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Matrix Solutions Inc.
A Montrose Environmental Company

Dixie-Dundas Flood Mitigation Project
Municipal Class Environmental Assessment
Environmental Study Report
Little Etobicoke Creek
Mississauga, Ontario

Prepared for:
City of Mississauga

Prepared by:
Matrix Solutions Inc., a Montrose Environmental Company

Version 0.4
March 2024
Guelph, Ontario

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Prepared for the City of Mississauga, March 2024

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Disclaimer

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V0.1	30-Aug-2023	Draft	24603-531 Dixie-Dundas ESR R 2023-08-30 draft V0.1.docx	Sections 1 to 5 issued to client for review
V0.2	25-Oct-2023	Draft revised 1	24603-531 Dixie-Dundas ESR R 2023-10-23 draft V0.2.docx	Updated Sections 1 to 5 with client comments and added Sections 6 to 15 for client review
V0.3	20-Nov-2023	Draft revised 2	24603-531 Dixie-Dundas ESR R 2023-11-20 draft V0.3.docx	Updated Sections 6 to 15 with client comments and reissued to client for review
V0.4	21-Mar-2024	Draft revised 3	24603-531 Dixie-Dundas ESR R 2024-03-21 draft V0.4.docx	Issued to client

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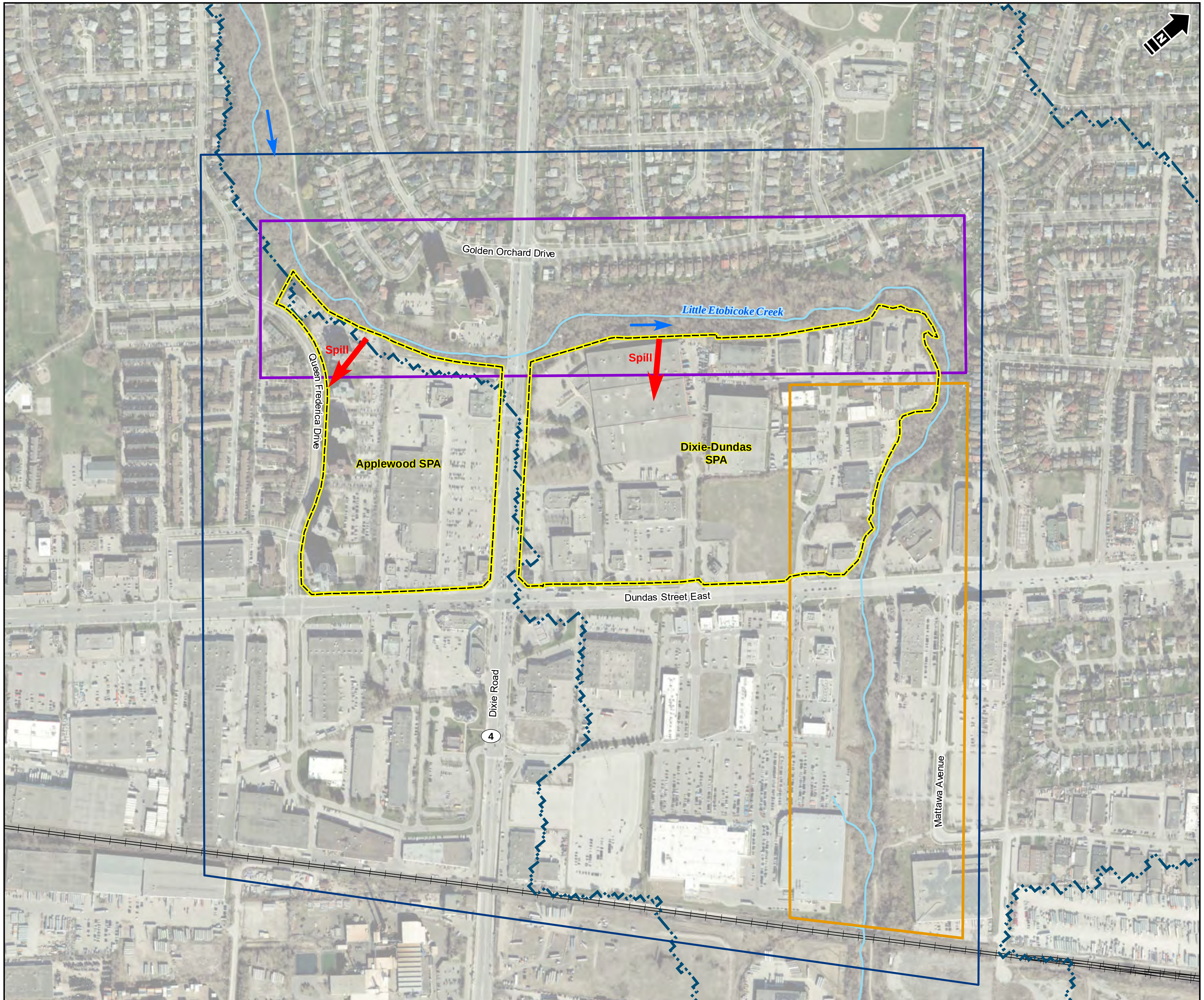
1 Introduction

The City of Mississauga (the City) has undertaken the Dixie-Dundas Flood Mitigation Project (the Project) Municipal Class Environmental Assessment (EA) to address riverine spill of flood water from Little Etobicoke Creek that occurs near Dixie Road. The Project is located within a flood-vulnerable area and is subject to land use development restrictions through the designation of two Special Policy Areas (SPAs) by the Province of Ontario. The area west of the intersection of Dixie Road and Dundas Street East is known as the Applewood SPA and the area east of Dixie Road and Dundas Street East is known as the Dixie-Dundas SPA (Figure 1).

An SPA is a land use planning designation that acknowledges the historic development practices and existing land use within a flood-vulnerable area and stipulates how only limited changes to development within the area can occur. Flood risk from extreme flood events, such as the Regulatory flood, must be mitigated for an SPA designation to be removed.

The Little Etobicoke Creek watershed has experienced flooding and erosion concerns recorded back to at least the 1970s. The recent large flood event on July 8, 2013, which approximately corresponded to a 350-year storm (MMM 2015), resulted in many reports of flooding-related incidents and damage, particularly in the Dixie Road and Dundas Street area. The primary river spill occurs upstream of Dixie Road near Queen Frederica Drive, where flood waters leave Little Etobicoke Creek and flow southerly through over 1,000 commercial, industrial, and residential properties. A smaller spill occurs downstream of Dixie Road where water exits Little Etobicoke Creek, is conveyed overland toward Dundas Street East, and flows back toward the Little Etobicoke Creek valley (Figure 2).

The City intends to solve the Little Etobicoke Creek spilling to protect flood-vulnerable residences and businesses and to intensify the Dixie-Dundas area to fulfill a vision of growth expressed in the Dundas Connects Master Plan (City of Mississauga et al. 2018). This vision of growth centres around the Dixie GO Station and proposed higher-order transit along Dundas Street East. Effective flood mitigation must first be implemented here, such that existing SPAs can be adjusted or eliminated. This process is part of a concurrent initiative by the City's Planning and Building Department.



1. Base digital information obtained from the City of Mississauga (SHP and DGN format).

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

1:6,500 metres
50 0 50 100
NAD 1983 UTM Zone 17N

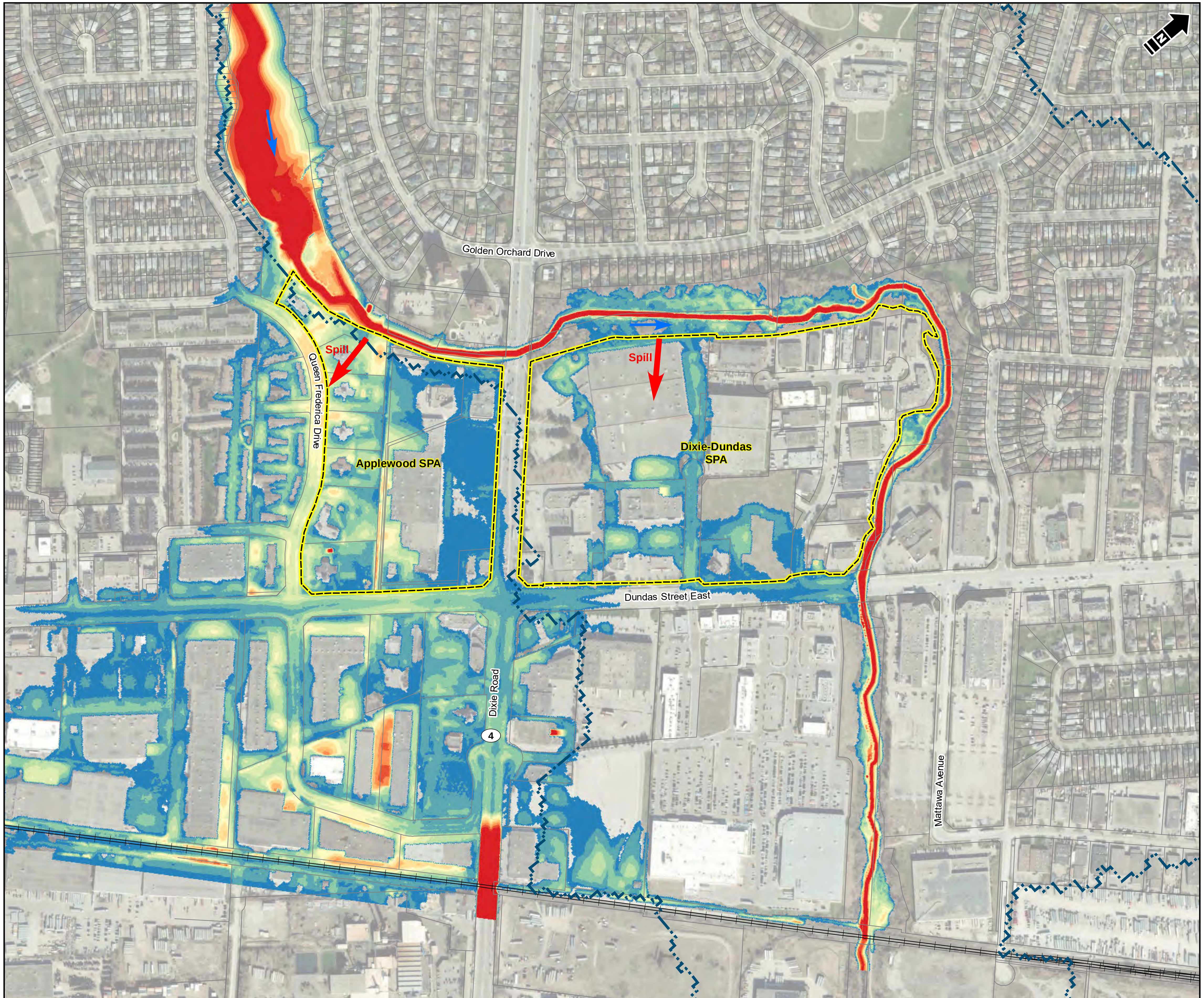
Matrix Solutions Inc.
A Montrose Environmental Company

City of Mississauga
Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Study Area

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 1



Special Policy Area
Little Etobicoke Creek Watershed Boundary
Spill Direction
Flow Direction
Property Boundary
CN Railway

Existing Conditions Regional Flood Depth (m)

- 0.00
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m^3/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).

1:6,500 metres
50 0 50 100
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

Matrix Solutions Inc.
A Montrose Environmental Company

City of Mississauga
Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Existing Conditions Regional Flood Depths

Date: March 2024	Project: 24603	Submitter: A. McKay	Reviewer: S. Braun

Disclaimer: The information contained herein may be compiled from numerous third party materials that are subject to periodic change without prior notification. While every effort has been made by Matrix Solutions Inc. to ensure the accuracy of the information presented at the time of publication, Matrix Solutions Inc. assumes no liability for any errors, omissions, or inaccuracies in the third party material.

Figure 2

1.1 Project Location and Context

The Project study area is centered around the intersection of Dixie Road and Dundas Street in Mississauga, Ontario (Figure 1). During periods of infrequent high flows in Little Etobicoke Creek, two spills occur from its valley. The main spill location is upstream of Dixie Road near Queen Frederica Drive. This spill is the main reason for the current Applewood SPA, which includes only a fraction of the 1,000-plus properties affected by flooding located between the spill location and the QEW (Figure 2). Based on the findings of previous studies (Matrix 2018, MMM 2015), spill from the channel occurs at the Queen Frederica Drive location during as little as a 5-year flood event.

A lesser, but still significant, spill occurs from Little Etobicoke Creek on the east side of Dixie Road. Flooding associated with this second spill required the implementation of the existing Dixie-Dundas SPA. Previous studies (Matrix 2018, MMM 2015) indicate that spill in this location occurs only during the Regional storm event. Together, the two SPAs form the heart of the Project study area.

