-Site & Site Vicinity	Along the Haul Routes	Wider Area	Duration: Operational Period	Post-Closure Period
10	Disruption to use and enjoyment of residential properties.	Potential nuisance effects associated with the waste disposal facility operation, or traffic moving to and from the waste disposal facility along the haul route, may disturb the daily activities and uses of residential properties. Disturbances could result from noise, dust, litter, odour, visibility, birds and traffic congestion.											☑			✓	✓		✓	✓
11	Disruption to use and enjoyment of public facilities and institutions.	Potential nuisance effects associated with waste disposal facility operations, or traffic moving to and from the waste disposal facility, may disturb the daily activities at community facilities. Disturbances could result from noise, dust, litter, odour, visibility, birds and traffic congestion.											☑			✓	✓		✓	
12	Disruption to local traffic networks.	Increased traffic volume resulting from a waste disposal facility could disturb the overall traffic flow along the haul routes, and effectively reduce the available road capacity.												☑			✓		✓	
13	Visual impact of the waste disposal facility.	Development and operation of a waste disposal facility can affect the visual appeal of a landscape.													☑	✓			✓	✓
14	Nuisance associated with vermin.	Waste disposal facilities can attract vermin and birds, which can be a nuisance and lead to a decrease in property enjoyment by area residents. Vermin and birds can also be											☑			✓			✓	
Social and Cultural (continued)																				
15	Displacement/disturbance of cultural/heritage resources.	Cultural resources (including heritage buildings, cemeteries and cultural landscapes) are an important component of human heritage. These non-renewable cultural resources may be displaced by the construction of a waste disposal facility. The use and enjoyment of cultural resources may also be disturbed by the ongoing operation and traffic. Disturbances could result from noise, dust, odour, visibility, birds, litter and traffic congestion.				☑										✓	✓		✓	✓
16	Effects on land resources, traditional activities or other interests of Aboriginal Communities	Major new developments of any type may have positive or negative effects on the interests of Aboriginal Communities (i.e., businesses opportunities, joint ventures)											☑					✓	✓	✓
17	Displacement/destruction of archaeological resources.	Archaeological resources are non-renewable cultural resources that can be destroyed by the construction and operation of a waste disposal facility.			☑											✓			✓	
18	Level of public service provided by the waste disposal facility.	The presence of a waste disposal operation within a municipality can provide an increased level of public service (e.g., convenient access to waste disposal services) to local residents and businesses, as well as those in the broader community(ies).						☑										✓	✓	✓
19	Effects on other public services.	The presence of a waste disposal facility may have positive or negative spin-off effects on other public services in the community (e.g., leachate trucking, waste water treatment capacity, if there is discharge to the sewer system).						☑									✓	✓	✓	✓

	Criteria	Definition/ Rationale	Studies Addressing the Criteria													Study Areas			Duration	
			Agriculture	Air Quality	Archaeology	Cultural Heritage	Ecology	Economic/ Financial	Groundwater/ Surface Water	Human Health	Land Use	Noise/ Vibration	Social	Traffic	Visual/ Landscape	On-Site & Site Vicinity	Along the Haul Routes	Wider Area	Operational Period	Post-Closure Period
Social and Cultural (continued)																				
20	Changes to community character/cohesion.	Community character and cohesion refer to physical characteristics, social stability, attractiveness as a place to live and patterns of social interaction. A waste disposal facility may actually or perceptually interfere with these important community attributes.											☑			✓	✓	✓	✓	✓
21	Compatibility with municipal land use designations and official plans.	A waste disposal facility has the potential to affect the viability of present and future land uses, which may have an effect on planning decisions made in the surrounding community.									☑					✓		✓	✓	✓
Economics																				
22	Displacement/disruption of businesses or farms.	Any on-site businesses or farms would be displaced by a waste disposal facility, and there could be financial losses as a result of relocation. Some types of businesses located in the site vicinity or along the haul routes may suffer financial losses due to the potential nuisance effects or perceived effects associated with the operation of a waste disposal facility such as noise, litter, dust, odour, visibility, birds, vermin and traffic congestion.						☑								✓	✓		✓	
23	Property value impacts.	The establishment and operation of a waste disposal facility may adversely affect property values in the site vicinity or along the haul routes.						☑								✓	✓		✓	✓
24	Direct employment in waste disposal facility construction and operation.	A waste disposal facility may create new employment opportunities both in the construction and day-to-day operation.						☑										✓	✓	
25	Indirect employment in related industries and services.	A waste disposal facility has the potential to have impacts on employment opportunities in local firms supplying products or services directly, or as secondary suppliers.						☑										✓	✓	
Economics (continued)																				
26	New business opportunities related directly to waste disposal facility construction and operation.	A large capital project, such as the construction and operation of a waste disposal facility, can create new opportunities for local businesses supplying products or services.						☑										✓	✓	
27	New business opportunities in related industries and services.	New opportunities may be created for local businesses, or as secondary suppliers to industries working for the waste disposal facility (e.g., restaurants, gas stations, machine shops, repair shops, welding shops, equipment rentals, etc.).						☑										✓	✓	
28	Public costs for indirect liabilities.	Some public services may have to be upgraded to accommodate the establishment and operation of a waste disposal facility (e.g., snow removal, sewer and water connections, etc.).						☑										✓	✓	✓
29	Effects on the municipal tax base.	A waste disposal facility has the potential to affect municipal tax revenues from the site it occupies.						☑										✓	✓	✓
30	Effect on the cost of service to customers.	The costs of constructing a waste disposal facility will affect the price of tipping fees to the site. This affects the cost of service to customers in Oxford County and the province.						☑										✓	✓	

	Criteria	Definition/ Rationale	Studies Addressing the Criteria													Study Areas			Duration	
			Agriculture	Air Quality	Archaeology	Cultural Heritage	Ecology	Economic/ Financial	Groundwater/ Surface Water	Human Health	Land Use	Noise/ Vibration	Social	Traffic	Visual/ Landscape	On-Site & Site Vicinity	Along the Haul Routes	Wider Area	Operational Period	Post-Closure Period
31	Effects on the provincial/ federal tax base.	A waste disposal facility has the potential to affect provincial/federal tax revenues.						☑										✓	✓	✓
Natural Environment & Resources																				
32	Loss/displacement of surface water resources.	Construction of a waste disposal facility may cause the removal of all or part of a natural stream or pond.							☑							✓			✓	
33	Impact on the availability of groundwater supply to wells.	A waste disposal facility can impact the availability of groundwater supply if groundwater is pumped from aquifers or if recharge to aquifers is reduced.							☑							✓			✓	✓
34	Effects on stream baseflow quantity/quality.	The presence of a waste disposal facility has the potential to affect the quality or quantity of baseflow to surface water.							☑							✓			✓	✓
Natural Environment & Resources (Continued)																				
35	Loss/disturbance of terrestrial ecosystems.	Terrestrial ecosystems refer to the land-based habitats connected through the vegetation cover; their protection and integration maintains and regulates ecological health. Waste disposal facility operations and/or traffic may remove or disturb the functioning of these systems.					☑									✓	✓		✓	
36	Loss/disturbance of aquatic ecosystems.	Aquatic ecosystems refer to the water-based habitats connected through the surface water; their protection and integration maintains and regulates ecological health. Waste disposal facility operations may remove or disturb the functioning of these systems.					☑									✓			✓	
37	Displacement of agricultural land.	The establishment of a waste disposal facility has the potential to displace existing or potential agricultural resources, including the loss of prime agricultural land.	☑													✓			✓	✓
38	Disruption of farm operations.	The establishment and operation of the waste disposal facility may affect agricultural crop or livestock production and related agriculture activities	☑													✓	✓		✓	✓
39	Sterilization of industrial mineral resources.	The establishment of a waste disposal facility may limit the opportunity to extract industrial mineral resources located beneath the site.									☑					✓			✓	✓
40	Displacement of forestry resources.	The establishment of a waste disposal facility may limit the opportunity to utilize forestry resources on or near the site.									☑					✓			✓	✓
41	Loss/disruption of recreational resources.	Waste disposal facility operations and traffic may displace/disrupt existing recreational resources in the area, which could adversely affect the community at large. Disturbances could result from noise, dust, odour, visibility, birds and traffic congestion. Recreational resources include naturalist and interpretive opportunities.											☑			✓	✓		✓	✓

☑ Study that will be primarily responsible for addressing criterion.

Note: Many of the studies will provide key input to criteria that will be address through other impact assessment studies.

Table B-2 – EA Technical Studies Interconnectivity Matrix

Because effectively evaluating the EA criteria provided in **Table B-1** may require input from experts in many disciplines, WEG adopted a methodology that facilitates a cross-functional approach among the experts. Each EA criterion has been assigned a 'lead' expert for reporting purposes (see **Table B-1**). The lead expert is responsible for coordinating efforts with any other expert they determine necessary to effectively report on that criterion as well as providing information to other experts who need input from them to report on any other criteria. Table B-2 provides possible relationships required between experts to effectively report on their respective EA criteria. The actual relationships will be developed during the EA process in consultation with interested parties.

		Reference Studies												
		Agriculture	Air Quality	Archaeology	Cultural Heritage	Ecology	Economic / Financial	Groundwater / Surface Water	Human Health	Land Use	Noise / Vibration	Social	Traffic	Visual/ Landscape
Technical Studies	Agriculture		✓							✓	✓		✓	
	Air Quality												✓	
	Archaeology													
	Cultural Heritage									✓		✓		✓
	Ecology		✓					✓			✓		✓	
	Economic / Financial	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
	Groundwater / Surface Water	✓										✓		
	Human Health		✓					✓			✓			
	Land Use													
	Noise / Vibration													
	Social	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
	Traffic	✓								✓		✓		
	Visual Landscape											✓		

Appendix B

Golder Surface Water Assessment Data Summary for Aquatic Receptors

Appendix B

SW1A

WQ Parameter		Guidelines			Low Flow			Average Flow (Min Pond Effluent)			Average Flow (Max Pond Effluent)			High Flow (Min Pond Effluent)			High Flow (Max Pond Effluent)		
	Background	PWQO	CCME longterm	CCME shortterm	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2
1,2-Dichorobenzene	ND (RDL - 0.5)	2.5	0.7		**2.5**	**2.5**	**2.5**	0.14	0.155	0.167	0.155	0.168	0.179	0.022	0.023	0.026	0.071	0.073	0.085
Dicamba	ND (RDL - 1)	200	10		**200**	**200**	**200**	**10.752**	**12.036**	**13.003**	**10.752**	**12.036**	**13.003**	0.233	0.253	0.287	0.233	0.253	0.287
Fluoride	0.14		0.12		ND	ND	ND	**0.127**	**0.127**	**0.126**	**0.127**	**0.127**	**0.136**	**0.121**	0.12	0.117	**0.121**	0.12	0.117
Nitrite	0.02		0.06		ND	ND	ND	0.023	0.022	0.022	0.057	0.051	0.049	0.042	0.042	0.046	**0.151**	**0.154**	**0.177**
Total Arsenic	ND (1)	5	5		5	5	5	0.508	0.505	0.517	2.364	2.092	2.01	0.785	0.805	0.936	**6.838**	**7.013**	**8.157**
Total Boron	15	200	1500	29000	200	200	200	32.7	32.8	33.3	83	75.8	73.7	40.5	41.2	45.4	204.5	209.3	241
Total Cadmium	ND (0.1)	0.5	0.09	1	**0.5**	**0.5**	**0.5**	0.056	0.055	0.056	**0.446**	**0.388**	**0.369**	**0.096**	**0.099**	**0.115**	**1.367**	**1.402**	**1.631**
Total Chromium	ND (RDL - 5)	1	1		1	1	1	0.599	0.526	0.503	**2.149**	**1.851**	**1.75**	**1.777**	**1.823**	**2.12**	**6.833**	**7.008**	**8.151**
Total Selenium	ND (RDL - 2)	100	1		**100**	**100**	**100**	**5.54**	**6.16**	**6.64**	**9.57**	**9.6**	**9.87**	0.66	0.69	0.8	**13.78**	**14.14**	**16.44**
Total Silver	ND (RDL - 0.1)	0.1	0.25		0.1	0.1	0.1	0.014	0.014	0.014	**0.424**	**0.364**	**0.343**	0.029	0.03	0.034	**1.367**	**1.402**	**1.63**
Total Phosphorus	0.009	0.02	0.035		0.02	0.02	0.02	0.012	0.011	0.011	0.031	0.028	0.027	0.016	0.016	0.017	**0.077**	**0.079**	**0.091**
Iron	-	0.3	0.3		0.3	0.3	0.3	0.034	0.033	0.033	**0.687**	**0.591**	**0.559**	0.057	0.059	0.068	**2.187**	**2.243**	**2.608**
Copper	-	0.005	0.002		**0.005**	**0.005**	**0.005**	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.002	**0.004**	**0.004**	**0.005**
Zinc	-	0.02	0.007	37	**0.02**	**0.02**	**0.02**	0.003	0.003	0.003	**0.018**	**0.016**	**0.015**	0.007	0.007	**0.008**	**0.055**	**0.056**	**0.065**

SW2

WQ Parameter		Guidelines			Low Flow			Average Flow (Min Pond Effluent)			Average Flow (Max Pond Effluent)			High Flow (Min Pond Effluent)			High Flow (Max Pond Effluent)		
	Background	PWQO	CCME longterm	CCME shortterm	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2
1,2-Dichorobenzene	ND (RDL - 0.5)	2.5	0.7		**2.5**	**2.5**	**2.5**	0.161	0.18	0.195	0.168	0.186	0.201	0.014	0.015	0.018	0.039	0.041	0.05
Dicamba	ND (RDL - 1)	200	10		**200**	**200**	**200**	**12.636**	**14.169**	**15.4**	**12.636**	**14.169**	**15.4**	0.314	0.346	0.421	0.314	0.346	0.421
Fluoride	0.15		0.12		ND	ND	ND	**0.138**	**0.137**	**0.136**	**0.138**	**0.137**	**0.136**	**0.139**	**0.139**	**0.136**	**0.139**	**0.139**	**0.136**
Nitrite	0.02		0.06		ND	ND	ND	0.023	0.02	0.02	0.036	0.033	0.033	0.031	0.031	0.034	**0.087**	**0.09**	**0.106**
Total Cadmium	ND (0.1)	0.5	0.09	1	**0.5**	**0.5**	**0.5**	0.045	0.047	0.05	**0.227**	**0.206**	**0.201**	0.05	0.052	0.064	**0.704**	**0.736**	**0.901**
Total Chromium	ND (RDL - 5)	1	1		1	1	1	0.317	0.292	0.289	**1.039**	0.922	0.891	0.916	0.957	**1.173**	**3.517**	**3.677**	**4.504**
Total Selenium	ND (RDL - 2)	100	1		**100**	**100**	**100**	**6.4**	**7.15**	**7.76**	**8.27**	**8.79**	**9.33**	0.44	0.47	0.57	**7.19**	**7.52**	**9.21**
Total Silver	ND (RDL - 0.1)	0.1	0.25		0.1	0.1	0.1	0.01	0.011	0.011	0.201	0.177	0.171	0.015	0.016	0.019	**0.703**	**0.735**	**0.901**
Total Phosphorus	0.011	0.02	0.035		0.02	0.02	0.02	0.013	0.012	0.012	0.021	0.02	0.02	0.014	0.015	0.015	0.046	0.048	0.056
Iron	-	0.3	0.3		**0.3**	**0.3**	**0.3**	0.027	0.028	0.03	**0.331**	0.294	0.284	0.03	0.031	0.038	**1.126**	**1.177**	**1.441**
Zinc	-	0.02	0.007	37	**0.02**	**0.02**	**0.02**	0.002	0.002	0.002	**0.009**	**0.008**	**0.008**	0.004	0.004	0.005	**0.028**	**0.029**	**0.036**

SW6

WQ Parameter		Guidelines			Low Flow			Average Flow (Min Pond Effluent)			Average Flow (Max Pond Effluent)			High Flow (Min Pond Effluent)			High Flow (Max Pond Effluent)		
	Background	PWQO	CCME longterm	CCME shortterm	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2	Operational	Post-Op 1	Post-Op 2
Fluoride	0.19		0.12		**0.188**	**0.188**	**0.188**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**
Nitrite	0.2		0.06		**0.202**	**0.202**	**0.202**	**0.204**	**0.204**	**0.204**	**0.204**	**0.204**	**0.204**	**0.204**	**0.204**	**0.204**	**0.205**	**0.205**	**0.205**

Part 3

Southwestern Landfill Environmental Assessment Potential Bird Hazard and Risk to Aviation

GUIDING SOLUTIONS IN THE
NATURAL ENVIRONMENT

FINAL DRAFT

Southwestern Landfill Environmental Assessment

Potential Bird Hazard and Risk to Aviation

Prepared For:

Walker Environmental Group

Prepared By:

Beacon Environmental Limited

Date:	*Project:*
January 2020	**217239**

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Appendices

1. Introduction

An Environmental Assessment ("EA") is being prepared by Walker Environmental Group Inc. ("Walker") under Ontario's *Environmental Assessment Act* ("Act") for the "*provision of future landfill capacity at the Carmeuse Lime (Canada) Ltd. (the Quarry) site in Oxford County for solid, non-hazardous waste generated in the Province of Ontario*". **Figure 1** shows the proposed landfill site location.

This is one in a series of technical studies that have been completed by qualified experts to examine the potential effects of the proposed landfill site on the environment, all in accordance with the requirements set out in the *Approved Amended Terms of Reference* ("ToR") dated May 10, 2016. This report accompanies and supports the *Environmental Assessment Report* prepared by Walker.

Note that Walker has carried out extensive consultation with government agencies, Aboriginal groups and interested members of the public regarding this study; details are provided separately in the EA report.

1.1 Purpose and Objectives

As part of the EA, Beacon Environmental Limited (Beacon) was retained by Walker to undertake an assessment for the potential for the proposed landfill site to create an increase in bird hazards to aircraft operating at airports in the local area. The potential for bird hazards to result in a risk to aircraft was identified as Criteria 8 for Public Health & Safety of the approved ToR.

Landfills that receive household and commercial waste that contains food waste can be highly attractive as a feeding area for several bird species, such as gulls, American Crow (*Corvus brachyrhynchos*) and European Starlings (*Sturnus vulgaris*). Depending on local conditions, a landfill can attract hundreds to thousands of birds.

The presence of a landfill near an airport has the potential increase bird-aircraft interactions, which can result in a bird strike. Transport Canada TP 1247 E *Aviation - Land Use in the Vicinity of Aerodromes, Part III - Bird Hazards and Wildlife* identifies landfills as a hazardous land use representing a high level of potential risk. However, Transport Canada recognizes that the acceptability of land use activities such as a landfill can be determined by detailed assessments of its surroundings with respect to aircraft operations and bird activity.

