APPENDIX E

Stormwater Management Design Brief

WASTE CONNECTIONS OF CANADA

Ridge Landfill Expansion

Stormwater Management Design Brief

March 2020 - 19-1859

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1.0 Introduction

1.1 Background

The Ridge Landfill has been in operation since 1966 and was expanded in 1999. Waste Connections of Canada (Waste Connections) operates the landfill, which is located at 20262 Erieau Road near Blenheim, Ontario in the Municipality of Chatham-Kent (see site location map below).

LOCATION OF RIDGE LANDFILL

The site is currently approved to receive waste from the industrial, commercial and institutional (IC&I) sectors in Ontario, including residential waste from the Municipality of Chatham-Kent and the surrounding Counties of Essex, Lambton, Middlesex and Elgin.

The existing approved Landfill Site Area of 262 ha operates under an Environmental Compliance Approval (ECA)[1] from the MECP (formerly the Ministry of Environment and Climate Change) as a waste management facility. The area within which waste disposal is permitted, called the Waste Fill Area, is 131 ha or half of the approved Landfill Site Area. As of April 2019, it is estimated that the existing Waste Fill Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021[2] at the current fill rate.

[1] MECP, Waste Environmental Compliance Approval No. A021601.
[2] Golder Associates, Ridge Landfill Annual Monitoring Report, April 2019.

1.2 Purpose and Objectives

The purpose of this report is to provide details regarding the proposed surface water management system that will service the landfill expansion site, including:

1) A description of existing site conditions with respect to topography, land use, and drainage;
2) An outline of the applicable design criteria to satisfy regulatory requirements;
3) Details regarding the design of the proposed stormwater management (SWM) pond components and related works;
4) The results of the technical analyses undertaken (i.e., hydrologic modeling, etc.); and
5) Operations & maintenance procedures related to the management of surface water.

The proposed future surface water management plan has been developed in coordination with Golder Associates Ltd., who is responsible for the overall design of the proposed landfill expansion.

2.0 Existing Site Description

2.1 Regional Setting

2.1.1 Location

The Ridge Landfill site is located at 20262 Erieau Road near Blenheim, Ontario in the Municipality of Chatham-Kent, which is situated in southwestern Ontario (Figure 1).

The Ridge Landfill property covers an area of approximately 340 ha on part of Lots 13, 14, 15, and 16 within Concession 4 GWRC[3] in the Township of Harwich. The property is bounded by Erieau Road to the east, Allison Line to the south, Charing Cross Road to the west, and agricultural lands to the north. The existing Landfill Site Area, which is permitted by the ECA from the MECP for waste management purposes, is 262 ha.

2.1.2 Climate

The regional climate in the vicinity of the Ridge Landfill is generally characterized by the climatic region of Kent and Essex (Brown et al., 1980). A summary of the long-term (1981-2010) climate normals for Chatham WPCP climate station 6131415 (Environment and Climate Change Canada) is provided in Table 1.

[3] GWRC, in legal descriptions it refers to the Great Western Railway Company former land parcels.

WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

FIGURE 1
REGIONAL SETTING

- Property Boundary
- Highway / Major Road
- Waterbody
- Watercourse

1:175,000

0 1,700 3,400 6,800 m

N W E S

MAP DRAWING INFORMATION:
DATA OBTAINED FROM MNRF

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

DILLON CONSULTING

PROJECT: 191859

DATE: 2020-01-03

FILENAME: G:\GIS\2019\191859 Ridge Landfill ECA & Design\Maps\Figure 1 Regional Setting.mxd

Table 1. Summary of Climate Normals (Chatham WPCP)

Parameter	Value
Precipitation	
Mean Annual Rainfall (mm)	803.1
Mean Annual Snowfall (cm)	79.2
Mean Annual Precipitation (mm)	882.3
Temperature	
Daily minimum temperature – January (°C)	-6.9
Daily maximum temperature – July (°C)	27.7
Mean monthly minimum temperature – January (°C)	-3.6
Mean monthly maximum temperature – July (°C)	22.6
Extreme low temperature (°C)	-27.0
Extreme high temperature (°C)	38.5

Source: Environment and Climate Change Canada (ECCC, 2019)

As indicated in the table above, the average temperatures range from moderately cold winters to hot summers. Precipitation is relatively consistent throughout the year, which is generally dominated by rainfall, with snow typically falling between November and April.