The Toronto and Region Conservation Authority (TRCA) has designated lands associated with the Project study area as flood vulnerable, with a high priority for mitigation. Modelled conditions (described in previous studies [Section 3]), which were largely confirmed through observations of the actual conditions experienced during the July 8, 2013, flooding event, indicate the Little Etobicoke Creek spills create extremely unsafe conditions for vehicle and pedestrian traffic. The spill upstream of Dixie Road at Queen Frederica Drive is also unique in that its spilled flood waters do not return to the Little Etobicoke Creek valley further downstream. Instead, this spill crosses the Little Etobicoke Creek watershed boundary and leaves the TRCA jurisdiction, entering area regulated by Credit Valley Conservation (CVC) to the south and west (i.e., the Applewood Creek watershed).

The spill east of Dixie Road does return to the Little Etobicoke Creek valley, albeit at a significant distance downstream at Dundas Street. Figure 2 illustrates the spill patterns from the two locations.

The Project study area consists of two main parts, divided to facilitate effective discussion of creek hydraulics and associated issues; however, these areas are not the same as and do not correspond to the two previously outlined SPAs. The first portion of the Project study area (referenced as the Dixie Area) encompasses the Little Etobicoke Creek channel and adjacent floodplain lands from 500 m upstream of Dixie Road to approximately 750 m downstream at the location of a prominent channel bend (Figure 1). The second portion of the Project study area (referenced as the Dundas Area) is located immediately downstream of the Dixie Area.

The Dundas Area encompasses the Little Etobicoke Creek channel and adjacent floodplain lands from 500 m upstream of Dundas Street to 600 m downstream of Dundas Street, which is just upstream of the Canadian Pacific Railway (CP) crossing (Figure 1). Together these two distinct and related portions of the Project comprise the overall study area of the Project.

Alternative solutions for the Dixie Area, as further outlined in this report, explore how to effectively mitigate the large existing spill from Little Etobicoke Creek at Queen Frederica Drive to the Applewood Creek watershed and contain the flood flows within the Little Etobicoke Creek valley. The contained flood flows have the potential to increase flood levels downstream at the Dundas Area, if left unmitigated. Accordingly, the Project also involves mitigative solutions for the Dundas Area to ensure the effects of the newly increased flow in the Little Etobicoke Creek watercourse do not cause unacceptable impacts.

The lands surrounding the entire Project study area (i.e., both the Dixie and Dundas areas together) are urban, consisting of a variety of park, commercial, industrial, and residential land uses, as illustrated on Figure 1.

1.2 Project Background

The Little Etobicoke Creek watershed has a drainage area of approximately 2,230 ha to its outlet to the Etobicoke Creek, which is located approximately 600 m downstream of the Project study area. Over the past 75 years, the Little Etobicoke Creek watershed and the Project study area itself have undergone a series of hydrologic changes. The farmland around the Project study area began developing into residential areas in the 1950s. By the early 2000s, nearly all the area in the Little Etobicoke Creek watershed had been developed into a variety of commercial, industrial, and residential land uses. These land use changes increased the imperviousness of the ground (i.e., due to paved surfaces), causing intensified runoff and flooding. Since 1970, multiple mitigation works have been completed in Little Etobicoke Creek to stabilize the channel and contain flooding to an extent. As a result, the Little Etobicoke Creek is highly altered within the Project study area, with treatments including heavy armourstone blocks and gabion baskets. Some of these channel protection features are failing in the Project study area and at other locations in the watershed.

1.3 Previous Studies

Flooding and erosion issues in Little Etobicoke Creek have been present since development began, and technical studies have been undertaken since the 1970s. As a result of the recommendations from these studies, several flood remediation and erosion control projects have been implemented over the past few decades. These projects largely included deepening the channel and hardening the channel banks through various armouring techniques. More recent studies characterizing the flooding causes and exploring more holistic flood mitigation solutions are described in Sections 1.3.1 to 1.3.4.

1.3.1 Etobicoke Creek Hydrology Update (2013)

The Etobicoke Creek Hydrology Update (MMM 2013) updated the hydrologic models for the Etobicoke Creek watershed to assess existing and future land use conditions. The TRCA's approved hydrologic model was used to develop estimated peak flows for the 2-year to 350-year design storms and the Regional storm under existing and future land use scenarios. Derived flow values contained in the MMM Group Ltd. (2013) study have supported various hydraulic modelling and mapping updates, including the assessment of mitigation alternatives in the subsequent studies described in the following sections. The current Project also relies on flows included in the Etobicoke Creek Hydrology Update.

1.3.2 Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area, Little Etobicoke Creek (2015)

In their study, Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area, Little Etobicoke Creek (the SPA Floodplain Mapping Study; MMM 2015), MMM produced a one-dimensional/two-dimensional (1D-2D) integrated MIKE FLOOD hydraulic model of Little Etobicoke Creek. This model was used to define Regional floodplain maps for the Applewood and Dixie-Dundas SPAs. A 1D-2D model was required to capture the complex nature of the overland flow patterns within the Project study area, which could not otherwise be adequately delineated using traditional 1D hydraulic modelling techniques (e.g., HEC-RAS). MMM also identified and assessed several preliminary flood mitigation alternatives based on the modelling results.

1.3.3 Special Policy Areas - Preliminary Flood Mitigation and Remediation Assessment Dundas Street Transportation Master Plan (2019)

In their report, Special Policy Areas - Preliminary Flood Mitigation and Remediation Assessment Dundas Street Transportation Master Plan (the Dundas Street Transportation Master Plan; AECOM 2019), AECOM Canada Ltd. reviewed potential flood mitigation measures to support eliminating or reducing the restrictions of the SPAs in the Project study area. Removing the SPA restrictions would enable intensification and transportation improvements along the Dundas Street corridor. The assessment identified that Little Etobicoke Creek flooding is caused by an undersized main channel and floodplain, undersized bridges and culverts, and large contributing upstream flows that have intensified through the effects of upstream urbanization. A long list of alternatives was developed, and of these, five flood mitigation measures were carried forward for modelling in MIKE FLOOD modelling software. AECOM's recommended alternatives from the Dundas Street Transportation Master Plan were considered in the high-level screening phase of the Project.

1.3.4 Little Etobicoke Creek Flood Evaluation Study and Master Plan (2021)

Phase 1 of the Little Etobicoke Creek Flood Evaluation Study and Master Plan (the FESMP; Matrix 2021) expanded upon the MMM (2015) modelling to further characterize flood risk in the study area and provide guidance for TRCA, CVC, and the City. In Phase 2 of that project, Matrix developed an urban dual drainage model using PCSWMM 2D software for the entire Little Etobicoke Creek watershed to assess areas at risk to both urban and riverine flooding. Portions of the study area were further modelled using a three-way integrated 1D-2D model to evaluate the feasibility and effectiveness of implementing stormwater management ponds in two flood-prone areas. Overall, the FESMP included flood characterization, recognition of flood mechanisms, identification of flood risk areas, and assessment of flood remediation plans.

Phase 1 of the FESMP included an expansion of the 1D-2D integrated MIKE FLOOD model developed for the MMM (2015) report. The expanded model better outlined the extents of overland spill from Little Etobicoke Creek downstream of the SPAs. The flood-affected areas south of the SPAs were seen to include over 1,000 existing structures, with the hydraulic model area being cut off at the QEW to the south.

1.4 Municipal Class Environmental Assessment Process

The Project follows the Municipal Class EA process outlined in the Municipal Class Environmental Assessment Manual (the MCEA Manual; MEA 2015), under the Ontario Environmental Assessment Act, Revised Statutes of Ontario (R.S.O.) 1990, Chapter E.18. The consultation process for this project complies with the Code of Practice for Preparing, Reviewing and Using Class Environmental Assessments in Ontario (MOE 2014). The MCEA Manual has since been updated (MEA 2023); however, the Project will continue to follow the 2015 regulations to align with its date of initiation.

Figure 3 illustrates the Municipal Class EA process and phases, as defined in the MCEA Manual (MEA 2015):

- "Phase 1: Identify the problem (deficiency) or opportunity.
- Phase 2: Identify alternative solutions to address the problem or opportunity by taking into consideration the existing environment and establish the preferred solution taking into account public and review agency input. At this point, determine the appropriate Schedule for the undertaking and document decisions in a Project File for Schedule B projects, or proceed through the following Phases for Schedule C projects.
- Phase 3: Examine alternative methods of implementing the preferred solution, based upon the existing environment, public and review agency input, anticipated environmental effects and methods of minimizing negative effects and maximizing positive effects.
- Phase 4: Document, in an Environmental Study Report a summary of the rationale, and the planning, design and consultation process of the project as established through the above Phases, and make such documentation available for scrutiny by review agencies and the public.
- 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 facilities."

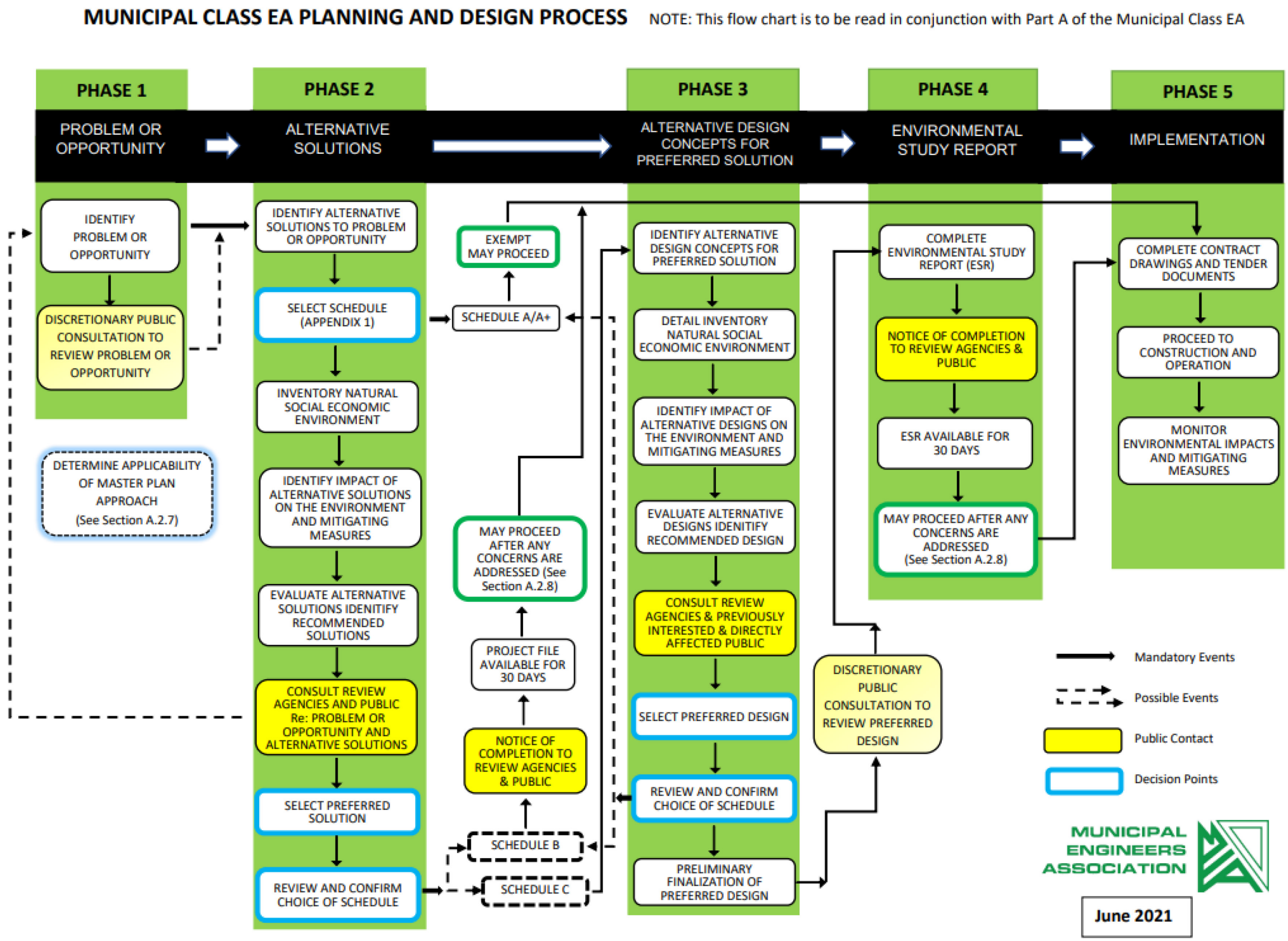


Figure 3 Municipal Class Environmental Assessment Process (MEA 2015)

There are several classifications or schedules associated with municipal infrastructure projects, as defined in the MCEA Manual (MEA 2015):

- “Schedule A (Phase 1 and Phase 5 completed only)
  - generally includes normal or emergency operational and maintenance activities
  - the environmental effects of these activities are usually minimal and, therefore, these projects are pre-approved
- Schedule A+ (Phase 1 and Phase 5 completed only)
  - in 2007, MEA introduced Schedule A+. These projects are pre-approved; however, the public is to be advised prior to project implementation. The manner in which the public is advised is to be determined by the proponent. Schedule A+ is discussed in Section A.1.2.2.
- Schedule B (Phases 1, 2, and 5 completed)
  - generally includes improvements and minor expansions to existing facilities
  - there is the potential for some adverse environmental impacts and therefore the proponent is required to proceed through a screening process including consultation with those who may be affected
- Schedule C (Phases 1 through 5 completed)
  - generally includes the construction of new facilities and major expansions to existing facilities
  - these projects proceed through the environmental assessment planning process outlined in the Class EA”

A project that is carried out following the approved Municipal Class EA process will comply with any Part II Order Requests as stipulated in the Environmental Assessment Act. This will come into effect if a project is identified as potentially having adverse impacts to Indigenous and treaty rights.