The objectives of this study, which are directed by Section 8.1 of the EA *Approved Amended Terms of Reference,* are as follows:

- Collect and analyse data with respect to bird numbers and activities, particularly gulls, by season and time of day using a combination of existing information, confirmatory counts and landscape habitat assessments;
- Identify current airport and aircraft activities in the vicinity of the proposed landfill site;
- Conduct a Bird Hazard Assessment that will identify species and areas of concern at and in the vicinity of the landfill site as they relate to air traffic movements;

- Conduct a risk analysis for identified hazardous bird species that are or may be associated with the proposed landfill site as they relate to air traffic movements. This risk analysis will be constrained to landfill associated birds that can pose a risk to aircraft (e.g., gulls, crows raptors, etc.) and not a full risk assessment for all potential bird management issues at the landfill;
- Identify primary elements for an Integrated Bird Management Plan (IBMP) that includes facility operational activities, as well as passive and active bird management techniques that would be employed to limit, to the extent possible, the use of the facility by bird species that are identified to pose a risk to aircraft movements; and
- Identify further study needs, i.e. monitoring of bird movements for the implementation of the IBMP.

2. Assessment Methodology

The following details the study methods and approach for assessing the potential bird hazard to aircraft traffic in and around the proposed landfill site.

2.1 Study Areas

At the start of the study three general study areas were defined as follows.

1. <u>On-Site Study Area</u>

For the purpose of this study, the on-site study area represents the lands associated with the current Quarry site, and immediate adjacent lands, bounded by King Street East/Karn Road to the south, 37th Line/Hwy 6 to the east, Road 68/Hwy 2 to the north and Pemberton Street/33 Line to the west. This study area was identified so that current ambient bird numbers and movements in the location of the proposed landfill site could be assessed.

2. <u>Site Vicinity Study Area</u>

A Site Vicinity Study Area within a 20 km radius centered on the location of the proposed landfill site was identified. This study area captured local airports and aircraft movements in the vicinity of the proposed landfill site and other land uses that could attract birds, such as other landfills and open bodies of water (**Figure 2**).

3. <u>Wider Study Area</u>

A general wider study area represents areas of interest that occurred outside of the 20 km Site Vicinity Study Area, including London International Airport, City of London Landfill Site, Strafford Landfill Site, Regional Waterloo Airport, Wildwood Lake, Fanshawe Lake and south shore of Lake Erie.

Site Location	**Figure 1**

Southwestern Landfill
Environmental Assessment

BEACON ENVIRONMENTAL

Project: 217238
Last Revised: January 2019

Client: Walker Environmental Group

Prepared by: RA
Checked by: BH

DRAFT

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Inset Map:1:100000

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Orthoimagery Baselayer: Google 2017 (Google 2017)

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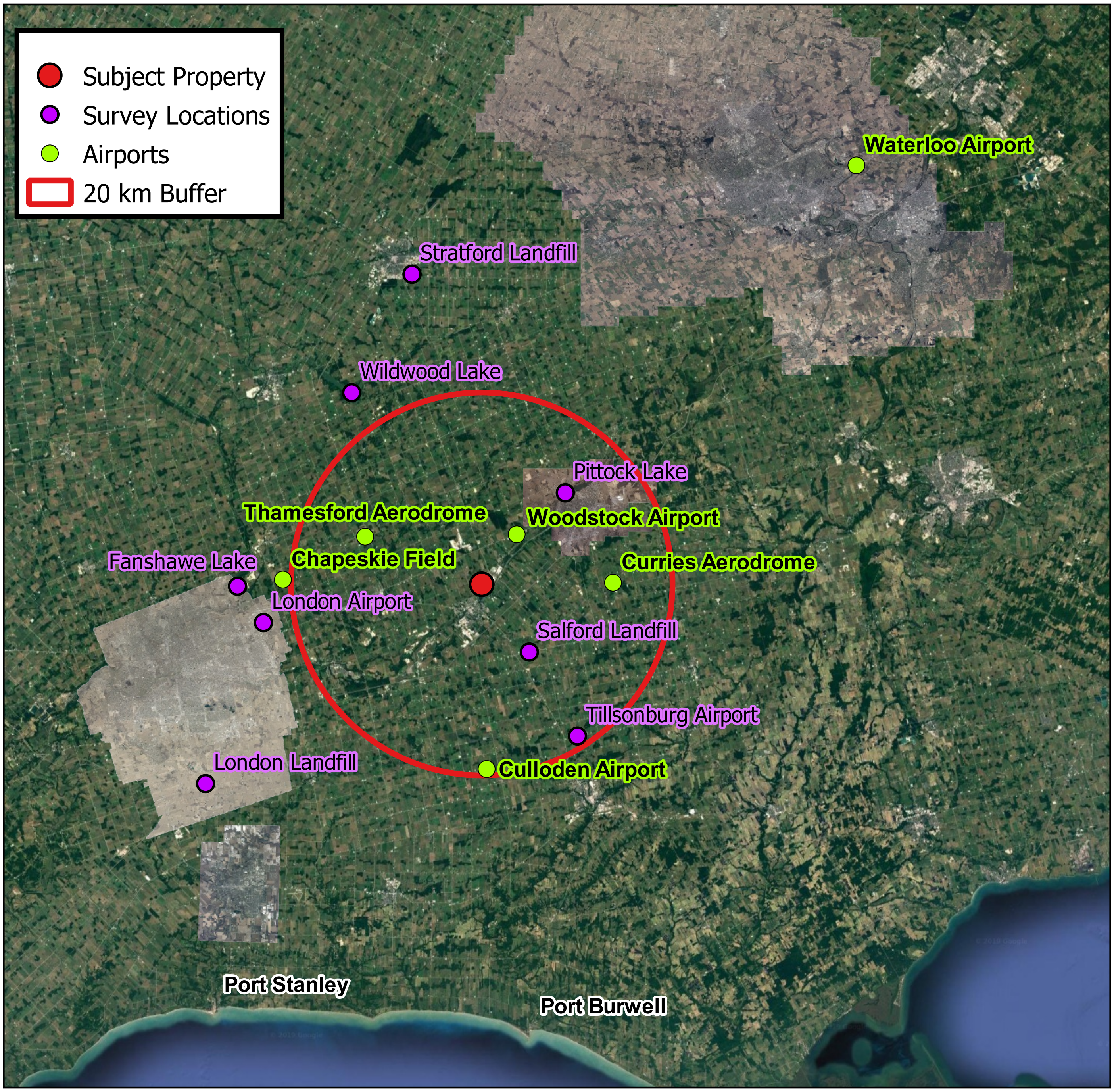

Site Vicinity Study Area	**Figure 2**
Walker Bird Hazard StudyWalker Bird Hazard Study	
BEACON ENVIRONMENTAL	Project: 217239 Last Revised: March 2019
Client: Walker Environmental Group	Prepared by: BD Checked by: **DRAFT**
N 1:860000	Inset Map:1:3000000

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Orthoimagery Baselayer: 2018 FBS & Google

C:\Dropbox\Dropbox (Beacon)\All GIS Projects\2017\217239\Q Project Files\2019-03-25 Figure02 Site Vicinity Study Area 217239.qgz

2.2 Background Data and Consultation

For the study, the management personnel of three airports were consulted with respect to operations at their airports, including the London International Airport, Tillsonburg Regional Airport and Woodstock Aerodrome and Flying Club (Norm Beckham/Bob Hewitt Field Aerodrome). In addition, Transport Canada was consulted with respect to bird strike data for the Tillsonburg and Woodstock airports. Also, ORNGE air ambulance (Medevac) was contacted to provide information regarding flights that occur through the air space over the proposed landfill site. Relevant correspondence is provided in **Appendix 1**.

In addition, members of the Woodstock Field Naturalists' Club were consulted with respect to bird numbers and movements within the Site Vicinity Study Area. Background data review included bird numbers based on the annual Christmas Bird Counts conducted by the Woodstock Field Naturalists' Club, Nature London and the online website e-bird Ontario.

2.3 Field Data Collection

Field surveys for the study were undertaken from February 2018 through to January 2019. The primary focus of the field program was to assess bird use of existing landfills and occurrence in the local landscape to determine potential numbers that could occur at the new future landfill. A key component of the field surveys was to document gull and crow numbers and movements between landfills, airports and roosting sites. For the study, numbers and movements of seven bird species that typically are attracted to landfills were recorded at various locations and times during the study, including Ring-billed Gull (*Larus delawarensis*), Herring Gull (*Larus argentatus*), American Crow, (further referred to as crow), Turkey Vulture (*Cathartes aura*), Red-tailed Hawk (*Buteo jamaicensis*), Bald Eagle (*Haliaeetus leucocephalus*) and European Starling (*Sturnus vulgaris*).

2.3.1 Survey Sites

During the field study, specific survey sites were visited to document bird numbers and movements (**Figure 2**). Sites where bird numbers and movements were recorded during the study included:

- On-Site Study Area;
- Salford Landfill;
- London Landfill;
- Stratford Landfill;
- Woodstock Airport;
- Tillsonburg Airport;
- London Airport;
- The Quarry Site's Former West Quarry;
- Pittock Lake (Woodstock);
- Wildwood Lake (St. Mary's);
- Fanshawe Lake (London); and
- Near Shore of Lake Eire (Port Stanley to Port Burwell).

Not all sites were surveyed on the same day or week although weather conditions were generally comparable. The number of surveys conducted at any one site varied, with some sites being visited more than others throughout the study. Some sites were visited only once or twice. Areas within the Site Vicinity Study Area and the London Landfill were the most frequently surveyed locations. A summary of the field data collected during the surveys is provided in **Appendix 2**.

For purpose of this study, management of the London Landfill and Stratford Landfill allowed full access to the site to document bird numbers. However, a request to conduct on-site surveys at the Salford Landfill was denied by Oxford County (see **Appendix 1**). As a result, bird numbers at the Salford Landfill could only be assessed by roadside survey along Salford Road. Though on-site access was not possible, based on conditions at the landfill, a reasonable visual assessment of bird numbers could be obtained by the roadside survey and any active control measures could be seen or heard.

2.3.2 Field Survey Methods

For the most part, during the surveys at each site, counts of birds were made through the identification of individual birds using Bausch & Lomb 10X42 BA binoculars. At each site, gulls were aged as either adult (more than one year old) or juvenile (less than one year old). For larger flocks, or where a high density of bird activity was occurring, numbers were estimated using a standard blocking technique. This technique involves counting individual birds for a specific representative area of the flock (up to 20% of the flock) and multiplying this block through the entire flock, repeating the process at least twice to insure greater accuracy in the count.

In addition to counting bird numbers at sites, movements of birds to and from a site were also noted. Specifically, early sunrise and evening sunset surveys were undertaken at a number of locations to document mass movements to and from landfills and roosting sites, including the Salford Landfill, the Former West Quarry within the On-Site Study Area, the London Landfill, Pittock Lake, Wildwood Lake and Fanshawe Lake. Bird numbers and movements recorded at sites during the survey are provided in **Appendix 2**.

Finally, during the study, road surveys of the On-Site Study Area and the local areas around the Salford Landfill, Woodstock Airport, Tillsonburg Airport and London Landfill were undertaken to document bird numbers and movements in rural, agricultural areas.

2.4 Transport Canada Documents

Transport Canada documents that were consulted for this study included:

- Transport Canada TP 1247 E Aviation - Land Use in the Vicinity of Aerodromes, Part III - Bird Hazards and Wildlife;
- TP 8240 - Airport Wildlife Management Bulletin No.38;
- TP 8240 – Appendix A - Safety Above All - A coordinated approach to airport-vicinity wildlife management;
- TP 8240 - Appendix B - Airport Bird Hazard Risk-Assessment Process; and
- TP 13549 - Sharing the Skies. An Aviation Industry Guide to the Management of Wildlife Hazards.

3. Existing Conditions

3.1 General Overview of Existing Conditions

The proposed landfill site is located centrally within southwestern Ontario, with the shore of Lake Huron 70 km the northwest, Lake Erie 50 km to the south and Lake Ontario 80 km to the northeast (**Figure 1**). As a result, a significant portion of the Great Lakes gull populations stage and migrate through the general area. In addition, located between the Great Lakes, southwestern Ontario acts as a “funnel” for migrating birds, including hundreds of thousands of crows. As a result, large fall and winter night roosts with thousands of crows have become established in and around towns in southwestern Ontario, such as Woodstock, Waterloo, Chatham, and Windsor.

A number of existing features within the vicinity of the proposed landfill site currently attract and concentrate large numbers of gulls and crows. The Salford Landfill, operated by Oxford County, is located 8.2 km to the south-southeast of the proposed landfill site. This landfill, which has been in operation since 1986, was found to attract large numbers of gulls and crows. In addition, there are two gull night roost sites that are already well established within the local area of the proposed landfill site; one in Woodstock at Pittock Lake, 13 km to the north-northwest, and the other at the Former West Quarry within the Carmeuse property quarry site. Also, a well-established winter crow roost is located in Woodstock (Pittock Lake/Brick Pond). Combined, the occurrence of these existing sites raises the possibility of significant numbers of birds occurring at a new food source in the area.

3.2 On-Site Study Area

As part of the EA being prepared by Walker for the proposed landfill, Beacon completed breeding bird surveys for the On-Site Study Area for the months of May and June in 2018. A total of 52 species of breeding, or potentially breeding birds, were recorded. No gulls were noted, and less than five pairs of crows were noted. A winter bird survey was completed on February 12, 2018, in which no gulls were noted, and crows were identified to be only occasional.

Road surveys of the On-Site Study Area conducted for this study found similar results through the entire survey period, with individual gulls occurring very sporadically in farm fields or as fly overs, and crows occurring in very low numbers during any one survey (less than ten birds). However, gulls were found to be roosting on the Former West Quarry during the late fall (see discussion in **Section 3.5** below).

3.3 Landfills

Three landfills were surveyed for this study. The following provides a summary of the landfills and bird numbers that were recorded.

3.3.1 Salford Landfill

The Oxford County Salford Waste Management Facility is located on Salford Road, 1.5 km east of Salford along Highway 19 (**Photograph 1**). The landfill is located only 8.2 km to the south-southeast of the proposed landfill site and has been in operation since 1986. The landfill property is divided into two working areas: the north fill area which is comprised of three completed landfill cells (Cells 1, 2 and 3) and one currently active cell (Cell 4). The site receives domestic (household) and commercial solid waste, brush, non-hazardous solid industrial and other waste limited to sewage sludge and non-hazardous industrial sludges. In 2017, it received 41,000 tonnes of mixed solids and domestic waste. Domestic and commercial waste is tipped throughout the day at an active working face, where it is spread and compacted, and a minimum of 150 mm of daily soil cover is applied at the end of the day. No day-to-day bird control is undertaken at the landfill.

Photograph 1. Oxford County Salford Landfill Site March 14, 2018

Both Ring-billed Gull and Herring Gull were observed on all days the site was surveyed. Through most of the survey, Ring-billed Gull was the most abundant, with Herring Gull typically representing 5% of the total number of gulls. However, starting in December, Herring Gull was more abundant (80%). As can be seen in **Figure 3,** total gull numbers recorded at the landfill varied significantly throughout the year. As expected, numbers were lowest during the winter months of January and February, with less than 100 birds recorded during February. Numbers rose quickly in March at the start of the gull spring migration, with 1,200 birds recorded on March 14th. These number dropped off quickly as gulls moved through the area onto the breeding colonies. On the mid-April count, only 620 gulls were recorded, and through May and June (the breeding period) gulls declined rapidly, with less than 100 birds being record on a day during this survey period. During the post breeding season, numbers began to rise in July, and reached 3,000 gulls during August and September. Peak numbers occurred during the October fall migration period, with over 3,500 gulls. During November and December 2,000 gulls remained at the landfill, of which 10% to 15% were represented by first year juvenile birds.

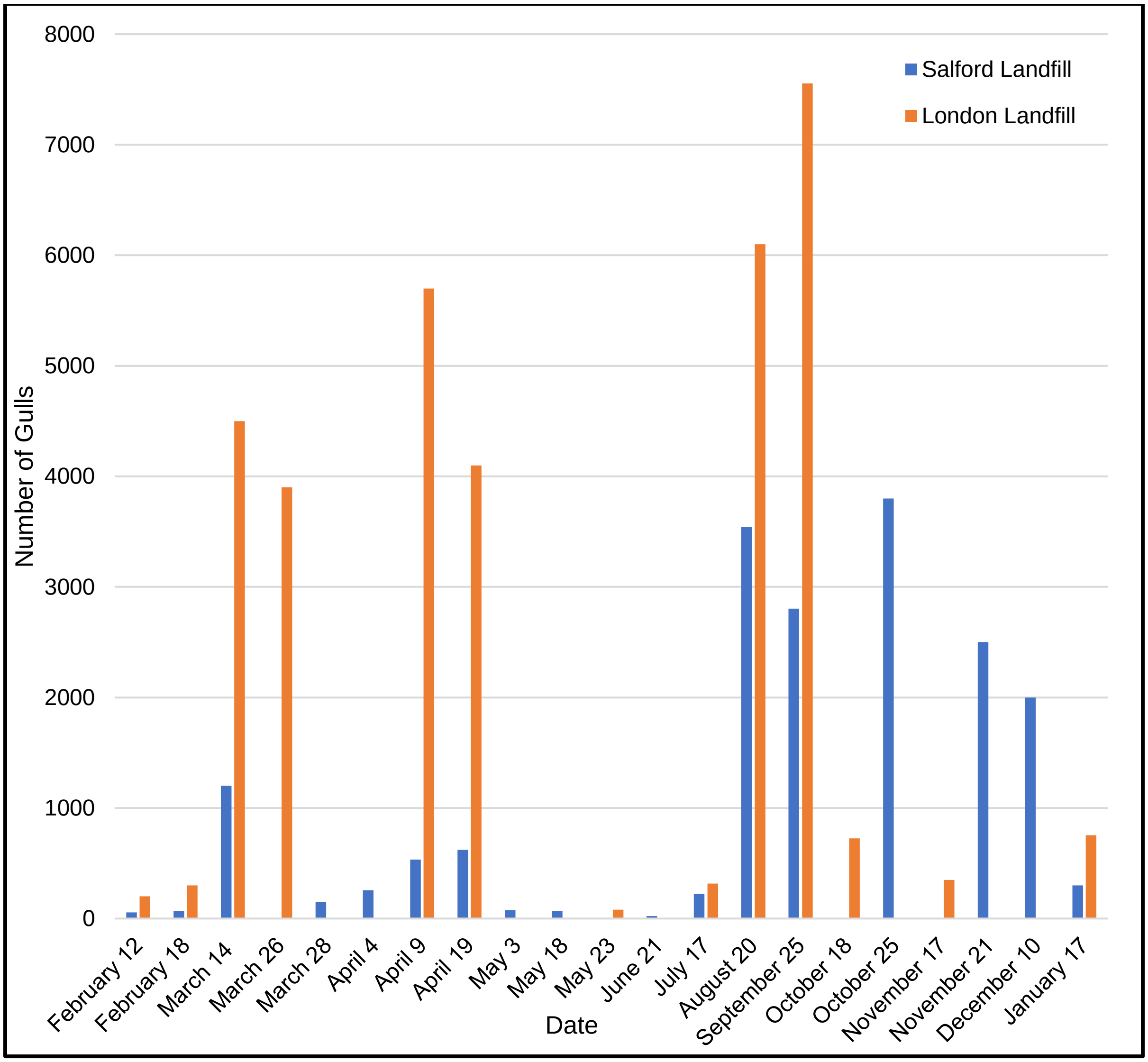


Figure 3. Gull Numbers at Salford and London Landfills in 2018 (and Jan. 2019)

During the surveys, the majority of the gulls at the landfill were found to be "loafing" on the site, with only a small fraction actively feeding at the active working face. Loafing in adjacent farm fields, while noted, occurred infrequently. Also, few towering events (rising to high altitudes on warm air thermals) were noted. Towering events are known to extend to 1,500 ft AGL or more depending on weather conditions, the time of day and gull activity.

