Baseline Inventory Report (Draft)

Beach Boulevard Community Flood Remediation
Municipal Class Environmental Assessment Study (Master Plan)
Hamilton, Ontario
Project # WW20101053

Prepared for:

City of Hamilton

71 Main Street West
Hamilton, ON L8P 4Y5

April 27, 2022

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Prepared for:

City of Hamilton
71 Main Street West, Hamilton, ON L8P 4Y5

Prepared by:

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited
3450 Harvester Road, Suite 100
Burlington, ON L7N 3W5
Canada
T: 905-335-2353

April 27, 2022

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Report Revision History		
Version	**Date**	**Description**
1	November 23, 2021	Initial Draft for City Review
2	February 24, 2022	Revised as per City Comments
3	April 27, 2022	Updated to include information from Stage 1 Archaeological Assessment Report, Cultural Heritage Report and Natural Heritage Report

April 27, 2022

Wood Reference No. WW20101053

Hanna Daniels
Project Manager, Watershed Management
Public Works
City of Hamilton
Hanna.Daniels@hamilton.ca

Dear Ms. Daniels,

We are pleased to submit the draft Baseline Inventory Report in support of the Beach Boulevard Community Flood Remediation Municipal Class Environmental Assessment Master Plan Study. This report was prepared to document the relevant planning policies and objectives, and existing conditions related to Socio-Economic, Cultural, Natural, Physical and Technical Environments within the Study Area for Beach Boulevard Flood Remediation Class EA Study.

The findings of this report will be used to inform the identification and evaluation of alternative solutions process to identify recommended solution for addressing flooding issues in the Beach Boulevard Community of City of Hamilton.

If you should have any questions regarding this submittal or require further information, please contact the undersigned.

Sincerely,

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited

Prepared by:

DRAFT

Mir Ahsan Talpur, M.Env.Sc., EP
Environmental Planner

Reviewed by:

DRAFT

Matthew Senior, M.A.Sc., P.Eng.
Associate – Water Resources Engineer

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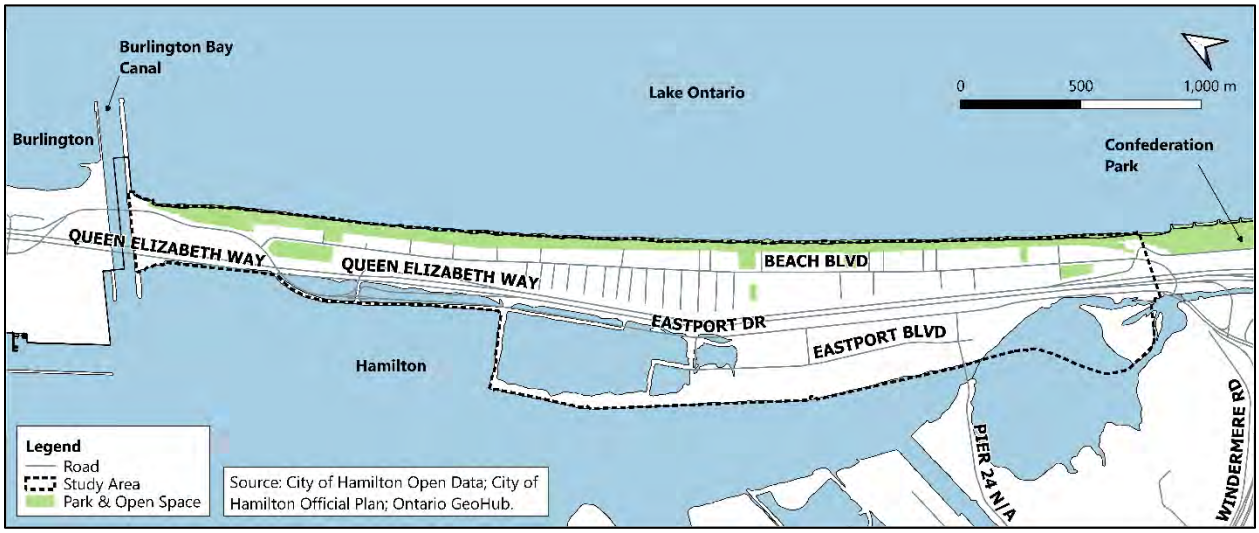
1.0 Introduction

The City of Hamilton (the City) is undertaking a Municipal Class Environmental Assessment Study (Class EA / the Study) to make recommendations to address flooding issues in its Beach Boulevard Community (Study Area). The general Study Area limits are shown on **Figure 1-1**.

Figure 1-1: Study Area



This Study is being carried out in accordance with Master Plan process as outlined in the Municipal Engineers Association's Municipal Class Environmental Assessment document (2000, as amended in 2007, 2011 and 2015). This study is anticipated to fulfill the requirements of Approach #2 of the Master Plan process, provided that sufficient information is available. Details about Master Plan approaches are provided in the following section.

2.0 Environmental Assessment Process

2.1 Municipal Class Environmental Assessment

The Ontario Environmental Assessment Act (R.S.O. 1990, c. E.18; EA Act) (Government of Ontario, 1990)) was put into place to provide for the protection, conservation and wise management of the environment within the province. The EA Act applies to all projects being undertaken by provincial, municipal or other public bodies within the province (unless explicitly exempted). It defines the environmental assessment works that must be completed prior to commencement of any undertaking, as well as the proponent's obligations to consult with all affected and/or interested parties. Under the EA Act, projects are classified as approved, subject to screening, subject to an approved Class EA process, or subject to a full Individual Environmental Assessment.

The Municipal Class EA process is an approved process under the EA Act. All municipalities in Ontario are required to follow this approved process for the infrastructure planning projects. It allows for planning of projects on an individual basis (for example, a new pumping station). The Class EA process classifies projects according to their level of complexity and potential environmental impacts. These are termed "Schedules" and are summarized below. A flow chart showing the Municipal Class EA process is provided in **Figure 2-1**.

Schedules A and A+ includes projects that involve minor modifications to existing facilities. Environmental effects of these projects are generally small. These projects are exempted from the requirements of the Environmental Assessment Act (Government of Ontario, 1990).

Schedule B includes projects that involve improvements and minor expansion to existing facilities. There is a potential for some adverse environmental impacts and, therefore, the proponent is required to proceed through a screening process, including consultation with those affected. Schedule B projects are required to proceed through Phases 1, 2 and 5 of the Class EA process.

Schedule C includes projects that involve construction of new facilities and major expansion of existing facilities. These projects proceed through the environmental assessment planning process outlined in the Class EA document. These projects are required to fulfil the requirements of all five phases of the Class EA process.

A description of the Class EA planning phases is provided below:

Phase 1: Identify the problem (deficiency) or opportunity.

Phase 2: Identify and evaluate alternative solutions to address the problem or opportunity by taking into consideration the existing environment and establish the preferred solution considering public and review agency input.

Phase 3: Identify Alternative Design Concepts for the preferred solution implementation by taking into consideration the existing environment and establish the preferred design concept by considering public and review agency input.

Phase 4: Document the Environmental Assessment including the design and consultation process in an ESR for public review.

Phase 5: Complete contract drawings and documents and proceed to construction and operation. Monitor construction for adherence to environmental provisions and commitments. Where special conditions dictate, also monitor the operation of the completed facility.

The Municipal Class EA process also allows for planning of a group of related projects, or an overall system, e.g., water, wastewater and/or roads network. This process is called Master Planning Process.

Master Plans are long range plans which integrate infrastructure requirements for existing and future land use with environmental assessment planning principles. Master Plans typically recommend a set of works which are distributed geographically and which are to be implemented over an extended period of time.

Master Plans provide the context for the implementation of the specific projects which make up the plan and satisfy, as a minimum, Phases 1 and 2 of the Class EA process. Notwithstanding that these works may be implemented as separate projects, collectively these works are part of a larger management system. Master Plan studies in essence conclude with a set of preferred alternatives and, therefore, by their nature, Master Plans will limit the scope of alternatives which can be considered at the implementation stage.

There are four approaches to completing master plans. These approaches are discussed on the following page:

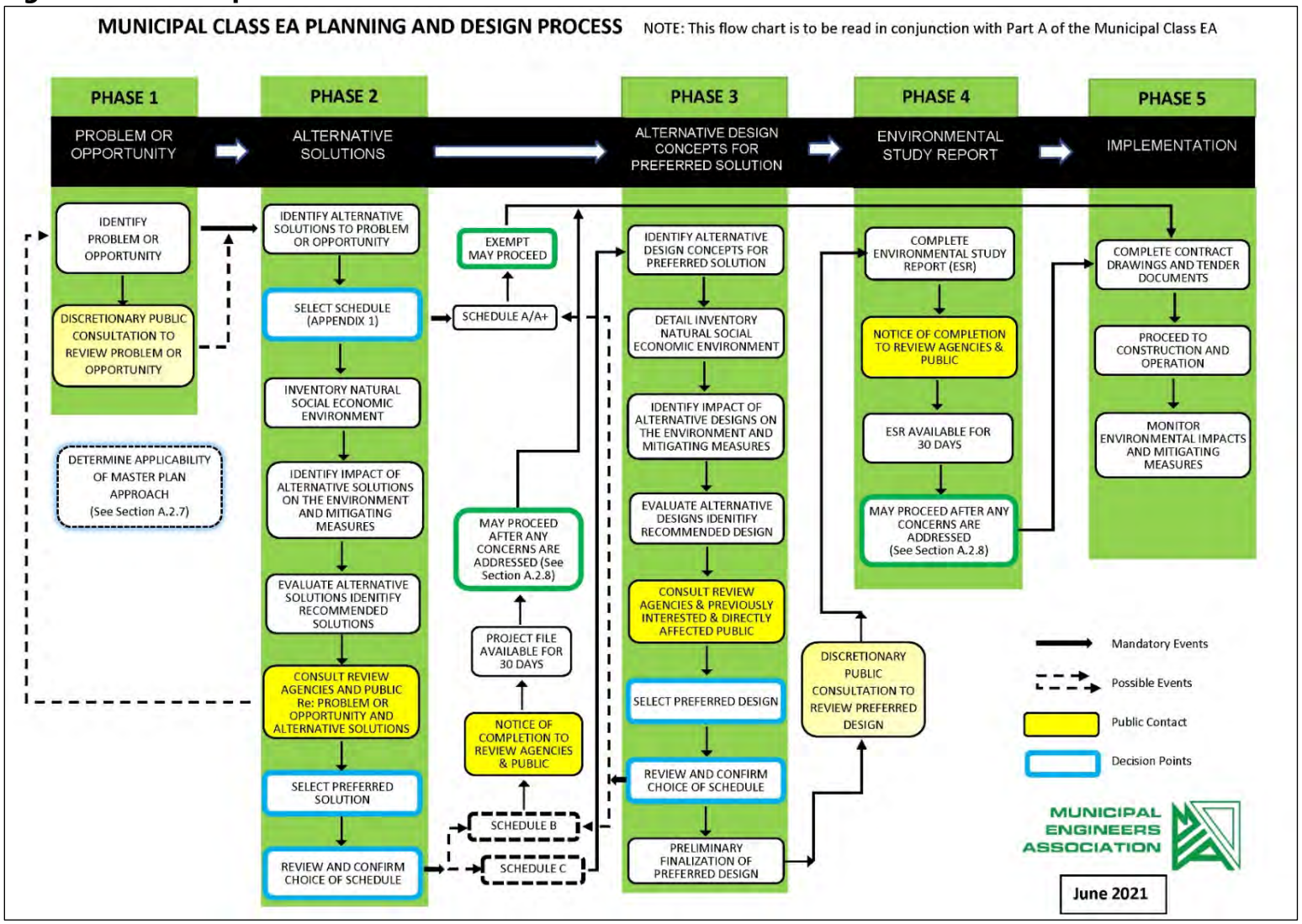
Approach #1: This approach requires completion of Phases 1 and 2 of the Municipal Class EA process and preparation of a Master Plan Report. The Master Plan would be completed at a high level of assessment, such that more detailed investigations will be required at the project-specific level in order to fulfil the Class EA requirements for the specific Schedule B and C projects identified within the Master Plan. Therefore, Schedule B projects identified within the Master Plan would require separate Project File Report(s) for public review while Schedule C projects would have to fulfil requirements of Phases 3 and 4.

Approach #2: In this approach, the level of investigation, consultation and documentation are completed at sufficient level of detail such that the Class EA requirements for Schedule B projects are addressed. Accordingly, the final public Notice of Master Plan Study Completion could become the Notice of Completion for the Schedule B projects identified within it. It is important to note that any Schedule C projects identified within the Master Plan, would require completion of Phases 3 and 4.

Approach #3: This approach involves the preparation of a Master Plan document at the conclusion of Phase 4 of the Municipal Class EA process. In this approach one document is prepared to document Phases 1 to 4 of the Class EA process for Schedule B and/or Schedule C projects. Therefore, the final public notice for the Master Plan could become the Notice of Completion for the Schedule B and C projects within it.

Approach #4: This approach allows to integrate planning process of infrastructure projects with approval process under the Planning Act. For example, the preparation of a new official plan could be accompanied by master plans for water, wastewater and transportation. This approach would satisfy early phases of the Class EA including Phases 1 and 2 for Schedule B projects and may satisfy, in addition, Phases 3 and 4 for Schedule C projects. This approach is best suited when planning for a significant geographical area in the long term where interdependent decisions which impact servicing and land use are being made and the range of servicing alternatives needs to be addressed in an integrated fashion in order to recommend the best overall solution for the community.

Figure 2-1: Municipal Class Environmental Assessment Process



2.2 Class EA Study Team

Wood Environment and Infrastructure Solutions (Wood) has been retained by the City of Hamilton to carry out the Class EA Study. Key staff for the Class EA Study includes the following:

Proponent: City of Hamilton

- Hanna Daniels, Project Manager, Watershed Management, Public Works

Prime Consultant: Wood Environment & Infrastructure Solutions

- Matthew Senior, Project Manager
- Ron Scheckenberger, Project Advisor
- Mir Ahsan Talpur, Environmental Planner
- Allison Zhang, Water Resources Engineer
- Aniqa Shams, Indigenous Consultation Coordinator
- Peter Nimmrichter, Climate Change Specialist

Other Consultant: IBI Group

Managing sub-consultants responsible for archaeological, cultural heritage and ecological/natural environment investigations. IBI Group's subconsultants include ASI and LGL Limited.

3.0 Planning Policy Framework

3.1 International Joint Commission Policies and Plans

3.1.1 Lake Ontario - St. Lawrence River Plan 2014

Water levels on Lake Ontario and the St. Lawrence River are primarily determined by rain, snow, wind and other natural factors. The Moses-Saunders Dam, approved by the International Joint Commission in the 1950s, also provides some control over water levels and flows. Regulating levels and flows has provided benefits to various uses and interests by allowing for hydropower production; improving conditions for commercial navigation, recreational boating and water intakes; and reducing the flooding and erosion of shoreline communities. In 2017, the International Joint Commission approved the Lake Ontario - St. Lawrence River Plan 2014. This plan replaced Plan 1958-D. Plan 2014 allows more natural water levels while minimizing impacts to other interests. For example, Plan 1958-D allowed the level of Lake Ontario to fluctuate 1.23 m (74.00 mASL to 75.23 mASL). Plan 2014 allows the level of Lake Ontario to fluctuate 1.57m (73.56 mASL to 75.73 mASL) resulting in potentially higher high lake levels than in the past (International Joint Commission, 2014). All water surface elevations in Plan 2014 are referenced to the International Great Lakes Datum, 1985 (IGLD 1985).

Relevance to this Study

This Study will review the summary of Lake Ontario water levels provided in previous reporting (Beach Boulevard Community Stormwater Ponding Study, April 2019, Dillon Consulting) and other current sources of Lake Ontario water level data (Water Survey Canada, the International Joint Commission and others). A review of applied vertical datums will be undertaken. The majority of the available information for Lake Ontario is in accordance with the IGLD 1985 datum; this differs from the typically applied CGVD28:78 (i.e., 1978 update) which is commonly used by municipalities in Southern Ontario, including the City of Hamilton.

3.2 Provincial Policies and Plans

3.2.1 Conservation Authorities Act (1990)

The purpose of the *Conservation Authorities Act* is to provide for the organization and delivery of programs and services that further the conservation, restoration,

development and management of natural resources in watersheds in Ontario (Conservation Authorities Act, c. 23, Sched. 4, s. 1). In order to achieve this, the conservation authorities were established under the Act.

Section 28 of the *Conservation Authorities Act* gives authority to conservation authorities to regulate development and activities through the permitting process in hazard-prone areas set out in regulation for purposes of public safety and natural hazard management. Each conservation authority administers an individual regulation that conforms to the requirements prescribed under *Ontario Regulation 97/04 – Content of Conservation Authority Regulations Under Section 28 (1) of the Act: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*. Section 4 of the Ontario Regulation 97/04 requires that conservation authorities describe areas that constitute hazardous land, wetlands, areas that are adjacent or close to the shoreline of the Great Lakes-St. Lawrence River System or to inland lakes, river and stream valleys, or areas that are susceptible to flooding in relation to one of the following flood event standards (Ontario Regulation 97/04, s. 4 (4)):

- The Hurricane Hazel Flood Event Standard;
- The 100 Year Flood Event Standard;
- The Timmins Flood Event Standard (not applicable to Southern Ontario);
- The Historic Flood Event Standard of the authority; and,
- The 100-year flood level and the flood allowance for wave uprush and other water-related hazards.

Relevance to this Study

The Study Area is located within the jurisdiction of Hamilton Conservation Authority, which administers *Ontario Regulation 161/06: Hamilton Region Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*. Hamilton Conservation Authority has developed mapping to identify areas where construction and development is regulated to control changes to watercourses, floodplains, wetlands and steep slopes, in order to prevent flooding and erosion problems. A review of Hamilton Conservation Authority's Regulated Areas Map Tool indicates that the regulated areas are located within the Study Area (Hamilton Conservation Authority, 2021). Accordingly, consultation with Hamilton Conservation Authority will be conducted to seek input into the Study to address flooding issues in the Beach Boulevard Community, and to identify any permitting requirements.

3.2.2 The Growth Plan for the Greater Golden Horseshoe (2019)

The Growth Plan for the Greater Golden Horseshoe – A Place to Grow, was adopted in 2019, replacing the former Growth Plan for the Greater Golden Horseshoe (2017), under the provisions of the *Places to Grow Act, 2005*. The plan provides the framework for implementing the Provincial Government's vision for building strong, prosperous communities by better managing growth to the year 2041 in the expanding Greater Toronto and Hamilton Area (Ministry of Municipal Affairs and Housing, 2019). Since implementation, the plan has been amended to provide population and employment forecasts to the year 2041.

The Growth Plan (2019) contains specific policies and directions regarding transportation infrastructure, land use planning, urban form, housing, natural heritage and resource protection to be considered by municipalities in their planning activities. The Growth Plan provides direction on where growth can occur, the form of future development and future population and employment forecasts.

The Growth Plan (2019) provides the following policies for the infrastructure to support growth that are relevant to this project:

3.2	Policies for Infrastructure to Support Growth
3.2.1	Integrated Planning
	4. Municipalities will assess infrastructure risks and vulnerabilities, including those caused by the impacts of a changing climate, and identify actions and investments to address these challenges, which could be identified as part of municipal asset management planning.

Relevance to this Study

This Study is consistent with the objectives of the Growth Plan, 2019, as it will develop a master plan to recommend actions to address flooding issues within the Beach Boulevard Community. The study will identify natural and cultural heritage and archaeological resources, as well as address potential impacts on those resources.

3.2.3 Provincial Policy Statement (2020)

The Provincial Policy Statement (PPS), 2020 provides policy direction for appropriate development while protecting resources of provincial interest, public health and safety, and the quality of the natural and built environment. The PPS supports improved land

use planning and management, which contributes to a more effective and efficient land use planning system (Ministry of Municipal Affairs and Housing , 2020). The PPS is issued under the authority of Section 3 of the *Planning Act, 1990*. The current PPS came into effect on May 1, 2020, and replaced the PPS issued on April 30, 2014. Section 3 of the PPS requires that decisions affecting planning matters "shall be consistent with" policy statements under the *Planning Act, 1990*.

The following policies of PPS, 2020 are of relevance to this Study:

1.6.6	Sewage, Water and Stormwater
1.6.6.7	Planning for stormwater management shall: d) mitigate risks to human health, safety, property and the environment e) maximize the extent and function of vegetative and pervious surfaces f) promote stormwater management best practices, including stormwater attenuation and re-use, water conservation and efficiency, and low impact development
2.1	**Natural Heritage**
2.1.1	Natural features and areas shall be protected for the long term.
2.1.2	The diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features.
2.6	**Cultural Heritage and Archaeology**
2.6.1	Significant built heritage resources and significant cultural heritage landscapes shall be conserved.
2.6.5	Planning authorities shall engage with Indigenous communities and consider their interests when identifying, protecting and managing cultural heritage and archaeological resources.
3.0	**Protecting Public Health and Safety**
3.1	**Natural Hazards**
3.1.3	Planning authorities shall prepare for the impacts of a changing climate that may increase the risk associated with natural hazards.

Relevance to this Study

Consistent with the objectives of the PPS, 2020, this Study aims to make recommendations to mitigate risks to human safety and property caused by the impacts of climate change. This Study will identify natural and cultural heritage and archaeological resources and address impacts on those resources.

3.2.4 Ontario's Flooding Strategy (2020)

The Ontario's Flooding Strategy was released in 2020. It outlines steps to be taken by Ontario over the next several years to help achieve this goal. This Strategy contains actions that are informed by the following principles of effective flood management (Ministry of Natural Resources and Forestry, 2020):

- Local governments hold the primary responsibility for identifying and managing flood risks;
- Provincial and federal governments must play a key role in supporting local decision-making;
- Local decisions on how to best manage flood risks need to be based on the latest data and science;
- The most cost-effective and sustainable way of reducing risks is to keep people and property out of high-risk areas;
- Where development exists, systems must be in place to support effective early warning and emergency response;
- Recovery efforts are most effective when they incorporate the principle of "build back better" – an approach to post-disaster recovery that reduces vulnerability to future disasters and builds community resilience; and,
- We all have a role to play – risks should be managed in strong partnership with municipalities, conservation authorities, the federal government, private landowners, industry, and Indigenous communities.