All issues that arise during a project should try to be resolved first with the project proponent, and a Part II Order should not be requested with the intent to solely delay or stop the planning and implementation of a Municipal Class EA project. If the issue cannot be resolved, a Part II Order request must be submitted to both the Ontario Ministry of the Environment, Conservation and Parks (MECP) and the Director of Environmental Assessment Branch via mail, email, fax, or hand delivery, after the proponent has issued a Notice of Completion. The proponent should also be sent a copy of the request. MECP will review the request, consider evaluation criteria, consult with other technical staff, and make a recommendation to the Minister. The Minister can request an individual Municipal Class EA for a project or apply further conditions to the Municipal Class EA that may entail further study, monitoring, or consultation.

1.4.1 Dixie-Dundas Flood Mitigation Project Schedule

The Project is a Schedule C project, which requires completion of all phases of the Municipal Class EA planning process, as described in Section 1.4. The applicable Municipal Class EA schedule was confirmed following the completion of Phases 1 and 2 of the Project.

2 Problem and Opportunity Statement

The Project was anchored by problem, opportunity, and summary statements that were provided to the public early in the Project for their consideration and to receive feedback. Following the expansion of the Project study area, the original problem and opportunity statements were modified for consistency and presented to the public once again through the Project website. The modified statements are outlined in Sections 2.1 to 2.3.

2.1 Problem Statement

The lands along Little Etobicoke Creek surrounding Dixie Road and Dundas Street, referred to as "Dixie-Dundas" for this Project, are subject to flooding from as little as a 5-year storm event. This urban area consists of park and trail, commercial, industrial, and residential land uses and includes designated SPAs, which regulate future development due to flood risks. The City has an interest to protect flood-vulnerable residences and businesses as well as to intensify Dixie-Dundas to fulfill the vision of growth expressed in the Dundas Connects Master Plan (City of Mississauga et al. 2018). This vision of growth centres around the Dixie GO station and proposed higher-order transit along Dundas Street and it cannot be fully implemented without first addressing the flooding and updating the SPA policies as part of a concurrent initiative by the City Planning Strategies Division.

2.2 Opportunity Statement

The Dixie-Dundas Flood Mitigation Project seeks solutions to address flooding from Little Etobicoke Creek to protect existing residences and businesses as well as to enable future growth. Any acceptable flood protection solution will, to the extent possible, lower or maintain delineated flood lines, and minimize impacts to landownership, land use conditions, and existing and proposed infrastructure. Floodplain mapping would be updated to reflect a flood mitigation solution, in addition to the concurrent SPA initiatives by the City, to provide greater certainty for future development and provide confidence that existing assets are protected to the extent possible.

2.3 Summary Problem and Opportunity Statement

Residences and businesses near the major transit station area at Dixie-Dundas are currently highly vulnerable to flooding from Little Etobicoke Creek. The Dixie-Dundas Flood Mitigation Project will assess solutions to provide flood protection to residences and business as well as to enable future growth.

3 Consultation

Consultation is an essential part of the EA process, and the goal for the Project was to be informative, understandable, and transparent; the incorporation of local knowledge, Traditional Knowledge, and other concerns is valuable in the Project's assessment and evaluation processes. The Project team worked to ensure that individuals, businesses, and Indigenous peoples with an interest in the Project were given the opportunity to provide input at various stages throughout the EA.

Online public engagement was conducted at each milestone (i.e., introduction, study expansion, and evaluation of alternatives) to allow the public to review Project information and provide input. A summary of the key points of contact in the EA process is provided in Table 1. Project updates were provided on the City website (http://www.mississauga.ca/flooding) and notifications were provided via postal mailing and email. A full description of the consultation process, including copies of the shared material, is provided in the Dixie-Dundas Flood Mitigation Municipal Class Environmental Assessment Consultation Report (the Dixie-Dundas Consultation Report; Matrix 2023; Appendix A).

Table 1 Summary of Points of Contact for the Municipal Class Environmental Assessment Process

Point of Contact	Distribution	Purpose

Notice of Commencement and PIC No. 1	• posted a recorded PIC on August 7, 2020, on YouTube, which has garnered over 500 views to date (at the time of reporting; Dixie-Dundas Flood Mitigation Project, PIC No. 1)
	• provided an online questionnaire for attendees to fill out and comment
	• a notice for the PIC (including the Notice of Commencement) was distributed:
	  ▪ email was sent to the contact list
	  ▪ mailed out the first notice through Canada Post to nearly 10,000 addresses starting the week of August 10, 2020
	  ▪ published on the City website on August 6, 2020
	  ▪ published in the Mississauga News on August 6, 2020
		• introduce the project and problem/opportunity statements to the public and interested parties
		• introduce preliminary details of the project to the public and interested persons
		• present alternative solutions and evaluation criteria for feedback
		• provide opportunity for interested parties to identify any concerns and/or information that will support the Municipal Class EA process
		• provide opportunity for the public to be added to the project mailing list

Project Bulletin	• the project bulletin was emailed out to the contact list and posted to the City's webpage on October 29, 2021
	• posted slides on the City website on August 4, 2021 (Dixie-Dundas Flood Mitigation Study Project Bulletin for Expanded Study Area)
	• a notice for the project bulletin was distributed:
	  ▪ email was sent to the contact list on August 5, 2021
	  ▪ published on the City website
		• introduce the expanded study area near Dundas Street
		• discuss conceptual alternative flood mitigation solutions for the expanded study area

Point of Contact	Distribution	Purpose

PIC No. 2	• posted a recorded PIC on May 19, 2023, on YouTube, which has garnered almost 100 views at the time of reporting (Dixie-Dundas Flood Mitigation Project, PIC No. 2)
	• provided an online questionnaire for attendees to fill out and comment
	• a local resident requested a hard copy of the material and was sent a package on May 23, 2023
	• a notice for the PIC was distributed:
	  ▪ email was sent to the contact list on May 16, 2023
	  ▪ published on the City website on May 16, 2023
	  ▪ flyers to local residents and businesses were distributed on May 12, 2023
		• present conceptual designs and a detailed evaluation of the alternative solutions
		• provide opportunity for interested parties to identify any concerns and/or information that will support the Municipal Class EA process

Notice of Completion	• a notice of completion was distributed:
	  ▪ email was sent to the contact / stakeholder list on March 28, 2024
	  ▪ published on the City website on March 28, 2024
	  ▪ flyers to local residents and businesses were distributed on March 28, 2024
		• highlight the end of the project and the location of the ESR summarizing the project's process and findings
		• provide the public a minimum 30-day period to review and comment on the ESR

Notes:
ESR - Environmental Study Report
EA - environmental assessment
PIC - Public Information Centre

This Project engaged many stakeholders, including Indigenous peoples and First Nations, local communities, residents, agencies, businesses, and developers. Matrix engaged Cambium Indigenous Professional Services (CIPS) from the onset of the Project to advise on the Project's Indigenous communication strategy and to facilitate discussions with the Mississaugas of the Credit First Nation, the Six Nations of the Grand River, the Haudenosaunee Confederacy (represented by the Haudenosaunee Development Institute), and the Huronne-Wendat Nation.

Agencies that were also engaged in the planning and development of the alternatives included MECP, TRCA, the Regional Municipality of Peel (Peel Region), and different City departments. Further discussions with the Project team included some specific groups and residents whose properties would potentially be impacted by the different scenarios, including a private commercial property (1607 Dundas Street East) located near the Dundas Street bridge. A full list of the groups consulted as well as meeting minutes and feedback are provided in the Dixie-Dundas Consultation Report (Matrix 2023; Appendix A).

4 Planning and Policy

4.1 Planning Context

This section provides a summary of the provincial, regional, and local plans and policies that were considered and reviewed to ensure that the Project would conform to the broader goals contained and expressed therein.

4.1.1 Provincial Planning Context

There are a number of provincial plans and policies that address the development of both regional and municipal official plans. The main provincial planning policies considered include Provincial Policy Statement, 2020 (PPS; MMAH 2020) and A Place to Grow: Growth Plan for the Greater Golden Horseshoe (the Growth Plan; Government of Ontario 2020). These plans and policies are summarized in Sections 4.1.2 and 4.1.3, as they relate to the Project. Other provincial plans, including the Oak Ridges Moraine Conservation Plan, the Greenbelt Plan, the Niagara Escarpment Plan (2017), and the Lake Simcoe Protection Plan were determined to not apply to the project due to its location.

4.1.2 Provincial Policy Statement, 2020

The most recent PPS (MMAH 2020) came into effect in May 2020. The PPS provides policy direction on matters of provincial interest related to land use planning and development and intends to protect resources, public health and safety, and the quality of the natural and built environment. The PPS informs land use planning decisions under the Planning Act in Ontario and requires that infrastructure be provided in a coordinated, efficient, and cost-effective manner. The PPS recognizes the complex relationships between economic, environmental, and social factors in planning, and that works must embody good planning principles. The PPS advises on issues that affect our communities and infrastructure, such as transportation, connectivity and sensitivity of natural features, species and habitats, and protecting health and safety.

The intent of the Project is to reduce the risk to life and property from riverine flooding and to enable the City to remove or reduce the SPA designations associated with hazardous flood conditions within the Little Etobicoke Creek and adjacent Applewood Creek watersheds. Reducing flood risks and removing the SPAs will allow growth and urban development within the City, which are consistent with policy objectives of the PPS.

PPS components applicable to this study include:

- focusing growth within settlement areas away from significant or sensitive resources and areas that may pose a risk to public health and safety
- efficient management of resources (such as land use) to direct, promote and/or sustain growth
- protecting life and property from hazards such as flooding and considering the potential effects of climate change that may increase the risk associated with natural hazards
- ensuring that resources are managed in a sustainable manner to protect essential ecological processes and public health and safety, while minimizing environmental and social effects to meet its long-term needs

4.1.2.1 A Place to Grow: Growth Plan for the Greater Golden Horseshoe

The Ontario government established the Growth Plan (Government of Ontario 2020) to provide a framework for municipalities to implement Ontario's vision for stronger communities and growth management throughout the Greater Golden Horseshoe (GGH) region. This long-term planning document recognizes the differences between cities, suburbs, towns, and villages and how these areas will grow alongside one another. Built up areas, Urban Growth Centres, and transit corridors and stations are outlined as key areas to concentrate growth. The Growth Plan also aims to create environmentally sustainable communities by considering climate change and approaches to reduce greenhouse gas emissions in planning and managing growth.

The goal of the Growth Plan is to focus growth in compact development patterns and offer a variety of housing options and mixed-use development opportunities within Urban Growth Centres. The Growth Plan sets out minimum density targets for jobs and residents per hectare in Urban Growth Centres. Downtown Mississauga is identified as an Urban Growth Centre in the Growth Plan, with a minimum density target of 200 residents and jobs combined per hectare by 2031 or earlier. The current flood SPA designations for the project area restrict land use development and therefore limit the City's ability to meet this target. Through the implementation of the preferred alternative solution(s) from the Project, the SPA designations may be able to be completely removed, thereby helping the City to meet the density targets set out in the Growth Plan.

In addition to outlining targets for growth, the Growth Plan prioritizes the protection of lands, features, and resources that are essential for long-term quality of life, economic prosperity, environmental health, and ecological integrity of the GGH region. Specific lands, features, and resources of the Project that need to be protected include water resources systems and public open space.

4.1.3 Regional Planning Context

4.1.3.1 Region of Peel Official Plan

The Region of Peel Official Plan (the Peel Official Plan; Peel Region 2022) implements and outlines various policies that support other planning documents within the Peel Region.
The Peel Official Plan is a long-term plan to guide Peel Region, which includes the City, in managing growth and development. The main purpose of the Peel Official Plan is to provide a long-term regional strategic policy framework for guiding growth and development in Peel Region, while also considering the protection of the environment, management of non-renewable and renewable resources and a regional structure for managing growth. The

Peel Official Plan provides direction for future planning activities and for public and private initiatives aimed at improving the existing physical environment.

Included in the Peel Official Plan is the objective to prevent or minimize the risk to human life and property associated with development, which can create or aggravate existing floodplain management problems along flood susceptible riverine environments. To support this objective, the Peel Official Plan policies encourage consultation with conservation authorities, evaluation and implementation of flood remediation measures, inclusion of policies for stormwater management in local official plans, and obtaining approvals from the Ontario Ministry of Natural Resources and Forestry (MNRF) and the Ontario Ministry of Municipal Affairs and Housing (MMAH) to change the boundaries of an existing SPA.

4.1.3.2 Toronto and Region Conservation Authority Living City Policies

The Living City Policies for Planning and Development in the Watersheds of the Toronto and Region Conservation Authority (the Living City Polices; TRCA 2014) guides TRCA in its responsibilities in the planning and development approvals process. Among other objectives, the Living City Policies attempt to advance urban redevelopment that emphasizes restoration of degraded natural areas, remediation of flooding hazards, reduction of flood risk, and redevelopment in urban intensification areas. TRCA policies and objectives provide the basis for approving permit applications under Section 28 of the Conservation Authorities Act.