As with gulls, the number of crows at the landfill varied significantly during the survey period (**Figure 4).** However, unlike gulls, crow numbers peaked in number during the winter months, with 2,000 birds recorded in mid February and March. By April, and through the summer and fall, less than 50 crows were noted during the surveys. Numbers began to rise again in January 2019 with 600 birds recorded. Starling numbers changed significantly also, with 2,000 to 3,000 birds during the winter, to only hundreds during the summer and fall. The number of Turkey Vultures was low, generally less than ten birds, however, a peak number of 67 birds was recorded in late August, post breeding, and at the start of the fall migration period. Eleven Turkey Vultures were recorded in late October. The numbers of Red-tailed Hawk were very low, with only one resident bird noted. One Bald Eagle was recorded, in late October.

The occurrence of landfills in the landscape attracts gulls and crows in greater numbers during late fall and winter as they are a reliable food source. Summaries of annual Christmas Bird Counts conducted by the Woodstock Field Naturalists' Club were reviewed. These data show that gull numbers during December vary through the years. Between 1989 and 2018, in the Woodstock area, Ring-billed Gull numbers averaged at around 1,200 birds, and Herring Gull averaged 170 birds. However, peak numbers do occur, for example, almost 8,000 Ring-billed Gull occurred in 2011, and 2018 had peak numbers for Herring Gull at 1,370, with only 95 Ring-billed Gull. It is possible that 2011 was a relatively mild period in December.

During this study, on December 10, 2018, 2,000 gulls were surveyed at the Salford Landfill, of which 80% were estimated to be Herring Gull. This indicates that in December 2018, most of the gulls in the Woodstock area were associated with the landfill.

Christmas Bird Count crow numbers also vary with an average of 22,000 birds between 1989 and 2018, with a peak of 87,000 in 2011. In 2018, 21,000 crows were recorded, with 320 recorded for the area within which the Salford Landfill is located.

On December 10, 2018, 120 crows were recorded at the landfill, which indicates that most of the crows in the Woodstock area in December 2018 were not directly related with the landfill.

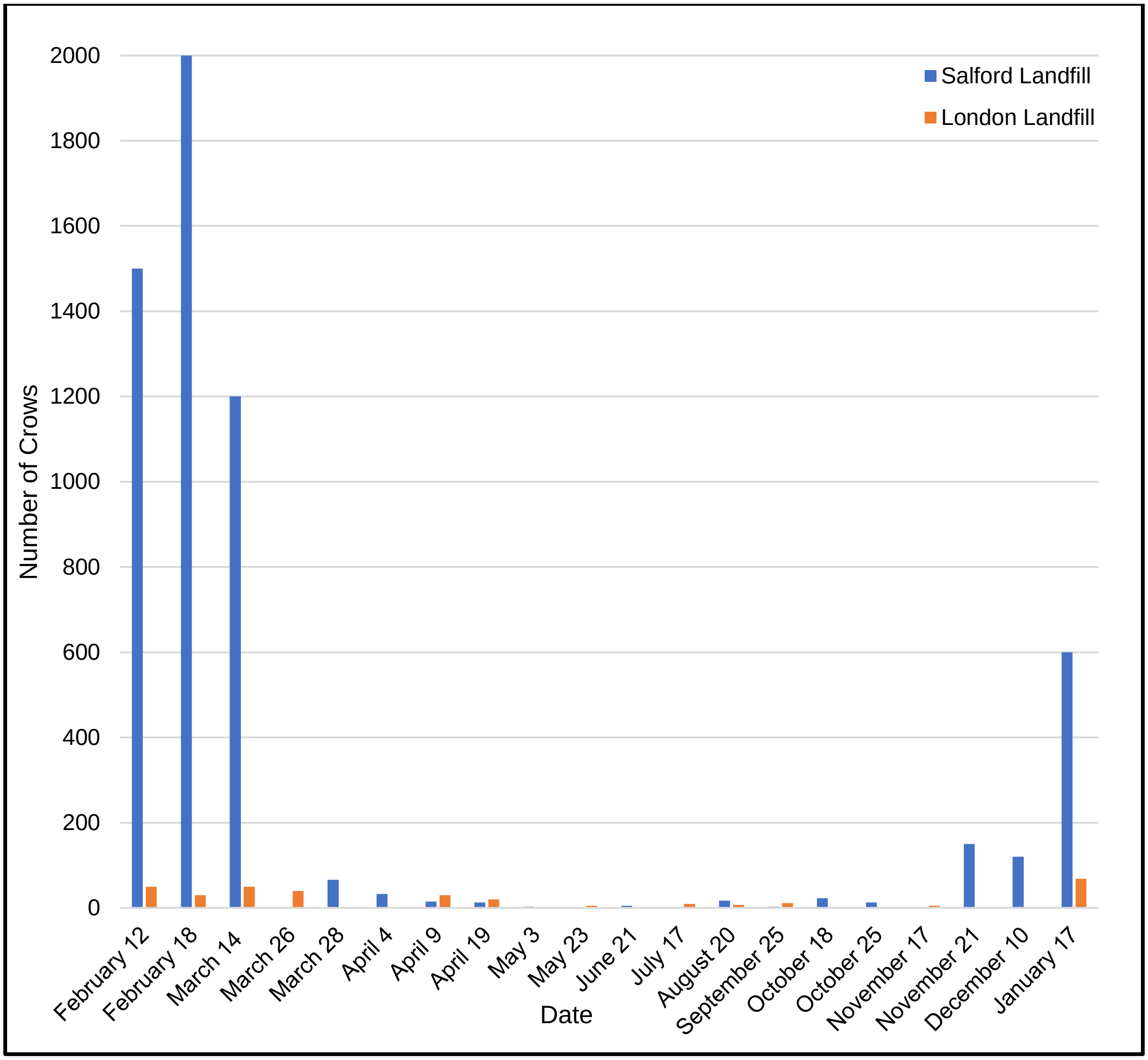


Figure 4. Crow Numbers at Salford and London Landfills in 2018 and 2019

3.3.2 London Landfill

The City of London Landfill is located on Manning Drive, south of Highway 401, 5 km south of the built-up areas of the City of London. The landfill accepts waste generated within the City of London, the Municipality of Thames Centre, Lake Huron areas and the Elgin area. Waste was first disposed in the landfill during the summer of 1977. Approximately 8,500,000 tonnes of waste have been disposed of at the landfill since then. Since the year 2000, the landfill has received 90,000 to 100,000 tonnes of household waste per year, representing 42% of the total waste received annually. Waste is received seven days a week and is tipped throughout the day at an active working face, where it is spread and compacted (**Photograph 2**), and a minimum of 150 mm of daily soil cover is applied at the end of the day. Six cells have been filled with waste, with the last full cell currently being covered with a final clay capping (**Photograph 3**). There is no day-to-day bird management program at the landfill. On occasions when gull number are vey high, like can happen during the migration periods when bad weather holds birds up and numbers increase at the landfill, the landfill staff will call in a falconer to drive off the birds. No cannons, pyrotechnics or other active measures are used.

Photograph 2. Gulls Feeding at the London Landfill Tipping Face March 26, 2018

As shown in **Figure 3** the general pattern of the occurrence of gulls at the London landfill through 2018 was similar to that of the Salford Landfill, however the total numbers were significantly higher. February numbers were low, with 200 to 300 birds. During the March-April migration period, the numbers of gulls at the landfill jumped to a daily peak of over 5,000 birds. Again, during the breeding period (May through the end of June) only small numbers occurred, with less than 500 gulls. Post-breeding dispersal from the breeding colonies resulted in peak numbers of gulls at the landfill, with over 7,000 birds recorded at the end of September. Numbers declined below 500 birds from October though January.

During the surveys, most gulls were found to be loafing on the bare ground close to the location of the active tipping face (**Photograph 3).** Only a few hundred gulls were feeding at any one time on the tipping face. A number of loafing flocks were noted in farm fields within 1 km of the landfill, and a day loafing site was identified at a quarry pond located 1.5 km directly north of the landfill. Also, unlike Salford, towering events were found to be a more common occurrence.

Like the Salford landfill, crow numbers at the London landfill were highest during the winter months, however, as can be clearly seen in **Figure 4**, the numbers of crows were significantly lower at the London landfill. Numbers ranged between 60 and 30 birds during the winter-early spring, with very low numbers (less than ten) during the summer months.

The December 2018 Nature London Christmas Bird Count recorded 413 Ring-billed Gull and 750 Herring Gull. The average over the past ten years is 335 for Ring-billed Gull and 765 for Herring Gull, with a maximum number around 6,000 (i.e., 3,000 for each species). The survey conducted at the landfill on January 17, 2019, recorded a total of 754 gulls of which 453 were Herring Gulls. As with the Salford Landfill, the data indicate that most of the London gulls recorded during the December count are associated with the landfill. The 2018 count recorded 334 crows, and the ten-year average is 590, with 13,488 recorded as the maximum number. Only 68 crows were recorded at the landfill in early January. Again, like the Woodstock area, the number of crows in the London area are not directly associated with the landfill.

Starling numbers during the winter and early spring were similar to those at the Salford landfill, with 2,000 to 3,000 birds as daily counts. During the survey, Turkey Vulture numbers were generally low, with less than ten birds recorded during each visit. A spike in Turkey Vulture numbers occurred in October during the migration period, with 31 birds recorded. Two resident Red-tailed Hawks were noted, and a small number of Bald Eagles were daily residents at the landfill during late October. As can be seen in **Figure 4**, when compared to gull numbers at the Salford Landfill, the presence of the Bald Eagles most likely caused the significantly reduced gull numbers in the late fall.

Photograph 3. Gulls Loafing on Cell Capping Soils at the London Landfill August 20, 2018

3.3.3 Stratford Landfill

The Stratford landfill is located on Romeo Street South, in the south east corner of the built-up area of the Town. The site is 33 km directly to the north of the proposed landfill site. This small landfill began operations in 1960 and is constructed as a two-cell system. In 2018, the total tonnage of waste received was 22,059, of which 6,000 tonnes represents household waste. Household waste is received six days a week and is tipped throughout the day at an active working face, where it is spread and compacted (**Photograph 4),** and a minimum of 150 mm of daily soil cover is applied at the end of the day. No day-to-day bird management is undertaken at the landfill.

The site supports moderate numbers of starlings, with 700 and 300 birds recorded during March and April, and 250 in late November. Four Turkey Vultures were noted on March 28, and one on April 19.

Photograph 4. Tipping Face of the Stratford Landfill March 28, 2018

This site was surveyed six times, from March through November. Daily gull numbers were below 50 birds during March and peaked at 577 in the first week of April, representing birds on migration to breeding sites. Fall migration numbers were 335 in late September and 453 in late November. E-bird data for the site identified 25 Herring Gull in the first week of January 2019. Crow numbers were highest during the spring, March (42) and April (36), with fall numbers below 20 birds. E-bird data for the site identified 80 crows in February 2019.

3.4 Airports

Bird surveys were conducted at three airports, the London Airport located 22 km to the west of the proposed landfill site, and two within the Site Vicinity Study Area, the Woodstock Airport and Tillsonburg Airport.

The London Airport supports a large area of airside grass fields, runways and taxiways that provide feeding and loafing opportunities for gulls and crows. As discussed above, the London landfill attracts large numbers of gulls to the London area and is located 18 km to the south of this airport. Surveys of the airport environment found only low numbers of gulls to occur, with often no gulls noted, with a high of only seven gulls during the April spring migration period. Given that thousands of gulls occurred at the landfill during the survey period, the low numbers of gulls at this airport indicates that the landfill gulls do not move onto the airport lands. Crows appeared to occur on airside lands more than gulls, but numbers were also very low, less than five, during March and April. Of note, the London Airport does have a bird control management program, mostly using pyrotechnics when birds are on or alongside the runway.

The Tillsonburg Airport, located 18 km to south of the proposed landfill site, was regularly surveyed on the same day as the Salford Landfill. Throughout the survey, gull and crow numbers within the airport environment were very low, with no gulls seen on many survey days, and typically only two to five crows. Small flocks of gulls (less than ten) were noted on a number of surveys - flying over the airport lands - but were not observed to be stopping to feed or loaf at this airport. The largest number of gulls recorded occurred on April 19th, during the spring migration period, when 107 were observed in a farm field to the north adjacent to the runway (**Photograph 5**). Airport management indicated that gulls are typically not present on airside lands but do occur in greater numbers in adjacent fields during the spring ploughing and fall harvesting periods. The Tillsonburg Airport reports that it does have a bird management program; using pyrotechnics when birds are on or alongside the runway.

Photograph 5. Gulls Feeding in Farm Fields along Tillsonburg Airport Runway April 19, 2018

The Woodstock Airport was also found to support very low numbers of birds. No gulls were observed to occur throughout the survey period. Crows, when present, occurred as one or two individual birds, mostly within the grass field areas around the airport office/hanger building (**Photograph 6**). Based on existing conditions, the airport environment is not attractive to gulls or crows. The grass strip runway is only 40 m wide and during the summer and fall is surrounded by tall stands of corn, creating an enclosed environment (see **Photograph 7**), a condition that is typically avoided as a feeding or loafing area by gulls and crows as approaching predators cannot be detected. There is no bird management program at this facility.

Photograph 6. Grass Lawn Around the Office and Hangers of the Woodstock Airport that is Occasionally used for Foraging by Crows August 20, 2018

Photograph 7. Narrow Grass Strip Runway of Woodstock Airport Enclosed by Tall Stands of Corn
August 20, 2018

3.5 Roosting Sites

Outside of the breeding period, both gulls and crows will congregate in the evening at specific roosting sites to sleep and leave again in the early morning hours. Gulls typically roost on large bodies of water while crow roosts utilize mature forest stands, mature treed parks, and large treed hedgerows. For both gulls and crows, roosting sites are often well developed in a local area, to which the birds move to and from a much greater area and the same sites are repeatedly used for many years. For this study, surveys of roosting sites for gulls and crows were undertaken for the On-Site Study Area, Site Vicinity Study Area and Wider Study Area.

3.5.1 Gull Roosting Sites

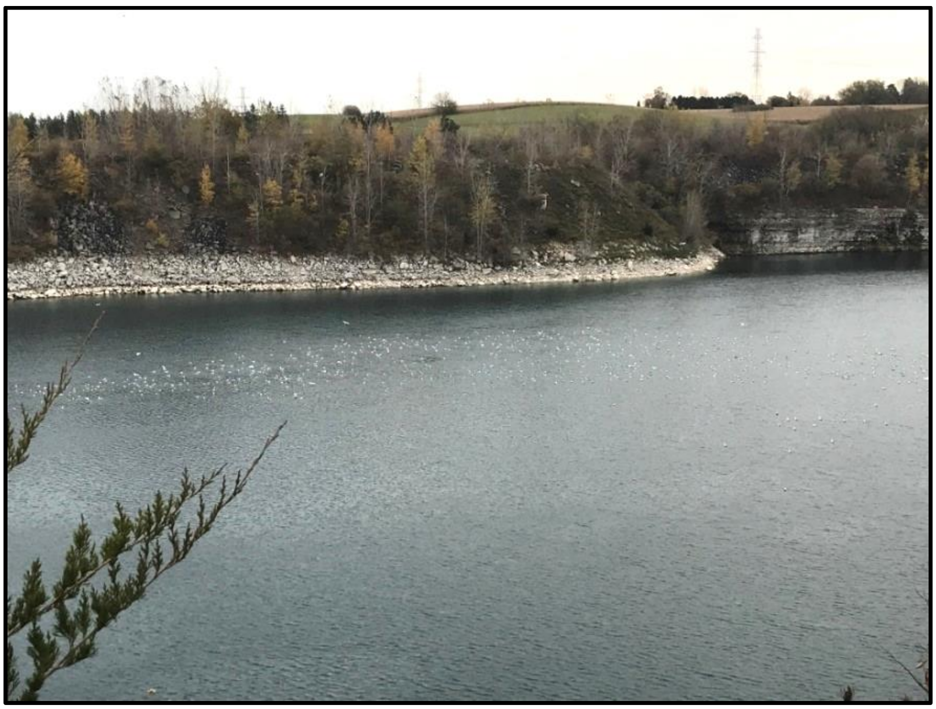
Roosts are overnight sleeping sites (whereas loafing areas are daytime resting sites). During the spring migration period, gull roosts (supporting thousands of gulls) were noted along the Lake Erie shoreline between Port Stanley and Port Burwell. Gulls from these spring roost sites would move inland during the day to feeding sites and return to the lake in the evening.

Four inland gull roosting sites were surveyed, two within the Site Vicinity Study Area, the Former West Quarry, located within the Quarry Site and Pittock Lake in Woodstock. The other two sites were located just outside of the Site Vicinity Study Area: Wildwood Lake near St. Mary's and Fanshawe Lake in the City of London (**Figure 2**).

3.5.1.1 Quarry Site: Former West Quarry

The Former West Quarry is an additional Carmeuse property that is located south of the proposed landfill site (**Figure 1**) that has filled with water by receiving ground water and precipitation as part of the Site's rehabilitation plan (after limestone extraction ceased). The Former West Quarry is rectangular with a length of approximately 1.1 kilometres (km) and is generally 300 m wide except for the eastern part, where it is approximately 120 m wide. The total surface area is approximately 27 hectares (ha). Vertical quarry walls that rise approximately 30 m above the water level.

The site is known to historically support a fall gull roost. Evening roost surveys of the site were conducted on October 30, and November 26. During both surveys, flocks of gulls (100-500) were observed to be arriving from the south and south west and continually landed within the site until dark. A total of 4,000 gulls were estimated to be in the roost (**Photographs 8** & **9**). In addition, about 200 Canada Geese and over 50 other waterfowl were found to be roosting as well. Based on the number of gulls that were surveyed at the Salford Landfill during this period and the direction of their approach, most of the gulls using this roost are believed to be associated with the Salford Landfill feeding site.



Photograph 8. Gull Roost Forming at the Former West Quarry Site Lake November 26, 2018

Photograph 9. Thousands of Gulls at the Former West Quarry Site Roost November 26, 2018

3.5.1.2 Pittock Lake Woodstock

Pittock Lake is located in Woodstock 13 km to the northeast of the proposed landfill site. It is a dammed reservoir lake associated with the South Thames River. The lake is linear in shape with a length of 6 km but with a width of 400 m to 500 m throughout (**Photograph 10**). Evening roost surveys at this lake were conducted on October 29, and December 10. During both surveys, small flocks of gulls (ten to 50) arrived from all directions, with their final approach concentrated along east-west river corridor. The numbers of gulls were estimated to be 3,000 in October and 1,500 in December. Based on the varying directions of the arrival flights to the roost, the gulls were likely returning from feeding in the local rural landscape.

Photograph 10. Pittock Lake Gull Roost October 29, 2018

3.5.1.3 Wildwood Lake and Fanshawe Lake

Like Pittock Lake, both Wildwood Lake and Fanshawe Lake are inland dam reservoir lakes. The main body of Wildwood Lake is 3 km long and 500 m wide. The lake is located along Highway 7, 4 km to the east of the Town of St. Mary's. A night roost survey of the lake conducted on November the 24th recorded approximately 1,000 gulls roosting on the lake by night fall. Flight lines of small flocks of five to 20 gulls were noted coming from the west, from the direction of the St. Mary's Landfill (4 km to the west) and from the northeast from the Stratford Landfill (a distance of 12 kms). Other small flocks arrived from various directions from farm fields in the area.