2.1.3 Drainage

The Ridge Landfill is located in the southeastern portion of the Jeanette's Creek subwatershed, which encompasses a total catchment area of approximately 380 km^2. The subwatershed is generally oriented in a southeast to northwest direction, which outlets to the Thames River approximately 3 km upstream of Lake St. Clair.

Surface water from the Ridge Landfill is received by three municipal drains (Howard, Duke, and Scott), which are tributaries of the Flook and Hinton Drain (refer to Figure 2). Flows are conveyed from the Flook and Hinton Drain in a northwesterly direction to the Raleigh Plains Drain, which outlets to Jeanette Creek downstream of its crossing of Highway 401.

2.2 Howard Drain Subwatershed

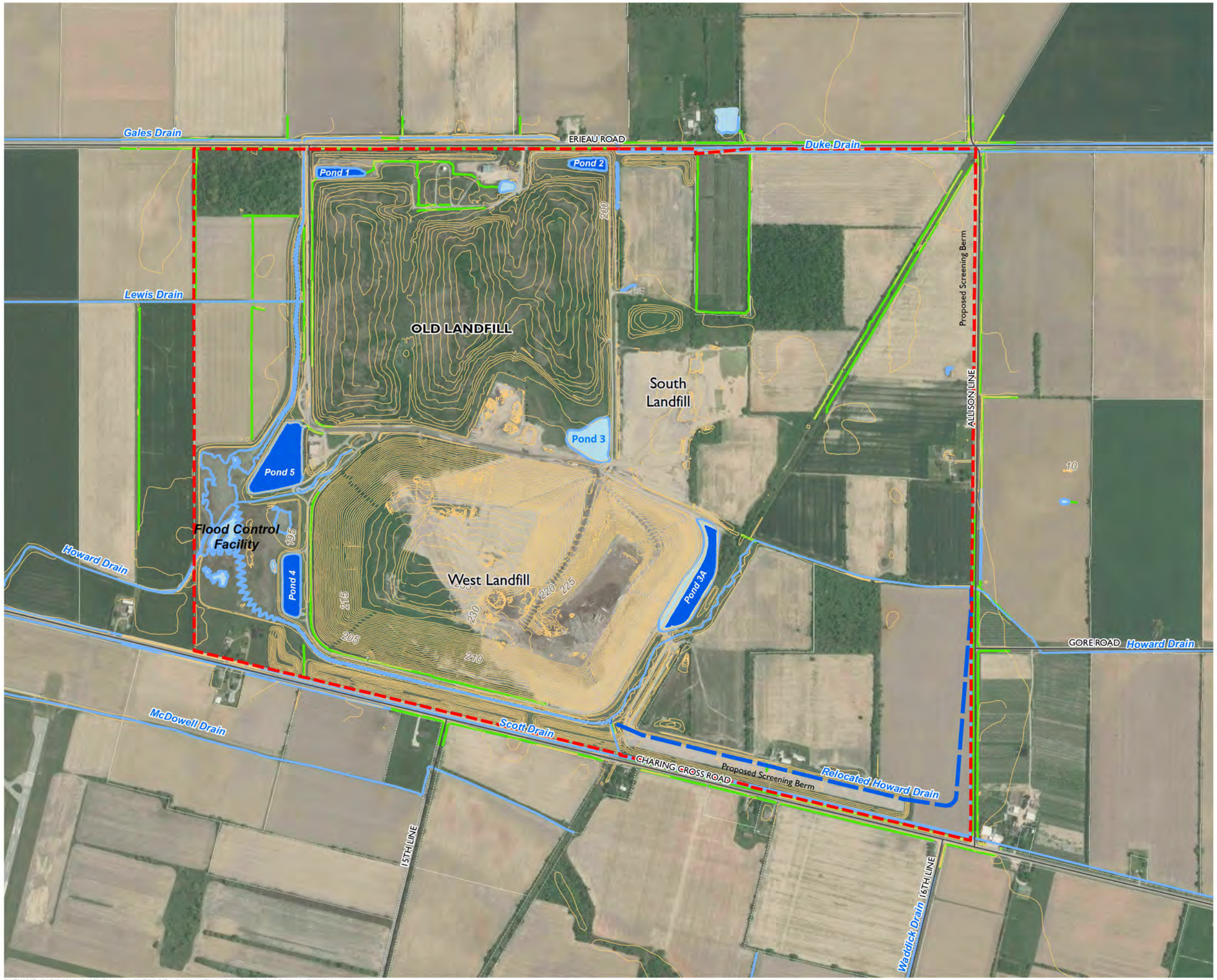
2.2.1 General

The Howard Drain subwatershed covers a catchment area of approximately 10.8 km^2, which is oriented in a southeast to northwest direction (Figure 3). The subwatershed has an average width of approximately 2.5 km and length of 5 km. The Howard Drain outlets to the Flook and Hinton Drain at Fourteenth Line. The Howard Drain has multiple tributary drains, including the Duke Drain, Scott Drain, and McDowell Drain.

WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

FIGURE 2
EXISTING SURFACE DRAINGE CONDITIONS



- Property Boundary
- Roads
- Contours
- Watercourse / Constructed Drain
- Ditch
- Waterbody
- Stormwater Mangagement Pond
- Parcel

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0 100 200 400 m