The Project study area is situated within areas regulated by TRCA under Section 28 of the Conservation Authorities Act. These regulated areas are required to be established where development is potentially subject to flooding, erosion or dynamic beaches, or where interference with wetlands and alterations to shorelines and watercourses might have an adverse effect on environmental features. Any proposed development, interference, or alteration within a regulated area requires a permit from TRCA under Ontario Regulation (O. Reg.) 166/06: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.

In May 2019, the Province of Ontario introduced Bill 108 (More Homes, More Choices Act), which contains amendments to the Conservation Authorities Act. Bill 108 became law as of June 2019 and continues the requirement that conservation authorities provide programs and services that are relevant to the Project, including those related to the risk of natural hazards and to the conservation and management of lands owned or controlled by the conservation authority.

4.1.4 Local Planning Context

4.1.4.1 Mississauga Official Plan

The City is responsible for regulating land use and establishing policies for physical, economic, and social development within its jurisdiction. The Mississauga Official Plan (City of Mississauga 2023a) sets out the vision for where and how Mississauga will grow to the year 2031. The Planning Act requires that an official plan conforms to, or does not conflict with, provincial plans. Moreover, Section 3 of the Planning Act requires that all decisions affecting planning matters "shall be consistent with" policy statements issued under the Planning Act, including the PPS (Government of Ontario 2023).

The Mississauga Official Plan sets out the vision and direction for how Mississauga will grow and develop into the future. It provides guidance and standards for how development applications will be reviewed and approved by the City, including those that may be subject to an SPA or otherwise identified as potentially affected by flooding. New buildings and structures need to be protected from flooding and allow both access and egress during emergencies. When the velocities and depths experienced during flood events exceed the MNRF criteria, hazards to human life and structures can result. The intent of the Mississauga Official Plan is being preserved through the implementation of the Project, as flood mitigation solutions for the Little Etobicoke Creek watershed, in particular at the Project study area, will be identified.

Special Policy Areas

The Project study area is centred at the intersection of Dixie Road and Dundas Street East and includes two existing SPAs that were designated in 1988, which have not been revised since. A figure illustrating the limits of the relevant SPAs, as provided in the Mississauga Official Plan (City of Mississauga 2023a) and the latest SPA delineation available from TRCA, are shown on Figure 1. The SPA boundaries reflect TRCA's delineation of the Regional storm hydraulic modelling results for the area, while the City's SPA delineation must also take property boundaries into consideration.

The first existing SPA relevant to the Project study area is the similarly named Dixie-Dundas SPA, located northeast of the Dixie Road and Dundas Street East intersection (Figure 1). The second relevant SPA for the Project study area is the Applewood SPA, which is located northwest of the Dixie Road and Dundas Street intersection (Figure 1). The urban area surrounding these SPAs consists of a variety of park, commercial, industrial, and residential land uses. Flood spills occur during as little as the 5-year storm (MMM 2015), and the delineation of flood spills indicates that over a thousand commercial, industrial, and residential properties are vulnerable to flooding during a Regional storm (i.e., modelled on Hurricane Hazel; Matrix 2018).

4.1.4.2 Dundas Connects Master Plan

The Dundas Connects Master Plan "aims to integrate transportation and land-use planning, and implement best practices along the [Dundas Street] corridor to address current and future demand" (City of Mississauga et al. 2018). The Dundas Connects Master Plan acknowledges that current policies associated with the Dixie-Dundas and Applewood SPAs (referred to as the Dixie SPA in the Dundas Connects Master Plan), both of which were approved by the Province of Ontario in 1988 due to riverine flood risks, limit redevelopment within the Regional storm floodplain. Future works were directed to consider, among other options, an update to the SPA boundary(s)/policies that would open opportunities to facilitate the transportation corridor, intensify development within the mixed-use land area, establish a gateway image, and better connect the trail system.

The transportation corridor for this portion of Dundas Street includes plans that accommodate a bus rapid transit (BRT) system. The Dundas Street bridge is an important element that overlaps the Project study area and the BRT corridor. The BRT aims to reduce bus delays and increase service by optimizing the benefits of speed and capacity found in a typical rail system with the lower cost and flexibility of a bus system. The Project aims to eliminate flooding that would impact Dundas Street and the BRT route. Matrix has worked together with the City's BRT team to arrive at a Dundas Street bridge design that best aligns with the BRT's implementation plans while also satisfying the objectives of the Project.

4.2 Flood-related Policy and Guidelines

Many existing flood-related policies and criteria must be considered in the screening of alternative solutions for the Project. The most pertinent ones include the provincial flooding hazard standards (MNR 2002), Toronto and Region Conservation Authority Flood Protection Land Forming Technical Design Considerations (the FPL Guidelines; AECOM 2018a), the Ontario Ministry of Transportation (MTO) Highway Drainage Design Standards (MTO 2008) and the PPS (MMAH 2020) related to climate change. The pertinent portions of each are provided in Sections 4.2.1 to 4.2.3.

Other related guidelines that were considered include:

- Ministry of Environmental – Stormwater Management Planning and Design Manual (MOE 2003)

- City of Mississauga Transportation and Works Requirements Manual (City of Mississauga 2020)
- Region of Peel Stormwater Design Criteria (Aquafor Beech 2019)
- TRCA Stormwater Management Criteria (TRCA 2012)

4.2.1 Provincial Flooding Hazard Standards

The province has a set of policies and performance standards to support land use planning in areas susceptible to flooding hazards. “Flooding hazards means the inundation, under the conditions specified below, of areas adjacent to a river system (that are not ordinarily covered by water). The flooding hazard limit within TRCA’s jurisdiction is the greater of: i) the flood resulting from a rainfall actually experienced during the Hurricane Hazel storm (1954), transposed over a specific watershed; ii) the one hundred year flood […]” (p.11 MNR 2002).

The Technical Guide, River & Stream Systems: Flooding Hazard Limit (the Technical Guide) document also indicates that “[n]ew development which is susceptible to flood/erosion hazards or which will cause or aggravate flood/erosion hazards […] must not be permitted to occur unless the flood/erosion hazards and environmental impacts have been addressed” (p. 10 MNR 2002). This requirement provides a key driver for the City to complete the Project, as development is currently being limited by the two existing SPAs and their associated policies due to spills occurring from Little Etobicoke Creek during the Hurricane Hazel storm event.

The Technical Guide classifies alternative solutions as passive or active, dry or wet, and temporary or permanent. A key consideration in the Technical Guide is that flood mitigation measures be passive, dry, and permanent for lands to be considered outside of the flood hazard area.

> “Active floodproofing requires some action, i.e. closing watertight doors or sandbagging for the measure to be effective. Advance flood warning is almost always required in order to make the flood protection operational.
>
> Passive floodproofing measures are defined as those that are in place and do not require flood warning or any other action to put the flood protection into effect. These include construction of development at or above the flood standard, or the use of continuous berms or floodwall.
>
> The objective of dry floodproofing is to keep a development and its contents completely dry. Such can be carried out by elevating the development above the level of the flood standard or by designing walls to be watertight and installing watertight doors and seals to withstand the forces of flood waters.

> Wet floodproofing is undertaken in expectation of possible flooding. Its use is generally limited to certain specific non-residential/non-habitable structures (e.g. arena, stadium, parking garage). The intent of wet floodproofing is to maintain structural integrity by avoiding external unbalanced forces." (p. A25 MNR 2002)

Permanent floodproofing measures are those that are resistant to time and extreme conditions with limited monitoring or maintenance. These measures are in place regardless of neglect and will withstand the pressures of flooding, including piping, blowout, and hydrostatic force. Increased conveyance is an example of a permanent floodproofing measure.

Temporary floodproofing measures are those at risk of failure due to structural neglect or the extreme conditions that occur during a flooding event. "Dykes and flood walls are not regarded as permanent flood control structures and the land behind the dykes and flood walls should continue to require protection to the revised (increased) flood standard." (p. 16 MNR 2002).

The temporary versus permanent classification of floodproofing measures may not be inherently obvious. Due to the level of inspection and maintenance required, MNRF policies do not consider some flood mitigation measures, including berms, dykes, flood control ponds, and flood walls, to be permanent, but rather passive, and would not contribute to an eventual removal of an SPA designation. Accordingly, only solutions considered permanent will advance the process of removing the SPAs in the Project study area, thereby better allowing unrestricted development from a purely flood-risk standpoint.

4.2.2 Flood Control Design Guidance

4.2.2.1 Flood Protection Landform Guidelines

The FPL Guidelines (AECOM 2018a) have been used for the conceptual sizing and design of flood protection landforms (FPLs) within TRCA's jurisdiction. The FPL Guidelines was prepared to outline design requirements if an FPL is the preferred option for flood protection, and it includes geotechnical considerations, development setbacks, and acceptable land uses on and adjacent to the FPL. The following high-level design considerations were used to generally establish the FPL requirements:

- Fill slopes on the wet side (river side) of the FPL should be 5% to 10%, with 10% to 15% for localized areas.
- Fill slopes on the dry side of the FPL should be 1.5% to 3.5%, or as determined through a geotechnical analysis.

- The crest width must be a minimum of 3 m, with 5 m or greater preferred.
- The FPL core elevation should allow for 0.5 m of freeboard protection above the greater of the 100-year storm or the Regional storm (including 0.2 m for climate change considerations).
- Overtopping velocities on the dry side should be limited to 1.2 m/s or less.
- Seepage/groundwater exit gradient limited to 0.5 or less.
- Intrusions into the core of the FPL should be restricted/regulated to preserve the integrity of the FPL (i.e., services, deep rooted vegetation, etc.).
- Local drainage should be directed away from the FPL.
- No hydraulic connection is permitted between the wet and dry sides of the FPL.
- No structure or foundation should be supported on or within the FPL.
- Critical infrastructure should not be located on, in, or beneath the FPL.
- Development should be set back 10 m from the dry side toe of slope.

In addition to the design considerations, an FPL would only be considered a feasible alternative if it is able to fully mitigate flood risk to existing flood vulnerable areas (i.e., eliminate Regional storm spill) without causing adverse impacts to upstream or downstream flood risk.

4.2.2.2 Channel Design Guidance

Channel design parameters used for the Project are based on TRCA policies and consideration for protecting property and life. TRCA guidance recommends sloped channel banks/valleys rather than vertical walls. Throughout TRCA's jurisdiction, a 15 m allowance width is normally included from the stable top of slope/bank when defining the regulated area (TRCA 2023). This guidance is based on requirements for future maintenance and consequence of potential failure. Where possible, this constraint is considered; however, in some more urbanized riverine environments, significant property constraints can exist that limit the ability to incorporate naturally stable side slopes and maintain a 15 m setback. In these cases, localized use of vertical walls may be required to meet flood mitigation objectives while minimizing the need for further property acquisitions.

The Project primarily seeks to achieve flood conveyance objectives; however, the project also may also be able to provide a dynamically stable channel/floodplain/valley in some reaches to ensure long-term protection for infrastructure (primarily trunk sanitary sewers), property, valley users, and improve the overall ecological function of the valley system. The proposed EA alternatives followed the Crossing Guideline for Valley and Stream Corridors (TRCA 2015), ensuring that the proposed channel crossings account for flooding, geomorphic, and geotechnical hazards. Geomorphic conditions have been assessed as part of the background to the project, and geomorphic design principles also guide channel recommendations being put forward.

4.2.2.3 Bridge Design Guidance

The MTO Highway Drainage Design Standards (MTO 2008) is a manual for engineers on the design and replacement of highway drainage infrastructure in Ontario. The standards include guidance on the design flows, freeboard and clearance, and scour protection, amongst other items for bridges and culverts. The MTO Highway Drainage Design Standards were considered throughout the EA design process. On urban arterial roads, such as Dixie Road and Dundas Street East, bridges with a total span greater than 6 m require the 100-year design storm be used for clearance and freeboard calculations. The clearance required for the Dixie Road and Dundas Street road crossings is 1 m from the 100-year water level to the underside of bridge. There are no clearance requirements stipulated by MTO for the Regulatory flow for arterial roads.

The Canadian Highway Bridge Design Code (the CHBDC; CSA Group 2019) is widely recognized as an authoritative source of guidance for the design, construction, and maintenance of bridges in Canada. The CHBDC also covers the design of pedestrian bridges, bicycle bridges, retaining walls, barriers, and highway accessory supports of a structural nature. The CHBDC was followed throughout the assessment of alternative solutions and associated design considerations for the Dixie Road and Dundas Street bridge replacements. In term of freeboard, the CHBDC requires 0.3 m of clearance between the bridge soffit and the normal design flood, which is considered to be the 50-year event.

4.2.3 Incorporating Climate Change

4.2.3.1 Provincial Policy Statement on Climate Change

The Province of Ontario has recognized the need to examine current floodplain management methodologies in light of climate change. The PPS (MMAH 2020) has articulated this need at the policy level. The MNRF has acknowledged the need to evaluate the Technical Guide for municipalities, conservation authorities, and others to integrate consideration of climate change at an operational level (EWRG 2017). Accordingly, in addition to the standard methodologies undertaken for flood risk assessments, the Project has included assessment of resiliency to climate change.