Fanshawe Lake lies directly to the north of London International Airport. The lake has a total length of 4 km and average width of 400 m. A night roost survey of the lake conducted on October 22 recorded approximately 400 gulls roosting on the lake by night fall. Small flocks were noted coming from the direction of the London Landfill (19 km to the south), and from various directions from the city and farm fields in the area.

3.5.2 Crow Roosting Sites

Located between three of the Great Lakes, southwestern Ontario acts as a "funnel" for migrating birds, including hundreds of thousands of crows. As a result, large fall and winter night roosts with thousands of crows have become established in and around towns in southwestern Ontario, such as Woodstock, Waterloo, Chatham and Essex near Windsor.

A well-established crow roost occurs in Woodstock, located 13 km north-northwest of the proposed landfill site. At present, the Woodstock crow roost is located in mature pine plantation and hardwood woodlot located along the north shore Pittock Lake. Over the past several years, annual fall and winter numbers of 10,000 to more than 40,000 birds have been recorded during Christmas Bird Counts.

For this study a Pittock Lake night roost survey was undertaken in October, November and December, which confirmed the presence of tens of thousands of crows. Birds were noted to approach the roost site from all directions and flocks of 20 to hundreds of birds were observed flying to the site from tens of km away. Christmas Bird Count data undertaken each year in December by the Woodstock Field Naturalists' Club shows that crow numbers average 22,000 birds, with a high of 87,000 in 2011. In 2018, the Christmas Bird Count recorded 21,000 crows in the Woodstock area.

Monitoring of crow numbers at the Salford Landfill, located 8.2 km south-southeast of the proposed landfill site, found the greatest number of crows to occur during the winter months of January and February, with 1,500 to 2,000 birds. Numbers were found to drop quickly and significantly by March and through the summer and fall, with less than 20 birds noted at any one time. Numbers at the landfill in October were less than 50 birds, even though over 10,000 birds were roosting at Pittock Lake, which is only 18 km to the north east. Monitoring at the landfill found that the crows at the landfill were making flights from the Pittock Lake roost site to feed at the landfill. Yet, only a very small fraction of the Pittock Lake roost birds was found to be feeding at the landfill at any one time.

Road surveys for crows for the On-Site and Site Vicinity Study Area resulted in very low numbers of birds to occur throughout the year, with less than ten birds noted at any one time. Evening surveys of the On-Site and Site Vicinity Study Area conducted in October and November did not identify the movements of flocks of crows or the occurrence of roosts, even though 100 or more crows were recorded feeding at the Salford Landfill in November and tens of thousands were roosting at Pittock Lake.

The results of the surveys indicate that even though tens of thousands of crows occur within 20 km of the Salford Landfill, the site does not attract significantly large number of crows. In addition, the survey found that during the fall and winter months, a small percentage of crows at the landfill make morning and evening flights to and from the well-established roost in Woodstock and do use an alternate roost site nearer to the landfill.

3.6 Bird Movements

For conducting a hazard/risk assessment for aircrafts, an understanding of bird numbers in conjunction with bird movements in a landscape is required. During this study, in addition to counting bird numbers at the survey sites, bird movements to and from these sites were noted while at a site, and while in transit to these sites.

Throughout the study, movements were generally of small flocks (i.e., five to ten) of crows and gulls were located below 150 m Above Ground Level (AGL) throughout the landscape. Typical of the flight of most bird species, movements of gulls and crows to and from the landfills and roosts occurred at (or just above) tree height, which is between 20 to 50 m AGL. Movements at higher altitudes, above 150 m AGL were only noted during gull towering events, a behavior where flocks of birds' circle to ride rising air thermals 300 m AGL and higher, and then drift off. Towering events that involved flocks of gulls were noted to occur with some frequency at the London Landfill, but it was a rare event at the Salford Landfill. This observation can be explained by the site conditions at the London Landfill, which supports a large area of bare ground over which rising air thermals can become established (the London Landfill has a bare ground foot print of 1 km^2, while the Salford Landfill footprint is only 0.18 km^2).

In the early spring, there was a clear regular tree-top flight line of small flocks of gulls moving from the Lake Erie shoreline roosts to the Salford Landfill in the early morning and returning to the lake in the evening. These movements resulted in birds in the airspace around the Tillsonburg Airport. However, as noted, the gulls do not frequent the airside lands of this airport. Similar spring shoreline to landfill movements were noted at the London Landfill.

Following the breeding period, most of the gulls that frequented the Salford Landfill roosted at the Carmeuse Site Quarry Lake. They moved with a clear tree-top flight line from the landfill following the north-south hydro tower corridor. This switch to post breeding roosts on inland lakes was also noted for Fanshawe Lake and Wildwood Lake reservoirs. No strong or regular movement of gulls from the Salford landfill to the Pittock Lake roost were noted. For the Pittock Lake roost, the South Thames River was used as a movement corridor to and from the lake. No regular gull flight lines were noted to occur northward past the proposed landfill site, or from the north to the proposed landfill site.

Only one clear regular flight line was found to occur for crows: a direct northeast-southwest line between the Salford Landfill and the Pittock Lake roost site. These flights of individuals and small flocks (less than 20) of crows were almost in a direct line over farm fields often below tree top height. As noted, the numbers of crows that feed at the Salford Landfill is only a small fraction of the total numbers of crows that roost at Pittock Lake, where large numbers of crows arrived from the local landscape from all directions.

3.7 Summary

The current locations of airports, landfills and roosting sites in the vicinity of the proposed landfill site allow for a reasonable assessment of potential bird numbers and movements during the operation of the proposed landfill to be located at the Quarry site.

The Salford Landfill (located only 8.2 km south-southeast of the proposed landfill site), which has been in operation since 1986, does attract gulls, crows and starlings in large numbers (thousands). The London Landfill 20 km to the west has a footprint that is five times larger than the Salford Landfill and receives two times the tonnage of food waste. During the peak period, the gull numbers were twice as large at the London Landfill. Conversely, for the much smaller Stratford Landfill during the peak periods, less than a thousand gulls were recorded. These findings most likely demonstrate that there is a reasonable linkage between the physical size of a landfill operation and the available food waste at a given landfill and the number of gulls feeding at a landfill; which is generally consistent with our experience. Based on existing conditions, gull numbers at the proposed landfill site, which will have a large physical footprint that includes various attractive habitat components and receives larger volumes of food waste annually, could be expected to occur in the thousands or tens of thousands without a bird control management plan. This is because in addition to the supply of food there is a nearby roost and watering site. There will also be extensive loafing areas (these, when considered with food supply are three habitat components that gulls require). Covering of waste making them unattainable is a standard management technique, however this assessment assumes that good management practices will be applied.

Crow numbers at the Salford Landfill are significantly larger when compared to the London Landfill, and can be directly linked to the very large fall/winter annual crow roost at Pittock Lake located only 18 km to northeast of the Salford Landfill. However, this study has found that only a very small fraction of the crows that roost at Pittock Lake regularly visit the Salford Landfill. Nevertheless, based on existing conditions at the Salford Landfill, similar numbers of crows can be expected to occur regularly at the proposed landfill site without an active bird management program. In addition, the survey found that during the fall and winter months, a small percentage of crows at the landfill make morning and evening flights to and from the well-established roost in Woodstock. This site fidelity to an existing roost site is not uncommon for crows. Therefore, the presence of a new landfill site in the vicinity of the Woodstock area would not necessarily result in the establishment of a new crow roost in the immediate vicinity of the new landfill. Based on numbers recorded at the Salford, London and Stratford Landfill sites, large numbers of starlings can also be expected to occur in the fall and winter.

Red-tailed Hawks, Bald Eagles and Turkey Vultures were found to occur in low numbers at all three of the surveyed landfill sites. For the proposed landfill site, based on numbers recorded at the Salford Landfill, Turkey Vultures numbers could peak at a hundred or more birds per day count for a few weeks during the spring or fall migration period. Total hawk or eagle numbers are expected to be less than ten birds.

Spring gull movements from Lake Erie to the Salford Landfill occur as small flocks at low altitude, and a similar movement pattern to and from the lake can be expected to occur at the proposed landfill site. However, though located directly between the lake shore and the Salford Landfill, management of the Tillsonburg Airport do not consider gulls to be a problem species at their facility, and no bird strike involving a gull has been reported to occur to date. The findings of the site surveys undertaken for this study also found that gulls occur very infrequently at the Tillsonburg Airport. Similarly, gulls that are associated with the Salford Landfill do not frequent the Woodstock Airport and no regular movements of gulls through the Woodstock Airport airspace occurs. A similar condition was found in London, where gulls at the London Landfill did not result in high numbers of gulls at the London Airport located to the north.

As is the case at most landfills, gulls feeding at the Salford Landfill spent the day loafing on the bare ground areas of the landfill site. Few movements to adjacent farm fields were noted and no regular loafing sites were found to occur in the farm fields in the local area. Given the existing conditions of the quarry site where the proposed landfill will be located, following feeding at the landfill it can be expected that the gulls will remain and loaf for the day within the current Carmeuse site. Finally, it can be expected that during the post-breeding season and until freeze-up in the winter, gulls feeding and loafing at the proposed landfill site will move to the Former West Quarry roost, as they currently do. During the spring, it is expected that gulls feeding at the proposed landfill will also move between the landfill and shore of Lake Erie to the south.

4. Airport Operations and Bird Hazard Zones

For airports, Transport Canada has identified Bird Hazard Zones (BHZs) where aircraft operating at an airport can be exposed to birds (Transport Canada 2007).

Two zones are identified. These are the Primary Bird Hazard Zone (PBHZ) and Secondary Bird Hazard Zone (SBHZ). These zones represent a cone of airspace centered on an airports' runway in which aircraft can occur from ground level up to 1,500 ft AGL, the altitudes most populated by hazardous birds and at which collisions with birds have the potential to result in the greatest damage. The PBHZ extends 9 km from the approach and departure ends of a runway, and at the end is 4 km wide on either side of the extended runway line. The SBHZ is extended an additional 4 km outside of the boundary of the PBHZ and represents a zone that captures variables in pilot behaviour and technique, variations in departure and arrival paths, and the unpredictability and variations of bird behaviour and movements.

4.1 Woodstock (Norm Beckham/Bob Hewitt Field) Aerodrome

The Woodstock Airport is located 6 km northeast of the proposed landfill site. Established in 1963, the main occupant of this airport is the Woodstock Ontario Flying Club. There is a single runway, (06/24) which is a grass strip 3040 feet long with 100-foot over-run grass area. A grass taxiway from midfield leads to a grass infield, hangars, and a clubhouse (**Photograph 11**). The airstrip and taxiway are surrounded by active farm fields which grow corn directly adjacent to the edge of the grass runway (**Photograph 12**). Though soya is sometimes rotated with corn, the fields adjacent to the runway and taxiway have been actively farmed for the past 30 years, and this farming activity is expected to continue. Currently there is no planned expansion of this airport (runway extension or paved runway).

Photograph 11. Grass Runway and Taxiway of Woodstock Airport August 20, 2018

Photograph 12. Woodstock Airport Grass Runway Surrounded by Corn Fields August 20, 2018

As shown in **Figures 5a** and **Figure 5b**, the proposed landfill site lies within the PBHZ of the Woodstock Airport. The centre of the proposed landfill site lies 5.5 km from the button (a colloquial term referring to the end of the runway) of runway 06 and the extended runway centreline for direct approach lies 0.55 km to the northwest of the northwest corner of the proposed landfill area. At this location, aircraft will be operating below 1,000 ft. The button of runway 24 lies 6.5 km northeast of the proposed landfill site. There are no regular flights of the key hazard species to the north of the proposed landfill site that would cross where the direct approach line currently occurs, and the predicted flight patterns of these species are not expected to occur here during the proposed landfill's operation either. However, some general movements of birds that will occur at the proposed landfill site could expose aircraft to birds in the approach/takeoff airspace.

There are currently 17 aircraft owned by the club members that are stored in hangers at the Woodstock Airport. Only piston engine aircrafts operate at this airport, including Piper Cub, Cessna 172, Harvards, Champ, Citabria, Beech and Stearman. There are only between 2,000 and 3,000 movements (takeoffs or landings) per year. Due to the prevailing west wind, most movements occur on runway 24, with takeoffs and landings occurring westward on the runway. The flying club members fly once to three times a week to practice. There is no on-site training school. The Woodstock Airport is closed during the winter months. Most aircrafts flying to this airport are at an altitude of between 500 feet to 1,000 feet AGL at 5 km out from the runway. Training circuits occur within 1 to 3 km of this airport at an altitude of 500 to 1,000 feet AGL. No Medevac flights occur at this airport since the Woodstock hospital installed its own helipad. In the past, the Woodstock Airport has been used occasionally for local crop spraying; however, it is not an annual operation due to a lack of water resources.

The Woodstock Airport management and Transport Canada have identified that no gull or bird strikes have been reported at this facility (see **Appendix 1**). In addition, the airport management indicates that gulls currently occur very infrequently at the Woodstock Airport, but can occur in the local farm fields during ploughing and cultivation. The reported absence of gulls is consistent with the findings of surveys conducted at the Woodstock Airport for this study.

4.2 Tillsonburg Regional Airport

The Tillsonburg Regional Airport is located 18 km south-east of the proposed landfill site. This airport was originally constructed to support flight training by the Royal Canadian Air Force during World War II. For many years the federal government leased the airport to the Town of Tillsonburg, but in 1981, the municipality took over full ownership and administration. Currently the Tillsonburg Airport supports approximately 50 aircraft, including the Canadian Harvard Aircraft Association (CHAA), which is headquartered at the airport and maintains a fleet of ten Harvard aircraft. The Tillsonburg Flying School provides training on piston engine Cessna 150 and Cessna 172.

The BHZs of the Tillsonburg Airport run east-west and are 18 km to south of the proposed landfill site.

Tillsonburg Regional Airport is Oxford County's only airport with a paved runway. The paved runway (08/26) is 5,502 ft in length and is open year-round. There are also two grass strip runways that are open through the summer. The average yearly number of aircraft movements is 13,000. Most aircrafts used here are piston engine, with the Cessna 172 being the most common type of aircraft operating at this facility. However, the long paved runway also allows for turbo-prop and small jet engine aircrafts to operate at this facility. The general altitude of aircrafts operating to the airport is between 1,000 ft and

Woodstock Airport Bird Hazard Zones | **Figure 5a**

Walker Bird Hazard Study

Legend

- Primary Bird Hazard Zone
- Secondary Bird Hazard Zone
- Points of Interest
- Direct Runway Approach/Departure Flight Line

BEACON ENVIRONMENTAL

Project: 217239
Last Revised: October 2019

Client: Woodstock Airport

Prepared by: BD
Checked by: KQ

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Woodstock Airport Bird Hazard Zones

Figure 5b

Walker Bird Hazard Study

Legend

- Primary Bird Hazard Zone
- Secondary Bird Hazard Zone
- Points of Interest
- Direct Runway Approach/Departure Flight Line

BEACON ENVIRONMENTAL

Project: 217239

Last Revised: October 2019

Client: Woodstock Airport

Prepared by: BD
Checked by: KQ

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4,000 ft AGL and training flights occur at 1,000 ft AGL. Airport management indicates that Medevac flights also occur. The airside lands contain maintained grass fields in the vicinity of the runways, taxiways and terminal (**Photographs 13 & 14**, while active crop fields surround the airside lands. Airport management and Transport Canada have identified that no gull or bird strikes have been reported at this facility (see **Appendix 1**).

Photograph 13. Grass and Farm Fields Surrounding Tillsonburg Airport (August 2018)

Photograph 14. Airside Grass Fields along Runway and Taxiway of the Tillsonburg Airport (August 20, 2018)

4.3 Private Grass Airstrips

As shown on **Figure 2**, there are four privately owned grass airstrips in the local area within 20 km of the proposed landfill site, including:

- Thamesford Aerodrome, 13 km to the northwest;
- Chapeskie Field, 20 km to the west;
- Curries Aerodrome, 14 km to the east; and
- Culloden Airport, 19 km to the south.

These airstrips are associated with farms and represent privately maintained and operated airfields. These airstrips are not known to support crop spraying operations in the local area.

4.4 London International Airport

The London International Airport lies 22 km west of the proposed landfill site. The facility is owned and operated by The Greater London International Airport Authority (GLIAA). The airport supports commercial, corporate and general aviation. Commercial airlines that operate regularly at this airport include Air Canada and WestJet with daily flights, and seasonal flights by Air Transat and Sunwing Airlines from December through March. In addition to commercial jet aircraft, private jet, turbo-prop and piston engine aircraft also operate at this location.

The main runway (15/33) is 8,800 feet long and 200 feet wide. The secondary runway (09/27) is 6300 feet long and 200 feet wide. This makes the London International Airport capable of landing wide-bodied jet aircrafts. The average yearly number of aircraft movements is between 55,000-60,000, with DA-40, Dash-8, B-737 representing the most common types of aircraft to operate here. Runways 15 and 27 are the most used runways. Most commercial jet aircraft use Runway 15, while Runway 27 is predominantly used by turbo-prop Dash 8 aircraft.

The BHZs of the London Airport lie distant from the proposed landfill site. With respect to the location of the proposed landfill site and commercial jet aircraft operating to the airport, the extended centreline for approach to Runway 27 brings aircraft approximately 1.5 km to the north of the proposed landfill location. However, the typical height for approaching aircraft at that distance from the airport is approximately 7,000 ft AGL. The minimum approach descent altitude over the location of the proposed landfill site (which is 22 km from the airport) is 3,700 ft AGL which is higher than the bird towering events of 1,500 ft. AGL. For “go arounds” prior to landing, commercial jet aircraft do to not occupy the air space over the location of the proposed landfill site.

4.5 Regional Waterloo Airport

The Regional Waterloo Airport lies 59 km northeast of the proposed landfill site. Since 1969, this airport has been municipally-owned and supports commercial, corporate and general aviation.

Commercial airlines that operate regularly at this facility include WestJet with daily flights, FLYGTA with three daily flights to Toronto Island, and Sunwing Airlines with weekly service from December through March. In addition to commercial jet aircrafts, private jet, turbo-prop and piston engine aircraft operate at the Waterloo Airport. This facility also supports the Adler Aviation Training Centre, the Great Lakes helicopter Training School and Waterloo-Wellington Flight Centre. Combined, this airport has over 100,000 aircraft movements per year, making it one of the top 20 busiest airports in Canada.

The BHZs of the airport lies distant from the proposed landfill site and transient flights operating to the airport typically occur above 1,500 ft AGL.

4.6 ORNGE Medical Transport

ORNGE provides air ambulance and patient transport services in Ontario and performs approximately 20,000 patient-related transports per year. There are 12 air bases located across the province.

ORNGE air ambulance helicopter movements in the vicinity of the proposed landfill site typically occur at or above 1,500 ft AGL and typically will not be exposed to birds that occur at the landfill.

Two bases service southwestern Ontario and the Niagara Region, including Base 7792 that operates out of the London Airport and Base 7799 that operates out of the Toronto City Centre Airport. Each one operates one 11 Leonardo AW-139 helicopter. The air ambulance service undertakes two types of flights: first response/emergency transport to hospitals, and scheduled patient/medicine transport to and from airports and/or hospitals.