Ontario's Flooding Strategy (2020) has identified priority areas which are supported by a comprehensive set of actions and associated activities to help increase Ontario's resiliency to flooding.

The following priority area and associated action and activities of Ontario's Flooding Strategy, 2020 are of relevance to this study:

Priority #2	Strengthen Governance of Flood Risks
Action	Promote Sound Land Use Planning Decisions
Activities	Enhance the Resiliency of Provincial Infrastructure and Other Built Form • Identify further climate change impacts on provincial infrastructure assets including accelerated asset deterioration due to increased frequency and severity of extreme precipitation events • Facilitate the development of adaptation strategies to increased frequency of inundation of provincial infrastructure, including consideration for altering zoning and land use, change of building codes and condition assessment of aging infrastructure • Utilize available weather data and climate change projections in long-term provincial infrastructure planning

Relevance to this Study

This Study is consistent with the above noted action and associated activities as it will utilize climate change projections as part of climate change stress-testing and will make recommendations to address flooding issues associated within the Beach Boulevard Community.

3.3 Municipal Policies and Plans

3.3.1 The City of Hamilton By-Law Nos. 99-169 and 99-170 (1999)

In 1999, City of Hamilton's Zoning By-law No. 6593 was amended, by By-law Nos. 99-169 and 19-170. The implementation measures contained special provisions to minimize drainage concerns and address the high water-table in this area. The following amendments were made:

By-Law No 99-169	Lands Located East (Lake Side) of Beach Boulevard, in the Beach Neighbourhood
	• all buildings and structures, including accessory buildings, shall provide a side yard along each side lot line, of a width of at least 1.7 metres; and, • a side yard maybe reduced to a width of at least 1.5 metres, only where a common swale between the adjoining properties has been

approved under a Lot Grading Agreement or approved under a Site Plan Control Agreement

- all buildings and structures, including accessory buildings, shall provide a side yard along each side lot line, of a width of at least 1.7 metres;
- a side yard maybe reduced to a width of at least 1.5 metres, only where a common swale between the adjoining properties has been approved under a Lot Grading Agreement or approved under a Site Plan Control Agreement;
- the minimum ground floor elevation of any building or any building addition shall be 76.0 metres above mean sea level, as defined by the Geodetic Survey Datum, except for any building addition less than 14 square metres in area and any accessory building or structure;
- no basement or cellar shall be permitted for any building;
- any addition, less than 14 square metres in area, shall have a minimum floor elevation at or above the existing ground floor elevation of the building; and,
- prior to the issuance of a building permit for every new building, a Lot Grading Agreement with the City of Hamilton shall be entered into and registered on title to the satisfaction of the Building Department Director, except for developments that require approval under the Site Plan Control By-law No. 79-275, as amended.

Relevance to this Study

The primary objective of this Study is to recommend stormwater management practices to address flooding issues in the Beach Boulevard Community. There may be recommendations through this Study that may require implementation through an amendment to the zoning by-laws.

3.3.2 City of Hamilton Storm Drainage Policy (2004)

In 2004, the City of Hamilton established the Storm Drainage Policy for use in the planning and design process for land development and redevelopment and storm drainage infrastructure within the City. The key goals of this policy document (as related to this Study) include minimizing risk to life and property from flooding and erosion, providing direction for design of stormwater infrastructure, and establishing criteria for acceptable service levels for the hydraulic capacity of both the minor and major

drainage systems to provide reasonable levels of service for the connected property owners (Philips Engineering Ltd., 2004). To implement this policy document, the City of Hamilton issued the "Criteria and Guidelines for Stormwater Infrastructure Design" document in 2007. These guidelines provide standards and details of how to implement the Storm Drainage Policy, specifically the following (Philips Engineering Ltd., 2007):

- Outline criteria to be used to design storm drainage infrastructure within Hamilton;
- Specify storm drainage criteria to be applied to all storm infrastructure design including municipal projects and new land development, and redevelopment of existing lands;
- Specify design guidelines for storm drainage design and reporting at various stages of the land development process; and,
- Provide reference and context to applicable Federal, Provincial, and Municipal policies and regulations that you need to consider when planning or designing storm drainage systems.

Relevance to this Study

The primary objective of this Study is to recommend stormwater management practices to address flooding issues in the Beach Boulevard Community. The proposed stormwater management practices will be recommended in accordance with applicable provincial and municipal policies and guidelines (including the "City of Hamilton Storm Drainage Policy", 2004, and "Criteria and Guidelines for Stormwater Infrastructure Design", 2007).

3.3.3 Urban Hamilton Official Plan (2013)

The Urban Hamilton Official Plan (UHOP) (2013) implements and outlines various goals and policies that move the City of Hamilton towards its future vision. It was adopted by the City Council in July 2009 and approved by the Ministry of the Municipal Affairs and Housing in 2011. It has been effective since August 2013 (except for policies, schedules, maps and appendices that are still under appeal by the Local Planning Appeal Tribunal). The UHOP, 2013, provides direction and guidance on the management of communities, land use change and physical development within the City (City of Hamilton, 2013).

The following policies of UHOP, 2013 are of relevance to this Study:

3.4.2	General Cultural Heritage Policies
3.4.2.1	The City of Hamilton shall, in partnership with others where appropriate: a) Protect and conserve the tangible cultural heritage resources of the City, including archaeological resources, built heritage resources, and cultural heritage landscapes for present and future generations; b) Identify cultural heritage resources through a continuing process of inventory, survey, and evaluation, as a basis for the wise management of these resources; and, i) Use all relevant provincial legislation, particularly the provisions of the Ontario Heritage Act, the Planning Act, R.S.O., 1990 c. P.13, the Environmental Assessment Act, the Municipal Act, the Niagara Escarpment Planning and Development Act, the Cemeteries Act, the Greenbelt Act, the Places to Grow Act, and all related plans and strategies in order to appropriately manage, conserve and protect Hamilton's cultural heritage resources.
3.4.4	**Archaeology Policies**
	The City shall require the protection, conservation, or mitigation of sites of archaeological value and areas of archaeological potential as provided for under the Planning Act, R.S.O., 1990 c. P.13, the Environmental Assessment Act, the Ontario Heritage Act, the Municipal Act, the Cemeteries Act, or any other applicable legislation.
3.4.6	**Cultural Heritage Landscapes**
3.4.6.2	An inventory of cultural heritage landscapes shall be prepared by the City and may be included in the Register of Properties of Cultural Heritage Value or Interest. Cultural heritage landscapes may also be considered for designation under the *Ontario Heritage Act* and shall be protected in the carrying out of any undertaking subject to the *Environmental Assessment Act* or the *Planning Act, R.S.O., 1990 c. P.13*.
C.2.0	**Natural Heritage System**
	The Natural Heritage System, identified on Schedule B – Natural Heritage System, consists of the Niagara Escarpment Plan area, and Core Areas and Linkages identified by the City, based on requirements of the Provincial Policy Statement.

2.3	Natural Heritage System - Core Areas
2.3.2	Core Areas include key natural heritage features, key hydrological features and provincially significant and local natural areas that are more specifically identified by Schedule B-1-8 – Detailed Natural Heritage Features. Core Areas are the most important components in terms of biodiversity, productivity, and ecological and hydrological functions.
2.3.3	The natural features and ecological functions of Core Areas shall be protected and where possible and deemed feasible to the satisfaction of the City enhanced. To accomplish this protection and enhancement, vegetation removal and encroachment into Core Areas shall generally not be permitted, and appropriate vegetation protection zones shall be applied to all Core Areas.
C.5.0	Infrastructure
5.4	Storm Water Management Facilities
	The City shall ensure that appropriate stormwater management facilities are built and maintained to provide a safe and secure system for storm water.
E.2.0	Urban Structure
2.2.1	Hamilton's urban structure is identified on Schedule E – Urban Structure and includes the following structural elements: a) Urban Nodes, b) Urban Corridors, c) Major Activity Centres, d) Employment Areas, and e) Major Open Space.
UH-2	Lands along Lake Ontario Shoreline, on the north and south side of Beach Boulevard
1.0 a)	The City shall ensure that appropriate shoreline protection measures as may be prescribed by the province and will be taken to mitigate flooding, erosion and pollution.

Relevance to this Study

A review of various schedules and mapping of UHOP, 2013 was completed to identify the presence of natural, archaeological and cultural heritage resources within the Study Area. According to Schedule B (Natural Heritage System) of UHOP, 2013, the Hamilton Beach within the Study Area is classified as a Core Area. Appendix F (Cultural Heritage Resources) indicates that the Beach Boulevard Community is classified as a Cultural Heritage Landscape, and there is a Heritage Conservation District located within the

community. Guidance regarding the protection of the heritage character of the Hamilton Beach Heritage Conservation District is provided in *Hamilton Beach Heritage Conservation District: Guidelines for Conservation and Change*. Appendix F-4 (Archaeological Potential) indicates that there are areas of Archaeological Potential within the Study Area. This Study is consistent with the policies of the UHOP, 2013, as it will involve completion of a Cultural Heritage Assessment, a Stage 1 Archaeological Assessment and a Natural Heritage Assessment to identify cultural heritage, archaeological and natural heritage resources within the Study Area. The identification of these resources will inform the evaluation of alternatives process.

This Study is also consistent with stormwater management policies of UHOP, 2013, as its primary objective is to recommend stormwater management practices to address flooding issues in the Beach Boulevard Community.

Based on a review of Schedule E-1 – Urban Land Use Designations of UHOP, 2013, the land use designations within the Study Area include Neighbourhoods, Open Space, and Employment Area Designation (Shipping & Navigation).

4.0 Background Review

4.1 Information Received

The following currently available information which is relevant to the current reporting was provided by City of Hamilton:

GIS and Mapping Data

- Aerial Photos (Assumed 2020 - City of Hamilton, 2021)
- 0.5 X 0.5 m bare earth DTM LiDAR in NAD83 UTM 17_CGVD28 (City of Hamilton, 2021)
- 0.5 X 0.5 m DEM LiDAR in NAD83 UTM 17_CGVD28 (City of Hamilton, 2021)
- 0.25 m topographic Contour mapping (City of Hamilton, 2021)
- Hamilton Beach Point Cloud in NAD83 UTM 17_CGVD28 (City of Hamilton, 2021)
- Storm sewer database: nodes, catch basins, manholes, and sewer main shapefiles (City of Hamilton, May 2021)
- Land use mapping (City of Hamilton, March 2021)
- Building footprint mapping (City of Hamilton, March 2021)
- Zoning boundaries mapping (City of Hamilton, March 2021)
- Parcels mapping (City of Hamilton, March 2021)
- City properties mapping (City of Hamilton, March 2021)
- Street centerlines mapping (City of Hamilton, March 2021)
- Hamilton Water - Hansen Flood Call Database (City of Hamilton, March 2021)

Drawings

- Urban Hamilton Official Plan Schedule B (City of Hamilton, July 2020)
- 11-S-20 Beach Boulevard Interceptor Proposed Pumping Station Storm Sewer and Ditch Construction Plan From: Dunraven Avenue To: Arden Avenue (City of Hamilton Prepared by McCormick Rankin Corporation and AECOM, July 2011)
- 84-S-54 Hamilton, Ontario East Port Development Pier 25 – Stage I Site Services "As-Built" Plan and Profile (The Hamilton Harbour Commissioner and Public Works Canada Ontario Region prepared by S-M-P Marine Consultants Ltd., February 1983)
- H-400 Part 'A' From: Highway 2 southernly to Woodward Avenue on Highway 20. Part 'B' Nelson Street in Burlington westerly to Queen Elizabeth Way Interchange on Highway 2 (Province of Ontario Department of Highways, October 1962)

- 1064 Beach Boulevard 600 Storm Sewer Relocation From: Beach Boulevard To: South Westerly 73m (City of Hamilton, July 2007)
- Beach Boulevard Storm Water Pumping Station (City of Hamilton, November 2007)
- MTO CONT No. 86-74 WP No. 83-74-05 New Construction 13-19 and Storm Sewer Profiles Sheets 31-33 (Ministry of Transportation, Unknown Date)
- Beaches - Outlet Capacity vs Lake Level Curves at Eastport, Hamilton Harbour, Dunraven, Lagoon, Townhouse, Bayside, and Fletcher (Unknown, 2018)
- D-404_micro Plan Showing Catch Basins & Manholes South End of Skyway Bridge (City of Hamilton, June 1958)
- B-396_S1 Plan and Profile of Storm Sewers on Burlington Beach (September 1942)

Large Service Plans

- LSP_2447 (City of Hamilton, Planning and Development Department Development Division – Engineering Section, Completed April 14, 2006)
- LSP_2601 Ardin Beach Limited Beach Boulevard Condo-Towns 424-470 Site Servicing Plan (City of Hamilton prepared by S. Llewellyn Associates Limited, July 2007)
- LSP_2704 Beach House Townhomes 315-351 Beach Boulevard, Hamilton, Ontario (Branthaven Development prepared by MTE, July 2008)
- LSP_2943 Servicing Plan – Phase 1 Fishermen's Pier Inc 1081-1105 Beach Boulevard Hamilton, Ontario (City of Hamilton prepared by IBI Group, January 2012)
- LSP_3198 536 Beach Blvd Hamilton, Ontario Site & Grading Plan of Part of Burlington Beach West Side of Beach Boulevard (Unregistered) (City of Hamilton prepared by Weekes Engineering, November 2014)
- LSP2135 City of Hamilton Beach Waterworks Plant High Lift Pumping Station Key Plan (City of Hamilton, Date Unknown)
- LSP_3237 Sewer and Water Installation Site Plan 532 Beach Boulevard, Hamilton Ontario (City of Hamilton prepared by Fred Jewett, December 2014)

Information Updates

- Information Update: Emergency Works – High Lake Levels (HW.19.07) (City of Hamilton Public Works, October 16, 2019)
- Information Update: Damage from recent rainfall and high-water levels (City of Hamilton Public Works, June 30, 2017)

- High Water Levels – Sanitary Sewer Flooding & Directing Basement Floodwaters Letter (City of Hamilton, April 8, 2020)

Geotechnical Reports

- Soil Engineering Report on the Proposed Low Lift Pumping Station and Discharge Lines for the Corporation of the City of Hamilton (City of Hamilton prepared by E. M. Peto Associates LTD., October 1961)
- Geotechnical Investigation Pumping Station and Various Utilities East Port Industrial Park Hamilton Harbour (The Regional Municipality of Hamilton – Wentworth prepared by L. J. Rak Engineering LTD., June 1983)
- Subsurface Conditions Proposed Eastport Watermain at Beach Boulevard and Eastport Arterial Road City of Hamilton, Ontario (The Regional Municipality of Hamilton – Wentworth prepared by Morton & Partners Limited, March/April 1986)
- Hydrogeological Investigation Groundwater Sampling Beach Boulevard Hamilton, Ontario (The Regional Municipality of Hamilton – Wentworth prepared by Peto MacCallum Ltd., November 1989)
- The New City of Hamilton Geotechnical Investigations & Pavement Rehabilitations Recommendations Section 1 – Hamilton District Major Roads (City of Hamilton prepared by Amec Earth & Environmental Limited, April 2002)
- Pavement Design Report QEW/Red Hill Creek Expressway Interchange and QEW/Burlington Street Interchange (Ministry of Transportation prepared by Golder Associates Ltd., March 1999)
- Geotechnical Investigation Proposed Residential Development 315, 337 and 351 Beach Boulevard Hamilton, Ontario (Branthaven Homes Ltd. prepared by Soil-Mat Engineers & Consultants, February 2009)
- Geo-Environmental Investigation Road Resurfacing and Widening Sierra Lane Hamilton, Ontario (City of Hamilton prepared by Amec Earth & Environmental Limited, March 2015)
- Geotechnical Investigation Proposed Sound Wall 586 and 610 Beach Road Hamilton, Ontario (SLC Design prepared by Soil-Mat Engineers & Consultants Ltd., January 2013)

Previous Studies

- Master Drainage Plan Hamilton Beach (Marshall Macklin Monaghan, July 1999)
- Hamilton Beach Pumping Station Municipal Class Environmental Assessment, 2007/2008.

- Existing Conditions Drainage Investigation & Preliminary Design of Flood Protection for Beach Boulevard Community, August 2008. Completed by MRC.
- Lake Ontario St. Lawrence River Plan 2014: Protecting against extreme water levels, restoring wetlands and preparing for climate change (International Joint Commission, June 2014)
- Summary of 2017 Great Lakes Basin Conditions and Water Level Impacts to Support Ongoing Regulation Plan Evaluation (Great Lakes-St. Lawrence River Adaptive Management (GLAM) Committee, November 2018)
- Beach Boulevard Community Stormwater Ponding Study (Dillon Consulting, April 2019.

Models

- PCSWMM 1D-2D Hydrologic/Hydraulic Modelling Files (Dillon Consulting, 2019)

Time Series Data

- Pump Station SCADA_Daily January 1, 2010, to December 31, 2020 (City of Hamilton, 2021)
- Pump Station SCADA_hourly January 1, 2010, to December 31, 2020 (City of Hamilton, 2021)

Summaries and key details of background reports were incorporated into this report as noted. Key findings/recommendations have also been included in Appendix A where available and appropriate.

4.2 Summary of Previous Studies

Master Drainage Plan, Hamilton Beach (July 1999)

The City of Hamilton retained Marshall Macklin Monaghan Limited (MMM) to undertake a Master Drainage Plan for the Hamilton Beach Neighbourhood to study and recommend strategies for the mitigation of street flooding and lot grading for lots to be re-developed. The study area is situated between Hamilton Harbour and Lake Ontario where the land acts as a barrier aside from the Burlington Canal which runs between the City of Hamilton and the City of Burlington. This study was based on water level elevations using the International Great Lakes Datum, 1955 (IGLD 1955). Under existing conditions, the streets were noted to flood periodically particularly in the spring. During these periods, City staff were required to operate pumps to minimize impacts from ponded areas. It was concluded that flooding occurs when lake water levels exceed 75.2

mASL and there is additional input from a rainfall and/or snowmelt event. Areas which were noted to be regularly impacted by flooding were Windermere Avenue, Knapmans Drive, Wickham Avenue, Grafton Avenue, Comet Avenue, Granville Avenue, Clare Avenue, Lagoon Avenue, and Arden Avenue. These areas are lower in elevation than the surrounding areas along the beach strip. The report determined that lot grading of individual lots should be re-developed to achieve a minimum ground elevation of 76.0 mASL while not impacting existing development due to any changes of grade and/or drainage patterns.

It was detailed that the International Joint Commission (IJC) issued an Order of Approval (Plan 1958) to regulate the water levels in 1958 within a 1.2 m range (74.16 m to 75.38 m IGLD 1955). Regulation began in 1960 and greater than expected quantities of water have passed through Lake Ontario since the implementation of the plan. The recommendation to reduce flooding resulting from the study was based on a target water level of 75.4 m (IGLD 1955).

In this study, an OTTSWMM hydrologic model was designed for land use conditions which assumed all lots were developed except those that were designated for public sale. An EXTRAN hydraulic model was used to simulate routing of hydrographs through storm sewers. The models were developed for the proposed widening of the QEW and proposed drainage systems. It was concluded that option 2A (gravity drainage improvements with larger storm sewers) would provide the required 1 in 10-year level of protection to mitigate street flooding and was recommended for implementation (refer to Appendix A for relevant summaries). A new outlet under the QEW was proposed, including flow from ditch inlet catchbasins at the end of Grafton, Comet, Granville, Clare and Arden Streets, which were proposed to be conveyed in a new storm sewer parallel to the QEW berm. The new outlet pipe at the end of Granville Avenue was proposed to convey stormwater across the QEW to a ditch between Eastport Drive and the QEW. The proposed option would require 84 m of tunneling under the QEW for the 1200 mm diameter pipe. Additionally, this option would not preclude a future addition of a pump lift station if higher level of service were deemed required.

It was noted that the City of Hamilton already has a site control process for all re-developing lots to the west (bay side) of Beach Boulevard. Therefore, it was also recommended that the City of Hamilton implement site plan control for any future development east of Beach Boulevard as well, as changes have the potential to impact existing development and the site plan control process provides a means to control lot grades prior to and after re-development.

Hamilton Beach Pumping Station Class EA (2007/2008)

The City of Hamilton Public Works completed a Schedule "B" Municipal Class Environmental Assessment for the Hamilton Beach Pumping Station which identified drainage deficiencies and proposed solutions for the Beach Community. Existing drainage systems, particularly at the area from Dunraven Avenue to Arden Avenue, experience frequent flooding and only provide a 10-year level of protection, short of the 25-year level protection required by the City of Hamilton at the time of the study. It was recommended to proceed with the implementation of a new pumping station outlet from Grafton Avenue under the QEW to a ditch at Eastport Drive. A copy of the recommendations from the study are included in Appendix A.

Existing Conditions Drainage Investigation & Preliminary Design of Flood Protection for Beach Blvd Community (2008)

McCormick Rankin Corporation (MRC) completed an Existing Condition Investigation and Preliminary Design of Flood Protection for the Beach Boulevard Community for the Ministry of Transportation (MTO). The study investigates the condition and function of existing drainage infrastructure in the Beach Boulevard and QEW right-of-ways and recommends flood protection measures that could mitigate flooding in the Beach Boulevard Community. It was concluded that the street flooding problems were attributed to the minimal elevation difference between the lake water and surface elevations, as well as the land use changes over time.