MAP DRAWING INFORMATION:
DATA OBTAINED FROM MNRF

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FILENAME: G:\GIS\2019\191859 Ridge Landfill ECA & Design\Maps\Figure 5 Existing Surface Drainage Conditions.mxd

WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

FIGURE 3
HOWARD DRAIN SUBWATERSHED

- Watercourse / Constructed Drain
- Contours (5m)
- Road
- Property Boundary
- Subwatershed / Subcatchment Boundary
- Waterbody
- Existing Stormwater Management Pond

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0 200 400 800 m

N W E S

MAP DRAWING INFORMATION:
DATA OBTAINED FROM MNRF

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DATE: 2020-01-07

FILENAME: G:\GIS\2019\191859 Ridge Landfill ECA & Design\Maps\Figure 2 Howard Drain Subwatershed.mxd

2.2.2 Physiography

2.2.2.1 Topography

The topography of the Howard Drain subwatershed can be characterized as low-gradient. The subwatershed has an average slope of approximately 0.3% from its highest elevation of approximately 210 m near Talbot Trail (Highway 3) to 195 m at its outlet to the Flook and Hinton Drain at Fourteenth Line.

2.2.2.2 Surficial Soils

The Howard Drain subwatershed is located within the St. Clair Plain physiographic region (Chapman and Putnam, 1984), which is characterized by an extensive clay plain underlain by limestone in portions of Kent County. The plain was formed by the succession of glacial lakes that once inundated the region, leaving a deep cover of overburden of 30 to 60 m in thickness.