The ORNGE Head Office Management of Operations was contacted to gain information regarding helicopter movements in southwestern Ontario. The number of flights undertaken per year vary year to year but number in the hundreds. In transit flights occur between 1,000 and 2,000 ft AGL, and typically occur above 1,500 ft AGL (lower level fights are weather related). The helicopter only occupies airspace below 1,000 ft AGL when on near approach to a scene first response and/or when operating at an airport or hospital. For all operations in the province, approximately five to ten bird strikes are reported annually. No bird strike or bird hazard concern specific to the location of existing landfills in Ontario have been reported.

4.7 Other Airports

Airports that occur in the wider area, such as Stratford Municipal Airport 39 km to the north, Saint Thomas Municipal Airport 37 km to the southwest and Brantford Municipal Airport 44 km to the east are remote from the proposed landfill. The BHZs of these Airports are distant from the proposed landfill site and transient flights operating to these airports typically occur above 1,500 ft AGL.

5. Proposed New Landfill Operations

The landfill proposed by Walker is described in detail in the Environmental Assessment Report. The following is a brief summary, highlighting aspects of the proposal most relevant to this bird hazard study.

The landfill is proposed to be located on a portion of Carmeuse's landholdings at its Beachville Quarry Operations in the Township of Zorra, Oxford County. Approximately 17.4 million m^3 of solid, non-hazardous waste and daily/intermediate cover will be deposited within a footprint of about 59 ha. The balance of the 81.6 ha site will be comprised of buffer areas for monitoring, maintenance, environmental controls and other necessary infrastructure.

Landfill construction will proceed progressively in a series of cells, generally from north-to-south. The former quarry floor will be backfilled to within about 30 m to 40 m below ground surface, and then a double composite liner system (as specified by the Ministry of Environment, Conservation & Parks in the Landfill Standards under O. Reg. 232/98) will be constructed across the bottom and up the sides of the landfill to contain and collect leachate. The landfill will receive up to 850,000 tonnes per year of solid, non-hazardous waste, of which an estimated 225,000 tonnes will be food/organic waste.

The active working area (tipping area) within a cell will be approximately 0.2 ha in area at any given time in order to minimize the exposed waste. Waste will be compacted and covered with soil or other approved materials on a daily basis, and a final cap with vegetation will be applied when the landfill reaches its final height, which peaks at about 15 m above ground. A landfill gas collection system will also be installed as the landfill/cell development progresses.

Most of the supporting infrastructure for the landfill will be located in the buffer area along the northern site perimeter, including the leachate treatment plant and landfill gas management infrastructure. Leachate collected within the landfill will be treated on-site and the clean effluent from the treatment plant will be discharged into the Patterson-Robbins Drain next to the treatment plant. Clean precipitation that has not come into contact with waste will be segregated and treated in stormwater management ponds before being discharged from the site. Landfill gas will be collected from a network of extraction wells and pipes. Initially, the landfill gas will be flared (combusted), but when the quantities permit, it is planned that the gas will be beneficially utilized as a renewable fuel. The existing 27.4 ha Former West Quarry located on the Carmeuse property directly to the south of the southern limit of the proposed landfill fill area will be maintained by quarry operations and will not be part of the landfill operations.

The site will be open for waste deliveries from 7:00 a.m. to 5:00 p.m. on weekdays and from 7:00 a.m. to 1:00 p.m. on Saturdays but will be closed on Sundays and statutory holidays. On-site construction activities may start up to one hour before opening and continue up to two hours after closure. The primary designated haul route (i.e., for all waste trucks except deliveries from the local area) is from Highway 401 north along County Road #6, then west into the quarry property; trucks will then follow a newly constructed haul route across quarry property to a secondary landfill site entrance at the northwestern corner of the site. Vehicle traffic, including waste trucks as well as construction vehicles and staff, is expected to average approximately 210 trips per day.

Nuisance controls will include speed enforcement, regular haul road cleaning (on- and off-site), litter fencing and pick-up, a bird management plan, and a public complaint reporting and response system. The landfill is anticipated to receive waste for approximately 20 years commencing in about 2023. After closure, maintenance and operation of the relevant environmental controls and monitoring will carry on during the post-closure period, until there is no further risk of environmental contamination. The end-use is assumed to be passive green space and agriculture, but the design is flexible to accommodate other potential end-uses at the time of closure.

6. Bird Hazard and Risk Assessment

6.1 Introduction

The assessment of a bird hazard and risk to aircraft is based on an understanding of the bird species, their numbers and movements, and the type, number and frequency of aircraft operating in a specific airspace. For this analysis, the following definitions are employed:

Hazard

A hazard is a condition or circumstance that can lead to damage to an aircraft or injury to its occupants from a collision with a bird.

Application

For the risk assessment, a hazard can be of two general categories. These are:

1. A 'bird hazard' refers to the birds that might be struck by an aircraft. It is the risk of these hazards that are directly measured to determine the findings of the risk assessment that is conducted; and
2. A 'habitat hazard' refers to the land-use that attracts birds to the airspace through which aircraft operate. It is a precursor condition of a bird hazard. The proposed landfill site is the habitat hazard examined in this analysis.

Risk

Risk is the consequence of a bird hazard measured in terms both of severity and likelihood of occurrence.

Severity

The severity of a strike is determined by examining two circumstances. These are:

1. The damage experienced during the strike - damage to the airframe, engine or one or more aircraft systems. The damage can range from none to catastrophic, depending on the location of the impact(s) on the aircraft, the bird species, the aircraft type and aircraft speed; and
2. Any additional damage incurred after the strike. This damage can range from negligible to catastrophic, depending on the location and speed of the aircraft at the time of the strike, and the aircraft's flight worthiness after the strike. For example: post-bird strike damage will usually be negligible when the crew rejects the take-off of a slow-moving aircraft, or the damage could be catastrophic if the strike occurs just as the aircraft gets airborne, and the strike causes sufficient damage for the crew to lose control of the aircraft, causing it to impact the ground.

Likelihood of Occurrence and Exposure

Likelihood of occurrence is influenced by *exposure*. It qualitatively factors the frequency in which a risk can be expected to occur.

Exposure is the examination of the precursor conditions that influence the likelihood of a bird strike. Generally, the conditions include the number and nature of aircraft movements, and the number and nature of bird movements and where these two factors might intersect.

To illustrate, a flock of geese (bird hazard) feeding on airfield grass (habitat hazard) along the side of a runway (exposure) could result in damage (risk) to an aircraft during landing, take off, approach and taxiing as well as potentially resulting in injury to pilots, and/or passengers. The large size of geese, and their flocking characteristic means there is a high likelihood that an incident will involve multiple birds with the potential to cause significant damage (severity). The exposure, and therefore the likelihood, will depend on the number of geese that are feeding and how often, the number of aircraft operating from the runway, and the proximity of the birds to the aircraft operations.

The hazard analysis and the risk assessment followed the following lines-of-inquiry:

1. Are the bird species that will be attracted to the proposed landfill considered a hazardous species to aviation because of the potential severity of a strike?
2. Will the use of the proposed landfill by birds result in aircraft operating in the vicinity of the airport being exposed to these hazards?
3. Will bird use of the proposed landfill increase the likelihood of an aircraft striking birds?

As detailed in the previous sections, this study has provided relevant information on: bird species, numbers, movements and airport/aircraft operations, to allow for a reasonable and objective analysis and response to these questions.

6.2 Habitat Hazard

It is well-established in the literature and through the experience of landfill operators in southern Ontario that landfills that accept food waste have the potential to attract various kinds of birds. Although the routine management of the landfill will influence the variety and numbers of birds that can occur, without specific mitigation, large numbers of birds can be anticipated to occur on a seasonal basis. In particular as identified by this study, landfills can provide foraging and loafing habitat for large numbers of gulls, crows and starlings with lesser numbers of raptors and vultures.

6.3 Bird Hazards

Based on the surveys undertaken for this study, the key hazardous species that will be attracted to the proposed landfill site that have the most potential to critically affect aircraft operations are listed in **Table 1**. Based on multiple rating systems developed by Transport Canada and others, most of the hazardous bird species that have been identified are considered to have a high potential to result in a severe effect if struck by an aircraft. At a landfill, gulls are particularly hazardous as they can be attracted to the site in large numbers, they will “tower” well above some sites on thermals, occur in flocks and they are relatively large birds

Table 1. Key Hazardous Bird Species that could occur at the Proposed Landfill

Species Group	General Risk and Hazard Ranking Tools				Landfill Effects	
	Mass/ Flocking Rank[1]	Relative Risk Score[2]	Transport Canada Hazard Rank[3]	Severity Potential[4] /Post-strike[5]	Abundance at Landfill	Hazardous Behaviour
Highly Critical						
Ring-billed Gull/ Herring Gull	3	22	3	H/M H/M	High	High
Moderately Critical						
European Starling	4	9	13	M/L	Moderate	Moderate
American Crow	4	12	14	L/L	Moderate	Moderate
Non-Critical						
Raptors/vultures	1	80	9	H/H	Very low	Moderate

Notes:

1. This mass/flocking score is based on mass and the propensity of a species to flock. The scale is based on 1 being the highest hazard and 6 the lowest hazard.
2. The Dolbeer Ranking System for relative risk: 100 is the highest, 2 the lowest.
3. Transport Canada hazard list: 1 is the highest, 20 the lowest, all are considered to be hazardous and the status of some species has changed since the ranks were established.
4. This forecasts the potential damage subsequent to a strike. Categorized by examining the phase of flight within the bird hazard zone where the strike is most likely to occur. This accounts for bird behaviours. Categories were assigned as follows: High (H) – strike occurs during final stage of take-off and initial climb. Moderate (M) – strike during take-off roll, landing-roll, and on short final approach; Low (L) – strike during climb and approach; No subsequent damage (NS).
5. Takes account of worst-case scenario, and includes the damage incurred during the strike and any subsequent damage.

6.4 Severity

Categories of severity that were assessed are provided in **Table 2** and range from Category A (Catastrophic), to Category E (Negligible). For a risk assessment, an aircraft's exposure to a potential Category A event ultimately represents a much greater risk level than a Category D or E event.

Table 2. Categories of Severity

Degree of Loss	Descriptor	Description
Category A	Catastrophic	Loss of life or destruction of aircraft
Category B	Major	Major injury or damage to aircraft
Category C	Moderate	Injury or moderate damage to aircraft
Category D	Minor	Minor injury or damage to aircraft
Category E	Negligible	Inconvenience

The potential severity of a bird strike is also related to the type of aircraft that is involved in a bird strike. The primary factors of aircraft type that contributes to the potential severity of a bird strike is how the aircraft is powered, this relates the type of engine and number of engines (two or more engines provides redundancy in maintaining power and speed of the aircraft). **Table 3** rates aircraft type with respect to risk severity from a bird strike, from Level 1 (High) to Level 4 (Low). Light piston engine propeller powered aircraft are the most common aircraft that are operated in North America. This engine type is resilient to a direct bird strike, and typically the aircraft can maintain power following the strike. Bird strike damage is mostly related to damage to the aircraft wing, tail and windshield. Twin piston engine aircrafts are less susceptible to a catastrophic bird strike, as the potential for the loss of power from both engines is very low.

Table 3. Aircraft Type and Potential Severity of a Bird Strike

Aircraft Type	Degree of Potential Loss	Level of Severity by Aircraft Type
Multiple Turbo Fan Commercial Jet Engine	Category A	Level 1
Singe Turbo Fan Jet Engine	Category A/B	Level 2
Turbojet or Turboprop Jet Engine	Category B Moderate Potential for Category A	Level 3
Single Piston Engine	Category C/D Low Potential for Category A or B	Level 4
Turboshaft Engine (Typical Helicopter Engine)	Category C/D Low Potential for Category A or B	Level 4
Twin Piston Engine	Category D Very Low Potential for Category A, B or C	Level 5

Jet engine powered aircraft as a group are more susceptible to the risk of a severe strike. This is primarily due to the fact that a strike could result in the ingestion of a bird, or number of birds, into the engine, resulting in engine failure and loss of power to the aircraft. In addition, jet powered aircrafts typically operate a much higher speeds than piston engine aircraft, which results in greater damage to the aircraft when a bird is struck (and less opportunity for birds to avoid a strike).

Only piston engine aircrafts operate at the Woodstock Airport. The majority of aircrafts that operate at the Tillsonburg Airport are also piston engine aircrafts. However, the length of the paved runway allows turbo-prop and turbo-fan small jet engine aircrafts to also operate at this facility. Small jet engine aircraft also operate the other Regional and Municipal airports that occur in the wider study area.

6.5 Likelihood of Occurrence and Exposure

Information regarding aircraft operation was obtained for airports in the vicinity of the proposed landfill site and the wider area, and an assessment of the movements and numbers of the key hazard species was undertaken. This information has allowed for an assessment of aircraft exposed to a potential bird strike.

The likelihood of a bird strike to an aircraft is assessed based on the potential exposure to birds which considers the frequency which an aircraft is in airspace where exposure to birds can occur. **Table 4** presents five levels of likelihood that are considered, from Level 1 (Frequent) to Level 5 (Rare).

Table 4. Categories of Likelihood

Descriptor	Exposure	Level of Likelihood
Frequent	Will occur in most circumstances	1
Often	probably will occur	2
Occasional	Possibly may occur	3
Seldom	May occur infrequently	4
Rare	May occur in exceptional circumstances	5

London Airport and Waterloo Airport

Although these are busy airports with 55,000 to 100,000 aircraft movements each per year, both facilities lie distant from the proposed landfill site, and movements of the key bird hazard species to or from the landfill site will not result in birds occupying the airspace of their BHZs. In addition, aircraft operating to these airports while over the proposed landfill site will typically be above 1,500 ft AGL. Therefore, aircraft operating to these two airports will not be exposed to the key hazard species as a direct result of the birds occurring at the proposed landfill site.

Tillsonburg Airport

The BHZs of the Tillsonburg Airport run east-west and is 18 km to south of the proposed landfill site. Therefore, aircraft operating at this airport will not be exposed to birds that will occur at the proposed landfill site.

However, this study has identified that in the spring, flight lines of multiple small flocks of gulls can be expected to transit through the airspace of the PBHZ and SBHZ of the Tillsonburg Airport as they move to and from the proposed landfill site and likely Lake Erie shore roost sites. These gull movements typically occur below 500 ft AGL, and therefore an aircraft's exposure would only occur in the airspace during final approach and take-off at this airport.

Spring fights of small flocks of gulls through the airport's BHZs do currently occur as they move between the lake shore roosting sites and the Salford Landfill. To-date, no bird strike with a gull has been reported at this facility. This study, and consultation with the Tillsonburg Airport Manager, has also found that these gull flights to and from the Salford Landfill and lake shore do not result in regular feeding or loafing stops by gulls at this facility.

This location has 13,000 aircraft movements per year.

Woodstock Airport

As shown in **Figures 5a** and **Figure 5b**, the proposed landfill site lies within the PBHZ of the Woodstock Airport. The centre of the proposed landfill site lies 5.5 km from the button of runway 06 and the extended runway centreline for direct approach lies 0.55 km to the northwest of the northwest corner of the proposed landfill area. At this location, aircraft will be operating below 1,000 ft. The button of runway 24 lies 6.5 km northeast of the proposed landfill site. There are no regular flights of the key hazard species to the north of the proposed landfill site that would cross where the direct approach line currently occurs, and the predicted flight patterns are not expected to occur here during the proposed landfill's operation either. However, some general movements of birds that will occur at the proposed landfill site can be expected and these could expose aircraft to birds in the approach/take-off airspace.

Consultation with the Woodstock Airport manager has identified that training circuits occur within 1 to 3 km of the facility at an altitude of 500 to 1,000 feet AGL. These flights will not result in aircraft occupying airspace over the proposed landfill site, which will be located more than 5 km to the southwest of the airport. However, training and circuit flights that entered the airspace over the proposed landfill site would have an increased exposure to birds.

Surveys of the Woodstock Airport environment has found that it is not an attractive feeding/loafing area for gulls or crows as the narrow runway is surrounded by corn field that creates a confined space. Therefore, should present agricultural land use adjacent to the runways and taxiway continue, the occurrence of the landfill gulls or crows loafing or feeding on the grass runway strip is not expected. However, the presence of large numbers of gulls at the landfill site during the spring ploughing and fall harvesting periods can be expected to increase gull activity in the farm fields located within the Woodstock Airport's BHZs, resulting in an increase of exposure to aircraft operating at this facility.

It is important to note that this facility has only 3,000 aircraft movements per year, also it is closed during the winter. These factors significantly reduce the exposure to bird strike risk.

ORNGE Flights

Air ambulance helicopter movements in the vicinity of the proposed landfill site typically occur at or above 1,500 ft AGL and will not be exposed to birds that occur at the landfill. Flights that operate outside of these parameters are so infrequent that the increased exposure would not elevate the risk assessment.

General Aircraft Movements

General aircraft movements, such as transits between airports, and aircrafts operating at private grass airstrips will typically occur above 1,500 ft AGL when in the vicinity of the proposed landfill site. This will not result in an increased to the exposure to the key bird hazard species.

Crop Sprayers

Concern has been raised regarding an increase in the exposure to the key bird hazard species to aircraft conducting aerial spraying of crops. At present, the frequency of aerial spraying of crops in the vicinity of the proposed landfill site is not known, but as noted, it has been an infrequent activity out of the Woodstock Airport. Aerial spraying has typically been undertaken by piston engine fixed wing aircraft; however, the use of helicopters is becoming more prevalent in Ontario. These flights occur at almost ground level and in the airspace that is frequented by birds. Spraying activity is more frequently used during the late spring and summer for the application of fungicides, herbicides, insecticides. These spraying activities coincide the nesting period of the hazard species, a time when numbers at the landfill will be very low. Additionally, during the summer, species such as gulls typically will not feed in crops fields that grow corn or soya bean as the density and height of the plants inhibit visual detection of predators.

6.6 Risk Assessment

This risk assessment is primarily based on gulls and crows being the primary hazard species, with a Potential Severity rank of 3. Raptors and vultures are hazardous species; however, this study has identified that only very low numbers of these birds will be attracted to the proposed landfill site, and the exposure and risk associated with these species would be similar to existing background conditions.

The assessment of likelihood is based on an aircraft's expected increase in exposure to these key bird hazard species as a result of the future operations of the proposed landfill site (there is an existing background exposure/likelihood risk level associated with the airports and general transient aircraft movements).

However, of special note, this risk assessment does not consider mitigation measures during the operations at the proposed landfill site that would reduce a bird hazard or exposure of aircraft to the hazard. Mitigation measures are addressed after the initial risk assessment.

6.6.1 Initial Screening for Risk

This study assessed bird numbers and movements for three study areas, On-Site, Site Vicinity and Wider Study Area. Within these study areas airports, large and small, were identified and operations assessed. For the assessment of risk for a bird strike, an interaction between aircraft and birds associated with the proposed landfill site is required.

Where aircraft operating at an airport in the study areas do not have a reasonably foreseeable potential to interact with birds associated with the proposed landfill, then an assumption is made that no measurable increase in risk will occur, and no further assessment of the level of risk is required.