It was noted that during field investigations that the as-built end-of-street drainage systems for the QEW widening deviate from what was shown on the MTO contract drawings. Only 3 of the 13 ditch inlet catch basins were installed with the correct size at Granville Avenue, Bayside Avenue, and Lagoon Avenue. Many drainage works were not placed correctly at the ends of the streets due to difficulties associated with high groundwater levels during construction.

The study details that for the most part, the QEW drainage system that intercepts flows from the Beach Community operates independently from the drainage system of the highway. Drainage from the east portion of the QEW right-of-way is collected by inlet structures in the ditches and median and conveyed beneath the highway.

It was noted that all flows conveyed through the QEW right-of-way are discharged to the Eastport Drive drainage system. Drainage contributed from the Beach Boulevard Community and the QEW between Dunraven Avenue and Wickham Drive is conveyed to Hamilton Harbour by a trunk storm sewer. Drainage contributed from the Beach

Boulevard Community and the QEW between Wickham Drive and Kirk Avenue is conveyed by a well-vegetated ditch (full of sediment and debris) to Red Hill Creek. The ditch water level was noted to coincide with Hamilton Harbour (and thus Lake Ontario) water levels.

During a 27 mm rainfall event on November 29, 2005, the site was visited, and the following observations were noted:

- Windermere Avenue, Comet Avenue, Granville Avenue, and Lagoon Avenue all experienced significant flooding;
- Low to moderate flooding was observed on Dunraven Avenue, Rembe Avenue, Wickham Avenue, Clare Avenue, and Bayside Avenue;
- The flooding on Windermere Avenue inundated residential streets and driveways;
- The catch basins on Comet Avenue were blocked by sediment and debris; and
- Locarno Avenue, North Park Avenue and Kirk Avenue appeared to drain properly.

Hydrologic and hydraulic modeling was completed for this report. A 94 mm historical storm from August 24, 1982, with Lake Ontario water levels of 74.8 m (IGLD 1985) was used as input for the modeling. The modelling demonstrated that lake levels greatly influence the capacity of the storm sewers.

MRC also noted that several of the end-of-street catch basins were in extremely poor condition and would require water to pool (develop head) on the street, before it could overflow into the storm sewer pipe network, in part because catch basins were not located at the localized lowest elevation on the roadway. The report recommended approximately 920 m of gravity storm sewers, and a dedicated stormwater pumping station and forcemain with the discharge outlet into a ditch on Eastport Drive. The proposed pump station would include a wet well, a superstructure, and low head pumps (three pumps including a standby) being able to convey the estimated 25-year flow. Relevant excerpts have been included in Appendix A.

Lake Ontario - St. Lawrence River Plan 2014 (2014)

The International Joint Commission prepared the Lake Ontario – St. Lawrence River Plan 2014 for the Governments of Canada and the United States which outlines protection against extreme water levels, restoring wetlands, and preparation for climate change. This report detailed the replacement of Plan 1958-D with Plan 2014 on January 1, 2017. Plan 1958-D allowed for 1.23 m of water level fluctuation of Lake Ontario (74.00 mASL to 75.23 mASL). Plan 2014 allows for the fluctuation of 1.57 m (73.56 mASL to 75.73 mASL) resulting in greater high lake levels than in the past. The water surface elevations

in the report are referenced to the International Great Lakes Datum, 1985 (IGLD 1985). The IJC outlined several requirements (criteria):

- Criterion H4 indicates that the regulated monthly mean level of Lake Ontario shall not exceed the following elevations in the corresponding months as shown in the table below.
- Criterion H11 specifies that the levels of Lake Ontario shall be regulated for the benefit of property owners in both the United States and Canada.
- If water levels reach or exceed extremely high levels, criterion H14 states that the works of the International Rapids Section (the section of St. Lawrence River that prior to the project was characterized by rapids from Prescott, ON to Cornwall, ON) shall operate to provide potential relief to owners located in the riparian areas upstream and downstream. This includes increasing outflow releases to maximum flow limits from Lake Ontario to minimize high water level flooding impacts. Refer to Appendix A for further details including excerpts from Plan 2014.

Table 4.1: H4 Regulated Monthly Level of Lake Ontario from Plan 2014 (IGLD 1985 Datum)

Month	Maximum (m)	Minimum (m)
January	75.26	73.56
February	75.37	73.62
March	75.33	73.87
April	75.60	73.97
May	75.73	74.22
June	75.69	74.27
July	75.63	74.26
August	75.49	74.15
September	75.24	74.04
October	75.25	73.83
November	75.18	73.67
December	75.23	73.57

Summary of 2017 Great Lakes Basin Conditions and Water Level Impacts to Support Ongoing Regulation Plan Evaluation (Great Lakes-St. Lawrence River Adaptive Management (GLAM) Committee, November 2018)

The International Joint Commission's (IJC) Great Lakes – St. Lawrence River Adaptive Management (GLAM) Committee created a special report for the extraordinary high precipitation and high-water level conditions experienced in the Great Lakes-St Lawrence River system in 2017. The GLAM Committee evaluated the regulation of outflows from Lake Ontario and Lake Superior to help advise the IJC on how to adaptively manage and improve rules governing those releases. This report provides background, key findings, consequences of high-water conditions, and review of Lake Ontario regulation plans in light of record high levels in 2017.

It was found that that in the year 2017, Lake Ontario levels under Plan 2014 were not higher than they would have been operating under Plan 1958D. Plan 2014 performance was evaluated and found to help reduce, but not eliminate coastal damages that occur in extreme events while trying to balance and minimize impacts on other interests. Modifications to Plan 2014 such as maximum outflow limits, balancing high water conditions with protection to navigation, trigger levels that authorize the board to deviate from Plan 2014 were recommended to be investigated. No follow-up report is available to confirm whether the IJC implemented the recommendations.

Beach Boulevard Community Stormwater Ponding Study (2019)

The City of Hamilton retained Dillon Consulting Limited to complete an investigation and assessment study of potential mitigation measures to address the ongoing street ponding in the vicinity of Beach Boulevard. Lake Ontario exceeded record levels (75.88 mASL) on May 29, 2017, which caused extensive flooding across Ontario and beyond, and resulted in flooding impacts to the Beach Boulevard Community.

The Dillon study documented reported flooded sites from previous studies and made note of areas from Transport Canada and Natural Resources aerial imagery that indicated surface flooding on June 8, 2017 (refer to Appendix A). The City of Hamilton has an archive of service requests since 2002 (HANSEN database) and requests pertaining to flooding were also noted. Table A1 (ref. Appendix A) provides a tabular summary of the presented information.

This study included the generation of a baseline hydrologic/hydraulic model (PCSWMM) to assess the capacity of the drainage system in the vicinity of the Beach Boulevard Community. The model, which included a 2-dimensional (2D) surface mesh, was

simulated for four (4) storm scenarios (2, 5, 10, and 100-year storms), two (2) different lake levels (74.27 mASL, 75.88 mASL in the referenced NAVD88 vertical datum) and two (2) different outlet conditions. The model was used to evaluate the flood risk areas and support the development of mitigation recommendations.

The report included recommendations for operation and maintenance such as the creation of a defined Maintenance Agreement between the City and MTO for stormwater related facilities in the Beach Boulevard Community to formalize responsibilities for regular maintenance and emergency situations. It was also recommended that the City of Hamilton should continue to transfer ownership for properties located in the ditch area between the MTO Noise Barrier wall and the MTO chain link fence to the MTO.

The Beach Boulevard Community Stormwater Ponding Study proposed various recommendations related to Legislation or Programs. It was recommended that the City of Hamilton continue working with MTO, Hamilton Port Authority (HPA), and the Hamilton Conservation Authority (HCA) to determine design/construction feasibility of mitigation measures and confirm the existing size and condition of outlets within the QEW right-of-way.

Recommendations for lot level measures included the consideration for the City to install proper backflow preventers to protect residents from potential surcharging and consider direct connection features for private property owners to convey basement dewatering flows to the storm sewer directly. Additionally, it was recommended that residents be further encouraged, if required, to install foundation drains, weeping tiles and sump pumps. Foundation water should be directed to a free draining outlet, storm sewer, or stormwater harvesting feature on the resident's property, as it is a violation of the existing Sewer-Use By-Law to direct the water to the sanitary sewer system.

It was outlined in the report that the existing stormwater system should be upgraded to convey the 5-year storm under the Plan 2014 high Lake Ontario water levels. The sub-catchment specific recommendations were made based off the highest recorded water level of Lake Ontario (75.88 mASL IGLD 1985), 5-year and 100-year storm. The following are excerpts for sub-catchment specific recommendations from the Stormwater Ponding Study (Dillon, 2019):

- **Eastport System** - Installation of a new single gravity sewer outlet that matches existing capacity.
- **Hamilton Harbour System** - Installation of new gravity sewer system that has increased outlet capacity under the QEW.

- **Dunraven System** - Installation of a new pumping station that outlets to Lake Ontario or the Eastport Ditch.
- **Lagoon System** - Installation of a new pumping station that outlets to Lake Ontario or the Eastport Ditch.
- **Townhouse System** – City of Hamilton to confirm DEM data to ensure it covers the recently built private townhouse complex. Outlet location, size, and condition should be verified by staff.
- **Bayside System** - Installation of a new pumping station that outlets to Lake Ontario or the Eastport Ditch.
- **Fletcher System** - Installation of a new pumping station that outlets to Lake Ontario or the Eastport Ditch.

Relevant excerpts from the 2019 study have been included in Appendix A for reference.

It was also noted that prior to moving forward with any of the recommendations, the City of Hamilton would need to clearly define the desired level of service for the study area and complete an Environmental Assessment and/or other regulatory approvals/requirements.

5.0 Baseline Inventory

5.1 Socio-Economic Existing Environment

The Beach Boulevard Community is a waterfront community in the City of Hamilton. The Study Area is bounded by Lake Ontario to the east, Hamilton Harbour to the west, Burlington Canal Lift Bridge and ship canal to the north and Confederation Park to the south. The Burlington Canal Lift Bridge and ship canal to the north separates the cities of Hamilton and Burlington. The Study Area is located within Ward 5 of the City of Hamilton. According to the census data, the population in Ward 5 in year 2016 was 41,855 residents.

5.1.1 Roads

There are three (3) major roadways within the Study Area: Beach Boulevard, the Queen Elizabeth Way (QEW), and Eastport Drive (Figure 5-1).

As the name implies, the Beach Boulevard Community is named after Beach Boulevard which forms the central major road corridor within the community. It is identified as a Collector Road on Schedule C - Functional Road Classification of UHOP, 2013. The right-of-way width of Beach Boulevard ranges between 20 and 25 metres within the Study Area. It is connected by a number of local side roads that serve residential uses within the Study Area. To the north, Beach Boulevard provides a connection to Eastport Drive. To the south, it provides a connection to Eastport Drive and Woodward Avenue, and Queen Elizabeth Way (Toronto-bound).

The Study Area is bisected by Queen Elizabeth Way, which connects Hamilton with Toronto to the north-east, and Niagara Falls and Fort Erie to the south-east.

Eastport Drive is located west of Queen Elizabeth Way. To the north, Eastport Drive provides connection to Lakeshore Road, Northshore Boulevard E, and Queen Elizabeth Way (Toronto-bound). To the south, it provides connection to Woodward Avenue and Beach Boulevard.

5.1.2 Pedestrian and Cycling Network

A sidewalk is generally provided on both sides of Beach Boulevard and the majority of the intersecting local side roads within the Study Area. The Hamilton Waterfront\Breezeway Trail runs along the Lake Ontario Shoreline. It connects to trails within the City of Burlington via the Burlington Canal Lift Bridge. The trail extends to

Confederation Park to the south-east, terminating at Grays Road. The length of this trail segment is 8 kilometres. It is a 6 metres wide off-road trail with paved asphalt.

The location of sidewalks and Hamilton Recreation Beach Trail within the Study Area is shown in Figure 5-1.

5.1.3 Land-Uses

Land uses within the Study Area are shown in Figure 5-1.

5.1.3.1 Residential

The Beach Boulevard Community north of the Queen Elizabeth Way is primarily a residential community. The majority of the residential properties are single family dwellings (Urban Protected Residential), with some townhouses present.

5.1.3.2 Commercial

There are a number of businesses located within the Beach Boulevard Community. These businesses serve a variety of sectors. Names, sectors and location of these businesses is provided in **Table 5-1**. The location of these commercial uses is illustrated on Figure 5-1.

Table 5-1: Commercial Uses Located within Beach Boulevard Community

Business Name	Sector	Address	Feature ID on Map
Beach Marine	Canoe & Kayak Store	1127 Beach Blvd, Hamilton, ON L8H 6Z9	1
Guild Electric Ltd	Maintenance	1077 Beach Blvd, Hamilton, ON L8H 6Z9	2
Psychic Keri	Healthcare	991 Beach Blvd, Hamilton, ON L8H 6Z8	3
Harry's Pub	Restaurant	721 Beach Blvd, Hamilton, ON L8H 6Y5	4

Business Name	Sector	Address	Feature ID on Map
The Apparel Network	Clothing	8 Grafton Ave, Hamilton, ON L8H 7E7	5
INFOTAX LTD.	Tax Services	624 Beach Blvd, Hamilton, ON L8H 6Y1	6
Garden Elves Landscaping	Landscaping	14 Granville Ave, Hamilton, ON L8H 7E3	7
Odawgs Pet Paradise	Dog Day Care Centre	533 Beach Blvd, Hamilton, ON L8H 6X4	8
The Rustic Rose - Antiques & Vintage	Antiques & Vintage Supplies	538 Beach Blvd, Hamilton, ON L8H 6X3, Canada	9
Hamilton Beach Convenience	Retail	536 Beach Blvd, Hamilton, ON L8H 6X3	10
Wizards Hair Salon	Personal Care	395 Beach Blvd, Hamilton, ON L8H 6W8	11
Beach Motor Inn Motel	Hospitality	400 Beach Blvd, Hamilton, ON L8H 6W7	12
Martel Commercial Realty Inc.	Real Estate	347 Beach Blvd, Hamilton, ON L8H 6W4	13
Memar Homes	Custom Home Builder	347 Beach Blvd, Hamilton, ON L8H 6W4	14

5.1.3.3 Parks and Open Spaces

The Study Area encompasses Hamilton Beach Strip, which runs along the Lake Ontario Shoreline. The Beach Strip is classified as Open Space in UHOP, 2013. In addition, there are a total of six (6) parks within the Study Area. These parks include:

- Jimmy Lomax Park
- Dieppe Veterans Memorial Park
- Beach Blvd. Park No. 1
- Kinsmen Park
- Skyway Park / Reg Wheeler Park
- Jimmy Howard Park

The location of parks and open space is shown in Figure 5-1.

5.1.3.4 Institutional

The Study Area include five (5) institutional uses. The location of these uses is listed in **Table 5-2** and illustrated in Figure 5-1.

Table 5-2: Institutional Uses Located within Beach Boulevard Community

Name	Address	Feature ID on Map
Ontario Correctional Services College	467 Beach Blvd, Hamilton, ON L8H 6W8	1
Hamilton Beach Rescue Unit	316 Beach Blvd., Hamilton ON, L8H 6W2	2
Many Mansions Spiritual Centre	180 Beach Blvd., Hamilton, ON L8H 6V9	3
Hamilton Beach Community Council	Unavailable	Unavailable

5.1.3.5 Shipping & Navigation

The Study Area encompasses Piers 25-28 of the Port of Hamilton. A review of Hamilton-Oshawa Port Authority's website was completed in January 2021 to identify businesses located on Piers 25-28. A total of eleven businesses were identified, serving a variety of sectors (Hamilton-Oshawa Port Authority, 2021). These businesses, along with their sector and pier location, are listed in **Table 5-3**.

Table 5-3: Commercial Uses Located on Piers 25-28 of Port of Hamilton

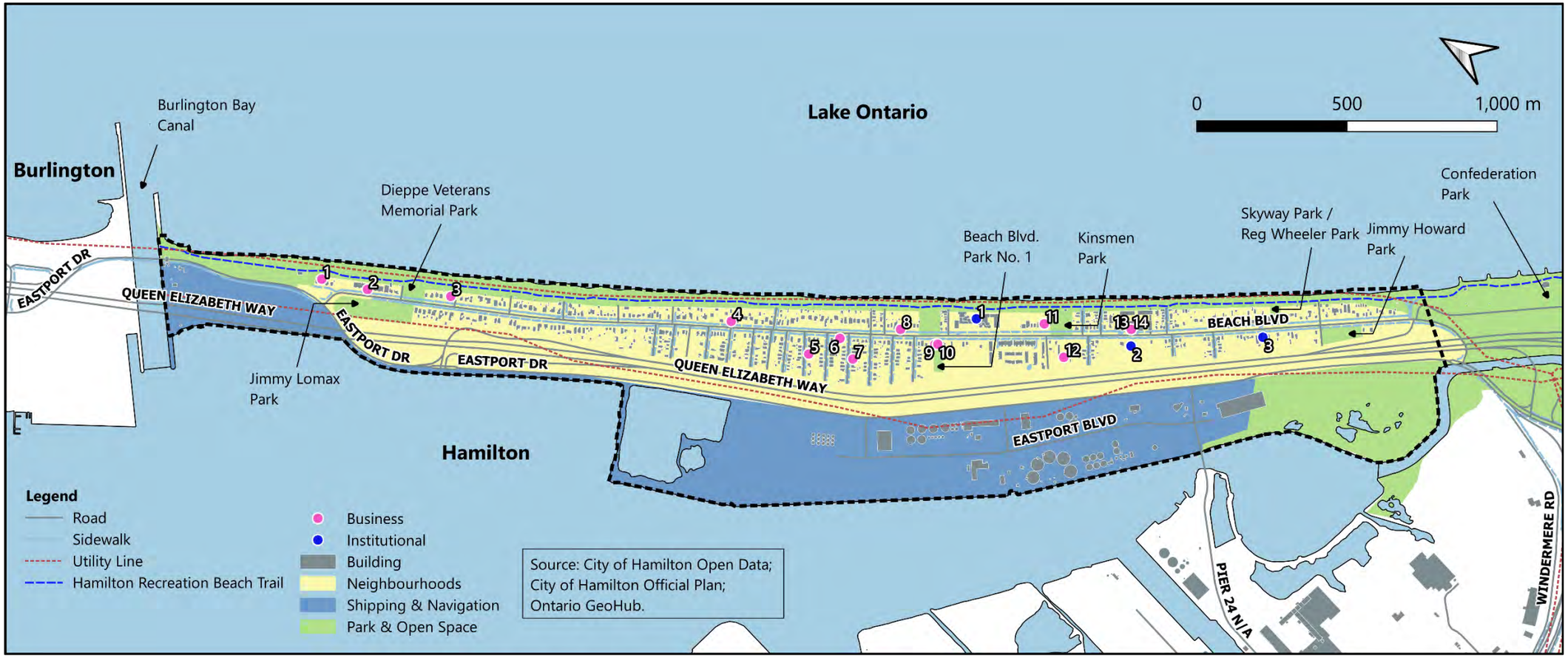
Business Name	Description	Sector	Location
Agrico Canada Ltd.	Fertilizer transload and storage	Agri-Food	Pier 25
Revolution Environmental Solutions	Biosolids management	Environmental Recycling & Clean-Tech	Pier 25
Chapel Steel Canada Ltd.	Steel services and products	Manufacturing	Pier 25
G3 Canada Ltd.	Grain Handling terminal	Agri-Food	Pier 26
Canadian Asphalt Industries Inc.	Asphalt	Infrastructure & Construction Materials	Pier 26
K + S Windsor Salt Ltd.	Salt storage and distribution	Infrastructure & Construction Materials	Pier 26
Hooper Engineered Vessels International	Engineered pressure vessels	Manufacturing	Pier 26
RNR Patient Transfer Services	Patient transportation service	Professional & Business Services	Pier 26
Toronto Tank Lines (TFI International Inc.)	Liquid bulk transportation	Logistics/Trucking	Pier 26
QSL	Stevedoring & marine terminal operations	Stevedoring	Pier 23, Pier 26
Fisherman's Pier	Recreational fishing tackle and supplies	Recreational Marine	Pier 28

5.1.4 Utilities

The following utilities were identified within the Study Area through Ontario One Call locate review request (Ontario One Call, 2021):

- Alectra Utilities
- Hydro One Networks Inc.
- Bell Canada
- Rogers Communications
- Enbridge Gas Inc.
- Trans Northern Pipelines
- City of Hamilton Street Lighting
- City of Hamilton Water

Figure 5-1: Socio-Economic Features within the Study Area



5.2 Cultural Environment

5.2.1 Archaeological Resources

A draft Stage 1 Archaeological Assessment Report was completed by ASI as part of this Class EA Study and is provided in Appendix B. This assessment identified that parts of the Study Area are considered to exhibit archaeological potential and parts of the Study Area have been cleared of further archaeological concern from previous archaeological assessments. Figure showing areas of archaeological potential is provided on the following page. The remainder of the Study Area has low potential on account of deep and extensive land disturbance from twentieth and twenty-first century residential development and industrial use.

As the Study progresses and the location of proposed works is identified, the Stage 1 Archaeological Assessment will be finalized to make recommendations for additional archaeological work (if required). The draft Stage 1 Archaeological Assessment will be shared with the local Indigenous Nations for their review and comment.

5.2.2 Cultural Heritage Resources

A draft Cultural Heritage Report was completed by ASI as part of this Class EA Study and is provided in Appendix C. A review of various background information sources was completed as part of development of this report. This review revealed that a total of 99 previously identified built heritage resources (BHLs) and cultural heritage landscapes (CHLs) were identified within the Study Area. Of the BHRs and CHLs identified within the Study Area there are three properties designated under Part IV of the Ontario Heritage Act and one heritage conservation district designated under Part V of the Ontario Heritage Act and the 65 properties identified within it as part of the heritage conservation district. In addition, other resources include: 25 inventoried properties, 20 properties listed in Hamilton's Heritage Volume 2 Inventory of Buildings of Architectural and/or Historical Interest (City of Hamilton, 2002), four properties listed in Hamilton's Heritage Volume 3 Canadian Inventory of Historic Building (City of Hamilton, 2003), one cultural heritage landscape identified in the Urban Hamilton Official Plan, one Provincial Heritage Property of Provincial Significance, and one potential cultural heritage landscape identified in a previous report.