4.2.3.2 Project Approach to Considering Climate Change

Project-specific criteria for incorporating resilience to climate change was developed through consultation with TRCA and the City. These criteria established that a minimum 0.5 m freeboard requirement above the Regional event water level at critical spill points be maintained within the channel/valley. In the study area, this included two primary spill points: one at Queen Frederica Drive upstream of Dixie Road and one along the south bank downstream of the Dixie Road crossing. To support meeting the required freeboard criteria up and downstream of Dixie Road, a 0.5 m freeboard requirement was added to the Dixie Road bridge crossing between the Regional water level and the bridge soffit. This additional requirement is seen to be more stringent than that stipulated in the existing MTO and CHBDC bridge standards.

Resiliency was also considered for the Dundas Street area and bridge design. The minimum freeboard/clearance of 0.5 m applied in the Dixie Area was not applied to the Dundas Street bridge soffit, as there is less risk associated with higher water levels in this area (e.g., no defined spill points). The confined nature of the channel in this area provides some inherent resiliency to keep the flood flows contained. A defined requirement of the Dundas Street bridge design was to pass the Regional flow below the soffit elevation. This ensures that the water levels are at a very low risk of overtopping the road, even if the magnitude of flood flows increases in the future. Any additional clearance provided in the alternative solutions or design concepts for the Dundas Street bridge is considered additional resiliency. Similarly, flood proofing, such as maintain the existing berm, can be considered additional resiliency but cannot be considered a permanent flood protection measure according to existing MNRF policy.

It is acknowledged that additional climate resiliency can be achieved by implementing a solution that will allow for a greater variability in flood flows and erosive forces and one that also provides additional freeboard. For example, additional resiliency could be achieved by providing additional height on top of slopes beyond the Regulatory flood level (even if considered a non-permanent type of solution).

5 Existing Conditions

5.1 Flood Risk Characteristics

TRCA and the City have been studying existing flood risk in the Project study area for many years. Definition of existing flood risk conditions and associated characterization have not been directly repeated within this report. Work completed for other recent projects, including Etobicoke Creek Hydrology Update (MMM 2013), the SPA Floodplain Mapping Study (MMM 2015), and the FESMP (Matrix 2021), has been relied upon, as summarized in Section 1.3.

5.1.1 Hydrology

Little Etobicoke Creek is located within the Etobicoke Creek watershed and has drainage area of approximately 2,260 ha. The confluence of Little Etobicoke Creek with Etobicoke Creek is located approximately 1.2 km downstream of Dundas Street. The history of urban development within the watershed has modified the fluvial system both in terms of the hydrological inputs of stormwater runoff to the creek as well as channel form and floodplain connectivity. Erosion and flood mitigation measures implemented within the channel and floodplain in response to the modified flow regime have had their own effect on watershed hydrology. As a result, the Little Etobicoke Creek watershed has a rapid response to rainfall events and displays degraded fluvial geomorphic conditions (TRCA 2010).

MMM (2013) completed the hydrology update for Etobicoke Creek for TRCA. A Visual OTTHYMO model was developed for the Etobicoke Creek watershed. The hydrologic model development included computing catchment parameters, identifying suitable rainfall events, and calibrating and validating the model. A total of 280 subcatchments were included in the hydrologic model, with an average catchment area of 80 ha. The model used precipitation from rain gauges at Heart Lake and Mississauga Yard Works and was calibrated to three streamflow gauges in the Etobicoke Creek watershed. The 2-year through 350-year design storms were simulated using the 12-hour Atmospheric Environment Service (AES) distribution. Consistent with hydrologic modelling principles that align with provincial policy, the Regional storm (Hurricane Hazel) was simulated using a 12-hour storm period with antecedent moisture conditions represented by an Antecedent Moisture Condition (AMC) III. Additionally, all stormwater management facilities were removed. A frequency analysis and sensitivity analysis were conducted to compare against statistically derived flows at hydrometric stations with long periods of record and to further understand the calibrated watershed model and compare flows to previous studies.

The watershed catchment and flow nodes within the Project study area are shown in Figure 4. Flows for the design storms and Regional storm within the Project study area for future conditions are presented in Table 1.

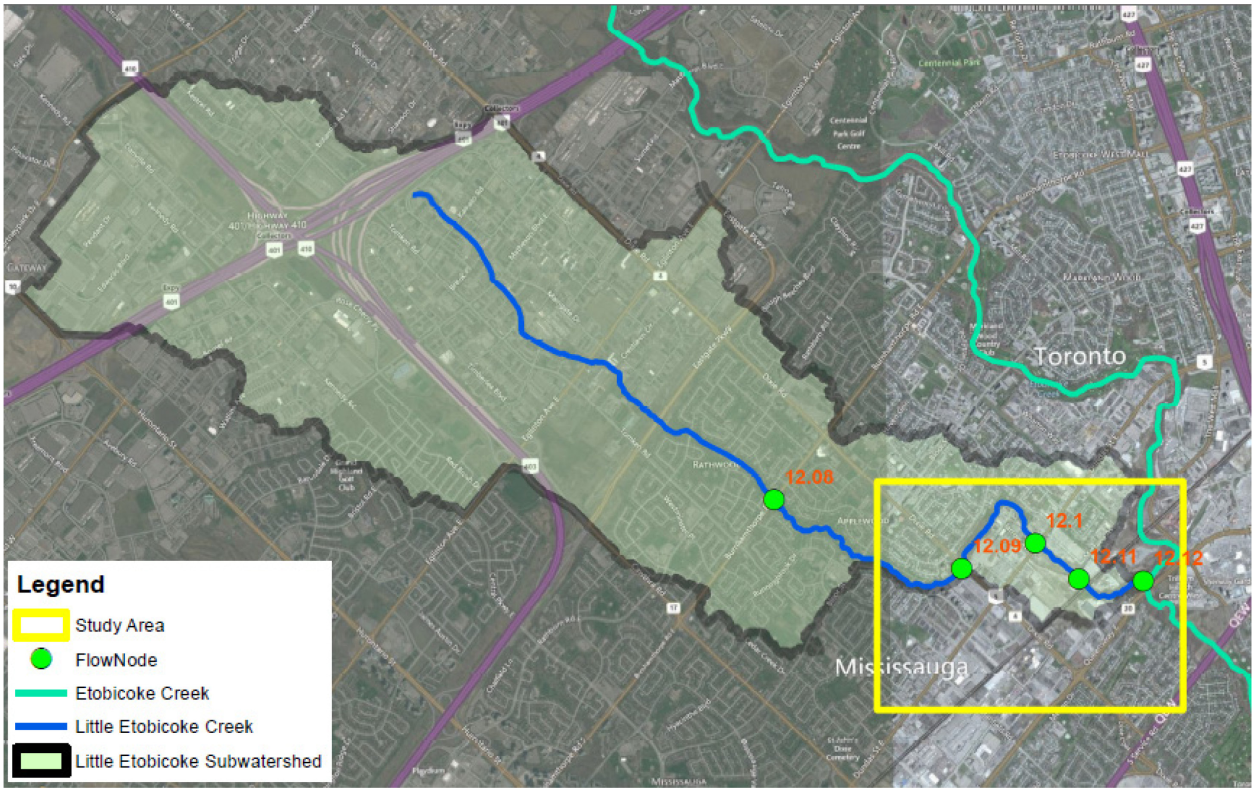


Figure 4 Little Etobicoke Creek Watershed and Flow Nodes (MMM 2015)

The flows from the Etobicoke Creek Hydrology Update (MMM 2013) have been used to support the hydraulic modelling and mapping updates and the assessment of mitigation alternatives in the subsequent studies described in Section 1.3. The future conditions peak flows from the MMM (2013) study presented in Table 2 were also used in the Project.

Table 2 Summary of Peak Flows for Little Etobicoke Creek

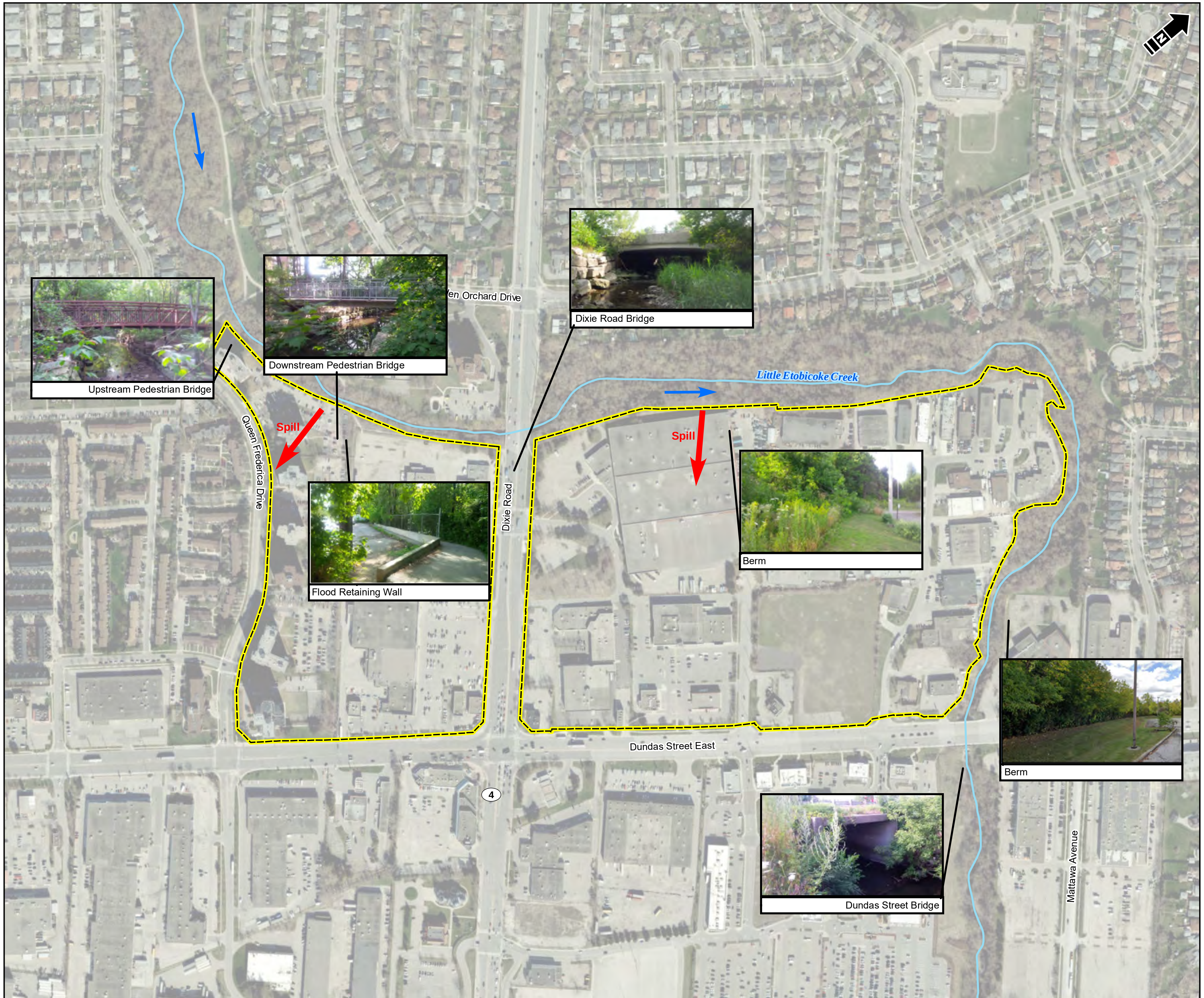
Flow Location	Node	2-year Peak Flow Rate (m^3/s)	5-year Peak Flow Rate (m^3/s)	10-year Peak Flow Rate (m^3/s)	25-year Peak Flow Rate (m^3/s)	50-year Peak Flow Rate (m^3/s)	100-year Peak Flow Rate (m^3/s)	350-year Peak Flow Rate (m^3/s)	Regional Storm Peak Flow Rate (m^3/s)
Bloor Street	12.08	42.9	55.4	63.9	75.6	84.5	93.7	141.4	193.6
Dixie Road	12.09	41.8	54.5	62.9	74.5	83.3	92.4	140.6	191.9
Dundas Street	12.10	42.9	56.5	65.5	77.6	86.8	96.3	146.6	201.8
At Confluence with Etobicoke Creek	12.12	44.7	58.7	68.3	80.9	90.4	100.2	152.3	209.5

Notes:
(1) Peak flow for future conditions. Source Etobicoke Creek Hydrology Update (MMM 2013), based on 12-hour Canadian Atmospheric Environment Service (AES) storm,
Source: MMM (2013) Table 1.1

5.1.2 Riverine Flood Characterization

Following the Etobicoke Creek Hydrology Update (MMM 2013), MMM completed the SPA Floodplain Mapping Study (MMM 2015) to map existing conditions within the SPA. Figure 5 illustrates the location of key hydraulic features within the study area (e.g., bridges, berms, and flood walls) including photographs for each feature. The flood wall and flood berm are not considered permanent flood control, which are consistent with current MNRF practice, and should not be included in assessment of Regional storm conditions. As such, the flood control features were removed from the Regional and 350-year storm models.