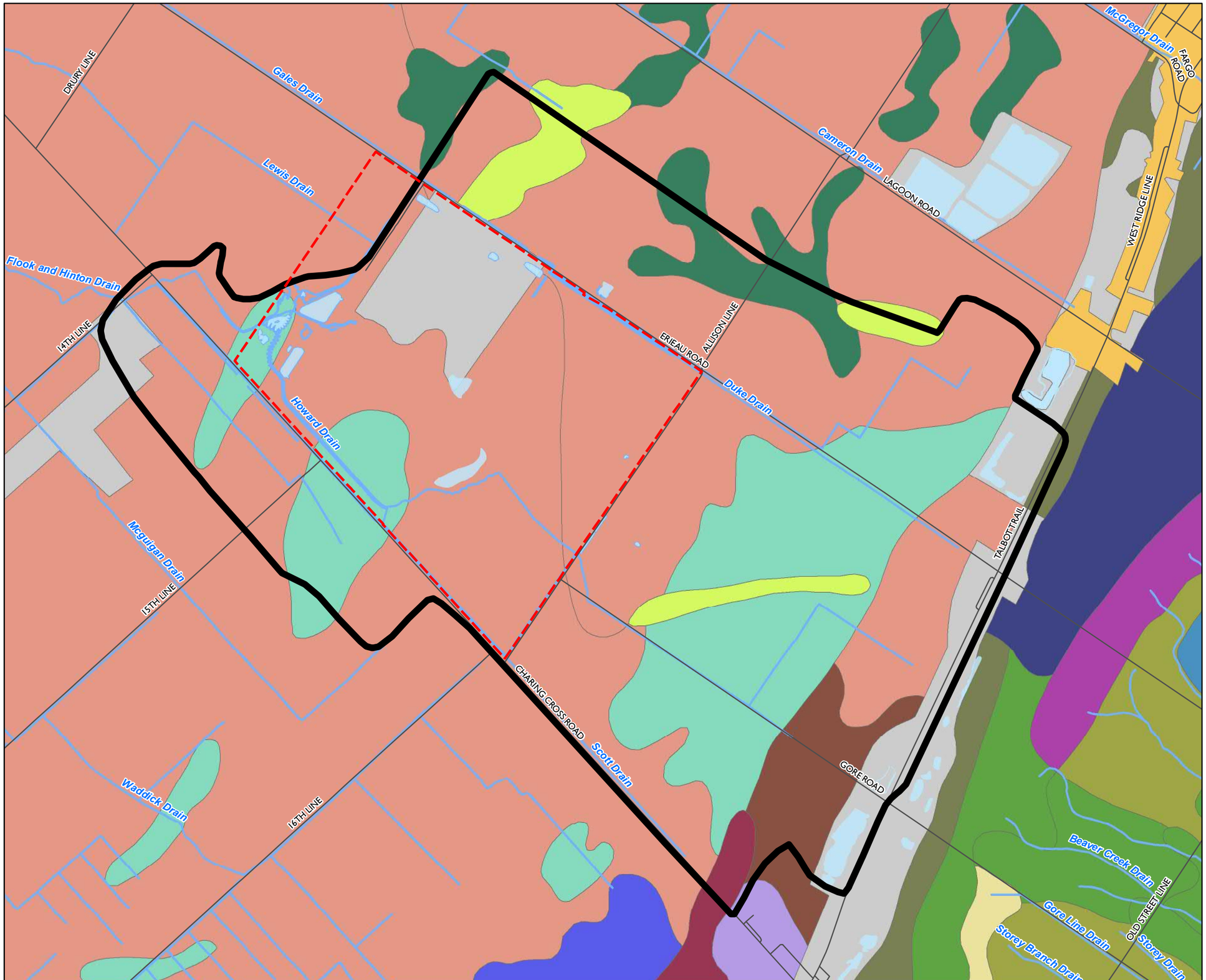
As shown on Figure 4, surficial soils within the subwatershed are predominately comprised of Brookston Clay, which covers approximately 80% of the area. The Brookston soil series consists of fine textured silty clay loam glacial till that exhibits poor internal drainage. The soils for the remaining portion of the subwatershed include the Perth and Kintyre series, which consist of coarse textured material overlying gravelly coarse textured beach material. This type of soil exhibits good internal drainage characteristics and can be associated with gravel deposits found along the south boundary of the subwatershed.

2.2.3 Land Use

The current land uses within the Howard Drain subwatershed were identified through a review of available mapping and recent aerial photography, together with field reconnaissance conducted in the study area.