Identified cultural heritage resources are historically, architecturally, and contextually associated with land use patterns in the City of Hamilton and more specifically representative of the settlement of the Beach Boulevard community.

The entire Study Area (with the exception of a small portion of grassland in the southwest corner of the Study Area) is included in the Hamilton Beach (A,B,C) Historic Neighbourhood Inventory (CHR 99) (City of Hamilton, n.d.). Further, the entire Study Area east of the Queen Elizabeth Way is included in the Hamilton Beach Strip Cultural Heritage Landscape (CHR 30) (City of Hamilton, n.d.). Accordingly, all individual properties within these areas are considered to be included within these larger CHLs.

Identified BHRs and CHLs are shown on figures provided on the following pages.

As the Study progresses and the location of proposed works is identified, the Cultural Heritage Report will be finalized to identify project's potential effects on BHRs and CHLs and propose mitigation measures (if required). The draft Cultural Heritage Report will be shared with the local Indigenous Nations for their review and comment.

Figure 12: Beach Boulevard – Archaeological Potential Model

Figure 12: Location of Identified Built Heritage Resources and Cultural Heritage Landscapes in the Study Area (Key Plan)

Figure 13: Location of Identified Built Heritage Resources and Cultural Heritage Landscapes in the Study Area (Sheet 1)

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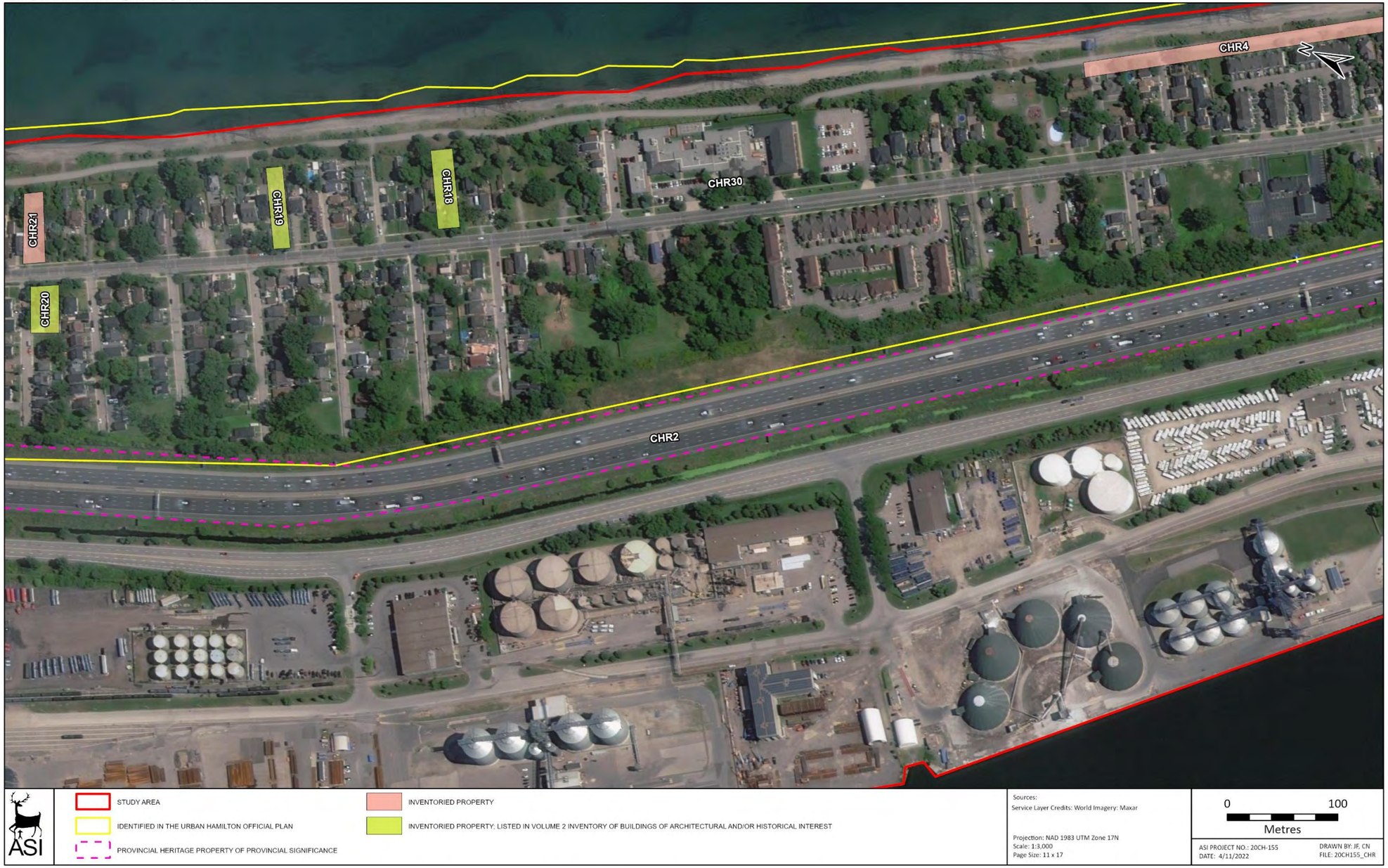

Figure 14: Location of Identified Built Heritage Resources and Cultural Heritage Landscapes in the Study Area (Sheet 2)

Figure 15: Location of Identified Built Heritage Resources and Cultural Heritage Landscapes in the Study Area (Sheet 3)

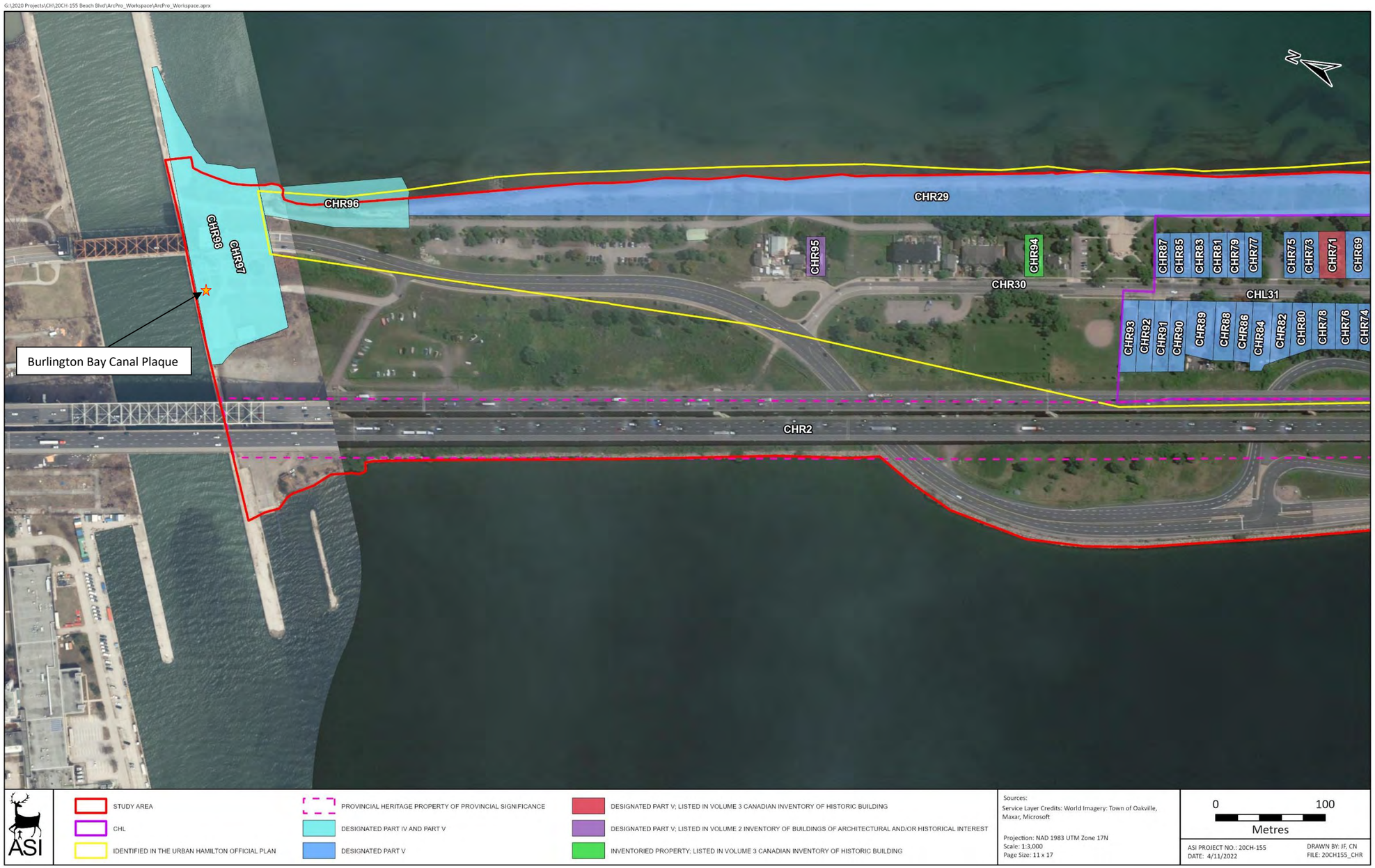

Figure 16: Location of Identified Built Heritage Resources and Cultural Heritage Landscapes in the Study Area (Sheet 4)

5.3 Natural Environment

A draft Natural Heritage Report was completed by LGL as part of this Class EA Study and is provided in Appendix D. This report described the existing conditions in the Study Area related to natural heritage, including physiography, bedrock and surficial geology and soils; fish and fish habitat: vegetation and vegetation communities; wildlife and wildlife habitat; and, designated natural areas. A summary of results from draft Natural Heritage Report is provided below. The draft Natural Heritage Report will be submitted to the Indigenous Nations for review and comment.

5.3.1 Physiography, Bedrock and Surficial Geology and Soils

The site is located within the Iroquois sand plain physiographic region (Chapman & Putnam, 1984). The Iroquois sand plain was flooded by glacial Lake Iroquois and is comprised mostly of permeable sand deposits. Bedrock consists of the Queenston Formation, which is Upper Ordovician in age, and comprised of shale, limestone, dolostone and siltstone (Ontario Geological Survey, 1991). Quaternary geology consists of recent Lake Ontario deposits of stratified sands and gravel, known locally as the Burlington Bar (Karrow, 1987). The study area is mostly level and slightly above lake levels in Lake Ontario and Hamilton Harbour.

5.3.2 Aquatic Habitats and Communities

LGL conducted a secondary source review to identify the fish community within each water feature located within the Study Area. The secondary source review included a species at risk screening though the Department of Fisheries and Oceans Canada (DFO) Aquatic Species at Risk Mapping, as well as the 'Make a Map' feature of the Natural Heritage Information Centre (NHIC) of the Ministry of Northern Development, Mines, Natural Resources and Forestry (MNDMNRF) website. In addition, LGL sent an initial data request to Hamilton Conservation Authority (HCA) on April 27, 2021, followed by subsequent data requests on June 2, 2021 and June 24, 2021 to obtain fisheries community information and watershed/subwatershed studies. Correspondence with HCA indicated that no information pertaining to fish or fish habitat was available.

LGL fisheries specialists conducted a fish habitat assessment at each of the three Eastport Ditches, Red Hill Creek, Hamilton Harbour, Burlington Canal, and along the Lake Ontario shoreline on April 7, 2021 and November 9, 2021 to observe and document existing aquatic habitat conditions. It should be noted that the habitats associated with Red Hill Creek, Hamilton Harbour, Burlington Canal and the Lake

Ontario shoreline form the perimeter of the study area and are parts of relatively large bodies of water when compared with the Eastport Ditches.

Figure 2 in the Natural Heritage Report presents the location of the watercourse features identified within this section of the Study Area. This figure is provided on the following page. An aquatic habitat summary is presented below which describes existing conditions at each of the watercourse features.

5.3.2.1 Watershed Characteristics

The Study Area lies within three watersheds; Urban Hamilton Core Watershed, Urban Hamilton Beach Strip Watershed, and the Red Hill Creek Watershed. Each of these watersheds, both portions within and adjacent to the study area, are under the jurisdiction of the HCA and the MNDMNRF Guelph District.

Urban Hamilton Core Watershed

The Urban Hamilton Core Watershed encompasses the City of Hamilton's downtown core, waterfront properties and Port of Hamilton Lands, including the Hamilton Harbour. The majority of this watershed is residential, with significant industrial and commercial land uses. All municipal services within this watershed drain into the Hamilton Harbour. Water levels within the Hamilton Harbour affect shoreline habitats including that of wetlands. Water quality within the Hamilton Harbour has been degraded due to industrial practices, industrial and sewage discharge, contaminated materials and dredging (Halton-Hamilton Source Protection Committee, 2017). Several Walleye (*Sander vitreus*) spawning areas have been identified within the Hamilton Harbour by the MNDMNRF (2022). Due to its diversity of habitats, the Hamilton Harbour originally contained coolwater, coldwater, and warmwater fish species, however, although it contains an abundance of species, Brown Bullhead (*Ameiurus nebulosus*) and White Perch (*Morone americana*) are among the dominant species as they are tolerant of high turbidity (Bowlby, McCormack, & Heaton, 2010).

Urban Hamilton Beach Strip Watershed

The Urban Hamilton Beach Strip Watershed is located entirely along the spit of land that separates Lake Ontario from Hamilton Harbour. This sand bar extends to the Burlington Canal. Land use within this watershed is mostly comprised of residential and commercial zones, with some natural areas along the shoreline. All drainage flows to either Hamilton Harbour or Lake Ontario.

NATURAL HERITAGE

LEGEND

- ARA Survey Location (GU-7012-RED) (Red Hill Creek)
- ARA Survey Location (GU-7013-RED) (Windermere Basin)
- Double-crested Cormorant (*Phalacrocorax auritus*) Nesting Site/Colony
- Walleye (*Sander vitreus*) Spawning Area
- Railway
- Watercourse - Warm Thermal Regime
- Waterbody - Unknown Thermal Regime
- Beach Boulevard Study Area
- Regulation Limit (HCA)
- Deepwater Sculpin (*Myoxocephalus thompsonii*) Distribution (DFO)
- Waterfowl Winter Concentration Area
- Important Bird Area (West End of Lake Ontario)
- Important Bird Area (Hamilton Harbour Waterbird Colonies)
- Environmentally Significant Area (Hamilton Beach Strip) (City of Hamilton)
- Environmentally Significant Area (Van Wagner's Ponds and Marshes) (City of Hamilton)

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Project:	TA9030	**Figure:**	2
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 14,000	**Checked By:**	GNK

Data Sources: City of Hamilton, Hamilton Conservation Authority (HCA), Bird Studies Canada, Department of Fisheries and Oceans Canada (DFO) & Ministry of Natural Resources and Forestry (LIO). Contains information licenced under the Open Government Licence - Ontario.

Red Hill Creek Watershed

The Red Hill Creek Watershed is comprised of eight subwatersheds within the City of Hamilton, and covers approximately 68 km^2 (Hamilton Conservation Authority, 2013). The watershed contains significant natural features including the Niagara Escarpment, Eramosa Karst/Escarpment, Felker's Falls Escarpment Valley and Red Hill Creek Escarpment Valley, and also contains valleylands, meadows and successional habitats (Hamilton Conservation Authority, 2013). As a result of residential, commercial, and industrial development, this watershed is highly urbanized with many of its watercourses subjected to realignment, channelization, increased surface flows from stormwater runoff, and reduced groundwater flows, all of which have contributed to reduced water quality and thermal degradation (Bowlby, McCormack, & Heaton, 2010). Channel erosion and changes in stream dimensions are noted throughout the watershed because of altered drainage and increased flows from urban sewer systems during high flow and storm events (Bowlby, McCormack, & Heaton, 2010). Red Hill Creek discharges into Hamilton Harbour through the highly industrialized Windermere Basin (Bowlby, McCormack, & Heaton, 2010). The majority of stream reaches within the headwaters of the Red Hill Creek are small, coldwater riverine habitat. As the watercourse proceeds downstream below the Niagara Escarpment towards the Windermere Basin, thermal degradation occurs due to urbanization and low groundwater contribution to base flow, resulting in an intermediate warmwater riverine zone. Brook Stickleback (*Culaea inconstans*) followed by Northern Redbelly Dace (*Chrosomus eos*) make up the majority of the fish community in coldwater zones above the escarpment while Blacknose Dace (*Rhinichthys atratulus*) followed by Longnose Dace (*Rhinichthys cataractae*) are the most common members of the fish community in coldwater zones below the escarpment (Bowlby, McCormack, & Heaton, 2010). The fish community within the intermediate warmwater zone is dominated by Fathead Minnow (*Pimephales promelas*) (Bowlby, McCormack, & Heaton, 2010). Although spawning migrations of Atlantic Salmon (*Salmo salar*) were historically observed in Red Hill Creek, the lack of groundwater contribution and varying thermal regimes within the watershed do not currently provide ideal spawning habitat for salmonids (Bowlby, McCormack, & Heaton, 2010). In efforts to enhance all the water bodies within the Hamilton Harbour watershed, the Hamilton Harbour and Watershed Fisheries Management Plan (HHWFMP) was created to improve aquatic community, aquatic habitat and planning within each watershed.

5.3.2.2 Fish and Fish Habitat

Beach Boulevard Drainage Systems

There are two drainage networks within the Beach Boulevard Community that operate independently of one another to convey storm water into either Hamilton Harbour or the Eastport Ditch. The Beach Boulevard Community is comprised of 17 residential streets that run westerly between Beach Boulevard and the QEW right-of-way. Stormwater runoff from the west ends of these streets is collected by municipal infrastructure or ditches and is conveyed beneath the QEW right-of-way, where it is intercepted by surface runoff from the QEW right-of-way. All Beach Boulevard Community drainage and QEW drainage contributed into the drainage network between Dunraven Avenue and Wickham Drive is directed into Hamilton Harbour by a large diameter storm sewer (MRC, 2008). Alternatively, Beach Boulevard Community drainage and QEW drainage contributed into the drainage network between Wickham Drive and Kirk Avenue are directed into the Eastport Ditch and conveyed into Red Hill Creek (MRC, 2008). A well vegetated 2 m deep, flat-bottomed ditch was created along Eastport Drive (Eastport Ditch) and the QEW with significant depth and cross-sectional area to compensate for the extremely flat longitudinal gradient (MRC, 2008). The Eastport Ditch water levels are coincident with the water levels within the Hamilton Harbour, and the groundwater levels within the Beach Strip which likely contributes to flooding (MRC, 2008). Additionally, field investigations conducted by MRC (2008) during the winter of 2005 were not able to identify several pipe outlets into the Eastport Ditch and noted that they were likely covered beneath sediment or covered by dense, overgrown vegetation.

Eastport Ditch 1

Eastport Ditch 1 is located along the west side of Eastport Drive approximately 295 m south of the Windermere Basin Park entrance. This ditch was created in the late 1990s to redirect drainage from Windermere Basin into the Red Hill Creek (MRC, 2008). To facilitate this, a berm with a series of sewers underneath was constructed to transport storm water from Eastport Ditch 2 upstream, towards Eastport Ditch 1. These sewers collect surface runoff from the QEW right-of-way and municipal storm water infrastructure which outlet into a large 1400 mm Corrugated Steel Pipe (CSP) sewer, and eventually into Eastport Ditch 1 (MRC, 2008).

Flow enters the Eastport Ditch 1 via a CSP reinforced with rip rap. This ditch is approximately 143 m long, confined by its steep banks approximately 2 m in height and is trapezoidal/U-shaped with a flat bottom (approximately 1 m to 1.2 m wide). The lower

banks are reinforced with rip rap while the upper portions are well vegetated with deciduous trees, shrubs and grasses.

This drainage feature is permanent and constitutes direct fish habitat, as a result of its connectivity to Red Hill Creek. Although the thermal regime of this drainage ditch has not been evaluated by MNDMRF, it is identified as warmwater based on its fish community and direct connectivity to Red Hill Creek. In addition to historic fish data provided by MNDMNRF (LIO), fish sampling conducted by LGL on November 9, 2021, identified two warmwater species, Fathead Minnow and Goldfish (*Carassius auratus*) utilizing this drainage ditch. LGL also identified White Sucker (*Catostomus commersonii*) within the drainage ditch during this sampling event. No species at risk are present within the Study Area; however, one provincially tracked species, American Eel (*Anguilla rostrata*), is identified as having the potential to be found within the Study Area through the Natural Heritage Information Center managed by MNDMNRF.

Eastport Ditch 2

Located on the east side of Eastport Drive and situated adjacent to the QEW right-of way, Eastport Ditch 2 flows in a southerly direction along Eastport Drive. Originally, water from this ditch outleted into the Windermere Basin; however, in the late 1990's fill was placed to create a berm separating Eastport Drive and the industrial development and facilitated the placement of a large diameter sewer along the west side of Eastport Drive (MRC, 2008). This sewer is a 1400 mm diameter CSP that is approximately 520 m long with several pipes from the Beach Boulevard community and sewers from the QEW connecting to it (MRC, 2008). The CSP crosses Eastport Drive perpendicularly and outlets into Eastport Ditch 1 on the west side of Eastport Drive, which has been redirected to flow into Red Hill Creek (MRC, 2008).

Flow enters Eastport Ditch 2 via a CSP which LGL fisheries specialists were unable to locate during their April 7, 2021, or November 9, 2021 field investigations as it has likely been buried in sediment. It is likely that this pipe outlet has been buried in sediment for nearly 15 years as field investigators from MRC (2008) that conducted field work in the winter of 2005 did not find this pipe outlet and suggested it was likely buried in sediment or dense vegetation. It should be noted that significantly more water was present within Eastport Ditch 2 during the November 2021 site visit than was present in April of the same year.