Accordingly, aircraft operating at, or in transit to and from, the following airports have been screened out of the risk assessment process:

- London International Airport;
- Regional Waterloo Airport; and
- Other Municipal Airports in the Wider Study Area (i.e. Stratford Municipal Airport, Saint Thomas Municipal Airport, Brantford Municipal Airport, etc.).

The BHZs of these airports lies distant from the proposed landfill site and transient aircraft flights operating to these facilities typically occur above 1,500 ft AGL, well above the normal upper limits of birds associated with landfills. In addition, birds associated with the proposed landfill site are not expected to move to these airports and therefore will not increase exposure to aircraft operating at these airports.

6.6.2 Risk Assessment

For aircraft operating at airports and operations where a reasonably foreseeable potential risk for a bird strike could occur as a result of the operation of the proposed landfill site, a detailed risk assessment is undertaken. The level of risk was assessed using a matrix table, **Table 5**, that considers the severity levels of a bird strike and the levels of likelihood for the occurrence of a bird strike.

Table 5. Matrix for Qualitative Assessment of Risk

Severity	Likelihood of Occurrence				
	Will occur in most circumstances Level 1	**Probably will occur Level 2**	**Possibly may occur Level 3**	**May occur infrequently Level 4**	**May occur in exceptional circumstances Level 5**
Catastrophic Level 1					
Major Level 2					
Moderate Level 3					
Minor Level 4					
Negligible Level 5					

Overall Risk Level:

Level 1	High	Urgent mitigative action required
Level 2	Moderate	Management action indicated
Level 3	Low	May require specific actions
Level 4	Very Low/Background	Normal best practices

The Overall Risk Level is based on the potential, or likelihood, of a bird strike occurring with species that could cause catastrophic or major damage (i.e., gulls and crows). A Level 1 High Overall Risk is a condition were such a bird strike has a high probability to result in a catastrophic event (i.e. plane crash) and has a high probability to occur as a result of the operation of the proposed landfill site. A Level 4 Very Low Overall Risk is a condition where there is no increase in the risk of bird strike occurring as a direct result of the operation of the proposed landfill site. It is important to note that this risk assessment is examining potential effects created by the proposed landfill. The results of the overall risk assessment are summarized in **Table 6**.

Table 6. Pre-Mitigation Risk Assessment by Airport

Airport/Operations	Severity	Likelihood of Exposure	Overall Risk Level
Tillsonburg Regional Airport	Level 3	Level 3	Moderate
Woodstock Airport	Level 4	Level 3	Low
Crop Spraying Operations in the Vicinity of the Landfill	Level 4	Level 4	Very low/background
Local Private Grass Strip Airfields	Level 4	Level 5	Very low/background
Southwest ORNGE Air Ambulance	Level 4	Level 5	Very low/background

If a do-nothing scenario is considered (i.e., no landfill was postulated) the overall risk levels would all be at whatever their current levels are, as no additional bird activity due to the landfill would occur.

No Level 1 High Overall Risks were identified. This is primarily due to the fact that jet aircraft do not operate at the Woodstock Airport and occur infrequently at the Tillsonburg Airport.

A Level 2 Moderate Overall Risk was assessed for the Tillsonburg Airport. A number of factors were considered for the assessment. The airport has a moderate level of activity, with 13,000 aircraft movements per year, and the paved runway can support private and commercial jet aircraft. In addition, there may be an increase in spring low level movements of gulls through the airspace of the airport's bird hazard zones as they move between the roost sites at Lake Erie and the proposed landfill site. However, it is noted that this condition presently exists, and no bird strike or problem with airside loafing or feeding by gulls has been reported. Nevertheless, as the number of gulls would be expected to increase, a conservative Level 2 Moderate Overall Risk has been assessed related to the proposed landfill.

As detailed in **Section 6.5**, the proposed landfill site is located within the PBHZ of the Woodstock Airport. The total number of aircraft movements at the airport is very low (2,000-3,000/year) and the airport is closed during winter. This study has determined that during the operation of the proposed landfill, exposure to bird hazards within the airside lands of the runway will not increase. In addition, no regular movements of birds to and from the landfill through the airspace over the airport is expected to occur. However, general movements of birds around the landfill can be expected, and spring ploughing and fall harvesting periods can be expected to increase gull activity in the farm fields located within the airport's BHZs, resulting in the potential for an increase of exposure to aircrafts operating at the airport. Departure and take-off on Runway 24 and arrival and landing on runway 06 will locate aircraft in an airspace below 1,000 feet AGL that is 0.55 km to the northwest of the northwest corner of the proposed landfill, an area where greater bird activity at the proposed landfill site can occur. Training and circuit flights occur within 1 to 3 km of the airport at an altitude of 500 to 1,000 feet AGL. These flights will not result in aircraft occupying airspace over the proposed landfill site, which is located more than 5 km to the southwest of the Woodstock Airport. However, some training flights can be expected to occasionally occupy airspace over the proposed landfill where birds will occur. Based on all these factors, a Level 3 Likelihood of Occurrence was assessed. Only single and twin piston engine aircrafts operate at this facility and therefore a Level 4 Severity was identified. Based on the likelihood of bird strike and level of potential severity, a Level 3 Low Overall Risk was assessed.

Due to their infrequent occurrence and type of aircraft, aircrafts operating at private grass airstrips and crop spraying operations in the vicinity of the proposed landfill site were assessed to have a Level 4 Very Low Overall Risk, with no increased risk above existing levels. ORNGE Air Ambulance that transits between airports in the wider area can on occasion occupy airspace where birds attracted the proposed landfill site may occur. However, the type of helicopter used has a low level of potential severity, and aircraft movements that would be in an airspace below 1,500 feet AGL in the vicinity of the proposed landfill site will be very infrequent. Therefore, a Level 4 Very Low Overall Risk is assessed.

6.7 Summary and Recommendations

This bird hazard and risk assessment identified that unmitigated landfill operations at the proposed landfill site will attract large numbers of gulls, American Crows, and European Starlings.

Based on a detailed assessment of existing conditions, the bird hazard and risk to aircraft movements in the vicinity of the proposed landfill site and wider area could be assessed for when the proposed landfill is in operation.

The overall risk for a bird strike for most airports and aircraft movements that would result in a Category A or B severity bird strike was assessed to be no risk or a very low overall risk. A Level 2 moderate overall risk was assessed for aircrafts operating on approach and departure at the Tillsonburg Airport during the spring months. For the Woodstock Airport that lies in closer proximity to the proposed landfill Site, a Level 3 Low overall risk was assessed due to the low number of aircraft movements and aircraft types.

For all other airports and aircraft operation the assessment identified either no measurable increased risk or a Level 4 Very Low overall risk, with no increased risk above existing levels attributable to the proposed landfill.

As a Level 2 Moderate overall risk and Level 3 Low overall risk was assessed for the Tillsonburg and Woodstock Airports, the following actions are recommended:

1. That the landfill operator implements reasonable measures to reduce bird use during landfill operations at the proposed site;
2. As a primary mitigation measure, the operator implements an Integrated Bird Management Plan (IBMP), discussed in **Section 7** of this report; and

3. To further mitigate the overall risk level to aircraft operating at the Woodstock and Tillsonburg Airports, prior to the start of operations at the proposed landfill site, the landfill operator initiate consultation with the airport management to identify and develop a system safety plan that integrates and co-ordinates measures that can be undertaken to reduce bird hazards to aircraft operating at the airports.

7. Integrated Bird Management Plan (IBMP)

To mitigate the bird hazard and risk to aircraft of a bird strike during the operation of the proposed landfill, implementation of an Integrated Bird Management Plan (IBMP) has been recommended.

Goal of the IBMP

The goal of the IBMP is to take measures to: 1) reduce the bird hazards and habitat hazards at the landfill site; and 2) to reduce the exposure or likelihood of aircraft to a bird strike.

Objective of the IBMP

The objective of the IBMP is to undertake mitigation measures that manage habitat hazards so that safety-critical bird species are not attracted to the landfill, and to reduce their numbers in order to reduce the likelihood of a strike that could lead to injury or damage. The primary objective is to maintain a presence of hazardous birds no greater than background levels.

Habitat hazard and bird hazard management can be achieved through mitigation operational activities at the landfill and active control measures to deter birds from entering or staying within the landfill environment. The development of the details of the IBMP will be undertaken as the project progress. The following provides a summary of the key elements that the IBMP should include.

The IBMP will consist of five key elements. These are:

1. Site operations to minimize the attractiveness of the site to the key bird hazard species, with a primary focus on gulls and crows;
2. Active bird control;
3. Staffing and responsibilities;
4. Communication with airports, and
5. Monitoring and review of the IBMP.

The following sections provide a general discussion of these elements that will need to be detailed in the IBMP.

7.1 Operations

The key hazardous bird species will occur at the proposed landfill site for two reasons. The primary reason is that site will provide a regular reliable source of food. The secondary reason is that it provides a safe environment from predators to loaf and spend the day. The following mitigation recommendations are related to the day-to-day operations to reduce the availability of food sources and safe loafing areas. They can be generally referred to as passive bird control measures.

7.1.1 Reduction in Available Food Waste

How readily available food waste is to the hazardous bird species is a critical determinant of the number of birds that will occur, and how persistent they are likely to be in the face of management activities. Though the landfill will receive food wastes, the reduction in the availability of food waste to birds can be achieved with specific operational measures, including the following:

- To the extent possible, the working face of cells receiving food waste should be kept at a minimum size to reduce the physical feeding area for gulls;
- Waste that includes food waste that is received and compacted at the landfill should be covered throughout the day with non-food wastes when available, and then daily cover should be applied at the end of each day to eliminate or reduce feeding opportunities by birds;
- Late-arriving deliveries of food waste must be handled expeditiously and covered with daily cover immediately once compacted. Should there be a public waste drop-off, the waste transfer bin containers containing food wastes must be properly covered at all times when not receiving waste;
- Waste/litter blowing from the active tipping face attracts gulls as it is often associated with food and it therefore should be contained to prevent widespread distribution throughout the landfill area; and
- Staff operating at the landfill area should identify and remove any garbage/litter that that is found to occur outside the areas designated for the receiving and handling of waste, including regular inspection of the haul roads.

7.1.2 Reduction in Standing Surface Water

Standing fresh water is known to attract gulls, and other birds, which is used for drinking and bathing and to avoid ground predators. At the site, during the spring thaw and following heavy rain events, standing water in the form shallow pools could occur throughout, and larger permanent stormwater ponds are present. In addition, the Former West Quarry lies directly the south of the proposed landfill area. For the reduction and/or elimination of the availability of standing water the following operational measures should be considered:

- To extent possible the elimination of standing water should be a priority in the operations of the cell system for the landfill and for final cap of the cells;
- Infilling, grading and ditching to eliminate areas of standing water throughout the landfill site should also be considered as a component;

- Regular monitoring for the occurrence of new areas of standing water within the landfill site should be undertaken and measures identified and implemented as soon as possible to eliminate or reduce the areas of standing water;
- The off-site Former West Quarry will provide drinking and bathing opportunities; however, design measures cannot be implemented to eliminate gull access to the lake. Active control measures will need to be considered; and

Should persistent areas of standing water develop within the landfill site that cannot be removed through filling or improved drainage, that also attract watering or loafing gulls it may be necessary to over-wire the standing water areas, which will only be implemented if all other control methods do not satisfy their objectives.

7.1.3 Reduction in Loafing Areas

Following feeding at a landfill, the availability of loafing areas results in the concentration of large numbers of birds that remain on a site for prolonged period of times. Loafing flocks can suddenly take to flight, filling the airspace above and around the landfill with large numbers of birds. Loafing areas at a landfill facility are areas where birds feel safe from predators and are typically associated with large areas of bare ground, large soil/waste piles, and the roofs of buildings. To eliminate and/or reduce loafing areas, the following measures should be considered:

- If stockpiles of soil or waste materials are to be established on the site, the location and size of stockpiles within the site should consider bird management objectives;
- Where large soil stockpiles are to be maintained intact for extended periods of time (i.e. more than one year, they could be covered with seed of appropriate cool-season grasses such as *Bromus inermis* and permitted to grow without cutting;
- As final cap grading proceeds for closure of a cell, capping material should be planted with tall grass species and should not be mowed, in order to promote a tall grass environment that is less attractive for loafing birds;
- Following construction of a perimeter berms, the berms should be planted with tall grass species so that it is less attractive to loafing birds;
- Other areas of the landfill site which are not part of the active area of the landfill should be landscaped to reduce habitat for loafing areas where possible. Landscaping should promote a tall grass environment, and areas of maintained grass/lawn should be kept to a minimum; and
- Buildings should be designed to make their roofs unattractive to loafing birds (e.g. reduce the physical areas of the roof, visual obstruction built into the roof design, over wire, physical wire spikes or needles).

7.2 Active Bird Control and Deterrents

The general management of birds, and especially of gulls and crows, at outdoor facilities that handle food waste inevitably requires the use of active control and the use of deterrents. A range of deterrents are available in the bird control marketplace. Managers are faced with a wide variety of relatively complex measures (e.g., cannons, falcons, air-operated human effigies, scarecrows, chemical repellents and distress calls) that have been used for the management of nuisance birds. Generally, almost all deterrents have some merit, for some applications, for a limited period of time. However, birds in general (and gulls and crows in particular) quickly habituate to deterrents that they come to associate with no real threat to their safety.

For this site, given the location and physical size of the site, it is recommended that a full-time falconry program be established as a main component of the bird control measures. The use of falconry as a bird control measure has been successfully employed at many airports (Pearson Toronto International Airport for example) and at landfill sites in southern Ontario. The program should be developed and implemented by persons with extensive experience in conducting a large-scale, full-time bird management program. The program should be developed to control birds for the entire landfill fill area and the Former West Quarry. The program should not include the Former West Quarry from March to August so as not to disturb breeding birds.

7.2.1 Contingency Active Bird Control Measures

Thresholds should be established through a monitoring program to determine when and if contingency measures need to be implemented. These contingency measures may need to be temporarily employed to address specific conditions and may include:

- The addition of Bird Control person(s) with extensive experience to compliment the Bird Control Supervisor;
- Use of pyrotechnics (i.e., pistol, shot gun, launchers);
- Lethal control (shooting); and
- Use of propane gas canons.

All pyrotechnic products entail a user risk, and must be used with appropriate safety training, the application or use of safety rules and equipment, appropriate storage and transportation of pyrotechnics, good judgment and skill. Employers must also ensure that adequate liability insurance is held, and that appropriate safety training is provided.

For the lethal control the following recommendations apply:

- Lethal control should be used when birds become habituated to other active bird control deterrents and management should ensure that this control measure is available at all times for use at the landfill site;
- During implementation, the site should develop Standard Operating Procedures to protect both employees and visitors;
- Appropriate ammunition (e.g., No. 4 shot, non-toxic) should be acquired for lethal control of gulls and crows using a 12-gauge shotgun;
- Canadian Wildlife Service permits will need to be acquired for lethal control, and all appropriate firearm and hunting permits must be on site;
- All required permits from the Ontario and local municipal governments (firearm and hunting permits, noise permits etc.) are to be obtained and retained on-site;
- All safety rules must be applied, including that all firearms and ammunitions must be stored in a locked storage area when not in use, no discharge of firearms from within or on a vehicle, either stationery or moving;

- All staff working at the landfill in the area of the lethal control should be notified by radio or other communications prior to any use of firearms;
- The users of firearms should survey the site to ensure that no individuals or machinery are in the area where firearm use is to occur; and
- All use of firearms should be recorded in the daily landfill operations log, including the name of the individual operating the firearm, time and result of control activities, as well as the location and direction of the discharge of the firearm.

To be most effective, this selective lethal control should be undertaken concurrent with the use of pyrotechnics and gas canon. One or two birds killed in view of the flock and left in clear view of other birds for a time can be a very effective reinforcement. Birds should never be shot when on the ground, as this has little visual effect and can present an increased safety issue.

As discussed in **Section 7.2.1** should persistent areas of standing water develop within the landfill site that cannot be removed through filling or improved drainage that attract watering or loafing gulls it may be necessary to over-wire the standing water areas. This method of control will only be implemented after all other control methods have been employed and are not effectively controlling watering or loafing gulls in this situation.

7.3 Staffing and Responsibilities

7.3.1 Staffing

To be effective, the IBMP should at a minimum include one dedicated Bird Control Manager at the facility, with other staff trained as back-up to cover those periods when the dedicated employee is unavailable.

The following staffing recommendations apply:

- A full-time dedicated Bird Control Supervisor position should be established at the landfill;
- A part-time assistant Bird Control position(s) should be established;
- The primary bird control activities will be implemented by persons that have extensive experience in conducting a falconry control program in addition to the other control methods discussed in this report; and
- Other key staff at the landfill, should be identified for implementing contingency bird control measures, including during times of vacation.

7.3.2 Responsibilities

Bird control management will only succeed at the landfill site if there is a commitment to effective management that is clear and unambiguous at all levels in the organization. All staff need to be empowered to participate in the program, informing managers immediately when issues arise. It needs to be made clear that the presence of gulls, crows, and other birds at the site is not acceptable, and is a potential liability issue for the landfill operator. The key responsibilities for the IBMP are summarized below, although hierarchy positions may differ.

Landfill Operator

Ultimately, the senior management of the landfill operations will be responsible to ensure the IBMP is developed, implemented and funded.

Manager of the Landfill Site

The Manager of the Southwestern Landfill will be responsible for the overall implementation of the IBMP, ensuring experienced persons are available, acquiring required funding and dedicating man power. Responsibilities also include;

- The acquisition of the various permits;
- The development of training and awareness programs;
- Conducting communications with the management of local airports; and
- The preparation and review of the annual monitoring reports.

Bird Control Supervisor

The Bird Control Supervisor will be responsible for insuring that the IBMP is implemented at the site. The primary responsibilities will include;

- Coordination of bird control requirements with the site staff responsible for the day to day operations at the facility when necessary;
- Staff training requirements;
- Ensuring that the appropriate permits are current and present on-site;
- Ensuring all activities are undertaken following standard practices and safety protocols;
- Implementing contingency plans as required;
- Daily maintenance of the Bird Management Log (e.g. including details on bird numbers and activity; IBMP measures undertaken);
- Preparing annual reports; and
- Communications with Manager of the Landfill Site with respect to required equipment needs, training, site alterations and changes to operations, as required to ensure the effectiveness of the IBMP.

Day to Day Site Operations Staff

Generally, site operations staff will not be directly responsible of the day to day activities of the IBMP. All site staff should be aware of the IBMP and have the responsibility to report any condition that is attracting large numbers of birds at the site. In addition, a number of on-site staff should be trained and be available for implementing contingency active control measures if they are required.

7.3.3 Training

An initial Tier One training program should include an introduction to bird hazards at airports and should be provided to all involved landfill management and staff. This initial awareness training can include the three Transport Canada Videos:

- Crossed Paths;
- Not In My Backyard; and
- There's Something Out There at the Airport.

An accompanying presentation should address the issue of bird hazards to aircraft, Transport Canada guidelines respecting landfills near airports, the importance of bird management to the continuing safe operation of the facility, and an overview of the IBMP, supported with site-specific information.

Tier Two training could also be provided, to site staff closely based on the IBMP, and could include:

- An understanding of the need for management;
- Responsibilities;
- Operational measures;
- Deterrents;
- Safety;
- Monitoring techniques; and
- Reporting requirements.