The SPA Floodplain Mapping Study (MMM 2015) found that spill from Little Etobicoke Creek to Queen Frederica Drive starts to occur during a 5-year event in the watercourse. The spill occurs just upstream of the existing flood wall and between the two pedestrian bridges (Figure 5). The magnitude of the spill during the 5-year event is small at approximately 1.0 m^3/s of the total peak flow of 58 m^3/s. However, the fraction of flow that spills from Little Etobicoke Creek to Queen Frederica Drive increases significantly for larger flow events. The percentage of spill flow to total flow increases from near zero for the 5-year event to 49% for the 350-year event with the existing flood wall and flood berm in place (MMM 2015). The breakdown of spill flow to total flow for each of the assessed events is presented in Table 3.



Special Policy Area
Spill Direction
Flow Direction
Watercourse

Notes:
Figures: MMM Group Limited. 2015. Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area, Little Etobicoke Creek. Prepared for Toronto and Region Conservation Authority, Report No. 1412606-000. Mississauga, Ontario. January 2015.

1. Base digital information obtained from the City of Mississauga (SHP and DGN format).

1:5,000 metres
50 0 50 100
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

Matrix Solutions Inc.
A Montrose Environmental Company

City of Mississauga
Dixie-Dundas Flood Mitigation Project - Environmental Study Report

Key Hydraulic Features (Bridges, Flood Walls, and Berms)

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 5

Table 3 Spill to Queen Frederica Drive

Condition	Return Period	Total Flow Rate (m^3/s)	Flow Rate in Channel at Dixie Road (m^3/s)	Flow Rate Spill to Queen Frederica Drive (m_3/s)	Spill to Queen Frederica Drive (%)
With Existing Berm and Flood Wall	5-year	59	58	1	<2
With Existing Berm and Flood Wall	25-year	81	65	16	20
With Existing Berm and Flood Wall	100-year	100	70	30	30
With Existing Berm and Flood Wall	350-year	152	78	74	49
Without Existing Berm and Flood Wall	350-year	152	74	78	51
Without Existing Berm and Flood Wall	Regional	210	80	130	62

Source: MMM (2015) Table 6.1

The wall and berm have minimal impact on the fraction of spill from Little Etobicoke Creek to Queen Frederica Drive during the 350-year event, increasing the spill rate from 49% of the total flow to 51% of the total flow. For the Regional storm event, 62% of the total flow spills into the Applewood SPA, primarily along Queen Frederica Drive. The magnitude of the spill means that only approximately 80 m^3/s is conveyed by Little Etobicoke Creek through the Dixie Road bridge during a Regional event, which is equivalent to the peak flow generated by the 25-year event (MMM 2015).

Although the location of the spill is predominately upstream of Dixie Road, there is also some spill between Dixie Road and Dundas Street to the Dixie Dundas SPA (Figure 5). There is no spill on the downstream side of Dixie Road under existing conditions with the berm in place for all events up to and including the 350-year event. However, if the existing berm is removed from the analysis (following provincial policy), spill occurs for both the 350-year event and the Regional storm. The existing conditions Regional storm depths are presented in Figure 2. The spill flow exits the Little Etobicoke Creek floodplain between buildings downstream of Dixie Road and then flows southeasterly to Dundas Street and back to Little Etobicoke Creek.

One of the most important considerations of riverine flood characterization for the Project is the recognition that flows downstream of Dixie Road would have to increase in direct response to mitigating the upstream spill. When the spill at Queen Frederica Drive is contained, flows downstream of Dixie Road are increased. The increased flows would cause additional spill within the Dixie Area, and throughout the Dundas Area without additional mitigation.

The 12 m single-span Dixie Road bridge is a recognized flow constraint within the Project study area (AECOM 2019, Matrix 2021, MMM 2015). Although the bridge's impacts have not been quantified separately from the channel capacity, the bridge flow capacity is a key factor in the flood levels and associated spill at Queen Frederica Drive.

The Dixie Road bridge and the narrow channel geometry leading into the bridge are the primary hydraulic restrictions creating backwater along this portion of Little Etobicoke Creek that spills at Queen Frederica Drive. In the Regional storm, backwater from the Dixie Road bridge propagates upstream to the Project study area limits. The two pedestrian bridges within the Project study area are currently submerged in the backwater from the existing Dixie Road bridge. However, when the backwater from Dixie Road is removed, these pedestrian bridges would also create hydraulic restrictions.

The 6 m single-span Dundas Street bridge is situated within a deeper valley which also has a steeper slope of channel than exists at the Dixie Road bridge. Under existing conditions, the Dundas Street bridge is not overtopped under any flow, up to the Regional event. The current level of service provided by Dundas Street bridge is due to the spill upstream, which reduces the peaks flow up to 62% under existing conditions. If the entire flows were to be contained within the Little Etobicoke Creek channel through mitigation works, the Dundas Street bridge would be overtopped during flood flows in the range of a 50-year flow event.

5.1.2.1 Flood Risk Assessment

A risk assessment was completed as part of the FESMP (Matrix 2021) that characterized the overland flooding resulting from the spill at Queen Frederica Drive and downstream of Dixie Road. The FESMP extended the model domain to further map the extent of the overland flow path for nine different storms. Flood hazard and risk mapping for the extended area are presented in Appendix B. The results of the FESMP were reviewed as part of the Project and considered acceptable for use as the existing conditions of the Project.

Flood risk assessments typically consider three risk factors: depth, velocity, and depth-velocity product. In accordance with current MNRF practices, the risk criteria outlined in Table 4 apply. Low-risk flooding includes areas that are inundated but where vehicular and pedestrian ingress and egress are still feasible. Medium-risk areas do not permit vehicular ingress and egress, but pedestrian ingress and egress is possible. High-risk areas do not facilitate safe land access of any kind. These flood risk criteria were used to develop the flood risk mapping presented as Sheet 4 in each of Maps B1 through B9 in Appendix B.

Table 4 Flood Risk Criteria

Risk Level	Low	Medium	High (1)
Depth	≤0.3 m	>0.3 m and ≤0.8 m	>0.8 m
Velocity	≤1.7 m/s	≤1.7 m/s	>1.7 m/s
Depth-Velocity Product	≤0.37 m^2/s	≤0.37 m^2/s	>0.37 m^2/s

Note:
(1) Exceedance of any one of the criteria results in high risk.

5.2 Fluvial Geomorphology

Matrix completed a fluvial geomorphology assessment (Appendix C) that characterized Little Etobicoke Creek reaches within and upstream of the study area and provided recommendations and guidance for the development of alternative solutions and future design. The assessment included a review of relevant background information, desktop assessment, meander belt width analysis, and site visits where rapid geomorphic assessments were conducted along with an erosion site inventory.

Within the Lake Iroquois Sand Plain physiographic region (Chapman and Putnam 2007), the channel of Little Etobicoke Creek transitions from a surface geology of dominantly fine-grained lake and glacial till deposits into valley reaches that have incised into the shales, limestones, and dolostones of the Georgian Bay Formation. The bedrock geology in the incised reaches is a source of platy-shaped limestone rocks that line the channel bed and makeup natural riffle features where native substrate is still available within the active channel. As such, these bedrock channels have some natural weathering, erosion, and degradation processes with native sediment regularly transported, especially during winter and spring snowmelt events (Siddiqui and Robert, 2010).

The geomorphology assessment characterized Little Etobicoke Creek as follows (see Figure 6 for reach delineation):

- Reach 1 (R1) upstream of the study area: 550 m of channel downstream of Bloor Street displaying moderate planform sinuosity set in a forested corridor. Bankfull widths ranging between 8.5 to 12.5 m and bankfull depths ranging between 0.5 and 1.0 m. Reach profile slope of 0.3%. Bank armouring has been completed at several locations, particularly along the east bank.

- Reach 2 (R2): approximately 920 m of channel that has been lined on both banks with armourstone blocks. The reach is further separated into Reach 2a (R2a) and Reach 2b (R2b).
  - R2a consists of 500 m of channel upstream of Dixie Road. The channel planform follows the valley trend along this reach with a few bends upstream and a 200 m long straight section before crossing Dixie Road. The armourstone blocks result in a confined, approximately 5 to 8 m wide rectangular channel with varying bank (armourstone) height. The bed is also stabilized with armourstone blocks that are arranged as “cross rib” structures placed on the channel bed perpendicular to flow. Reach profile slope is approximately 0.5%.

Photograph 1 Little Etobicoke Creek Looking Upstream of Dixie Road (R2a)

Photograph 2 Little Etobicoke Creek Looking Downstream to Dixie Road (R2a)

- R2b consists of 420 m of creek downstream of Dixie Road bridge. The channel displays two minor bends immediately downstream of the bridge before extending straight for 300 m. There is an exposed concrete encasement for a watermain crossing immediately downstream of the Dixie Road bridge. The armourstone-lined style of channel described for R2a continues, channel width (approximately 8 to 10 m). The armourstone bed control features are visible nearer the bridge; downstream armourstone is limited to the banks and the bed substrate ranges but include exposed bedrock. Reach profile slope is approximately 0.4%. Bank failures were noted throughout the reach and there were indicators of flows overtopping the armourstone walls.

Photograph 3 Little Etobicoke Creek Looking Upstream to Dixie Road (R2b)

Photograph 4 Little Etobicoke Creek Looking Downstream (R2b)

- Reach 3 (R3): extends for 800 m downstream of Dixie Road to Dundas Street East. The planform displays increased sinuosity compared to R2 and is set within a forested corridor with a mixture of natural boundary materials and constructed erosion countermeasures (both stable and failing). Bankfull dimensions in this reach vary but are generally 10 to 13 m wide and 0.5 to 0.8 m deep. There is an exposed encased sanitary sewer crossing, which acts as a profile high point. Reach profile slope is approximately 0.9%. There were three erosion sites noted along this section during the inventory.

Photograph 5 Little Etobicoke Creek Looking Downstream to Dundas Street East (R3)

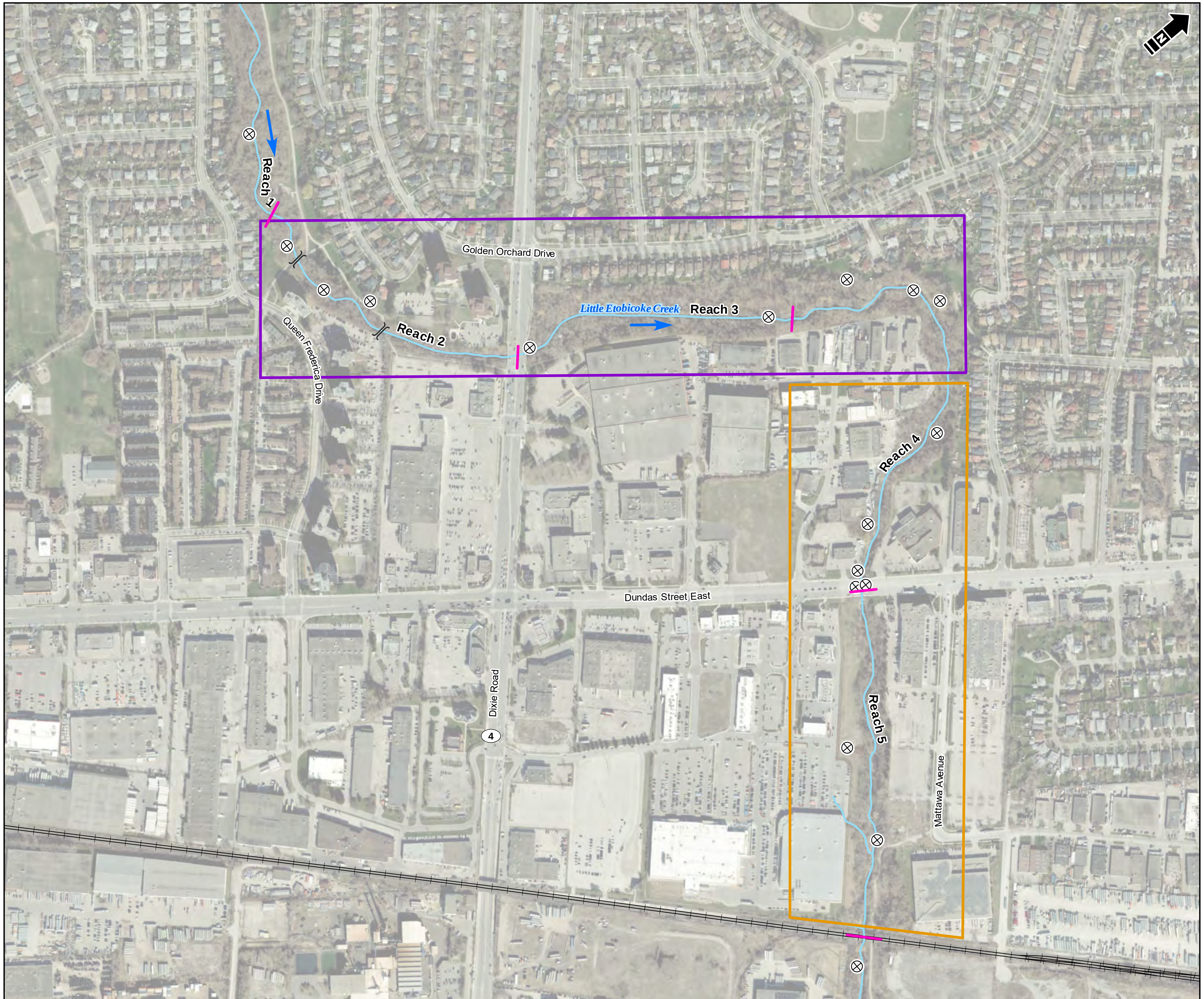
Photograph 6 Little Etobicoke Creek Looking Upstream from Dundas Street East (R3)

- Reach 4 (R4): extends approximately 550 m downstream of Dundas Street East to the CP rail crossing. This reach displays slight sinuosity with an artificially straightened corridor containing a variety of bank hardening measures (e.g., gabion baskets, riprap, armourstone). Most of the reach is within a confined valley setting. Bankfull dimensions in this reach mimic the upstream section ranging from 10 to 13 m wide and 0.5 to 0.8 m deep. Reach profile slope is approximately 0.9%. Two erosion sites were noted along this reach during the inventory.