Much refuse was noted within the channel consisting of car tires, couches, a mattress, and other various kinds of litter. Riparian vegetation consists of deciduous trees, shrubs

and grasses. Numerous dead Common Carp (*Cyprinus carpio*) were observed within the upstream portion of the channel during the April 2021 site visit.

This drainage feature is permanent and provides direct fish habitat. Although it is piped at the upstream and downstream ends, the presence of fish within the features indicates that one or both pipes do not form a barrier to fish passage, which likely can occur during high flow conditions and/or flooding events. During the November 9, 2021, field investigations, three fish species were captured during sampling: Green Sunfish (*Lepomis cyanellus*), Fathead Minnow and Common Carp. The fish assemblage present suggests this drainage feature supports a warmwater thermal regime. No species at risk are present within the Study Area; however, one provincially tracked species, American Eel, is identified as having the potential to be found within the Study Area through the Natural Heritage Information Center managed by MNDMNRF.

Eastport Ditch 3

This drainage feature is located along the west side of Eastport Drive, situated between Eastport Drive and the Hamilton Harbour basin. Flow is contributed to Eastport Ditch 3 via a 600 mm CSP on the upstream right bank, however, LGL could not locate this outfall during either April 7, 2021 or November 9, 2021 field investigations. Flows in and out of this ditch are unknown as its connectivity to surrounding water (Eastport Ditch 2, storm water system, Tollgate Ponds, Hamilton Harbour), if any, are not visible. The ditch is confined within steeply sloped banks; the upstream left bank is an earth berm which contains the holding pond (Tollgate Ponds) and is approximately 5 m high while the upstream right bank is approximately 2 m high and entirely rip-rap. Substrates, where visible, consist of silt, muck and debris. The ditch is straight, and morphology consists of one long pool as flow is stagnant. Riparian vegetation consisting of *Phragmites*, grasses, and deciduous trees and shrubs were also observed during the field visit. This area contained a large amount of garbage and debris as well.

This drainage feature is permanent and likely constitutes indirect fish habitat. This drainage feature provides poor quality fish habitat; however, given its proximity to Hamilton Harbour, fish may access this drainage feature via culvert access or during flooding events. No thermal regime has been prescribed by the MRNF; however, given the little influx of flow, it is likely warmwater. No fish community records have been identified for this drainage feature, nor were any fish observed or captured during LGL field investigations, as site conditions did not provide a safe working environment for fish sampling. No species at risk are present within the study area, however, one provincially tracked species, American Eel, is identified as having the potential to be

found within the study area through the Natural Heritage Information Center managed by MNDMNRF.

Red Hill Creek

An approximately 1 km reach of Red Hill Creek forms the perimeter of the southwest portion of the Study Area and it is the watercourse into which water from Eastport Ditches 1 and 2 flow. This portion of Red Hill Creek comprises the last reach of the watercourse before it discharges into Hamilton Harbour just outside of the Study Aarea.

The 1 km reach is bounded by the Eastport Drive crossing/Beach Boulevard intersection at the upstream end and the Pier 24/25 Gateway bridge at the downstream end. The north/east shoreline of this reach is located entirely within Windermere Basin Park. The banks are steeply sloped and comprised of rip rap boulders and concrete rubble/debris. Substrates nearshore, where visible, were of the same materials overlaid by silt. Instream cover is provided by substrates and large woody debris. Morphology is flat/run and the water, during the time of the site visits, was moderately turbid. No instream vegetation, submerged or emergent, was observed. The riparian areas of both banks were fairly well vegetated with grasses, shrubs and trees which grew almost down to the water's edge, depending on bank slope heights. The vegetation in Windermere Basin Park consists mainly of open meadow with scattered deciduous trees. Two species of fish were observed within the watercourse during site investigations: Common Carp and Gizzard Shad (*Dorosoma cepedianum*).

Hamilton Harbour

Hamilton Harbour forms the northeastern boundary of the Study Area from the Burlington Canal south to the "Tollgate Ponds", a length of approximately 1.5 km. The shoreline in this section of the harbour is comprised of steep, rock (armourstone, rubble) slopes. This rock protection extends into the lakebed and comprises the nearshore substrates. From Garmin LakeVu data, the bathymetry of the nearshore area is a gradually sloping shallow area (0.3-3.0 m) that extends approximately 120 m into the harbour. West of this shallow area there is a steep drop off that reaches depths of approximately 20 m over a short distance. Although no fish were observed during the site investigations, the Hamilton Harbour shoreline is likely used by a several fish species for a variety of life history functions.

Burlington Canal

The Burlington Canal is a human-made channel that divides the Hamilton Beach area from the Burlington portion of the beach that comprises the northern boundary of the study area. It is approximately 835 m long and 85 m wide. There are no banks as the canal edges are formed by vertical sheet piling walls with groynes that extend approximately 385 m into Lake Ontario and 115 into Hamilton Harbour. South of the harbour groyne there is a boat launch. Bathymetry mapping (Garmin LakeVu) indicated that the canal exhibits a steep drop from the sheet pile wall of approximately 1.5 m to 3.0 m to as deep as 12 m. The canal likely experiences strong wind-driven currents and contains transitional habitats for fish moving between habitats in Lake Ontario and Hamilton Harbour.

Lake Ontario Shoreline

The open shoreline of Lake Ontario forms the eastern boundary of the study area. It is characterized by a riparian area comprised of sand that is between 12 m and 20 m in width. There is a section of armourstone/boulder rock protection at the north end near the Burlington Canal, but most of the substrates in the area are comprised solely of sand. Garmin LakeVu mapping illustrates a gradually sloping bathymetry for approximately 385 m out to a depth of 20 m. Due to the open lake exposure to winds, wave scour, currents and weather-related phenomena (e.g., ice in winter), habitats for fish along the beach are likely limited to fish moving through the area in search of more suitable habitats within Hamilton Harbour or elsewhere along the Lake Ontario shoreline.

5.3.2.3 Species at Risk

A review of the MNRF Natural Heritage Information Centre database and DFO Species at Risk mapping identified one aquatic species at risk, American Eel, as present within the Study Area. DFO mapping also indicates that a distribution of Deepwater Sculpin (*Myoxocephalus thompsonii*) is located within a pocket of the Hamilton Harbour approximately 100 m west of the study area.

American Eel is regulated provincially as “Endangered” under the Ontario Endangered Species Act, 2007 (ESA) and listed as “Threatened” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). American Eel is not regulated or afforded protection under the federal Species at Risk Act (SARA). Deepwater Sculpin is regulated federally under SARA and COSEWIC as “Special Concern”. Deepwater Sculpin is not afforded protection under the ESA.

5.3.3 Terrestrial Resources

5.3.3.1 Vegetation and Vegetation Communities

The geographical extent, composition, structure and function of the vegetation communities were identified through air photo interpretation and field investigations. Air photos were interpreted to determine the limits and characteristics of the vegetation communities in the Study Area. Multi-season botanical field investigations were undertaken within the Study Area on May 27th, July 21st, and October 7th, 2021. The vegetation communities were classified according to the Ecological Land Classification for Southern Ontario: First Approximation and Its Application (Lee, et al., 1998).

Vegetation communities identified within the Study Area consist of a mixture of cultural communities and natural/semi-natural communities including: forest, wetlands, and, sand dunes.

Cultural communities include Dry-Moist Old Field Meadow (CUM1-1), Mineral Cultural Thicket (CUT1), Mineral Cultural Savannah (CUS1), and Mineral Cultural Woodland (CUW1). In general, the cultural vegetation communities were identified in areas where regular or past disturbances have occurred (i.e., adjacent to roadways or previous industrial sites) and were observed to be in a disturbed state. These areas contained a high proportion of invasive and/or non-native plant species that are disturbance tolerant. Overall, the quality of these communities is considered to be low.

As noted above, the natural/semi-natural features identified with the Study Area include forest, wetland and sand dune communities. A single deciduous forest (FOD4) type was identified within the Study Area. Two FOD4 communities were identified within the Study Area including a linear community adjacent to the Queen Elizabeth Way and a small community adjacent to the Watefront Trail. Given the close proximity of these communities to infrastructure, they were observed to be highly influenced by anthropogenic disturbance and generally supported a high proportion of non-native, disturbance tolerant plant species. In general, the deciduous forest communities within the study area would be considered to be of low quality.

A total of three wetland community types were identified within the study area including Meadow Marsh (MAM and MAM2-2), Shallow Marsh (MAS) and Swamp Thicket (SWT2-2). The wetlands within the Study Area were generally associated with the drainage features within the Study Area. The wetlands within the Study Area generally supported a low diversity of plant species and would be considered to be of low to moderate quality.

A large sand dune system was identified along the Waterfront Trail adjacent to Lake Ontario and extends the entire length of the study area. The sand dunes consisted of a mixture of Open Sand Dunes (SDO and SDO1-1), Shrub Sand Dune (SDS1), and Tree Sand Dune (SDT1 and SDT1-1) communities. Restoration efforts have been undertaken within the north portion of the sand dunes including the removal of nonnative plant species and the planting of native dune plant species including short-liguled beach grass (*Ammophila breviligulata*) and Indian grass (*Sorghastrum nutans*). Restoration efforts where most evident in the SDO1-1 communities where the species composition was almost entirely native plant species. Anthropogenic disturbance was widespread across the dunes including the planting of ornamental, non-native plant species by adjacent landowners and previous clearing of the hydro corridor which resulted in the removal of a large portion of tree cover. Overall, the sand dunes are considered to be of moderate habitat quality.

Overall, the vegetation communities identified within the study area are considered widespread and common in Ontario and are secure globally with the exception of one community. A review of the NHIC indicates that the Little Bluestem-Switch Grass-Beach grass Open Dune (SDO1-1) community identified along the Waterfront Trail is considered a S2 (Imperilled) vegetation community within Ontario.

The limits of the vegetation communities are delineated in on Figure 3 to Figure 3.12 of the Natural Heritage Report provided in this section further below.

Flora

A total of 136 plant species were recorded within the Study Area. Four of these plants could only be identified to genus and are not included in the following calculations. Of the 132 plant species identified, 51 (39%) plant species identified are native to Ontario and 81 (61%) plant species are considered introduced and non-native to Ontario. A list of vascular plants is presented in Appendix B of the Natural Heritage Report provided in Appendix D.

Species at Risk

No plant species that are regulated under the Ontario Endangered Species Act (ESA) or the Canada Species at Risk Act (SARA) were encountered during LGL's botanical investigation within the Study Area (those plant species regulated as Endangered, Threatened, or Special Concern).

Provincially/Locally Rare Plant Species

Five plant species that are considered rare or uncommon within Hamilton were identified within the Study Area. In addition, short-liguled beach grass, which is considered provincially rare, was also identified within the Study Area. The graphic below provides a list of the rare species that were identified, the applicable SRank and which vegetation community each species was identified within. The majority of rare species occurrences were within the dune system along the Waterfront Trail. A description of species rank definitions is presented in Appendix C of the Natural Heritage Report provided in Appendix D.

Figure 5-2: Significant Plant Species identified within the Study Area

Scientific Name	Common Name	SRank	Hamilton	Vegetation Community							
				CUM1-1	CUT1	FOD4	SDO	SDO1-1	SDS	SDT	SDT1-1
Celtis occidentalis	common hackberry	S4	h		X	X					
Ammophila breviligulata	short-liguled beach grass	S3	H				X	X	X	X	X
Elymus canadensis	nodding wild rye	S4S5	H	X							
Schizachyrium scoparium	little bluestem	S4	H				X				
Sorghastrum nutans	Indian grass	S4	H					X			

H – indicates a rare species in Hamilton, h – indicates an uncommon species in Hamilton

5.3.3.2 Wildlife and Wildlife Habitat

Field investigations were conducted by LGL with the purpose of documenting wildlife and wildlife habitat and to characterize the nature, extent, and significance of wildlife usage within the study area. In addition to targeted breeding bird and anuran call surveys, incidental observations of wildlife species were also documented during each site visit. Direct observations, calls and tracks were used to record wildlife presence within the study area. Field investigations were conducted on April 8, May 13, June 10, June 20 and July 10, 2021.

In addition, information regarding wildlife and wildlife habitat within the Study Area was obtained through a number of secondary information sources, including, but not limited to, Natural Heritage Information Centre data from the MNDMNRD, Ontario Breeding

Bird Atlas. 2001 – 2005, Hamilton Natural Areas Inventory Project 3rd Edition, Atlas of the Mammals of Ontario.

Wildlife Habitat

Overall, lands within the Study Area are highly disturbed as a result of residential development and wide-spread industrial land use. Natural heritage features were identified in association with Red Hill Creek, which is located in the southwest section of the Study Area. Red Hill Creek may provide important function for aquatic bird and herpetofauna species. Red Hill Creek and portions of Hamilton Harbour (in the vicinity of the Study Area) may function as waterfowl stop-over areas in the spring and fall. Eastport Ditch is also located between Eastport Drive and the QEW along much of the Study Area; however, this drainage feature was found to be highly disturbed and offered limited habitat function for wildlife species. Windermere Basin Park contained several ephemeral meadow marsh communities; however, these features were found to be dominated by invasive vegetation (*Phragmites spp.*) and targeted surveys did not find significant function for anuran or bird species.

No interior forest habitat was identified within the limits of the Study Area. Interior forest is generally defined as forested cover located at least 100 m from non-forested land cover. Only relatively small and highly disturbed deciduous forest communities were identified at several locations across the Study Area. Based on the habitat types present, wildlife species which occupy woodland edges, open country/agricultural, aquatic and anthropogenic communities are expected to occupy the Study Area.

There are no provincially significant wetlands (PSWs) or areas of natural and scientific interest (ANSIs) located within the Study Area; however, there are several natural heritage areas that are associated with municipal parks including Hamilton Beach, Windemere Basin Park, Skyway Park, Reg Wheeler Park, Nixon Park, Kinsman Park, Dieppe Veterans Memorial Park, and Jimmy Lomax Park. The Hamilton Beach Strip, located along the Lake Ontario and Hamilton Harbour shorelines, is designated as an Environmentally Sensitive Area (ESA). The West End of Lake Ontario and Hamilton Harbour Waterbird Colonies are recognized as Important Bird Areas (IBA) and Waterfowl Winter Concentration Areas.

5.3.3.3 Fauna

Anurans

Anuran surveys were completed to document the occurrence of frog and toad species, identify potential breeding areas, and estimate breeding population levels within the

Study Area. Anuran surveys were conducted on three separate nights between April 8 and July 20, 2021 using methodologies outlined in the Great Lakes Marsh Monitoring Program (2000). Three anuran breeding stations were strategically placed where amphibian breeding habitat was suspected, based on air-photo interpretation and a ground-truthing review of the study area (see Figure 3 to Figure 3.12 of the Natural Heritage Report provided in this section further below).

No evidence of anuran breeding evidence was documented during 2021 surveys. No herpetofauna species were identified during field investigations.

Breeding Birds

Breeding bird surveys were conducted on two mornings during the 2021 breeding bird season (June 10 and July 10, 2021) to document breeding bird evidence and to characterize the nature, extent and significance of breeding bird usage of the habitats within the Study Area. Breeding bird survey methodology and breeding bird behaviours used as evidence of breeding success were categorized according to the Breeding Bird Atlas five-year surveys organized by Bird Studies Canada (Cadman et al., 2007).

Thirty-eight bird species were documented during targeted breeding bird surveys conducted within the Study Area. The bird species identified during field investigations are species typically associated with open-country/agricultural, forest edge, aquatic and anthropogenic habitat types. Results of breeding bird surveys are summarized in Appendix D of the Natural Heritage Report provided in Appendix D.

Notably, Barn Swallow (*Hirundo rustica*), Chimney Swift (*Chaetura pelagica*) and Peregrine Falcon (*Falco peregrinus*) (all species at risk) were identified within the Study Area; however, no evidence of nesting of these species was identified. Migratory bird species are expected to be nesting across much of the Study Area.

Mammal Species

Two mammal species were recorded in the Study Area during field investigations. Several eastern cottontail (*Sylvilagus floridanus*) were observed along trails within Windermere Basin Park. Scat from American mink (Neovison vison) was noted along rocky shorelines associated with Windermere Basin Park. A modest assemblage of mammal species which occupy aquatic, treed and open country/anthropogenic habitats are expected to occupy the study area. Small areas of deciduous forest habitat found across the Study Area contained trees which would be considered limited in their suitability to support bat roosting habitat.

LEGEND

- Amphibian Monitoring Station
- Breeding Bird Point Count Station
- Eastport Ditch Drainage System
- Beach Boulevard Study Area

Vegetation Communities

- Vegetation Community Boundary

BBO1	Mineral Open Beach/Bar Ecosite
CUM1-1	Dry-Moist Old Field Meadow Type
CUS1	Mineral Cultural Savannah Ecosite
CUT1	Mineral Cultural Thicket Ecosite
CUT1-1	Sumac Cultural Thicket Type
CUW1	Mineral Cultural Woodland Ecosite
D	Disturbed
FOD4	Dry-Fresh Deciduous Forest Ecosite
M	Manicured
MAM2	Mineral Meadow Marsh Ecosite
MAM2-2	Reed-canary Grass Mineral Meadow Marsh Type
MAS	Shallow Marsh
SDO1	Open Sand Dune Ecosite
SDO1-1	Little Bluestem-Switchgrass-Beachgrass Open Dune Type
SDS1	Shrub Sand Dune Ecosite
SDT1	Treed Sand Dune Ecosite
SDT1-1	Cottonwood Treed Dune Type
SWT2	Mineral Thicket Swamp Ecosite
SWT2-2	Willow Mineral Thicket Swamp Type

Data Sources: LGL Limited field surveys, City of Hamilton & Ministry of Natural Resources and Forestry (LIO). Contains information licenced under the Open Government Licence - Ontario.

0 20 40 60 80 m

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EXISTING CONDITIONS

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environmental research associates

Project:	TA9030	**Figure:**	3.1
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 2,000	**Checked By:**	LMC

LEGEND

- Amphibian Monitoring Station
- Breeding Bird Point Count Station
- Eastport Ditch Drainage System
- Beach Boulevard Study Area

Vegetation Communities

- Vegetation Community Boundary

BBO1	Mineral Open Beach/Bar Ecosite
CUM1-1	Dry-Moist Old Field Meadow Type
CUS1	Mineral Cultural Savannah Ecosite
CUT1	Mineral Cultural Thicket Ecosite
CUT1-1	Sumac Cultural Thicket Type
CUW1	Mineral Cultural Woodland Ecosite
D	Disturbed
FOD4	Dry-Fresh Deciduous Forest Ecosite
M	Manicured
MAM2	Mineral Meadow Marsh Ecosite
MAM2-2	Reed-canary Grass Mineral Meadow Marsh Type
MAS	Shallow Marsh
SDO1	Open Sand Dune Ecosite
SDO1-1	Little Bluestem-Switchgrass-Beachgrass Open Dune Type
SDS1	Shrub Sand Dune Ecosite
SDT1	Treed Sand Dune Ecosite
SDT1-1	Cottonwood Treed Dune Type
SWT2	Mineral Thicket Swamp Ecosite
SWT2-2	Willow Mineral Thicket Swamp Type

Data Sources: LGL Limited field surveys, City of Hamilton & Ministry of Natural Resources and Forestry (LIO). Contains information licenced under the Open Government Licence - Ontario.

0 20 40 60 80 m

N

EXISTING CONDITIONS

LGL LIMITED
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Project:	TA9030	**Figure:**	3.2
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 2,000	**Checked By:**	LMC

LEGEND

- Amphibian Monitoring Station
- Breeding Bird Point Count Station
- Eastport Ditch Drainage System
- Beach Boulevard Study Area

Vegetation Communities

- Vegetation Community Boundary

BBO1	Mineral Open Beach/Bar Ecosite
CUM1-1	Dry-Moist Old Field Meadow Type
CUS1	Mineral Cultural Savannah Ecosite
CUT1	Mineral Cultural Thicket Ecosite
CUT1-1	Sumac Cultural Thicket Type
CUW1	Mineral Cultural Woodland Ecosite
D	Disturbed
FOD4	Dry-Fresh Deciduous Forest Ecosite
M	Manicured
MAM2	Mineral Meadow Marsh Ecosite
MAM2-2	Reed-canary Grass Mineral Meadow Marsh Type
MAS	Shallow Marsh
SDO1	Open Sand Dune Ecosite
SDO1-1	Little Bluestem-Switchgrass-Beachgrass Open Dune Type
SDS1	Shrub Sand Dune Ecosite
SDT1	Treed Sand Dune Ecosite
SDT1-1	Cottonwood Treed Dune Type
SWT2	Mineral Thicket Swamp Ecosite
SWT2-2	Willow Mineral Thicket Swamp Type

Data Sources: LGL Limited field surveys, City of Hamilton & Ministry of Natural Resources and Forestry (LIO). Contains information licenced under the Open Government Licence - Ontario.

0 20 40 60 80 m

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EXISTING CONDITIONS

LGL LIMITED
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Project:	TA9030	**Figure:**	3.3
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 2,000	**Checked By:**	LMC

LEGEND

- Amphibian Monitoring Station
- Breeding Bird Point Count Station
- Eastport Ditch Drainage System
- Beach Boulevard Study Area

Vegetation Communities

- Vegetation Community Boundary

BBO1	Mineral Open Beach/Bar Ecosite
CUM1-1	Dry-Moist Old Field Meadow Type
CUS1	Mineral Cultural Savannah Ecosite
CUT1	Mineral Cultural Thicket Ecosite
CUT1-1	Sumac Cultural Thicket Type
CUW1	Mineral Cultural Woodland Ecosite
D	Disturbed
FOD4	Dry-Fresh Deciduous Forest Ecosite
M	Manicured
MAM2	Mineral Meadow Marsh Ecosite
MAM2-2	Reed-canary Grass Mineral Meadow Marsh Type
MAS	Shallow Marsh
SDO1	Open Sand Dune Ecosite
SDO1-1	Little Bluestem-Switchgrass-Beachgrass Open Dune Type
SDS1	Shrub Sand Dune Ecosite
SDT1	Treed Sand Dune Ecosite
SDT1-1	Cottonwood Treed Dune Type
SWT2	Mineral Thicket Swamp Ecosite
SWT2-2	Willow Mineral Thicket Swamp Type

Data Sources: LGL Limited field surveys, City of Hamilton & Ministry of Natural Resources and Forestry (LIO). Contains information licenced under the Open Government Licence - Ontario.