Land use within the subwatershed is generally dominated by agricultural lands, with some fragmented woodlots (refer to Figure 5). There are several rural residences, farm buildings and active farming operations as well as aggregate pits and quarries located near Highway 3.

The subwatershed is serviced by several transportation corridors, which include Highway 3, County Road 10, Erieau Road, Gore Road, Allison Line and the abandoned Chesapeake and Ohio (C&O) Railway Line. The Chatham Municipal Airport is located in the northwest corner of the subwatershed.



WASTE CONNECTIONS of CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

FIGURE 4
SURFICIAL SOILS

- Property Boundary
- Road
- Watercourse / Constructed Drain
- Waterbody
- Subwatershed Boundary

Soils (Canadian Soil Information Service)

- BERRIEN - TILL PHASE
- BEVERLY
- BEVERLY - LOAMY PHASE
- BROOKSTON
- BROOKSTON - LOAMY PHASE
- GOBLES - LOAMY PHASE
- GOBLES - WASHED PHASE
- HIGHGATE
- KELVIN
- KINTYRE
- KINTYRE - TILL PHASE
- PERTH - LOAMY PHASE
- PERTH - WASHED PHASE
- TOLEDO
- TUSCOLA
- WATER
- BUILT UP AREA
- NOT MAPPED

1:20,000

0 200 400 800 m

N W E S

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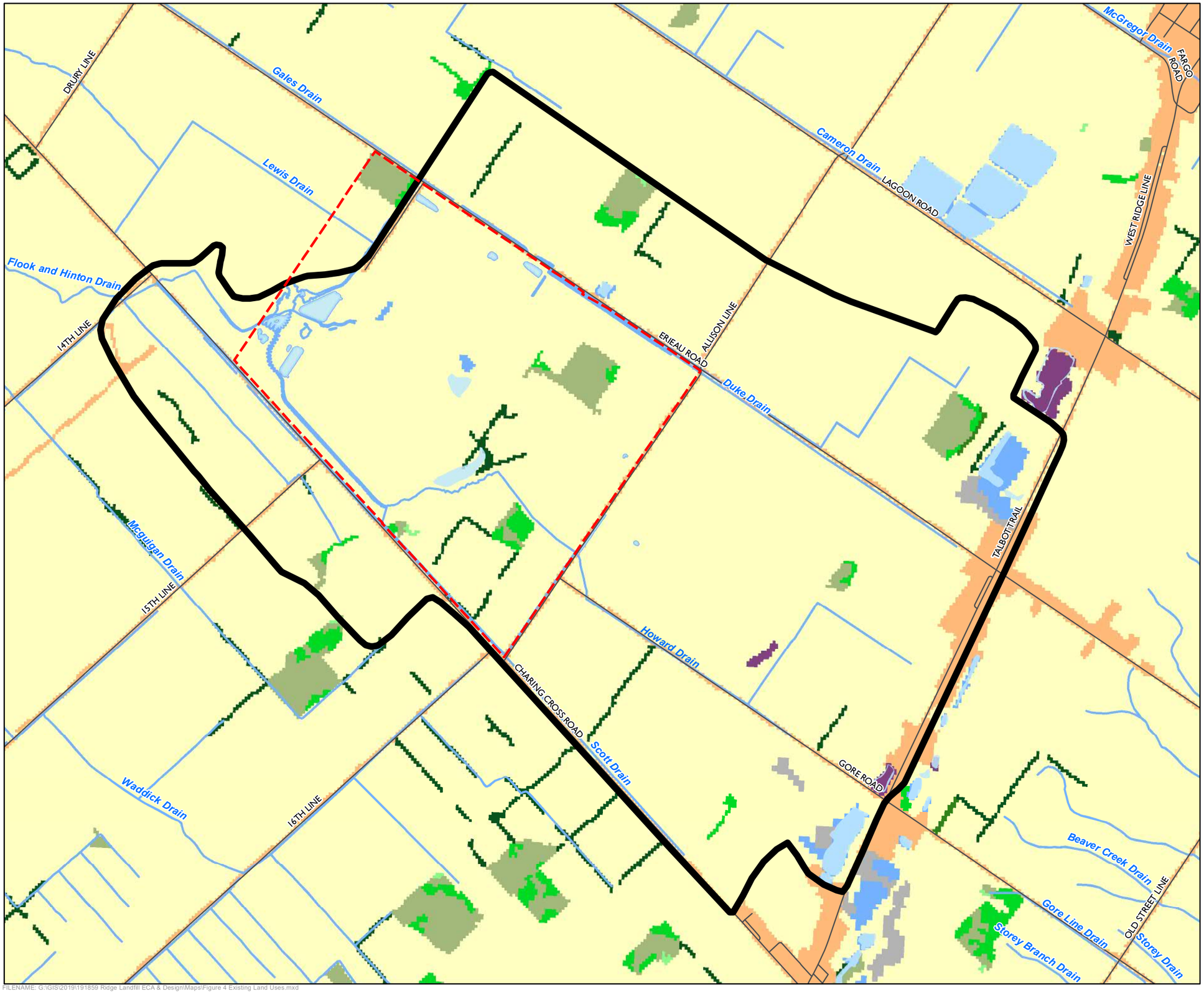
FILENAME: G:\GIS\2019\191859 Ridge Landfill ECA & Design\Maps\Figure 3 Surficial Soils.mxd