Specific training will need to be provided to site staff who are identified to be responsible for using pyrotechnics, or other deterrents. This will include a practical training session on the use of pyrotechnics and handling of firearms.

7.4 Communications with Airports

Ongoing communications with airports in the vicinity of the proposed landfill and wider area should be considered an important part the IBMP. Based on the risk assessment, regular communications should be established with the management of the Woodstock Airport and Tillsonburg Regional Airport. Discussions should be held with the Woodstock Airport regarding aircraft operations in the airspace over and around the landfill to reduce the risk of a bird strike. For both airports, at the initial stages of the implementation of the IBMP, communications with the airports will be required to ensure that the operation of the landfill is not creating an increased level of risk for aircraft operating in and out of the airport. This could happen, for example, if large numbers of gulls were to move from the landfill to the airside lands of the airports. Any significant increase in the numbers of the hazardous bird species at the airports should be reported by the airport management to the manager of the landfill so that reasons for the occurrence can be determined, and if required, mitigated.

7.5 Monitoring and Review

The IBMP monitoring plan will be used to determine use of the site by gulls, crows and other bird species, and specific areas on the site that may require adapted habitat management and control. This will in turn establish the thresholds for the use of contingency measures. Overall, monitoring will result in an assessment of the efficacy of the IBMP and allow further adaptation and improvement of the plan. It will also provide a basis for determining if bird use of the area changes through time.

The monitoring program should be developed by the Bird Control Supervisor that has the responsibility to direct the day to day activities of the IBMP, and conjunction with other Bird Control staff. It is recommended that regular meetings be undertaken between the Bird Control Supervisor and the Landfill Manager to review the success, or otherwise, of the programs. This will ensure that mutual concerns are properly addressed. The monitoring program could include:

- Maintenance of a bird control management log detailing species counts, locations, and control activities employed (i.e. types of pyrotechnics used, gas canon deployment, firearm use, etc.);
- Whether contingency methods were required;
- An annual summary of activities and results;
- Communications with management of local airports; and
- Public complaints.

7.6 IBMP Summary

The principal components of an IBMP presented here represent the current industry standard for effective long-term bird management. For the implementation of the plan, the operational measures that are identified to reduce the attractiveness of the proposed landfill site as a feeding and loafing area for birds should be considered the critical primary control measures and should be given top priority. The successful implementation of passive and active control mitigation measures of the IBMP will depend directly on the commitment of management of the landfill.

8. Post-Mitigation Risk Assessment

The objective of the IBMP is:

> *…to undertake mitigation measures that manage habitat hazards so that safety-critical bird species are not attracted to the landfill, and to reduce their numbers in order to reduce the likelihood of a strike that could lead to injury or damage. The primary objective is to maintain a presence of hazardous birds no greater than background levels.*

When implemented effectively, it is anticipated that bird use of the landfill (by target hazardous bird species) will be managed to background levels. By definition therefore, there should be no change in the existing levels of risk associated with each of the airports being examined due to the landfill. This does not mean that there is no risk nor does it mean that there are no existing levels of risk at each of these facilities. However, it does mean that no additional risk above the very low/background level would be anticipated as a result of the landfill after mitigation is effectively applied.

Table 7 summarizes this risk assessment after mitigative measures have been effectively applied. Risk levels will be very low or low.

Table 7. Post-Mitigation Risk Assessment by Airport

Airport/Operations	Severity	Likelihood of Exposure	Overall Risk Level
Tillsonburg Regional Airport	Level 3	Level 5	Low
Woodstock Airport	Level 4	Level 5	Very low/background
Crop Spraying Operations in the Vicinity of the Landfill	Level 4	Level 5	Very low/background
Local Private Grass Strip Airfields	Level 4	Level 5	Very low/background
Southwest ORNGE Air Ambulance	Level 4	Level 5	Very low/background

9. Summary

As part of the EA being prepared by Walker for the provision of future waste landfill capacity at the Carmeuse Lime (Canada) site in Oxford County, Beacon completed the tasks set out in the *Southwestern Landfill Proposal Environmental Assessment Ecological Assessment Work Plan* (Beacon 2017). The purpose of part of that work plan was to complete a Bird Hazard and Risk Assessment to aircraft as a result of operation of proposed landfill.

The study was based on site-specific field surveys, review of background data and application of current aviation industry methods and standards for bird hazard and risk assessment.

The assessment found that operation of the proposed landfill would not be anticipated to result in a High risk. Due to their location in relation to the proposed landfill site with no bird hazard mitigation, a Moderate risk was identified for Tillsonburg Airport and Low risk was identified for the Woodstock Airport.

To mitigate this risk, the implementation of an IBMP is required. The key elements of the IBMP that are to be implemented have been detailed in this report.

With the successful and effective implementation of the IBMP, it is anticipated that the net effect of the risk to aircraft during the operation of the proposed landfill will be reduced to a low level (Tillsonburg) or very low/background level (other airports or operations).

10. Disclaimer

Bird control management serves to reduce hazards and associated risks. However, even with a fully operational and effective program in place, the likelihood of bird strike cannot be entirely eliminated. Beacon has detailed the elements of an Integrated Bird Management Plan following the standard practices of the industry, adapted for site-specific conditions. Beacon including its staff and Directors, assume no liability whatsoever for bird strikes or accidents that may occur in the local vicinity during the operation of the landfill or at the proposed landfill site. The implementation of this plan may require the use of firearms and pyrotechnics. Beacon assumes no responsibility or liability for accidents that may occur in the future as a result of the use of these control measures. Training and application of safety procedures is critical to avoiding such accidents and ensuring adequate training and application of safety procedures is the responsibility of those who seek to implement the recommendations of this document.

Prepared by:
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Appendix 1

Correspondence

Ron Huizer

From: Richard Holm <recholm@execulink.com>
Sent: December 7, 2018 4:46 PM
To: Ron Huizer
Subject: Re: Walker Environmental Group Inc. - Southwestern Landfill Project EA - Bird Hazzard Study - Woodstock Airport

Ron:

As far as I know, these are all private owners with planes. I don't think any of them do crop spraying.

Our field has been used for crop spraying, although we're not really set up with the water resources to do it.

Dick

On 2018-12-07 11:04 a.m., Ron Huizer wrote:

> Hi Richard, thanks again for the information you provide regarding operations at the Woodstock Airport.
> I have an other question which I am hoping you can help me out with.
> Google maps shows four other airports/aerodromes in the local area, Curries (Rand Private Airfield) Aerodrome, Thamesford (Harydale Farms) Aerodrome, Culloden Airport, and Chapeskie Field near London.
> They appear to be grass strips associated with farms.
> Are theses private owners with a plane, or are they used for crop spraying operations or both?
> Is your airport used for local crop spraying operations?
> Again short response is all I need.
> Thanks
>
> **From:** Richard Holm
> **Sent:** October 2, 2018 1:59 PM
> **To:** Ron Huizer
> **Subject:** Re: Walker Environmental Group Inc. - Southwestern Landfill Project EA - Bird Hazzard Study - Woodstock Airport
>
> Ron:
>
> Some of my responses are pure guesses, but they are my best guess.
>
> On 2018-10-01 10:34 AM, Ron Huizer wrote:
>
>> Hi Rickard, as discussed, on behalf of Walker Environmental Group, Beacon Environmental is conducting a Bird Hazard Study for a proposed landfill development to be located on lands associated with part of the Carmeuse Lime Canada Ltd quarry site in Beachville, see attached pdf for a location map. Transport Canada guidelines detailed in Safety Above All (TP 8240, Ninth Edition) and the Airport Wildlife Management and Planning Regulations (Canadian Aviation Regulations -CAR 302.301-306) identify landfills as a potential hazardous land use in the vicinity of airports, and require that an assessment of bird hazards and risk to aircraft be undertaken prior to development.

I am sending you this e-mail to obtain information regarding operations at the Woodstock Airport. As you know I conducted a site visit of your airport in August and that forms the bases of some of my questions. You can provide a simple response to my questions by a return e-mail. If you want to speak to me, call me at 416-726-0544.

1) What is the average yearly number of aircraft movements?

I assume take-offs and landings. My guess is between 2,000 and 3,000 per year.

2) What are the most common types of aircraft that operate at the Airport?

Two and four-seater planes. Piper Cub, Cessna 172, Harvards, Champ, Citabria, Beech, Stearman, and a few others I don't remember.

3) How many aircraft are associated with the Woodstock Ontario Flying Club?

There are currently 17 aircraft owned by the club and members.

4) In total, on average how many aircraft are hangered at the Airport?

We have hangar space for 17 aircraft, and all spaces are filled.

5) For general public pilot use of the Airport, except for emergency situations, is a Prior Notice by the pilot always required.

No.

6) What is the general altitude of aircraft operating to and from the Airport when within 5km of the Airport?

500 to 1,000 feet AGL

7) What is the general distance from the Airport and altitude of aircraft when conducting training/touch and go's at the airport and frequency of training?

500 and 1,000 feet AGL in the circuit. Circuits are between 1/2 mile and two miles. Frequency is probably once a week to 3 times per week. Pilots usually conduct their own practice for proficiency. We do not have on-site training.

8) What is the frequency of Medevac flights per year and type of aircraft?

We have zero Medevac flights since Woodstock hospital installed a helipad.

9) For runway 06-24, what is the most frequently used direction for take off, (i.e. to 06) and landing (to the button of 06 or 24) ?

Wind direction most often favours runway 24.

10) Currently the runway and taxi way are surrounded by active corn field – is this always the case, or is soya or another crop rotated, and are the fields around runways ever left fallow for a year or more?

Soya and corn have been planted in alternate years for several years now. Fields have never been fallow in the past 30 years.

11) Are gulls ever seen at the Airport, flying, feeding, loafing around, if yes, can you provide general numbers birds and usually when they occur, or are they in frequent and unpredictable?

Gulls are currently infrequent, except during field cultivation. Otherwise they are fairly unpredictable. Turkeys nest in the woods in the Northwest corner of the airport.

12) To your knowledge has a gull strike, or other bird, by aircraft operating at the Airport ever occurred or been reported, either on take-off, landing, approach, or departure?

None, as far as I know. I personally have been within 50 feet of gulls on a few occasions.

13) In the foreseeable future Is there any intent for expansion/upgrading of the Airport facilities (i.e. paved runways or extensions, more hanger capacity etc.)

There are no definite plans for airport expansion. We are currently holding any development ideas in abeyance until the Ownership of half the airport is resolved (Currently for sale). WE have discussed extra hangar space, and one of the owners has built two hangars in recent years.

Thanks for your willingness to participate in this study.
Ron Huizer, B.Sc. (Hons) / Principal, Senior Ecologist
BEACON ENVIRONMENTAL
373 Woolwich Street, Guelph, Ontario, N1H 3W4
Cell: 416.729.0544

Ron Huizer

From: Annette Murray <AMurray@tillsonburg.ca>
Sent: March 2, 2018 2:29 PM
To: Ron Huizer
Subject: RE: Bird Hazard Assessment for Proposed Ingersoll Landfill

Hi Ron,
Our average yearly number of aircraft movements is 13,000
Most common aircraft is a Cessna 172
General altitude is between 1,000' and 4,000' AGL
Touch and go's would be at 1,000' AGL
We had 8 Medevac flight in between 8:30 and 5PM, however we don't know what comes in after hours. Probably at least that number again.

Thanks, Annette

From: Ron Huizer [mailto:rhuizer@beaconenviro.com]
Sent: February-28-18 2:54 PM
To: Annette Murray
Subject: Bird Hazard Assessment for Proposed Ingersoll Landfill

Hi Annette, as I indicated to you when I visited your airport on February 18th, I am conducting a Bird Hazard/Risk Assessment at airports as part of the Environmental Assessment for the proposed new landfill site in Ingersoll. Your Airport falls within my study area. Attached is a letter requesting some general information on your airport operations. You can simple respond back to me by e-mail.

Thanks in advance.

Ron

Ron Huizer, B.Sc. (Hons) / Principal, Senior Ecologist
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Ron Huizer

From: Harris, Devon <devon.harris@tc.gc.ca>
Sent: October 19, 2018 8:41 AM
To: Ron Huizer
Subject: RE: Bird Strike Data for two Airports

Hi Ron,
Sorry for the delay this week! I checked our database, we have no records for Woodstock CPR5 or Tillsonburg CYTB.
Thanks!

Devon Harris
Wildlife Management / Gestion de la faune
Aerodrome Standards / Normes relatives aux aérodromes
613-990-4869
devon.harris@tc.gc.ca
Transport Canada / Transports Canada
Place de Ville (AARTA), Ottawa, Ontario K1A 0N8

From: Ron Huizer [mailto:rhuizer@beaconenviro.com]
Sent: Monday, October 15, 2018 8:08 AM
To: Harris, Devon
Subject: Bird Strike Data for two Airports

Hi Devon, Beacon Environmental Limited (Beacon) has been retained by Walker Environmental Group Inc. to conduct a Bird Hazard and Risk Assessment as a component of an Environmental Assessment (EA) for the provision of a future waste landfill facility to be located at the Carmeuse Lime (Canada) site, located east of Ingersoll, Oxford County.
As part my study I am requesting bird strike data that may be in Transport Canada database for two airports, Tillsonburg Regional Airport (ICAO - CYTB) and Woodstock (Norm Beckham/Bob Hewitt Field) Aerodrome (TC LID CPR5). I don't think you will have data for this one. For Tillsonburg, the last 10 years will do, if you have that much.
If you need more information please let me know via e-mail.
Thanks

Ron Huizer, B.Sc. (Hons) / Principal, Senior Ecologist
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Ron Huizer

From: Steve Faulkner <sfaulkner@flylondon.ca>
Sent: October 30, 2018 11:08 AM
To: Ron Huizer
Subject: RE: Walker Environmental Group Inc. - Southwestern Landfill Project EA - Bird Hazzard Study - London Airport

Ron,

Again, I apologize for the delay in my response to you.

I have provided my answers to your questions below in Red. I trust this is all the information you need, however if there is anything else please do not hesitate to reach out to me.

Thanks,

Steve

YXU Operations Manager
519-452-4001

From: Ron Huizer [mailto:rhuizer@beaconenviro.com]
Sent: Wednesday, October 24, 2018 8:26 AM
To: Steve Faulkner
Subject: RE: Walker Environmental Group Inc. - Southwestern Landfill Project EA - Bird Hazzard Study - London Airport

Hi Steve, just following up on my info request now that you are back.

Thanks

Ron Huizer, B.Sc. (Hons) / Principal, Senior Ecologist
BEACON ENVIRONMENTAL
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From: Steve Faulkner <sfaulkner@flylondon.ca>
Sent: October 12, 2018 1:45 PM
To: Ron Huizer <rhuizer@beaconenviro.com>
Subject: Re: Walker Environmental Group Inc. - Southwestern Landfill Project EA - Bird Hazzard Study - London Airport

Ron,

My apologies for the delay in my response. I am actually away from the office until next week, but I will see what information I can track down for you upon my return.

Thanks,

Steve

Sent from my iPad

On Oct 10, 2018, at 4:37 PM, Ron Huizer <rhuizer@beaconenviro.com> wrote:

Hi Steve, I sent you this e-mail a week or so ago and have not heard back from you.

If you not the person who can address my questions, can let me know who can.

Again, I only need very simple short responses to the question and you reply by e-mail

Please let me if you or some else will be providing the information.

Thanks

Ron

Ron Huizer, B.Sc. (Hons) / Principal, Senior Ecologist
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From: Ron Huizer
Sent: October 1, 2018 11:21 AM
To: 'sfaulkner@flylondon.ca' <sfaulkner@flylondon.ca>
Subject: Walker Environmental Group Inc. - Southwestern Landfill Project EA - Bird Hazzard Study - London Airport

Dear Mr. Faulkner, on behalf of Walker Environmental Group, Beacon Environmental is conducting a Bird Hazard Study for a proposed landfill development to be located on lands associated with part of the Carmeuse Lime Canada Ltd quarry site in Beachville, just east of the Town of Ingersoll, see attached pdfs for location maps. Transport Canada guidelines detailed in Safety Above All (TP 8240, Ninth Edition) and the Airport Wildlife Management and Planning Regulations (Canadian Aviation Regulations -CAR 302.301-306) identify landfills as a potential hazardous land use in the vicinity of airports, and require that an assessment of bird hazards and risk to aircraft be undertaken prior to development.

The proposed landfill site would be located to east of London Airport , 22 km from the 33 button of runway 15-33 and the 27 button of runway 09-27 . This would put the landfill location outside of the Airports Primary and Secondary Brid Hazard Zones, as defined by TP 8240. However, I am sending you this e-mail to obtain information regarding Airport operations with respect to the proposed location of the landfill. You can provide a simple response to my questions by a return e-mail. If you want to speak to me, call me at 416-726-0544.

1) What is the average yearly number of aircraft movements? Between 55,000-60,000

2) What are the most common types of aircraft that operate at the Airport? DA-40, Dash-8, B-737

3) Has the Airport identified a Primary and Secondary Bird Hazard Zone for the Airport. If yes, is it possible to obtain a map of the Zones. No.

4) On landing approach to the Airport, what is the typical altitude of commercial jet aircraft when 22 km out from the airport. Typical height for approaching aircraft at that at that distance from

the airport will be approximately 8,000. Minimum approach descent altitude 15 nautical miles (22kms) from the airport is 4640' ASL.

5) On typical landing approach to either runway, do commercial jet aircraft typically occupy air space over the location of the proposed landfill. The extended centerline and approach for Runway 27 brings aircraft approximately 1.5 km's north of the proposed landfill location.

6) On go arounds prior to landing, do commercial jet aircraft typically occupy air space over the location of the proposed landfill, and if so at what altitude do they typically fly. No.

7) Which is the most frequently used runway by commercial jet aircraft, 15-33 or runway 09-27 Runways 15 and 27 are our most used runways here in London. Most commercial jet aircraft use Runway 15 while Runway 27 is predominantly used by Dash 8 aircraft.

Thanks for your willingness to participate in this study.

Ron Huizer, B.Sc. (Hons) / Principal, Senior Ecologist
BEACON ENVIRONMENTAL
373 Woolwich Street, Guelph, Ontario, N1H 3W4
Cell: 416.729.0544

Ron Huizer

From:	Sara G Patterson <sgpatterson@ornge.ca>
Sent:	March 12, 2019 8:39 AM
To:	Ron Huizer
Subject:	RE: Ornge flights between London Airport and Waterloo Airport

Good Morning Ron ,

I sent your email off to my manager last week, I believe has sent it to someone at head office – I'm unsure of a time frame, but I would likely have a better idea next week as its March break and that could affect respond time

I will keep you posted – My manager is off a few days this week as well but I'll check in with him upon his return

Thank you

Sara G Patterson
Ornge
Base Administrator
2430 Hurricane Road
London ON N5V 3Z9
(519) 453-0103

ornge
care in motion

Sara

From: Ron Huizer [mailto:rhuizer@beaconenviro.com]
Sent: March-11-19 5:29 PM
To: Sara G Patterson
Subject: RE: Ornge flights between London Airport and Waterloo Airport

Just checking back on this – can you confirm you got the e-mail, and when a response may be forth coming – if it is going to take a lot effort to respond so some of the questions, let me know, and perhaps we can skip them.

Anyway, just wondering you are on this.