0 20 40 60 80 m

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EXISTING CONDITIONS

LGL LIMITED
environmental research associates

Project:	TA9030	**Figure:**	3.4
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 2,000	**Checked By:**	LMC

LEGEND

- Amphibian Monitoring Station
- Breeding Bird Point Count Station
- Eastport Ditch Drainage System
- Beach Boulevard Study Area

Vegetation Communities

- Vegetation Community Boundary

BBO1	Mineral Open Beach/Bar Ecosite
CUM1-1	Dry-Moist Old Field Meadow Type
CUS1	Mineral Cultural Savannah Ecosite
CUT1	Mineral Cultural Thicket Ecosite
CUT1-1	Sumac Cultural Thicket Type
CUW1	Mineral Cultural Woodland Ecosite
D	Disturbed
FOD4	Dry-Fresh Deciduous Forest Ecosite
M	Manicured
MAM2	Mineral Meadow Marsh Ecosite
MAM2-2	Reed-canary Grass Mineral Meadow Marsh Type
MAS	Shallow Marsh
SDO1	Open Sand Dune Ecosite
SDO1-1	Little Bluestem-Switchgrass-Beachgrass Open Dune Type
SDS1	Shrub Sand Dune Ecosite
SDT1	Treed Sand Dune Ecosite
SDT1-1	Cottonwood Treed Dune Type
SWT2	Mineral Thicket Swamp Ecosite
SWT2-2	Willow Mineral Thicket Swamp Type

Data Sources: LGL Limited field surveys, City of Hamilton & Ministry of Natural Resources and Forestry (LIO). Contains information licenced under the Open Government Licence - Ontario.

0 20 40 60 80 m

EXISTING CONDITIONS

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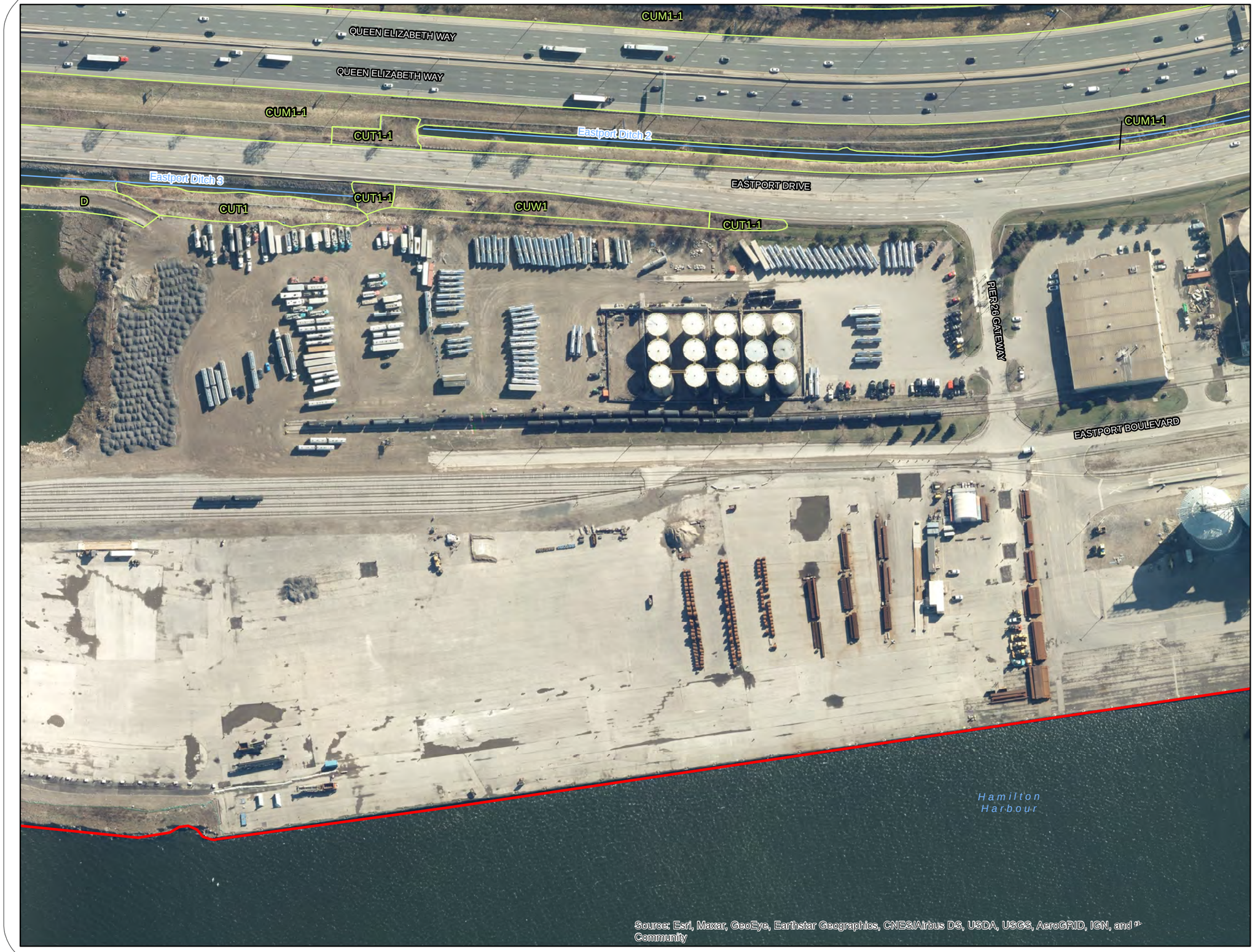
environmental research associates

Project:	TA9030	**Figure:**	3.5
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 2,000	**Checked By:**	LMC



LEGEND

- Amphibian Monitoring Station
- Breeding Bird Point Count Station
- Eastport Ditch Drainage System
- Beach Boulevard Study Area

Vegetation Communities

- Vegetation Community Boundary

BBO1	Mineral Open Beach/Bar Ecosite
CUM1-1	Dry-Moist Old Field Meadow Type
CUS1	Mineral Cultural Savannah Ecosite
CUT1	Mineral Cultural Thicket Ecosite
CUT1-1	Sumac Cultural Thicket Type
CUW1	Mineral Cultural Woodland Ecosite
D	Disturbed
FOD4	Dry-Fresh Deciduous Forest Ecosite
M	Manicured
MAM2	Mineral Meadow Marsh Ecosite
MAM2-2	Reed-canary Grass Mineral Meadow Marsh Type
MAS	Shallow Marsh
SDO1	Open Sand Dune Ecosite
SDO1-1	Little Bluestem-Switchgrass-Beachgrass Open Dune Type
SDS1	Shrub Sand Dune Ecosite
SDT1	Treed Sand Dune Ecosite
SDT1-1	Cottonwood Treed Dune Type
SWT2	Mineral Thicket Swamp Ecosite
SWT2-2	Willow Mineral Thicket Swamp Type

Data Sources: LGL Limited field surveys, City of Hamilton & Ministry of Natural Resources and Forestry (LIO). Contains information licenced under the Open Government Licence - Ontario.

0 20 40 60 80 m

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EXISTING CONDITIONS

LGL LIMITED
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Project:	TA9030	**Figure:**	3.6
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 2,000	**Checked By:**	LMC

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

- Amphibian Monitoring Station
- Breeding Bird Point Count Station
- Eastport Ditch Drainage System
- Beach Boulevard Study Area

Vegetation Communities

- Vegetation Community Boundary

BBO1	Mineral Open Beach/Bar Ecosite
CUM1-1	Dry-Moist Old Field Meadow Type
CUS1	Mineral Cultural Savannah Ecosite
CUT1	Mineral Cultural Thicket Ecosite
CUT1-1	Sumac Cultural Thicket Type
CUW1	Mineral Cultural Woodland Ecosite
D	Disturbed
FOD4	Dry-Fresh Deciduous Forest Ecosite
M	Manicured
MAM2	Mineral Meadow Marsh Ecosite
MAM2-2	Reed-canary Grass Mineral Meadow Marsh Type
MAS	Shallow Marsh
SDO1	Open Sand Dune Ecosite
SDO1-1	Little Bluestem-Switchgrass-Beachgrass Open Dune Type
SDS1	Shrub Sand Dune Ecosite
SDT1	Treed Sand Dune Ecosite
SDT1-1	Cottonwood Treed Dune Type
SWT2	Mineral Thicket Swamp Ecosite
SWT2-2	Willow Mineral Thicket Swamp Type

Data Sources: LGL Limited field surveys, City of Hamilton & Ministry of Natural Resources and Forestry (LIO). Contains information licenced under the Open Government Licence - Ontario.

0 20 40 60 80 m

EXISTING CONDITIONS

LGL LIMITED environmental research associates

Project:	TA9030	**Figure:**	3.7
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 2,000	**Checked By:**	LMC

LEGEND

- Amphibian Monitoring Station
- Breeding Bird Point Count Station
- Eastport Ditch Drainage System
- Beach Boulevard Study Area

Vegetation Communities

- Vegetation Community Boundary

BBO1	Mineral Open Beach/Bar Ecosite
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CUT1	Mineral Cultural Thicket Ecosite
CUT1-1	Sumac Cultural Thicket Type
CUW1	Mineral Cultural Woodland Ecosite
D	Disturbed
FOD4	Dry-Fresh Deciduous Forest Ecosite
M	Manicured
MAM2	Mineral Meadow Marsh Ecosite
MAM2-2	Reed-canary Grass Mineral Meadow Marsh Type
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SDO1-1	Little Bluestem-Switchgrass-Beachgrass Open Dune Type
SDS1	Shrub Sand Dune Ecosite
SDT1	Treed Sand Dune Ecosite
SDT1-1	Cottonwood Treed Dune Type
SWT2	Mineral Thicket Swamp Ecosite
SWT2-2	Willow Mineral Thicket Swamp Type

Data Sources: LGL Limited field surveys, City of Hamilton & Ministry of Natural Resources and Forestry (LIO). Contains information licenced under the Open Government Licence - Ontario.

0 20 40 60 80 m

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EXISTING CONDITIONS

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Project:	TA9030	**Figure:**	3.8
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 2,000	**Checked By:**	LMC

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

- Amphibian Monitoring Station
- Breeding Bird Point Count Station
- Eastport Ditch Drainage System
- Beach Boulevard Study Area

Vegetation Communities

- Vegetation Community Boundary

BBO1	Mineral Open Beach/Bar Ecosite
CUM1-1	Dry-Moist Old Field Meadow Type
CUS1	Mineral Cultural Savannah Ecosite
CUT1	Mineral Cultural Thicket Ecosite
CUT1-1	Sumac Cultural Thicket Type
CUW1	Mineral Cultural Woodland Ecosite
D	Disturbed
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MAM2	Mineral Meadow Marsh Ecosite
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SDO1-1	Little Bluestem-Switchgrass-Beachgrass Open Dune Type
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SDT1	Treed Sand Dune Ecosite
SDT1-1	Cottonwood Treed Dune Type
SWT2	Mineral Thicket Swamp Ecosite
SWT2-2	Willow Mineral Thicket Swamp Type

Data Sources: LGL Limited field surveys, City of Hamilton & Ministry of Natural Resources and Forestry (LIO). Contains information licenced under the Open Government Licence - Ontario.

0 20 40 60 80 m

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EXISTING CONDITIONS

LGL LIMITED
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Project:	TA9030	**Figure:**	3.9
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 2,000	**Checked By:**	LMC

LEGEND

- Amphibian Monitoring Station
- Breeding Bird Point Count Station
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- Beach Boulevard Study Area

Vegetation Communities

- Vegetation Community Boundary

BBO1	Mineral Open Beach/Bar Ecosite
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CUT1-1	Sumac Cultural Thicket Type
CUW1	Mineral Cultural Woodland Ecosite
D	Disturbed
FOD4	Dry-Fresh Deciduous Forest Ecosite
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SDT1	Treed Sand Dune Ecosite
SDT1-1	Cottonwood Treed Dune Type
SWT2	Mineral Thicket Swamp Ecosite
SWT2-2	Willow Mineral Thicket Swamp Type

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0 20 40 60 80 m

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EXISTING CONDITIONS

LGL LIMITED
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Project:	TA9030	**Figure:**	3.10
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 2,000	**Checked By:**	LMC

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

- Amphibian Monitoring Station
- Breeding Bird Point Count Station
- Eastport Ditch Drainage System
- Beach Boulevard Study Area

Vegetation Communities

- Vegetation Community Boundary

BBO1	Mineral Open Beach/Bar Ecosite
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CUT1-1	Sumac Cultural Thicket Type
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D	Disturbed
FOD4	Dry-Fresh Deciduous Forest Ecosite
M	Manicured
MAM2	Mineral Meadow Marsh Ecosite
MAM2-2	Reed-canary Grass Mineral Meadow Marsh Type
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SDO1-1	Little Bluestem-Switchgrass-Beachgrass Open Dune Type
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SDT1	Treed Sand Dune Ecosite
SDT1-1	Cottonwood Treed Dune Type
SWT2	Mineral Thicket Swamp Ecosite
SWT2-2	Willow Mineral Thicket Swamp Type

Data Sources: LGL Limited field surveys, City of Hamilton & Ministry of Natural Resources and Forestry (LIO). Contains information licenced under the Open Government Licence - Ontario.

0 20 40 60 80 m

N

EXISTING CONDITIONS

LGL LIMITED
environmental research associates

Project:	TA9030	**Figure:**	3.11
Date:	March, 2022	**Prepared By:**	JJP
Scale:	1 : 2,000	**Checked By:**	LMC

5.4 Physical Environment

5.4.1 Groundwater/Geology

5.4.1.1 Overview

A preliminary hydrogeological investigation has been completed to support the overall study. Further details and supporting figures are provided in Appendix E. It should be noted that no field investigation has been included as part of this scope of work.

The Beach Boulevard Community in Hamilton is a unique settlement due to its geography and physical form linking Hamilton to Burlington and also creating the embayment for Hamilton Harbour and Cootes Paradise. Unfortunately, it is this form, low-lying, proximate to lake and harbour, with permeable geology, which also makes the area highly flood prone.

The site consists of a spit-like feature that is surrounded by Lake Ontario and Hamilton Harbour to the east, north and west sides. The topography is relatively flat with slight dips towards the surface water surrounding the site. The site as a whole is very close to lake level. The topography and surface water features are shown in Figure 3 (ref. Appendix E).

5.4.1.2 Physiography and Geology

The site consists of beach deposits, possibly some sand plains associated with the sandy shoreline deposits commonly associated with the Iroquois Plain Physiographic Region. The physiography is shown in Figure 2 (ref. Appendix E).

The surficial geology mapping available for the site shows the site consists of coarse-textured lacustrine deposits, sand, gravel, minor silt and clay, and littoral deposits. These are consistent with glaciolacustrine beach and sand deposits that would be associated with Glacial Lake Iroquois. Surficial geology mapping for site is included in Figure 4 (ref. Appendix E).

Where bedrock is encountered at the site, it has been mapped as a mixture of shale, limestone, dolostone and siltstone interbeds associated with the Queenston Formation. The bedrock geology mapping is shown in Figure 5 (ref. Appendix E).

5.4.1.3 Water Well Records and PTTWs

Wood reviewed the water well records within a 500 m radius of the site to look for stratigraphic, hydrostratigraphic and groundwater information for the site. The individual well locations are shown in Figure 1 (ref. Appendix E).

In this review, Wood examined a total of 86 individual well records. Of these records, none of them were pumping wells, they generally all consisted of test wells or monitoring wells with limited hydrogeological information included. There were no current or former water supply wells included in this area that could provide any kind of hydraulic conductivity or pumping information for the local subsurface. A summary table of the details of the wells reviewed is included in Appendix E.

Additionally, there were no Permits To Take Water (PTTWs) issued within this area according to the online database maintained by the Ministry of the Environment, Conservation and Parks (MECP).

5.4.1.4 Groundwater Levels and Fluctuation

As no field investigation has been completed at the site, groundwater level data was collected from those water well records which included information across the site. This primarily consisted of what depths the individual drillers recorded they found water at. This depth varied between wells, ranging between 0.4 m and 3.3 m. The most consistent results suggested the groundwater level may be found between approximately 1.0 m and 3.0 m below ground surface.

The groundwater system at the site is unconfined and given the proximity of Lake Ontario and Hamilton Harbour and their relative size, the groundwater system, including seasonal fluctuation, would be heavily tied to those surface water systems. This means that the overall seasonal fluctuation at the site is likely low and would roughly follow that of the surrounding surface water. Additionally, groundwater flow would likely be towards the surrounding surface water.

5.4.1.5 Groundwater Chemistry

No groundwater chemistry data was included in the water well records so the groundwater quality across the site is unknown. Groundwater sampling could be included in future field programs to evaluate the groundwater quality for treatment or infrastructure design considerations.

5.4.1.6 Pumping and Removal of Groundwater

Based on the currently available information, it is not possible to provide estimates of groundwater takings at this time.

In order to evaluate or determine the need for and potential sizing of any dewatering systems for the site, site investigations would be required that should include hydraulic conductivity testing. This should consist of single well response testing at a minimum, but given the sandy nature of the soils, one or more pumping tests may provide better local characterization and provide some idea of potential impacts from any system installations being considered.

5.5 Technical Environment

5.5.1 Hydrology/Hydraulics

5.5.1.1 Previous Modelling and Potential Platforms

Hydrologic and hydraulic models were developed in various platforms in the previous studies, including:

- OTTSWMM and EXTRAN (Master Drainage Plan, Hamilton Beach, MMM, 1999)
- XPSWMM (Existing Conditions Drainage Investigation & Preliminary Design of Flood Protection for Beach Boulevard Community, MCR, 2008)
- PCSWMM (Stormwater Ponding Study for Beach Boulevard Community, Dillon, 2019).

The modelling from the 1999 and 2008 studies is considered too dated to be applicable for the current study directly, particularly given that the modelling platforms noted are no longer generally supported.

It has therefore been proposed to utilize PCSWMM for the modelling for the current study. This ensures some consistency with the work completed as part of the recent Stormwater Ponding Study (Dillon, 2019).

PCSWMM is a graphical user interface (GUI) which utilizes the US EPA-SWMM modelling code for model execution. PCSWMM includes both hydrologic and hydraulic modelling routines and is capable of completing integrated hydrologic and hydraulic analyses. The analyses can be used to assess storm sewer capacity, calculate flooding depths of overland drainage systems, and evaluate stormwater feature performance, including a dedicated Low Impact Development (LID) toolkit.

PCSWMM also includes a routine for simulating quasi 2-dimensional (2D) hydraulics, through the development of a series of equivalent 1-dimensional (1D) elements. 2D modelling allows for a more fulsome assessment of areas of spill flows or areas with flat topography

5.5.1.2 Limitations of Previous Modelling

The PCSWMM model generated from the previous Stormwater Ponding Study (Dillon 2019) was previously reviewed by Wood in June 2020 to determine whether it could reasonably be re-used for the current study. A number of potential limitations were identified with the modelling, as summarized herein.

Hydrology

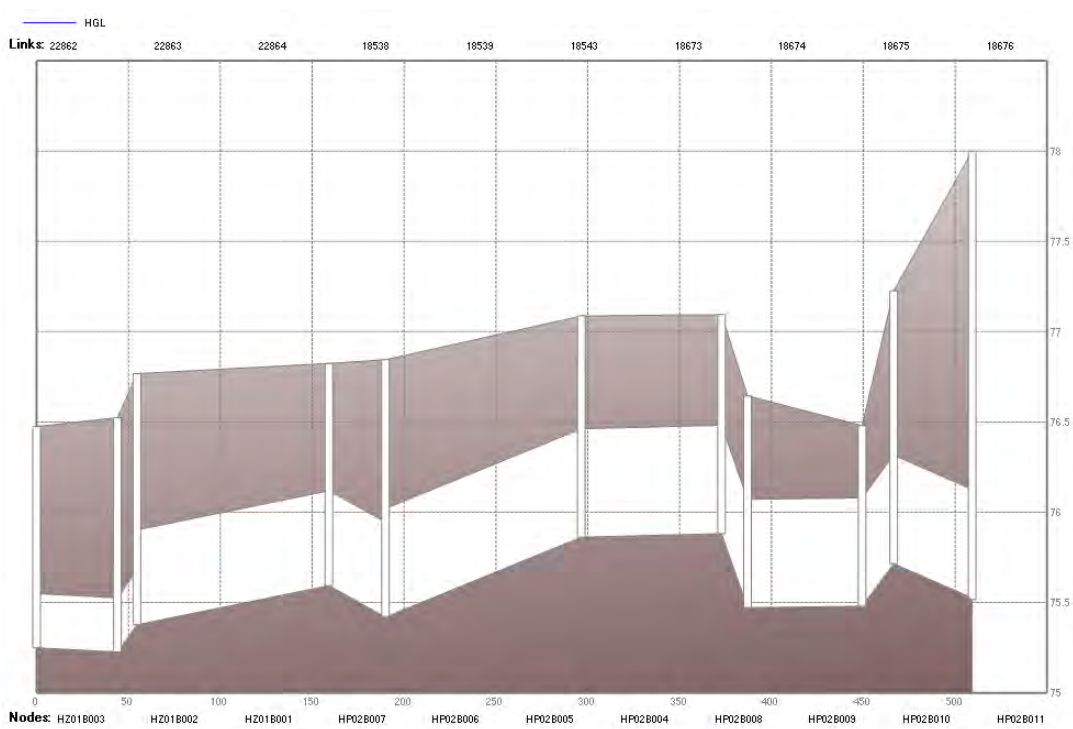
- Subcatchment resolution is considered too coarse for implementation into a 2D hydraulic model. Drainage areas are fairly resolute for those locations draining to "ditches" (i.e. those along Eastport and QEW) however those areas draining to "outlets" (residential areas) are much coarser (i.e. 7 subcatchments for 52 ha of contributing drainage (7.5 ha average)). These flows are uniformly applied to the outlets. This is considered too coarse a resolution to provide distributed inflows to the 2D mesh, and therefore misses the internal flow contributions within the subdivisions to assess local ponding/surface flow considerations. This is evident in the simulated 2D results, as large portions of the residential area indicate no ponding even during large storm events.
- The Manning's for impervious overland flow is considered to be an order of magnitude greater than typical values (0.11, this is typically in the range of 0.014 for impervious land segments)
- Default values or standard assumptions for overland flow length/width were used which do not all seem reasonable (i.e. 80 m flow width for a 15.4 ha subcatchment, 100 m flow width for a 0.8 ha subcatchment)
- The modelled infiltration rate may require review. Although the surficial soils would be expected to sand-based (as described in Section 5.4), the applied hydraulic conductivity of 120 mm/hr is extremely high. May need to consider impacts of ground cover in limiting infiltration, as well as high groundwater and other issues.
- The assumed sump pumping rate (as per Section 2.3.2 of the Dillon Report) was evenly split between the 8 outlets with a steady flow applied at each node. Each of the outlets would have different populations/pumping so it is unclear why this would not be allocated based on number of residences rather than divided

evenly. Also, the flows should be allocated through the sewer network rather than all at one lumped location.