FILENAME: G:\GIS\2019\191859 Ridge Landfill ECA & Design\Maps\Figure 4 Existing Land Uses.mxd

WASTE CONNECTIONS OF CANADA

RIDGE LANDFILL
ENVIRONMENTAL ASSESSMENT

FIGURE 5
EXISTING LAND USES

- Property Boundary
- Road
- Watercourse / Constructed Drain
- Waterbody
- Subwatershed Boundary

Ontario Land Cover Compilation (Version 2)

- Clear Open Water
- Marsh
- Swamp
- Treed Upland
- Deciduous Treed
- Plantations - Treed Cultivated
- Hedge Rows
- Sand/Gravel/Mine Tailings/Extraction
- Community/Infrastructure
- Agriculture and Undifferentiated Rural Land Use

1:20,000

0 200 400 800 m

N W E S

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DATE: 2020-01-03

2.2.4 Surface Drainage Characteristics

The surface water regime within the Howard Drain subwatershed is generally characterized by runoff traveling in the form of sheet flow towards one of four separate municipal drains. These municipal drains are the Howard Drain, Duke Drain, Scott Drain and McDowell Drain (refer to Figure 6).

The Howard, Duke, and Scott Drains are open drainage channels that were constructed under the provisions of the Drainage Act. Various repairs and improvements have been completed along all three (3) drains within the landfill property. The McDowell Drain is located outside the landfill property.

A summary of the characteristics for each of the municipal drains in the Howard Drain subwatershed is provided in Table 2.

Table 2. **Municipal Drain Characteristics**

Municipal Drain	Catchment Area (ha)	Channel Length (m)	Gradient (m/m)	Receiving Watercourse
Howard	450	5140	0.0015	Flook and Hinton Drain
Duke	470	4300	0.0013	Howard Drain
McDowell	120	2300	0.0017	Howard Drain
Scott	153	2650	0.0016	Howard Drain

2.2.5 Stormwater Management

2.2.5.1 Stormwater Management Ponds

There are five (5) existing stormwater management ponds that service the existing Ridge Landfill. The existing pond locations are shown on Figure 2. The ponds consist of extended detention 'wet' ponds that are intended to provide water quality enhancement and water quantity control (i.e., flow attenuation/flood control).

The existing stormwater management ponds are equipped with outlet control structures that discharge directly or indirectly (i.e., via onsite ditches) to either the Howard or Duke Drain. The ponds are currently operated in 'batch' mode (i.e., sampled and analyzed to confirm acceptable water quality prior to discharge).