Ron

Ron Huizer, B.Sc. (Hons) / Principal, Senior Ecologist
BEACON ENVIRONMENTAL
Cell: 416.729.0544

Note: For 2019 I will not be available Thursdays or Friday to respond to e-mails or phone calls.

From: Ron Huizer
Sent: March 7, 2019 9:58 AM
To: 'sgpatterson@ornge.ca' <sgpatterson@ornge.ca>
Subject: Ornge flights between London Airport and Waterloo Airport

As discussed, on behalf of Walker Environmental Group, Beacon Environmental is conducting a Bird Hazard Study for a proposed landfill development to be located on lands associated with part of the Carmeuse Lime Canada Ltd quarry site in Beachville, just east of the Town of Ingersoll, see the attached pdf location map. Transport Canada guidelines detailed in Safety Above All (TP 8240, Ninth Edition) and the Airport Wildlife Management and Planning Regulations (Canadian Aviation Regulations -CAR 302.301-306) identify landfills as a potential hazardous land use in the vicinity of airports, and require that an assessment of bird hazards and risk to aircraft be undertaken prior to development.

As part of the study, it has been identified that Ornge air ambulance flights occur between London Airport and Waterloo Airport, and that these flights occur through the Beachville/Ingersoll air space.

I am sending you this e-mail to obtain information regarding Ornge operations with respect to the proposed location of the landfill. You can provide a simple response to my questions below by a return e-mail. If you have any questions, please call me at 416-726-0544.

1) On average what is the yearly number of Ornge air ambulance movements between the Waterloo and London Airports?

2) Are there regular flights to other airports that would result in Ornge aircraft to occur in the air space over the proposed landfill site, e.g. Toronto Pearson, Hamilton International, Brantford Municipal Airport. If so what is the average yearly number of movements?

3) What are the most common types of aircraft that operate, the Pilatus Next Generation or the Rotor Wing Leonardo AW 139?

4) During transit to and from the Airports, what is the typical altitude of Ornge air ambulance aircraft when over the location of the proposed landfill site.

5) For Ornge aircraft operating out of the London Base 7792 has a bird strike ever been reported by pilots.

Thanks for your willingness to participate in this study.

Ron Huizer, B.Sc. (Hons) / Principal, Senior Ecologist
BEACON ENVIRONMENTAL
Cell: 416.729.0544

Appendix 2

Summary of Site Survey Data

Appendix 2

Field Notes

February 12

Sunny, -11 ^{0}C, light west wind.
Salford Landfill - 56 Gulls, 1500 Crows, 2000 Starlings - 12 noon
Tillsonburg Airport – 3 Crows, no Gulls, - 1 pm
London Landfill –200 gulls, 50 crows, 1500 starlings – 2:30 pm
On Site Study Area – 1 crow
Comments: In the vicinity of the Salford Landfill no gulls noted in rural landscape, few individual crows moving through landscape

February 18

Sunny, -9 ^{0}C, light west wind
Salford Landfill - 67 Gulls, 2000 Crows, 2500 Starlings, 1 Red tailed Hawk – 11 am to 12 noon
On Site Study Area – no birds
Tillsonburg Airport 5 Crows, no gulls – 1 pm
London Landfill – approximately 300 gulls, 30 crows, 1000 starlings, 2 Red tailed Hawk – 2pm
London Airport – 3 Crows, no gulls - 2:30 pm

March 14

Sunny, -2 ^{0}C, strong northwest wind.
Salford Landfill - 1200 Gulls, 5% Herring gulls, 2000 Crows, 3000 Starlings, 1 Red tailed Hawk – 7:30 am
On Site Study Area – no gulls, 3 Crows, 1 Red-tailed Hawk
Tillsonburg Airport - 5 Crows, 1 Gull fly over – 9:30 am
Woodstock Airport 2 Crows, no Gulls 11 am
Stratford Landfill 25 RBG, 4 HG, 700 Starlings, 42 Crows 1pm
London Landfill 4500 Gulls, 5% Herring gulls, 50 Crows, 3000 Starlings – 2:15 pm
London Airport 7 Crows, no Gulls – 3 pm
Comments: Morning gull movements to Salford from the south, small flocks up to 15 birds, low altitude, less than 200 feet. Crow flights small flocks of up to groups of 10 from north east, from roost at Woodstock east of Sweaburg, low altitude, less than 200 feet. No gulls seen in farm fields

March 26

Overcast, 10^{0}C, light northeast wind.
London Landfill - 3,500 Gulls (5% HG), 40 Crows, 3500 Starlings - 2:30 pm
London Airport – 7 Crows, 2 Gull fly overs - 3:30 pm
Comments: About 700 gulls on tipping face, the rest loafing, including flock (400) in farm field south of landfill along Manning Road. Loafing flocks in 5 locations around tipping face.

March 28

Partly cloudy 4 ^{0}C, light south wind.
Salford Landfill - 153 Gulls, 66 Crows, 300 Starling, 2 Turkey Vultures, 1 Red-tail Hawk, approximately 100 Canada Geese on pond - 7 am – 9 am.
Tillsonburg Airport 5 Crows, 5 Gull fly overs - 9:30 am
Woodstock Airport 2 Crows, no Gulls – 10am
On Site Study Area – no gulls, 1 Crows, 1 Red-tailed Hawk
Stratford Landfill - 32 gulls, 12 Crows, 300 Starlings, 4 Turkey Vultures, 3 Red-tailed Hawk, 100 Canada Geese – 11 am
Comments: Both gull and crow numbers have dropped significantly at the Salford Landfill over the last 2 weeks. Crow and gull flights lines to the landfill are the same, however, gull flights from the landfill to the north were now noted. Both gulls and crows are assumed to be moving to breeding grounds and leaving the landfill.

April 4

Partly cloudy, 6^{0}C, Strong south wind.
Salford Landfill - 255 Gulls, 33 Crows, 200 Starling, 1 Turkey Vultures, 1 Red-tail Hawk, approximately 100 geese - 2:30 pm.
On Site Study Area – no gulls, 2 Crows
Comments: Little movement of birds to and from the landfill. No gulls in farm fields.

April 9

Sunny, -2^{0}C, No wind.
Salford Landfill - 533 Gulls, 5% Herring gulls, 15 Crows, 150 Starlings, 7am – 8:30 am.
Tillsonburg Airport - 4 Crows, 3 Gull flyovers (going to landfill) – 9:30 am
Woodstock Airport - 3 Crows, no Gulls or crows - 10 am
On Site Study Area - No Gulls, Former West Quarry waters open but only 3 pair of Canada Geese. 5 Crows in farm fields.
Stratford Landfill - 562 Ring-bill Gull, 15 Herring Gull, 300 Starlings, 36 Crows - 10:30am
London Landfill - 5,500 Gulls, 10% Herring gulls, 30 Crows, 600 Starlings, 2 Red-tailed Hawk - 12 noon
London Airport - 11 Crows, 3 Gulls - 1:30 pm
Comments: Gull Movements to Salford still only from the south, small flocks most 2-5 birds, some up to 10 birds, low altitude, less than 200 feet. Most birds loafing on site and pond, only 100 at tipping face.

At London Landfill – Aaroc Aggregates quarry pond to the north is a loafing site (2000 birds). Constant movement of gulls at tree top altitude back and forth from the pond to landfill (50 birds at any one time). Two small (100) loafing sites in the adjacent farm fields. About 500 birds at tipping face, rest loafing at the landfill at two major loafing sites, 1500 to north of the tipping area, and rest to the south east of the tipping face. Towering events, one over tipping face, and one over farm field, 500 ft + 100 to 200 birds. No towering events at Salford ever noted.

April 19

Overcast, 2^{0}C, Strong northwest wind.
Salford Landfill - 620 Gulls, 5% Herring gulls, 13 Crows, 300 Starlings 9:00 – 9:30 am.
On site Study Area - No Gulls, Former West Quarry waters open but only 2 pair of Canada Geese. 3 Crows in farm fields – 10am.
Woodstock Airport - 2 Crows, no Gulls
Tillsonburg Airport - 107 Gulls in farm field to the north adjacent to the runway (going to or from landfill), 1 Turkey Vulture, 3 Crows. 12:30 pm
Stratford Landfill - 120 Ring-billed Gull, 20 Herring Gull, 300 Starlings, 5 Crows, 1 Turkey Vulture. About 20 gulls in high tower over landfill -1 pm.
London Landfill - 3,500 Gulls, 1% Herring gulls, 20 Crows, 2000 Starlings, 6 Turkey Vultures, 2 Red-tailed Hawk - 2 pm
London Airport 6 Crows, 7 Gulls - 3 pm
Comments: More movement of gulls away from Salford to farm fields. Most birds loafing, only 100 at tipping face. No towering.
At the London Landfill only 20 gulls loafing at Aaroc Aggregates quarry pond to the north. Constant movements of gulls at tree top back and forth from farm field to the west of the landfill (50 birds at any one time). Over 400 gulls in farm field. About 500 birds at tipping face, rest at landfill at two major day loafing sites. Towering events, one over tipping face, and one over farm field, 500 ft + 100 to 200 birds.

May 3

Overcast, Light Rain, 15^{0}C, light northwest wind.
Salford Landfill - 75 gulls, 3 Crows, 25 Starling - 10:30 am.
Tillsonburg Airport – No gulls, 1 Crow - 11:30 am
On Site Study Area - No Gulls, 1 crow in farm fields – 12am.
Woodstock Airport - 2 Crows, no Gulls -12:30
Comment: No gulls seen in farm fields during surveys.

May 18

Sunny, 23^{0}C, no wind.
Salford Landfill - 68 gulls, all loafing, no towering events- 12:30 pm.
Tillsonburg Airport - No gulls at the airport or surrounding farm fields- 1:20 pm.
On Site Study Area- No gulls, 2 crows -2pm.
Woodstock Airport - 2 Crows, no Gulls -2:30 pm
London Airport 3:30 – no gulls
Comment: Gulls are clearly at the colonies

May 23

Sunny, 23^{0}C, light south wind.
London Landfill – 25 gulls on tipping face, 56 loafing, 3 Turkey Vultures, 5 Crows, 12 starlings. No gulls on quarry ponds. No gulls on farm fields - 12 noon.

June 21

Sunny, 27^0 C, no wind.
Salford Landfill - 23 gulls, all loafing, no towering events, 5 Crows, 1 Turkey Vulture, 1 Red-tailed Hawk - 10:30 am
Tillsonburg Airport - No gulls at airport or in farm fields, 1 crow – 11:30 am.
On Site Study Area - No gulls, 3 crows, 4 TVs – 12 noon
Woodstock Airport - 2 Crows, no Gulls -12:30 pm

July 17

Sunny, 30 ^{0}C, light west wind
Salford Landfill – 223 gulls, all loafing, no towering events - 1:30 pm.
Tillsonburg Airport - No gulls at airport or in farm fields -2 pm.
On Site Study Area - No gulls, 3 crows, 4 Turkey Vultures 2:30 pm.
Woodstock Airport - 2 Crows, no Gulls -2:45 pm
London Landfill – 315 gulls, all loafing, no towering events, 7 Turkey Vultures, 9 Crows, 100 Starling - 3:30 pm.
Comment**:** Gulls are starting to move away from the colonies and back to the landfills.

August 20

Overcast, 24 ^{0}C, light southwest wind
Salford Landfill – 3,543 gulls, all loafing, no towering events, but some movements to and from landfill, north, east and west. No gulls in farm field, 67 Turkey Vultures on ground or on fence posts, 17 Crows, 27 Starlings - 11:30 am
Tillsonburg Airport – No gulls at airport or in farm fields – 12:40pm.
On Site Study Area - No gulls, 2 Crows, 2 Turkey Vultures - 1pm
Woodstock Airport - no gulls, surrounded by corn fields - 1:30pm
London Landfill – 6,050 gulls (5% HG, 5% Juveniles), of which about 1000 where feeding, rest all loafing, some towering events (10 – 50 birds), 7 Crows, 100 starlings, 7 Turkey Vultures, 2 Red-tailed Hawk - 2:30
London Airport – 3 gulls, 1 crow – 3:30 pm
Comment: Gulls off their colonies generally spreading through environment.

September 25

Overcast, some drizzle, 22 ^{0}C, light to moderate west wind
Salford Landfill - 2,563, gulls, all loafing, 133 on roof top of the building, no towering events, but some movements to and from land fill to fields. 107 gulls in cut alfa farm field along Hwy 19, 1 km north of landfill. 3 Turkey Vultures on ground and fence posts, 3 Crows, 300 Starlings - 11:00am

Tillsonburg Airport – 5 Ring-billed Gull loafing on taxiway – post feeding on worm on runway? No gulls on farm fields – corn- soya all around airport. 4 Crows and a Kettle of 45 Turkey Vultures migrating – 11:30 am.
On Site Study Area - No gulls, 6 crows, 15 Turkey Vultures on migration – 12:30 pm
Woodstock Airport – No gulls, 1 crow – 1 pm.
Stratford Landfill 325 Ring-bill Gull, 10 Herring Gull, 150 Starlings, 16 Crows – 2pm.
London Landfill – 7,455 gulls (5% Herring gull, 5% Juveniles), of which about 500 where feeding, rest all loafing, some towering events (50 – 100 birds). No gulls at Aaroc Aggregates quarry ponds. 13 Turkey Vultures, 11 crows, 200 starlings 1 Red-tailed Hawk - 3:30 pm.

October 18

Partly Cloudy, 12^{0}C, light west wind.
London Landfill - 500 gulls on tipping face area, 200 towering over the landfill, 25 gulls on quarry lake. 10% Herring Gulls, 1% first year birds. 23 crows, 31 Turkey Vultures (flying around not on landfill), One mature Bald Eagle, 500 Starlings, 2 Red-tailed Hawk – 10 am
Comment: Staff noted several Eagles were hanging around the landfill which is keeping gull numbers significantly below normal numbers for this time of year. An Eagle dread was noted during the survey. Also, staff indicated that in some years in the fall if gull numbers significantly increase, the landfill engages a falconer to keep numbers down.

October 22

Overcast, 13 ^{0}C, light west wind.
London Gull Roost Survey – 4:00 – 7pm
London Landfill – Gulls moving south from landfill in small flocks (10-20) at low altitude (500 ft). Moving to roost on Lake Erie (south of St. Thomas). Also, small flocks of gulls leaving the landfill flying north. Flocks flying north were roosting on Fanshawe Lake. Gull numbers on lake were estimated to be 300-400 birds.

October 25

Overcast, 11 ^{0}C, no wind.
Salford landfill - 3500 gulls, 300 gulls in nearby field, 200 starling, 13 crows, 11 Turkey Vultures soaring around the landfill, 6 on Landfill. One Bald Eagle – 1:30 pm.
On Site Study Area - No gulls, 3 crows, 6 Turkey Vultures on migration – 2 pm
Woodstock Airport – No gulls, or crows – 2:30 pm.

October 29

Cloudy, 10^{0}C, light west wind.
Pittcock Lake Roost Survey 4:30 to 7 pm - 3000 gulls on lake, coming in from south, south west, and north, 15 Mallard, 55 Canada Geese.
Crow roost on north shore, 10,000 +, coming from all directions.

October 30

Cloudy 11 ^{0}C, light west wind
On Site Study Area Former West Quarry Roost Survey 4:30 to 7 pm - 4000 gulls on lake, coming in from south, and south west. About 5% herring gull, many juveniles. About 5% juvenile RBG. 10 Mallard
Comment: No Crow roost flights noted. Number of gulls at the Former West Quarry roost similar to the numbers recorded at the Salford Landfill on October 25th, following the hydro corridor from the landfill to the quarry.

November 17

Cloudy, 5^{o}C, light southwest wind
London Landfill - 350 gulls 60% Herring Gull, 10% juveniles, 400 starlings, 5 Crow, 1 Eagle, 2 Red-tailed Hawk - 11 am

November 21

Overcast, 1^{o}C, moderate west wind.
Salford Landfill – 2,500 Gulls, 50% Herring Gull, 15% Juveniles, 150 Crows, 500 Starling. No gulls in farm fields – 10 am.
On Site Study Area - No gulls, 6 crows, 15 Turkey Vultures on migration – 10:30am
Woodstock Airport – No gulls, 2 crow – 11 pm.
Stratford Landfill - 320 Herring Gull, 133 Ring-bill Gull, 250 Starlings, 12 Crows – 12 noon.

November 24

Overcast, 5 ^{0}C, moderate west wind
Wildwood Lake Roost Survey 3:00 to 5:30 pm
Flight line of small flocks of gulls coming from the west (from St. Mary's Landfill). Other flight line of gulls coming from the north east (from Stratford Landfill). Other small flocks arriving from various directions (from farm fields in area). Approximately 1000 gulls roosting on lake by night fall.

November 26

Overcast, 4 ^{0}C, light rain, light west wind
On Site Study Area Former West Quarry Roost Survey 3:30 to 5:20 pm
4000 gulls, coming in from south, and south west. A few small flights from north.
About 60% herring gull, About 5% juvenile for both species.
210 Canada Geese coming in from the north and west, 50 Mallard, 6 Common Merganser,
7 Common Golden Eye, I Grebe spp.
Comment: No crow roost flights noted. As before the number of gulls at the Former West Quarry roost similar to numbers recorded at Salford Landfill on November 21st, following hydro corridor from the landfill to the lake roost.

December 10

Overcast, 1 ^{0}C, light south west wind
Salford Landfill – 2,000 Gulls, 80% Herring Gull, 15% Juveniles, 120 Crows, 200 Starling. No gulls in farm fields – 3 pm.
On Site Study Area - No gulls in fields, but movement to Former West Quarry, 1 crow, – 3:30pm
Pittock Lake – 4 - 6 pm – 1500 gulls on lake
10,000 + crows, both in forest along north shore of the lake and on ice shelves of lake.
Comment: Small flocks of gulls already moving from landfill to Former West Quarry roost, so there would have been more gulls at landfill. Gulls clearly following the hydro corridor leaving landfill to quarry. Gulls and crows moving to Pittock Lake from all directions – moving in from local area farm fields.

January 17

Overcast, -2 ^{0}C, light south west wind
Salford Landfill – 300 Gulls, 70% Herring Gull, 600 Crows, 1000 Starling. 7:30 am
On Site Study Area - No gulls, 1 crow, 8am
London Landfill - 754 Gulls, 60 % Herring Gulls, 68 Crows, 2000 starlings, 2:30 pm

Woodstock Field Naturalists' Club - Jeff Skevington (jhskevington@gmail.com; 613-720-2862)

In November-December large gull roost on Pittock Lake 100,000 --- mostly move to feed in cleared ag fields during the day, not known to occur in large numbers at Salford. Tend to move to Lake Huron and Lake Eire during the Spring and Summer month. Peak time at Pittock lake is mid-November till freeze up in December (which varies in time from year to year, then off to lakes.
Crow roost in City Parks, and industrial area - move around from year to year, up to 100,000, but 50,000 mostly.
Gulls tend to transit along the Thames River corridor and will also roost at Wildwood Dam at Hwy 7 at St. Mary's.

Woodstock Field Naturalists; Club - James Holdsworth Call 226-228-1428

Crows roost currently in Pine Plantation north of Pittock Lake – 20-30 k, up to 90 k one year often 40 k
Gull roost on Pittock lake and Former West Quarry - 20-30 k.
Area B Christmas Bird co-ordinator