Photograph 7 Little Etobicoke Creek Looking Downstream of Dundas Street East (R4)

Photograph 8 Little Etobicoke Creek Looking at Right Bank Downstream of Dundas Street East (R4)

- Reach 5 (R5) downstream of the study area: extends approximately 565 m downstream of the CP rail crossing until the confluence with Etobicoke Creek. The channel planform displays moderate sinuosity in a wider floodplain with valley-wall contacts in a few locations locally confining the channel.



DRAFT

- Dixie Area
- Dundas Area
- Flow Direction
- Reach Break
- Watercourse
- CN Railway
- Storm Sewer Outlet
- Pedestrian Bridge

1. Base digital information obtained from the City of Mississauga (SHP and DGN format).

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

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Matrix Solutions Inc.
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City of Mississauga
Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Geomorphology Reaches

Date: March 2024	Project: 24603	Submitter: A. McKay	Reviewer: S. Braun

Figure 6

The geomorphic assessment recommends the following items be considered within an investigation of flood mitigation design alternatives:

- The flow velocities and shear stresses within any newly designed channel reaches should consider the existing erosion and instability present throughout the Project study area.
- The channel designs should consider long-term adjustments to the channel grade to maintain adequate cover depth above infrastructure crossing Little Etobicoke Creek.
- The channel should provide for fish passage by maintaining profile connectivity (i.e., no large steps or drops), and low flows should be concentrated to provide adequate water depths.
- If the mitigation solutions have the potential to increase erosive forces downstream (e.g., at R3), channel monitoring or stabilization measures, or both, may be warranted.

As geomorphic processes play an essential role in the overall ecological health of watercourses, fish habitat has been considered in the geomorphology assessment, as well as being considered within the natural heritage study referenced in Section 5.3.

5.3 Natural Heritage Study

The Project study area is designated as a Significant Natural Area under the Mississauga Official Plan (City of Mississauga 2019). The study evaluated woodlands, valleylands, wildlife habitat, fish habitat, and species at risk (SAR; under provincial and federal designations) within the study area to identify natural heritage features. The evaluation consisted of a desktop study and field inventories to evaluate identified natural heritage against federal, provincial, and municipal policies (Appendix D).

The natural heritage features identified within the study area are highlighted as follows:

- significant wildlife habitat (SWH; downstream of Dixie Road) for eastern wood-pewee (Special Concern), which was heard calling during a site assessment
- potential presence of SAR bats
- fish and fish habitat (the fish species captured during the site assessment are common species within Ontario)
- a confirmed butternut tree downstream of Dixie Road (SAR)

The natural heritage study (Matrix 2024) recommends the following regulatory items and supplementary studies to be considered within an investigation of flood mitigation design alternatives:

- The integrity of the Significant Natural Area should be maintained, including the SWH for the confirmed eastern wood-pewee.
- A butternut health assessment should be completed during detailed design to determine whether the identified butternut is a hybrid or pure specimen. If the butternut is a pure specimen, any construction activities occurring within 25 m of the butternut will require an MECP Notice of Activity and potentially an offsetting plan (e.g., planting butternut seedlings).
- Trees present in the study area, including oaks and maples, provide suitable roosting habitat for SAR bats. However, there are not enough snags (e.g., trees with cavities, cracks, or loose bark) present for this habitat to be designated as SWH. Acoustic surveys should be completed during detailed design to confirm the presence or absence of SAR bats. If confirmed, the habitat must be preserved or impacts mitigated (e.g., placing bat boxes to offset lost habitat).
- No tree removals should be performed during the breeding bird window (April 1 to August 30).
- No in-water works should be performed during the fisheries timing window (April 1 to June 30). In-water works will require a Request for Review to Fisheries and Oceans Canada (DFO) to determine whether mitigation requires authorization under the Fisheries Act.
- Any mitigation works within the regulation limit will require a permit through the TRCA.

5.4 Geotechnical

Thurber Engineering Ltd. completed desktop geotechnical studies to characterize existing conditions within the Project study area (Thurber 2023a, 2023b, 2020; Appendix E). The studies included a review of MTO information and site visits to assess existing slopes, creek banks, and pavements.

In the Dixie Area, the site visits confirmed that most slopes were presently stable except for a few localized areas of steeper slopes/erosion observed along Willowcreek Park. Similar areas of instability were confirmed in the Dundas Area just north of Dundas Street East. North of the

Dixie Road bridge, the roadway pavement was identified as being in generally good condition, with few areas of visible distress. South of the Dixie Road bridge, roadway pavement was determined to be in fair to poor condition, with slight to moderate cracking.

In the Dundas Area, the site visits noted near vertical slopes on sections upstream of Dundas Street bridge on the east valley. The existing slopes through the Dundas Area were determined to be heavily vegetated, with some localized toe erosion and undermining. The pavement over the Dundas Street bridge was in good condition, with some moderate cracking.

The preliminary recommendations from the desktop assessment (Thurber 2020) suggested that similar erosion protection measures would be required throughout the creek if the slopes were to be cut back from their existing condition. Thurber suggests that new cut/fill slopes be designed at an inclination of 3H:1V (horizontal to vertical) or flatter, pending additional geotechnical investigations.

A preliminary geotechnical investigation (Thurber 2023a) was carried out to inform the design of the Dixie Road and Dundas Street bridge replacements anticipated to be required as part of most flood mitigation options. The investigation included drilling a borehole at each location to a depth of 10 to 11 m.

In the Dixie Road bridge area, the geotechnical study (Thurber 2023a) identified that bedrock is located approximately 3 m below the existing Little Etobicoke Creek channel bed. In the Dundas Road bridge area, bedrock was encountered approximately 1.5 m below the existing channel bed. Based on these findings as well as the groundwater elevations, Thurber anticipated that both shallow and deep foundations can be feasibly constructed at the site and that, depending on the load demand, bridges can be founded on spread footings bearing directly on bedrock.

Thurber recommended the following geotechnical drilling program be completed for the detailed design of a flood mitigation solution:

- two boreholes at each bridge foundation to a minimum of 3 m below refusal
- one borehole at each bridge approach embankment within 20 m of the abutment
- size boreholes (1.5 m deep) for pavement design at each bridge
- boreholes along the creek banks to provide further insight on creek widening and slope design, completed at an approximate spacing of 50 m and advancing to either 3 m or to practical refusal on bedrock

5.5 Archaeological and Cultural Environment

Archaeological Services Inc. (ASI) completed a Stage 1 archaeological assessment for the Project study area (ASI 2022; Appendix F), with an additional extension to consider the Dundas Area also completed. ASI identified that no previously registered archaeological sites are located within 1 km of the Project study area, based on a desktop review of the Ontario Archaeological Site Database. ASI concluded that some portions of the study area have "archaeological potential," thereby requiring a Stage 2 assessment. This recommendation was based on the following considerations:

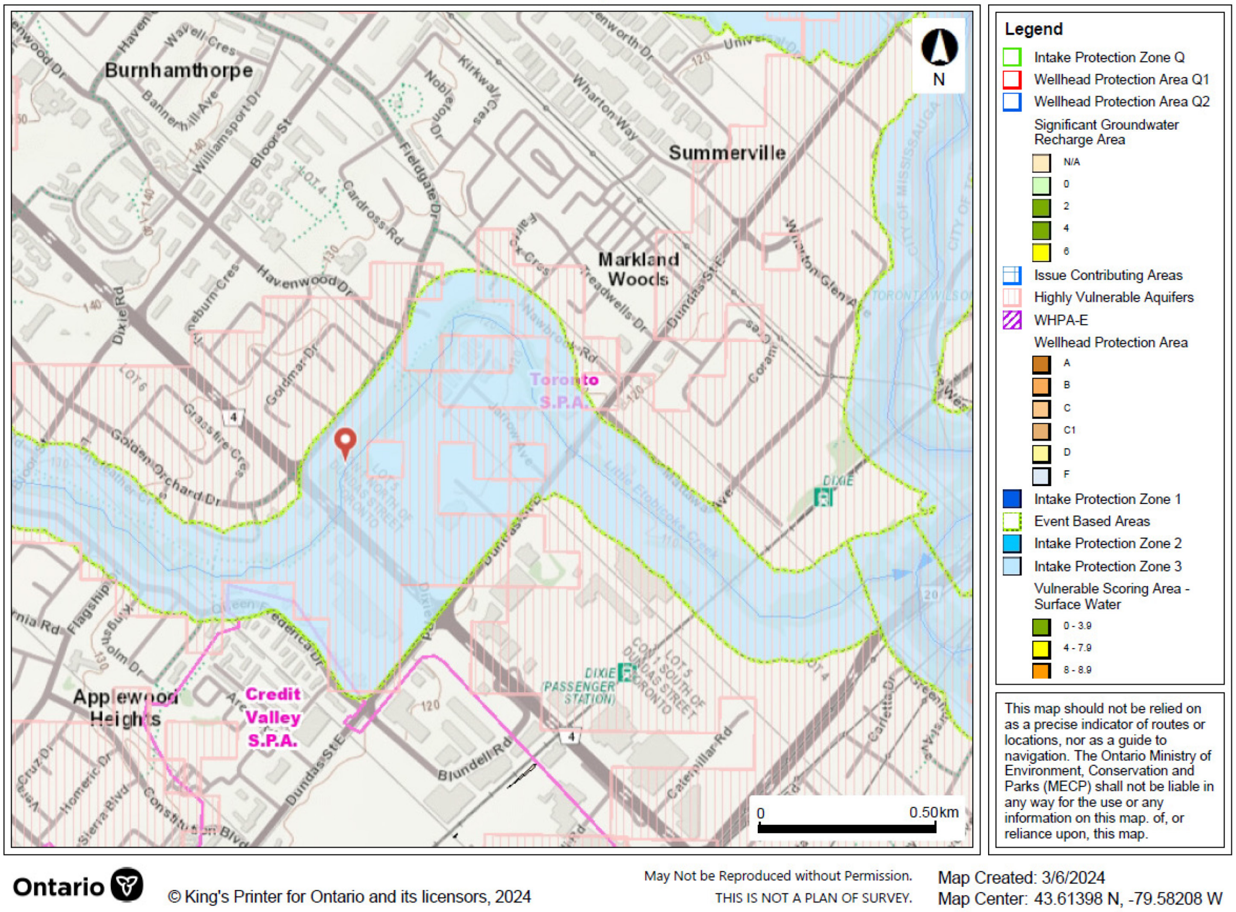
- the historical water source provided by Little Etobicoke Creek
- the existence of historic transportation routes at Dixie Road and Dundas Street East
- the proximity of early settlements including the villages of Dixie, Summerville, and Burnhamthorpe

The requirements for a Stage 2 assessment apply to previously undisturbed areas that might be disturbed as part of a flood mitigation solution. A Stage 2 assessment involves test pit surveys at 5 m intervals before construction. The desktop review was extended for the Dundas Area, which determined no further Stage 2 test pits were required; moreover, the Dundas Area has either been previously assessed or disturbed and does not have archaeological potential.

The Stage 1 archaeology assessment has been shared with Indigenous communities for review and comment during the subsequent Municipal Class EA process associated with the Project. No comments were provided; however, several groups have expressed interest in being involved in the Stage 2 assessments during the planning and field work stages.

5.6 Source Water Protection

The Project study area falls under the Credit Valley-Toronto and Region-Central Lake Ontario (CTC) Source Water Protection Region (CTCSPC 2022). The Source Protection Information Atlas (MECP 2023a) identifies that the study area overlaps an Event-based Area (EBA) for Pipeline Fuel/Oil Spill, an Intake Protection Zone (IPZ) 3, and a Highly Vulnerable Aquifer (HVA) with a score of 6. These Source Water Protection Zones are further explained in this section. The drinking water source impact is related to three drinking water inlets (R. L. Clark, Lorne Park and Arthur P. Kennedy Water Treatment Plants) in Lake Ontario near the outlet of Etobicoke Creek as well as the underlying aquifer. A source water protection map for the study area is provided in Map 1.