A summary of design information for the existing stormwater management ponds is provided in Table 3.

Table 3. **Summary of Existing Stormwater Management Ponds**[1]

SWM Pond	Catchment Area (ha)	Sub-Areas	Receiving Drain	Design Volume (m^3)		
				Permanent Pool[2]	Extended Detention[3]	Flood Control[4]
1	12.1	BFI-4	Duke	3,600	500	4,400
2	8.4	BFI-1	Duke	3,100	300	2,100
3	50.5	LF-1/LF-2/LF-2/F-1	Howard	2,600	2,400	16,300
4	24.4	LF-4	Howard	1,200	1,200	8,800
5	68.7	BFI-2/BFI-3/ LF-5	Howard	3,450	3,200	21,300

Notes:
1. Source: BFI Ridge Landfill Expansion EA Impact Assessment – Surface Water (December 1996).
2. Based on Normal 'Level 2' level of protection (MOE Stormwater Management Planning and Design Manual, 2003).
3. Extended detention sizing requirements based on 25mm – 4hr storm.
4. Flood control storage requirement for Regional Storm (1:250 year return period).

2.2.5.2 Flood Control Facility

The existing flood control facility is an online storage feature that was constructed to facilitate the previous expansion of the Ridge Landfill (i.e., West Landfill). It is located near the northwest corner of the Ridge Landfill property at the confluence of the Howard and Duke Drains. The flood control facility outlets to the Howard Drain.

The design objective of the flood control facility is to provide additional peak flow attenuation (in conjunction with the stormwater management ponds) along the receiving watercourse at or below existing levels for all design storm events up to, and including, the 100 year storm and the Regional Storm (250 year).

The flood control facility was designed to cover a total footprint of approximately 9 ha with an invert elevation of 194.6 m and a maximum water elevation of 197.0 m.

3.0 Surface Water Management Plan

The purpose of this section is to provide the following information:

- A description of the drainage concept and considerations for the landfill site expansion area;
- The goals and objectives of the proposed surface water management plan, including an outline of the stormwater management design criteria that have been adopted together with the proposed strategy to account for the potential effects of climate change; and
- Details regarding the surface water management plan components.

3.1 Landfill Site Expansion Area

As previously noted, the proposed landfill site expansion will occur within a total property area of approximately 340 ha. Within the proposed landfill expansion area there will be a horizontal expansion of the West and South Landfill areas, together with a vertical expansion of the Old Landfill.

The proposed site expansion will change the land use within the expansion area from predominately agricultural with some woodlot area to waste management area. From a surface water perspective, hydrologic characteristics and flow patterns will be altered through changes in topography, land cover, and drainage.

Under future conditions, surface runoff will generally travel by sheet flow off the landfill areas, which will be conveyed by open ditches to one of multiple stormwater management facilities prior to discharging to the receiving drainage system (Howard Drain and its tributaries). Four of the existing stormwater management ponds (1, 2, 4, and 5) will remain in operation and will be expanded/ retrofitted to provide a greater level of water quality and quantity control. The old Pond 3 has already been decommissioned as part of existing site development and Pond 3A will be decommissioned for the proposed landfill expansion. Three (3) new stormwater management ponds (6, 7, and 8) will be constructed to service the site expansion area.

The proposed landfill expansion will include the following site features:

- Stormwater management ponds (new and retrofitted existing facilities), which will be located at multiple locations on the site – additional information regarding the location, sizing, and performance of the stormwater management ponds is provided in ***Section*** 3.3.2.1;
- Perimeter berms will be constructed at the site boundary prior to landfilling activities to provide noise and visual screening. The berms will be constructed along Erieau Road and Allison Line to a top elevation of approximately 206 m;
- The leachate management area will continue to be located near the site entrance;

- The landfill gas management area will continue to be located south of the Old Landfill and east of the South Landfill; and
- Soil stockpile areas will be located with the southeast corner of the site.