Hydraulics

- The 2D mesh was developed from a Digital Terrain Model (DTM) which in turn was generated using the City's existing 1 m contours rather than an actual more resolute DTM. The vertical accuracy\resolution of the source DTM itself is also considered to be fairly low. Given the flat topography of the Beach Boulevard Community this may be a concern.
- The Grafton Street pumping station in included in the modelling, however the modelling indicates that it floods substantially in the modelling, and that flow is simply lost from the system (does not spill to surface or back up sewers). The operation should likely be refined to better represent its operation.
- The storm sewer system appears incorrectly represented. From the review it appears that the City's storm sewer GIS data was directly imported, and numerous assumptions were made (1 m depth applied uniformly). As presented in Figure 5-3, this does not result in meaningful or representative sewer profiles.

Figure 5-3: Example Sewer Profile from Stormwater Ponding Study PCSWMM Model



- The catchbasins and inlets within the drainage system are modelled as rating curves with a fixed capacity. This would not account for conditions where the storm sewer surcharges and catchbasins would operate in reverse flow condition. This also does not account for differing inlet capacities at sag points as compared to on grade catchbasins and inlets.
- Some of the outlets/culverts in the modelling have separate outfalls rather than being connected to downstream channels/ditches (i.e. does not account for dynamic boundary conditions).
- The ditches are coded in as 1D elements (trapezoidal channels with default geometries) but in some cases the ditches overlap with the limits of the 2D mesh. It may be more appropriate to simply include these features in a fulsome 2D mesh so that dynamic interactions are properly considered.

In summary, while there are elements of the Stormwater Ponding Study modelling which may be reusable for the current study there several areas of concern as noted. The key concerns include:

1. Storm sewer elevation data does not appear to be accurate and should be revised.
2. Topography data (DTM) used for the 2D mesh elevations appears to be of low accuracy and may not reasonably represent surface drainage patterns.
3. Various modelling connectivity issues and modelling parameters need to be amended or refined

Based on the preceding, Wood has concluded that a new PCSWMM model should be developed for the current study, which may utilize elements from the previous Stormwater Ponding Study to the extent possible. The proposed modelling approach is presented in section 5.5.1.4; the modelling will be developed as part of Phase 2 of the current study.

5.5.1.3 Topographic Data

As noted previously, a key constraint with the previously completed modelling was the accuracy of the available topography data. Given the flat topography of the Beach Boulevard Community, a high accuracy topographic surface is considered important both to the delineation of representative drainage boundaries, but also more critically for 2D surface elevations, including gap-filling storm sewer feature elevations (maintenance hole lids and catchbasin/ditch inlet elevations) as necessary.

To this end, the City of Hamilton retained a contractor to complete a LiDAR data collection for the Beach Boulevard community in the summer of 2021. The LiDAR data

uses the City standard vertical datum of CGVD28:78. The extents of the LiDAR coverage are presented in Figure 5-4

Wood has completed a cursory review of the supplied data and determined it is reasonable for the purposes of the current study. The Root Mean Square Error (RMSE) report included with the data indicates an average value of 0.041 m for hard surfaces for 44 points, which is within the limits of the original specifications (3 to 5 cm accuracy). The available data products include a bare earth DTM, DEM, contours, breaklines and hillshades, as well as the original LiDAR point cloud data.

Figure 5-4: LiDAR Data Collection Area

5.5.1.4 Proposed Modelling Approach

Hydrologic Parameters

Subcatchment Delineation: Subcatchment delineation will be refined based on the new LiDAR based topography provided by the City of Hamilton. A sufficiently resolute subcatchment boundary size will be required to ensure that flows are reasonably defined to low-lying areas; this will be confirmed as part of the model development effort.

Impervious Coverage: Impervious Coverage will be refined based on existing land use, new cartography, aerial photos, and typical coverage value corresponding to each land use type. A GIS-based land use layer map will be developed for parameterization purposes and model reproducibility.

Slopes and Flow Length: Slopes and Flow Length will be developed using GIS tools and the available LiDAR based topography data.

Infiltration Parameters: Subcatchments will be parameterized to reflect surficial soils (infiltration potential) based on the previously completed background review. The new model is currently proposed to retain the Green-Ampt infiltration methodology applied in the previous Stormwater Ponding Study (Dillon, 2019). Alternative infiltration routines (such as the SCS Curve Number or Horton Equation) could be considered if preferred by the City. Infiltration parameters will be refined based on soil types and background geotechnical reports.

Manning's roughness coefficients: Manning's roughness coefficients will be based on standard values and refined based on land cover as required.

Depression Storage: Depression storage values will be based on standard values and refined based on land cover as required.

Hydraulic Parameters

Minor System: Storm sewers, manholes, and catch basins will be coded based on City of Hamilton's database. Inlet and exit loss coefficients will be based on the Urban Drainage Design Manual, U.S. Department of Transportation, Publication No. FHWA-NH1-01-021 August 2011, Hydraulic Engineering Circular No. 22 (FHWA HEC-22).

Major System: A 2D mesh is proposed to be developed based on the LiDAR based topography data. Directional meshes are proposed for roads and drainage channels to ensure appropriate representation of direction. Hexagonal mesh elements are proposed in other areas. The resolution of the mesh will be determined as part of the model development phase; however, it is generally expected that mesh size will range between 3 and 10 m.

Catchbasins and Inlets: Inlets will be modelled as suitably sized orifices to allow for the multi-directional exchange of flow. Inlet sizes will be confirmed based on standard details (i.e. Ontario Provincial Standard Drawings (OPSDs)) and field measurements as required.

Culverts: Culvert information will be coded based on available drawings and GIS data, and field measurements where required.

Pump station: The Grafton Pump Station information will be incorporated based on available information such as drawings, reports, and time-series data. This will include the wet well, pump curves, and forcemain elements.

Boundary Conditions: Given the significant impact of lake levels/boundary conditions on model results, it is suggested that a range of static lake levels be considered, with two (2) scenarios – a typical or "average" lake level, and a more extreme high level, based on the findings of the previous background review. Potential storm surge can also be considered as part of this analysis; however, wave action is beyond the scope of the current study.

Storm Events

Design storm events: An event-based methodology will be applied for this study. Consistent with the current model, the 2, 5 and 100-year return periods will be simulated. The current City of Hamilton IDF curves for Mount Hope (2004) will be utilized. A brief sensitivity analysis will be undertaken to determine the critical design storm distribution.

Historical storm events: It is proposed to simulate the impacts of three (3) such storms, as applied recently for Ancaster Rurally Serviced Existing Residential Area Phase 2 drainage assessment by Wood. This currently includes the July 26, 2009 Red Hill Storm, the July 22, 2012 Binbrook Storm, and the August 14, 2014 Burlington storm events. The results of these analyses will then define the areas at highest and most immediate risk and direct opportunities for establishing additional resilience.

Climate Change Stress testing

Three (3) climate change rainfall scenarios will be generated based on the City's current IDF parameters. The climate change adjusted IDF parameters would be generated for various future projections (e.g. 2050, 2080) using three (3) Ontario based tools:

- IDF-CC Tool (University of Western Ontario, Canadian Water Network, March 5, 2015) – "Computerized Tool for the Development of Intensity-Duration-Frequency Curves under Climate Change"

- Ontario Climate Change Data Portal (IEESC, University of Regina, 2015) – "launched to ensure technical or non-technical end-users (e.g. municipalities, private sector) have easy and intuitive access to the latest climate data over the Province of Ontario, Canada"

- MTO IDF Curve Tool Lookup

5.5.2 Lake Levels

5.5.2.1 Datum Review

It was noted that the datum applied for lake levels in the previous studies include IGLD 1985 (e.g. IJC), IGLD 1955 (e.g. 1999 Master Drainage Plan by MMM), and NAVD88 (e.g. 2019 Stormwater Ponding Study by Dillon).

The City of Hamilton's standard vertical datum is CGVD28:78. The LiDAR data collected for this study utilizes this datum. The differences among the datums are summarized and presented as following.

- **IGLD 1955 to Geodetic Datum (1985)**

In the Master Drainage Plan it was determined that the elevation difference between the IGLD (1955) and the Geodetic Datum (1985) is negligible (personal communications with Ralph Moulton, Manager of Great Lakes-St. Lawrence Water Level Information Office in the Hamilton area).

- **IGLD 1955 to IGLD 1985**

As per the IGLD 1985 Brochure on the International Great Lakes Datum 1985, the Lake Ontario benchmark for IGLD 55 is 77.329 m and the benchmark for IGLD 85 is 77.487 m.

For Ordinary High Water Mark, IGLD 55 is 75.2 m and IGLD 85 is 75.4 m. The Ordinary High Water Mark (typically known as the water's edge) is defined as: "The limit or edge of a body of water where the land has been covered by water so long as to wrest it from vegetation or as to mark a distinct character upon the vegetation where it extends into the water or upon the soil itself" (Ballantyne, 2016).

Low water chart datum for Lake Ontario is 74.0 m for IGLD 55 and 74.2 m for IGLD 85.

- **IGLD 1985 to NAVD 88**

According to results of the General Adjustment of the North American Vertical Datum of 1988 by David B. Zilkoski et al., the only difference between IGLD 85 and NAVD 88 is that IGL benchmark values are given in dynamic height unit and NAVD 88 values are given in Helmert orthometric height units. It is clarified that geopotential numbers for individual benchmarks are the same in both systems.

- **IGLD85 to CGVD28**

A correction factor of adding 0.102 m to convert CGVD28 to IGLD85 has been utilized for Hamilton Harbour in a separate study Spatial Framework For Storage and Analyses of Fish Habitat Data in Great Lakes' Area of Concern: Hamilton Harbor Geodatabase Case Study (Fisheries and Oceans Canada, August 2010). Table 5-4 lists the elevation differences between IGLD85 and CGVD28 at various surveyed sites within the study area from the Canadian Geodetic Survey. The most centrally located sites within the study area are sites 65U130, 91U003 and 65U131. A proposed correction factor of 0.089 m can be assumed by taking the average between those 3 sites.

Table 5-4: Elevation Differences between IGLD85 and CGVD28 at Surveyed sites from the Canadian Geodetic Survey

Site ID (North to South of Study Area)	Latitude	Longitude	IGLD85 (lev) (m)	CGVD28 (lev) (m)	Elevation Difference (m)
60U3326	43°17' 54.0"	79° 47' 42.0"	76.626	76.524	0.102
653130H	43° 17' 56.25"	79° 47' 40.37"	76.906	76.801	0.105
65U130	43° 17' 20.0"	79° 47' 33.0"	76.580	76.483	0.097
91U003	43° 16' 41.0"	79° 46' 53.0"	76.691	76.602	0.089
65U131	43° 16' 40.8"	79° 46' 51.6"	77.469	77.387	0.082
91U004	43° 15' 50.4"	79° 46' 19.2"	77.886	77.803	0.083

- **CGVD28 to CGVD28:78**

As noted, the City of Hamilton standard vertical datum is CGVD28:78, which reflects a minor adjustment made in 1978. Based on data from the Ontario Ministry of Natural Resources' online COSINE service, there are three (3) benchmarks in the study area which provide the elevations in both datums and therefore allow for a data conversion. The data is presented in Table 5-5.

Table 5-5: Elevation Differences between CGVD28 and CGVD28:78 based on the COSINE Network

Site ID (North to South of Study Area)	Latitude	Longitude	CGVD28 (m)	CGVD28:78 (m)	Difference (m)
07720100031	43° 17' 31.2"	79° 47' 27.4"	77.778	77.667	-0.111
07720100032	43° 16' 40.6"	79° 46' 52.9"	77.397	77.286	-0.111
07720100033	43° 15' 55.3"	79° 46' 17.6"	78.209	78.098	-0.111

5.5.2.2 Lake Ontario Water Levels Summary

The summary of lake levels has been based on data from Fisheries and Oceans Canada. Available data at this time is years 1918 to 2019 and is referenced to IGLD1985. The yearly average water level of Lake Ontario from 1918-2019 was 74.77 mASL. Between 1918 and 2019, The average change in water level was 0.67 m and the maximum change in water level was 1.37 m.

The highest yearly average was 75.37 mASL in 1952 while the lowest yearly average was 74.00 mASL in 1935. The monthly average change in water level was 0.78 m in 1952 and was 0.43 m in 1935.

The maximum average water level was 75.91 mASL in June 2019 while the minimum monthly average was 73.74 mASL in December 1934. The monthly average change in water level was 1.08 m in 2019 and was 0.55 m in 1934. The International Joint Commission reported a maximum daily water level of 75.92 mASL on June 6, 2019. The maximum change in water levels of 1.19 m occurred in 2017, while the minimum change in water levels of 0.2 m occurred in 1920.

The preceding statistics are summarized in Table 5-6.

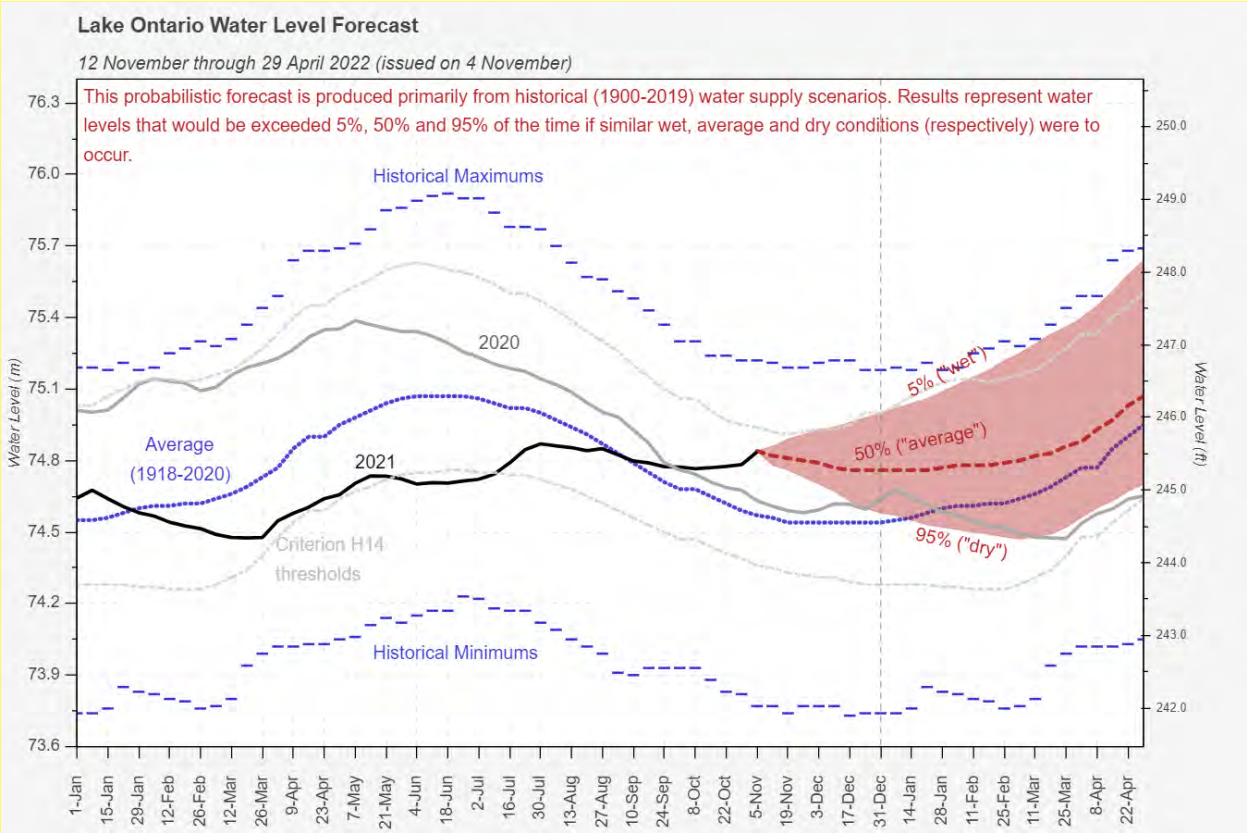
Table 5-6: Summary of Lake Ontario Water Level Statistics

Attribute	WL in IGLD85 (mASL)	WL in CGVD28:78 (mASL)	Date(s)	Changes in WL (m)
Average Yearly WL	74.77	74.57	1918-2019	0.67 (average change) 1.37 (max change)
Max Average Yearly WL	75.37	75.17	1952	0.78
Min Average Yearly WL	74.00	73.80	1935	0.43
Max Monthly WL	75.91	75.71	June 2019	1.08 (Year 2019)
Min Monthly WL	73.74	73.54	December 1934	0.55 (Year 1934)
Maximum Daily WL	75.92	75.72	June 6, 2019	-
Maximum Range in a Year	-	-	2017	1.19
Minimum Range in a Year	-	-	1920	0.22

5.5.2.3 Trend Analysis

The Beach Boulevard Community Stormwater Ponding Study (Dillon, 2019) noted that up until 2017, the highest recorded water level of Lake Ontario was 75.82 mASL in June 1952. The report details that on May 29, 2017, Lake Ontario reached a record high of 75.88 mASL causing major flooding and damages to Beach Boulevard Community. According to the International Lake Ontario-St Lawrence River Board, the lake reached 75.92 mASL (IGLD 1985) on June 6, 2019, and remained that level from June 16-23, 2019 thus surpassing previous records. Short term forecasting and historical data obtained from IJC is presented in Figure 5-5.

Figure 5-5: Lake Ontario Water Historical Maximums and Minimums, Criterion H14 thresholds, Average (1918-2020), 2020, 2021 and Projection for 2021/2022 referenced to IGLD85 (International Lake Ontario-St. Lawrence River Board, 2021)



A summary of lake level comparisons is presented in Table 5-7. Average yearly water levels have increased by 10 cm in the most recent 10 years of data. The record level high of Lake Ontario has also increased by 10 cm compared to the historic record from 1952.

Table 5-7: Summary of Comparing Recent Water Levels (2010-2019) to Prior Historic Water Levels (1918-2009)

Attribute	Water Level in IGLD85 (mASL)	Water Level in CGVD28:78 (mASL)	Date(s)
Average Yearly Water Level (2010-2019)	74.86	74.66	2010-2019
Record High (2010-2019)	75.92	75.72	June 6, 2019
Average Yearly Water Level (1918-2009)	74.76	74.56	1918-2009
Record High (1918-2009)	75.82	75.62	June 1952
Average Water Level Increase (from 2010-2019 to 1918-2009)	0.10		
Maximum Water Level Increase (from 2010-2019 to 1918-2009)	0.20		

Figure 5-6 through Figure 5-8 and Table 5-8 through Table 5-9 present the average monthly water levels and yearly average water levels between 1918 and 2019 based on the Fisheries and Oceans Canada data. The graphs and comparisons demonstrate that there is an increasing trend in the water level. The monthly average water level has been higher over the past ten years compared with earlier years. The maximum difference was approximately 20 cm in the summer months.