Similar to the surface water management plan employed currently at the Ridge Landfill, the surface water drainage system will be segregated from the leachate collection system. Leachate will be collected for off-site treatment, and measures will be taken to ensure that leachate is not discharged into the surface water drainage system.

3.2 Goals and Objectives

The overall goal of the proposed surface water management plan is to protect and preserve the offsite upstream and downstream drainage system. This will be achieved through the adoption of an integrated strategy that combines site design features, best operational management practices, and proven stormwater management methods.

3.2.1 Design Criteria

The design requirements for the proposed SWM system were established based on the understanding that the ponds will be operated in batch mode during landfill operations, and will be converted to a passive/continuous discharge configuration following the closure of the landfill.

Under the batch mode scenario, the SWM ponds have been sized to fully contain the runoff volume generated by a 100 year, 24 hour storm. Each pond will include a permanent pool in addition to an active event storage volume, which would be contained and discharged after the water quality is confirmed to be acceptable in accordance with the ECA requirements.

The new and retrofitted SWM ponds will operate as extended detention 'wet' ponds following landfill closure. A summary of the design criteria that have been adopted for the proposed SWM facilities is provided in Table 4.

Table 4. SWM Design Criteria

Design Objective	SWM Criteria
Quality Control	Enhanced level of water quality protection (80% suspended solids removal efficiency)
Erosion Control	Greater of 40 m^3/ha or runoff volume for 25 mm – 4 hour rainfall event
Quantity Control	Maintain post-development peak flows at or below pre-development levels up to the Regional storm event (250 year return period)

Source: Stormwater Management Planning and Design Manual (MOE, 2003).

To determine the preliminary sizing requirements for the proposed SWM system, a hydrologic model was developed to represent pre (existing) and post-landfill expansion conditions using the HEC-HMS software program. The model was simulated for the 2, 5, 10, 25, 50, 100 and 250 year (24 hour duration) storm events with an SCS Type II distribution.

3.2.2 Climate Change

To account for impacts associated with climate change, the proposed SWM system will be sized to accommodate the future mean rainfall conditions projected for the year 2050 (RCP 8.5) at the Ridgetown RCS climate station. Site specific future climate change rainfall projections were determined by Risk Sciences International, which are summarized in Table 5. Further information is provided in the Ridge Landfill Future Design Storm Values – Brief Description of Extreme Rainfall Projection Methodology (Risk Sciences International, 2019) (Appendix A).

Table 5. **Future Climate Change Rainfall Depth Projections for RCP 8.5 (mm)**

Timeframe	Adjusted 100 year, 24 hour Storm			Adjusted 250 year, 24 hour Storm		
	25th Percentile	Mean	75th Percentile	25th Percentile	Mean	75th Percentile
CHATHAM WPCP CLIMATE STATION						
Current	N/A	100.3	N/A	N/A	110.8	N/A
2050	113.3	115.8	119.4	125.2	128.0	131.9
2080	121.9	126.4	130.9	134.7	139.6	144.6
2100*	N/A	138.4	N/A	N/A	N/A	N/A
RIDGETOWN RCS CLIMATE STATION						
Current	N/A	121.9	N/A	N/A	136.5	N/A
2050	137.7	140.8	145.1	154.2	157.6	162.4
2080	148.1	153.6	159.1	165.8	171.9	178.1
2100*	N/A	163.3	N/A	N/A	N/A	N/A

* Future rainfall projections for the year 2100 obtained from IDF_CC Tool Version 3.0.

The site-specific future climate change projections indicate that the 2050 Ridgetown RCS climate station rainfall depths are higher than the 2080 projections at the Chatham WPCP climate station, and approximately equivalent to the 2100 (RCP 8.5) projections for Ridgetown RCS using the IDF_CC tool 3.0 developed at the University of Western Ontario.

The 2050 future rainfall projections for the Ridgetown RCS climate station (highlighted in the table above) provides a conservative basis for the Ridge Landfill expansion and were adopted for the design of the proposed SWM system.