Figure 5-6: Average Monthly Mean Water Levels 2010-2019 and 1918-2009 referenced to IGLD85 based on Fisheries and Oceans Canada Data

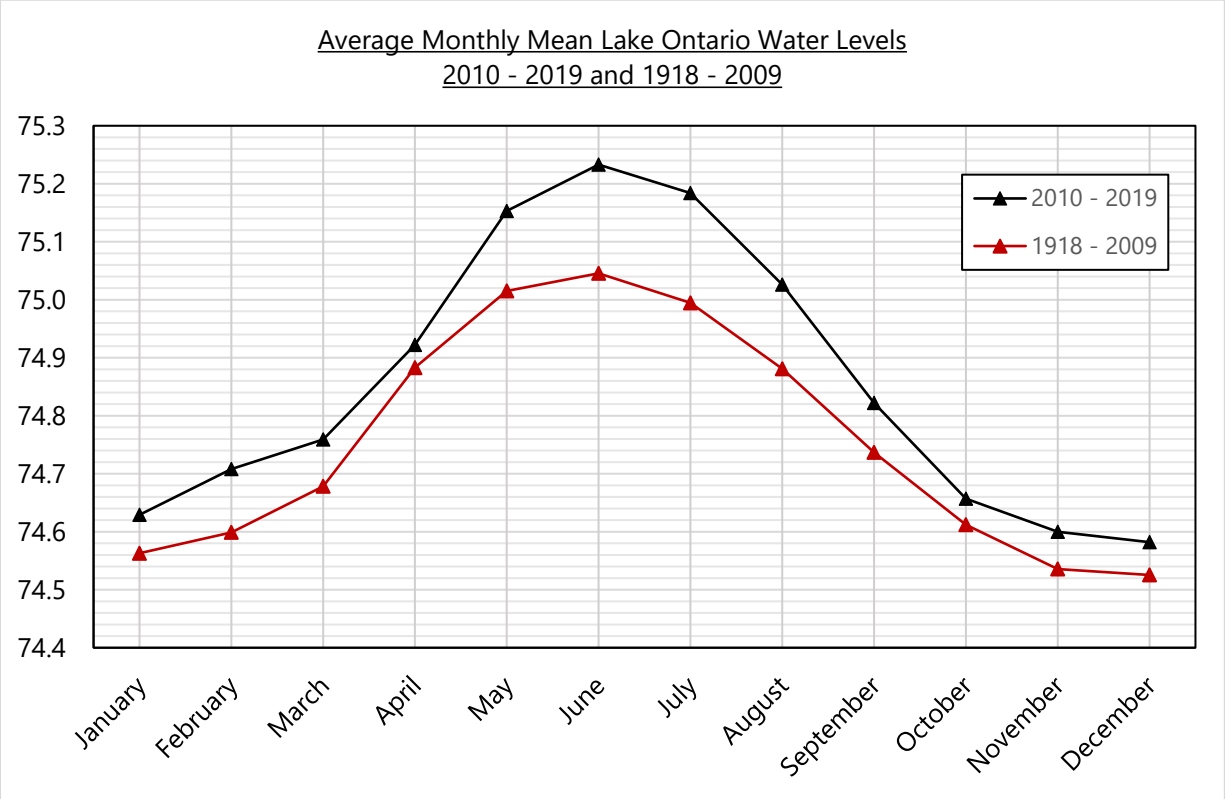


Figure 5-7: Yearly Average Lake Ontario Water Level referenced to IGLD85 based on Fisheries and Oceans Canada Data

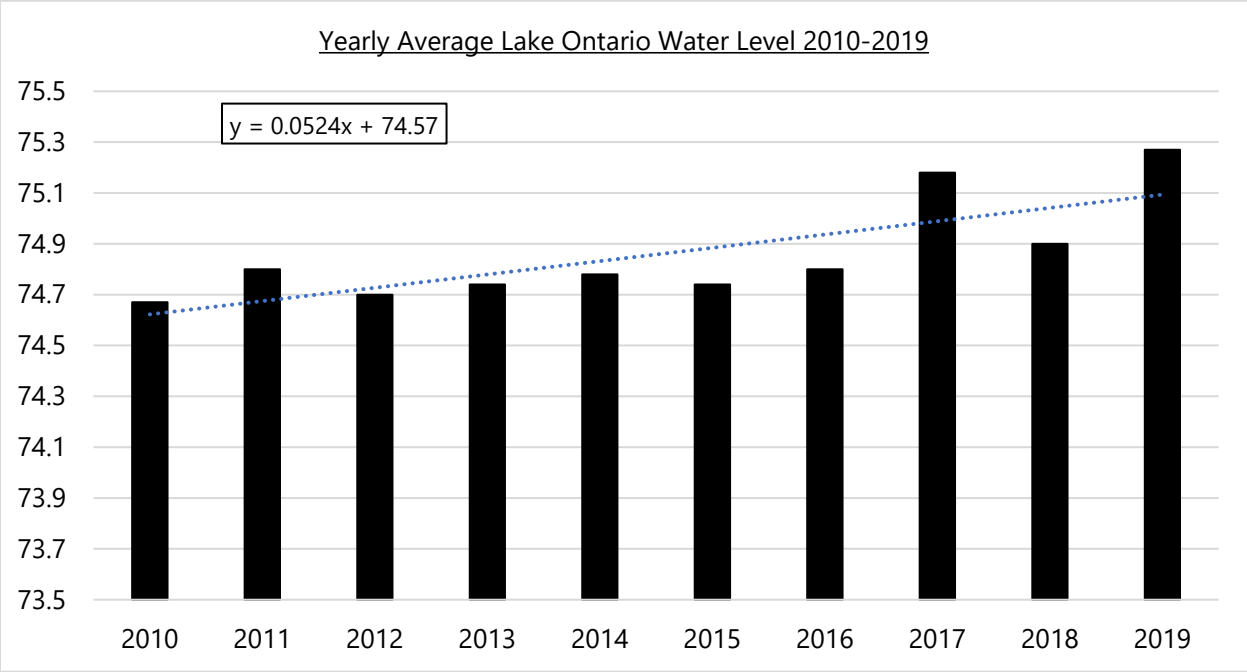


Figure 5-8: Yearly Average Lake Ontario Water Level with Trendlines based on Fisheries and Oceans Canada Data

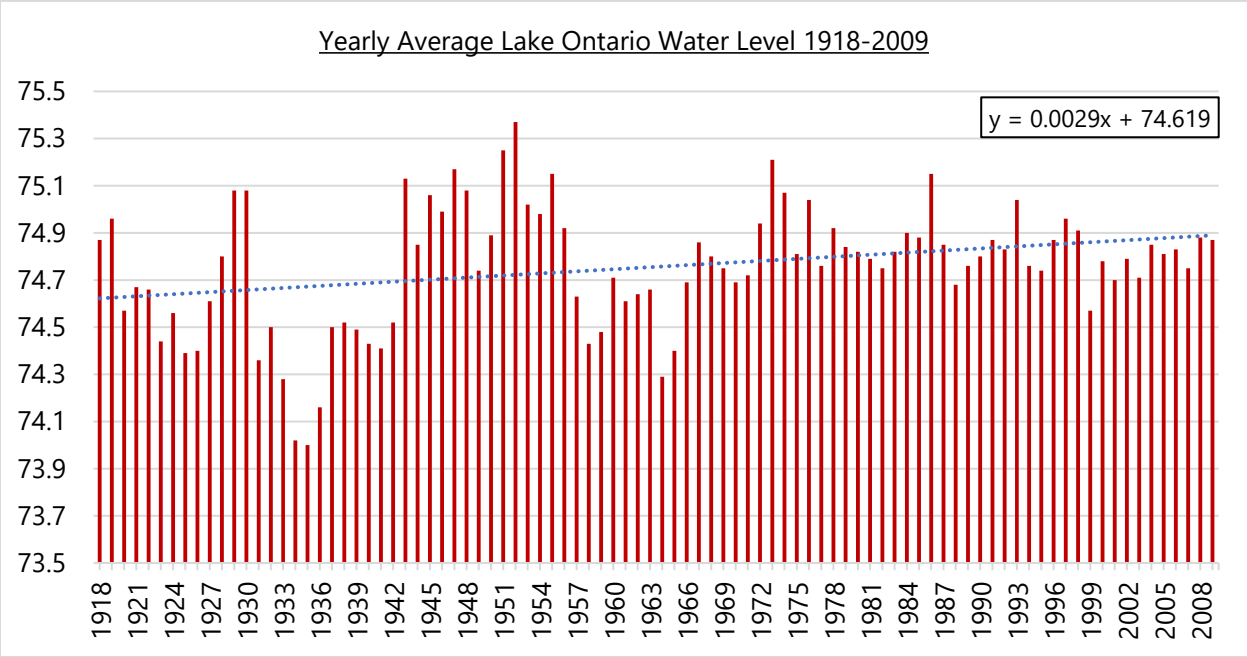


Table 5-8: Lake Ontario Monthly Mean, High and Low Monthly Water Levels for Years 2010-2019 and 1918-2009 referenced to IGLD85 based on Fisheries and Oceans Canada data

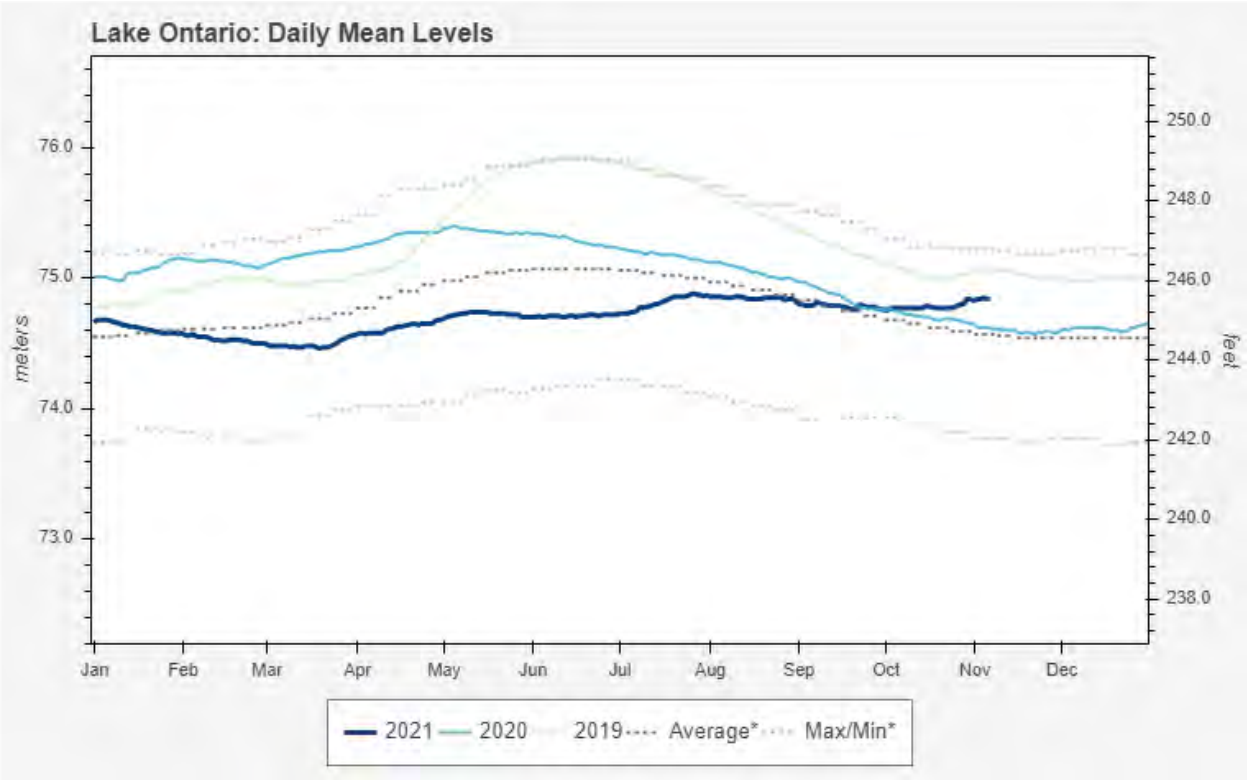
Month	Average WL (m) (2010-2019)	High WL (m) (2010-2019)	Low WL (m) (2010-2019)	Average Historical WL (m) (1918-2009)	High Historical WL (m) (1918-2009)	Low Historical WL (m) (1918-2009)
January	74.63	74.83	74.38	74.56	75.16	73.81
February	74.71	74.99	74.41	74.60	75.27	73.78
March	74.76	75.00	74.41	74.68	75.37	73.94
April	74.92	75.35	74.62	74.88	75.65	74.03
May	75.15	75.80	74.71	75.02	75.73	74.11
June	75.23	75.91	74.85	75.05	75.76	74.19
July	75.18	75.80	74.79	74.99	75.66	74.14
August	75.03	75.53	74.65	74.88	75.58	74.00
September	74.82	75.24	74.50	74.74	75.41	73.91
October	74.66	75.04	74.34	74.61	75.22	73.82
November	74.60	75.04	74.29	74.54	75.18	73.75
December	74.58	75.00	74.28	74.53	75.20	73.74

Table 5-9: Differences Between Lake Ontario Monthly Mean, High and Low Monthly Water Levels for Years 2010-2019 and 1918-2009 referenced to IGLD85 based on Fisheries and Oceans Canada data

Month	Difference in Average (m) 2010-2019 to 1918-2009	Difference in High (m) 2010-2019 to 1918-2009	Difference in Low (m) 2010-2019 to 1918-2009
January	0.07	-0.33	0.57
February	0.11	-0.28	0.63
March	0.08	-0.37	0.47
April	0.04	-0.30	0.59
May	0.14	0.07	0.60
June	0.19	0.15	0.66
July	0.19	0.14	0.65
August	0.15	-0.05	0.65
September	0.09	-0.17	0.59
October	0.04	-0.18	0.52
November	0.06	-0.14	0.54
December	0.06	-0.20	0.54

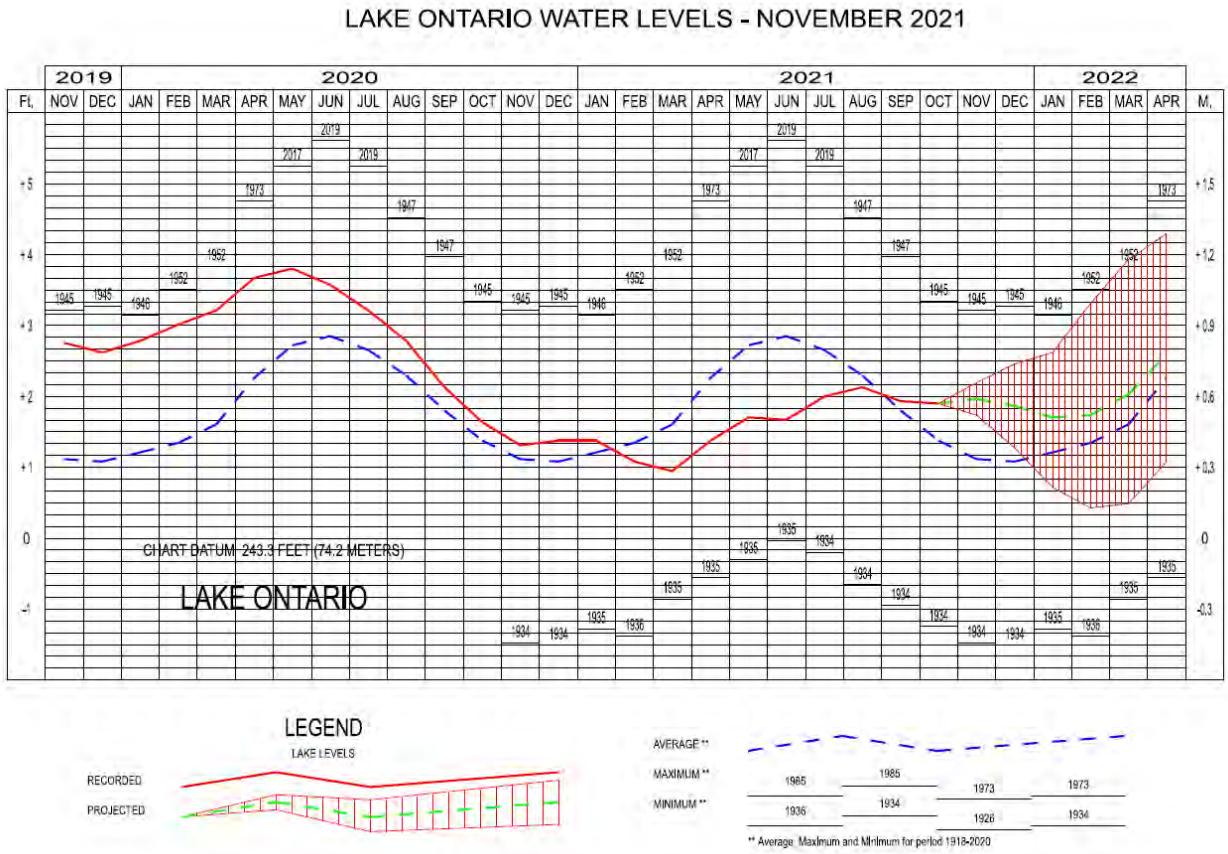
Figure 5-9 presents the statistics of daily mean levels for 2019, 2020 and the current year (2021) from IJC. The graph shows that the maximum water level is approximately 75.8 m (in IGLD 1985) in June 2019, which is in consistency with the Fisheries and Oceans Canada data. The lake levels tend to be higher in the summer months of 2019 and the winter months of 2020. Lake levels in the current year of 2021 are close to and mostly below the average water level, with the exception of January to February and September to November.

Figure 5-9: Lake Ontario Historical Min/Max Water Levels based on historical (1918-2020) Data and Daily Mean Levels for 2019, 2020 and 2021 referenced to IGLD85 (International Lake Ontario-St. Lawrence River Board, 2021)



In the Great Lakes – St. Lawrence Adaptive Management (GLAM) Committee Report 2017, a sequence of climate parameters based on recent future climate scenarios used during the IUGLS predicts that months with extreme precipitation over Lake Ontario would be between two and three times more common during 2050 when compared to the current climate change. Thus, it is expected that Lake Ontario will experience more frequent high levels and higher water level highs that will need to be regulated (ref. Figure 5-10).

Figure 5-10: Average, Historical and Projected Lake Ontario Water Levels for 2021/2022 referenced to IGLD85 (US Army Corps of Engineers, 2021)



5.5.3 Infrastructure

5.5.3.1 Data Summary

The previous review of the City's storm sewer data (as applied in the Stormwater Ponding Study, 2019) indicates data gaps including missing sizes, missing inverts, reversed slopes, improper pipe alignment, incorrect outlets to properties, missing pipe connections to an outfall, and various irregular sewer profiles. This appears to be consistent with the source GIS data base of storm sewer data as provided by the City of Hamilton.

The City subsequently undertook a gap filling and data correction exercise for storm sewer data, including pulling available record drawings. The updated dataset was supplied to Wood on May 12, 2021. Wood has reviewed the updated dataset and noted that there remain several data gaps; specific issues are noted in Appendix F.

5.5.3.2 Proposed Gapping filling techniques

For the balance of the storm sewer pipes with missing elevation information which are required for modelling through the screening process, it is recommended to fill the available gaps as follows:

- According to correspondence with the City (ref. e-mail – Daniels-Senior, May 14, 2021), as-built drawings are available for certain private pipes currently missing information
- Missing lengths are to be calculated using GIS tools
- Missing pipe sizes are to be assumed as the same diameters of the upstream pipe segments.
- For pipes with missing elevation or reversed slopes, it is recommended to estimate the missing elevation using numerical techniques such as linear interpolation and fill the gaps by maintaining a consistent slope based on upstream and downstream storm sewer pipes.
- Missing rim elevations are to be estimated using the LiDAR data the City of Hamilton recently provided.
- For storm sewer outfalls which could not be accessed or located, LiDAR and imagery provided by the City are to be used to estimate the locations and the rim elevations.

Additional field reconnaissance or scoped topographic survey would be proposed if the gaps cannot be addressed through the preceding approach.

5.5.3.3 Recommendations

In addition to the preceding, it is recommended that a site visit to be conducted to investigate the problematic areas identified from the background review including poor inlet locations, obstructions, sediment filled ditches, and other areas of concern. Specific areas that are recommended to be visited include:

a) The Existing Conditions Drainage Investigation & Preliminary Design of Flood Protection for Beach Blvd Community prepared by McCormick Rankin Corporation noted areas of drainage issues and noted 10 ditch inlets were installed with the incorrect sizes at Granville Avenue, Bayside Avenue, and Lagoon Avenue.

b) A 600 x 600 mm DICB located at the end of Dunraven Avenue adjacent to the rail barrier was reported to be full water and debris.

c) A DCIB located behind a concrete barrier at the end of Locarno Avenue was also reported to be full of debris.

d) A small ditch located behind debris and sediment trapped by a guide rail barrier conveys water from two small channels located on either side of North Park Avenue. An inlet to a 300 mm diameter CSP that conveys flow beneath the Q.E.W. noise berm is located above the road and must pond before it can overflow into the pipe.

e) A 300 mm CSP was found to be partially buried and obstructed by sediment and leaves at the west end of Rembe Avenue.

f) The inlet to a 300 mm CSP running under the berm toward the Q.E.W. was found to be elevated slightly above the roadway at Windermere Avenue.

g) At Knapmans drive a 300 mm diameter CSP runs under the berm towards the Q.E.W. Water must pond at the end of the street to clear small earth obstruction to reach the culvert. This pipe may also connect to a 600 mm CSP under the Q.E.W.

h) The inlet to a 300 mm diameter CSP running under the berm toward the Q.E.W. was found to be elevated slightly above the roadway at Wickham Avenue.

i) The inlet to a 300 mm CSP running under the berm toward the Q.E.W. was found to be elevated slightly above the roadway at Grafton Road and the CSP was almost completely obstructed by sediment and debris. Drawing indicated a 600 mm concrete storm sewer located at the Q.E.W. right-of-way at Grafton Road but could not be located during the field visit.

j) The inlet to a 300 mm diameter CSP is located behind sediment build-up at the end of Comet Road. Two catch basins were full of water and debris at the time of a site visit.

k) At the west end of Granville Avenue, a 600 mm x 600 mm DICB that intercepts flow around the SBGR was noted to be full of water and sediment.

l) At Clare Avenue there are two 300 mm diameter pipes, and one was noted to be partially buried.

m) Additionally, a vegetated ditch located between Wickham Drive and Kirk Avenue that drains to Redhill Creek was noted to be full of sediment should also investigated.

6.0 Closure and Next Steps

This report was prepared to document existing conditions within the Study Area for the Beach Boulevard Community Flood Remediation Class EA Study.

Additional gap filling and field verification work is proposed to be completed, with a focus upon residual storm sewer data gaps, and previously identified problematic drainage areas.

The findings of this report will be used to inform Phase 2 of this study, namely the identification and evaluation of alternative solutions process to identify recommended solution for addressing flooding issues in the Beach Boulevard Community of City of Hamilton.

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