Map 1 Source Water Protection Mapping

An event-based area is specified using modelling and other analyses to determine potential exceedance at a drinking water intake zone and threats to be identified within this boundary. For the Project study area, the event-based area generally overlaps the floodplain and the SPA. Similarly, the IPZ 3 designation refers to Little Etobicoke Creek's potential to quickly convey drinking water threats to the inlet of the water treatment plant. Given the nature of the flood mitigation efforts being evaluated and the activities identified as drinking water threats under the Clean Water Act, no significant drinking water threats appear to result from the Project.

Typically, movement or replacement of a trunk sanitary sewer would be a concern in terms of source water protection. The potential requirement for lowering any existing sanitary sewers would therefore have to be managed carefully to avoid contamination. Lowering the existing sanitary sewers reduces the long-term risk to source water by providing more adequate cover over the pipes. Sanitary sewers crossing Dundas Street (i.e., the maintenance of the existing siphon structure) is being managed through the City's BRT project.

Lastly, an HVA designation refers to more permeable soils and the associated increase in potential for contamination to groundwater. City residents do not rely on groundwater as a drinking water source and the HVA score of 6, coupled with the nature of the Project, provides reason that the flood mitigation efforts will not pose a significant drinking water threat.

Best management practices will be in place during all future mitigation and construction activities, including spill and emergency response protocols. Construction on Region of Peel infrastructure will be verified by a Regional Representative, a Qualified Inspector will be present onsite. Construction phasing and general consideration for water quality of stormwater runoff will be woven into the future construction and implementation plans.

5.7 Socio-economic

5.7.1 Population and Demographics

The Neighbourhood Information Tool (Region of Peel 2023) provided by the Region of Peel summarizes the 2016 statistics for the neighbourhoods (0510.00, 0524.02, and 0525.02 census tracts) overlapping the Project study area. Note that these census tract areas do not perfectly line up with the boundaries of the Project study area (i.e., census tracts cover a larger area), and thus the analysis of the following summary should consider a reasonable margin of error. Additionally, The Neighbourhood Information Tool has not yet been updated with the 2021 statistics; however, these results are sufficiently representative for the purposes of this Project.

In 2016, the combined census tracts cover a population of 13,785 people (estimated 13,164 in 2021 [Statistics Canada 2023]) and 5,374 dwellings. The demographics distribution demonstrates that the child-youth population (0 to 19 years old) ranges between 17% and 23%, the senior population (65 years and older) ranges between 18% and 25%, and that the remaining and majority of the population comprises the working population.

Using a 2016 neighbourhood comparison, the identified overlapping neighbourhoods of the Project study area are named Applewood Neighbourhood and the Dixie Employment Area (City of Mississauga 2023b). Note that these neighbourhoods also cover a wider area than the Project study area coverage. The average age of the population ranges from 41 to 52, with an average household size ranging from 1.8 to 2.7 for both neighbourhoods. Approximately 22% of the population reported commuting to work by public transportation and 3% reported walking or biking.

5.7.2 Land Use

The Project study area is heavily urbanized, apart from the existing floodplain that connects to parks and a trail system. The Mississauga Official Plan (City of Mississauga 2023a) indicates that the majority of the study area comprises business employment and mixed use. The remaining area comprises industrial, residential (low density I, low density II, and high), and utility.

The current zoning (City of Mississauga 2023c) designates the study area as commercial (general and motor vehicle), industrial (employment), and residential (detached and semi-detached dwellings, apartment, long-term care, and retirement buildings) areas. The SPAs generally overlap the areas currently designated as industrial and commercial, with a smaller portion on the west side designated as residential (apartment, long-term care, and retirement buildings).

5.7.3 Roadways and Bridges

There are two major roadways within the Project study area. Dixie Road is a regional road (Regional Road 4) managed by Peel Region (Peel Region 2021). The Region's Road Character Map considers it Suburban, Urban Main, and Industrial Connectors within the study area limits (Peel Region 2013). These different road characters have different lane widths, speed limits, aesthetic goals, etc. to service their respective areas. The City has identified it as a corridor ("lands adjacent to and framing a right-of-way [RoW]") in the Mississauga Official Plan (City of Mississauga 2023a). Long-term goals have designated it as a regional arterial road and transit priority corridor (City of Mississauga 2023a). Dundas Street is managed by the City and extends to Toronto. It is an arterial road planned as an intensification corridor, as demonstrated through the Dundas Connects Master Plan (City of Mississauga et al. 2018). Residents have mentioned that the heavy traffic and congestion is a common problem in this area.

The Dixie Road bridge is a 12 m single-span structure owned by Peel Region. The structure includes a 20° skew to accommodate the natural bend in Little Etobicoke Creek. There are numerous utilities within and surrounding the bridge structure including a Bell communication line, a sanitary sewer, a watermain, and storm sewers. The surface of Dixie Road bridge was rehabilitated in 2012.

The Dundas Street bridge crossing is a 6.1 m single-span structure owned by the City. It has been modified and extended over time in response to Dundas Street road widenings. There are three stormwater outlets in the immediate vicinity of the crossing, and sanitary sewer the crosses Little Etobicoke Creek on the north side of the structure. Repairs due to erosion on the footings have been completed, with the most recent occurring in 2014 on the upstream side.

5.7.4 Transit

MiWay is the City's public transportation system (City of Mississauga 2023d, 2023e) and GO Transit also services this area (GO Transit 2023). From Monday to Friday, MiWay runs the no. 5 bus along Dixie Road and the nos. 1, 1C, 101, and 101A busses along Dundas Street. On the weekends, the nos. 101 and 101A busses are not in service. A GO Transit train line runs south and parallel to Dundas Street at this location. The Dixie GO station is located along this tract at 2445 Dixie Road.

As mentioned, the City is currently implementing a new BRT project along Dundas Street to suit the City's vision expressed in the Dundas Connects Master Plan (City of Mississauga et al. 2018).

There are currently no dedicated bike lanes within the Project study area.

5.7.5 Utilities

The Project study area contains both private and public utilities that need to be considered in the alternative solutions. A desktop review of utilities was completed utilities in the Project study area that may be impacted from derived alternatives. Utilities include:

- stormwater mains and outfalls (City of Mississauga)
- sanitary sewers (Peel Region)
- watermains (Peel Region)
- hydro utilities (Hydro One, Alectra Utilities)
- gas (Enbridge)
- cable (Telus, Bell, and Rogers)

Key utilities and infrastructure details are outlined in Section 5.8.

5.7.6 Noise

Noise was not specifically assessed for the Project. The Project study area is highly urbanized and surrounded by several high-traffic roads including Dixie Road and Dundas Street East, along with the CP rail crossing located to the south and parallel to Dundas Street. The City has a noise control by-law (0360-1979) that prohibits noise and regulates it when it is likely to disturb residents outside specific windows. Operation of construction equipment it limited to 7 a.m. to 7 p.m. Monday to Saturday, unless otherwise authorized (City of Mississauga 2023f).

5.7.7 Air Quality

Air quality was not specifically assessed for the Project. The MECP monitors the Air Quality Health Index (AQHI) throughout the province, including Mississauga. The AQHI is measured on a scale between 1 and 10, with 1 being a low impact to human heath and 10 being a high impact human health. The range does extend above 10 when the air quality is very poor.

A review of the AQHI for the Mississauga monitoring stations indicates that most days range between a 1 and 3 ranking (a low impact to human health). The Air Quality in Ontario 2020 Report (MECP 2023b) looked at air quality trends over the past 10 years and found that overall, the air quality throughout the province (including Mississauga) has been improving. Air quality can range from year to year depending on the local (emissions) and environmental factors (e.g., forest fires).

No long-term changes to the AQHI are predicted by implementation of works associated with the Project.

5.7.8 Active Transport and Trail Infrastructure

Upstream of Dixie Road, a paved pedestrian path/trail is present along both banks of Little Etobicoke Creek. Pedestrians can cross the channel via two wooden pedestrian walking bridges approximately 200 m and 400 m upstream of Dixie Road. The trail connects to Dixie Road sidewalk on the south side of the Creek.

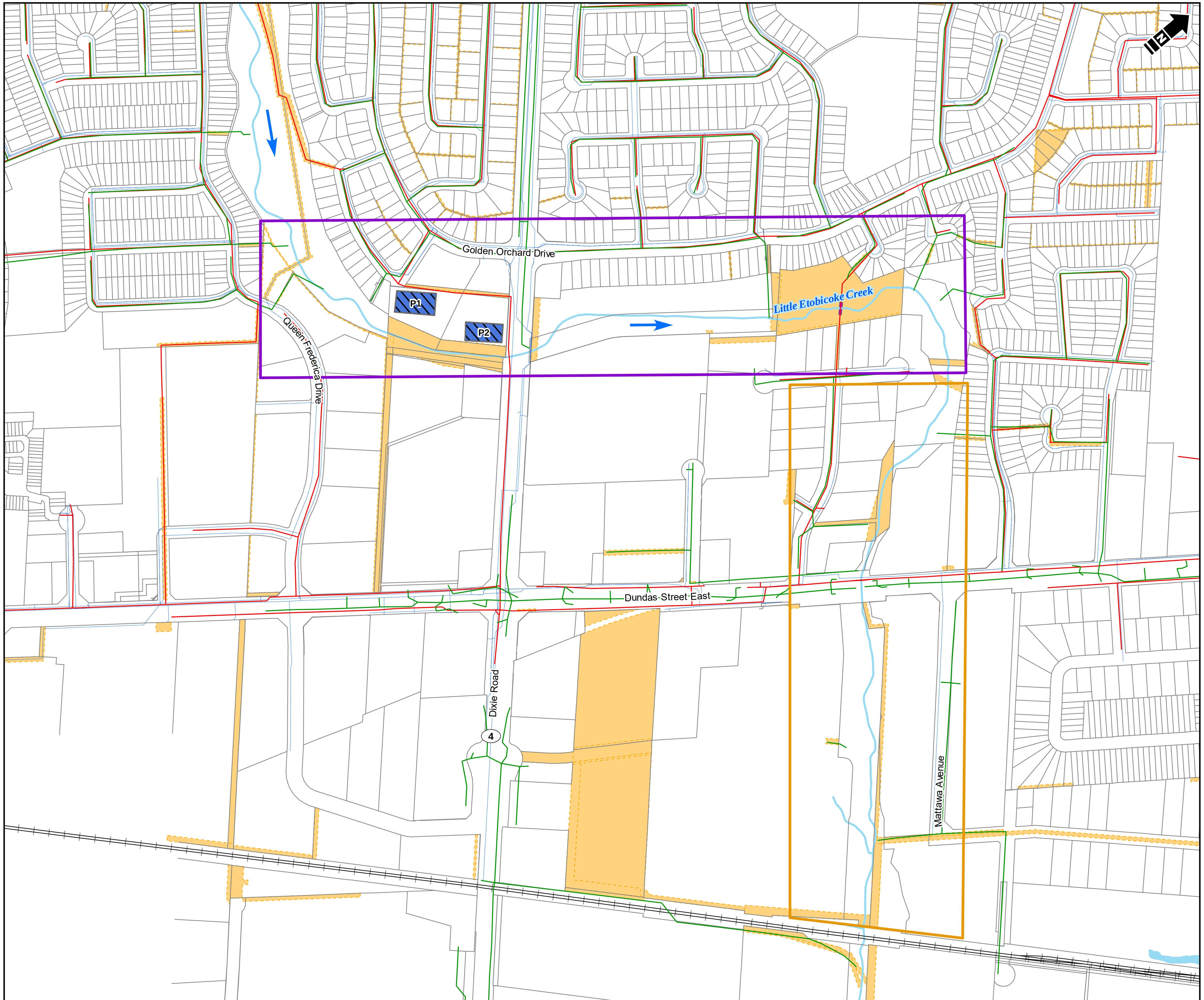
Downstream of Dixie Road, a paved pedestrian trail/path is present on the north side of the Creek with several small informal trails noted within the deciduous forest. The trail connects to a formal walkway off Fieldgate Drive. Downstream of the walkway, there are some informal trails that lead to Willowcreek Park.

Upstream and downstream of Dundas Street there are very informal, infrequently used trail connections surrounding the Creek corridor. Approximately 400 m downstream of Dundas Street, access is available to the Creek on the east side from Mattawa Avenue via an existing construction access route. This route continues under the railway.

Improved safe and convenient access to trails can support opportunities for City of Mississauga residents to be physically active (through recreational use of the trail or for active transportation) and aligns with Peel Public Health's strategic priority of enabling active living.

5.8 Constraints

Key project constraints within the study area were identified during the background review, technical studies, and through data received from the TRCA, the City, and Peel Region. These constraints were considered and accommodated as much as practical in the development of alternative solutions and design concepts. The key constraints include property, infrastructure, natural heritage, and archaeology constraints, and are illustrated on Figures 7 to 9.



- Dixie Area
- Dundas Area
- Easement
- Underground Parking Limits
- Water Body
- Watercourse
- Flow Direction
- Exposed Sanitary Sewer
- Sanitary Sewer
- Storm Sewer
- Watermain
- CN Railway
- Property Boundary

1. Sanitary sewers, storm sewers, and watermains (SHP and DGN format) provided by the Region of Peel.
2. Storm easements, utility, roads, and property boundaries (SHP format) provided by the City of Mississauga.
3. Base plans will be advanced during preliminary design to further document infrastructure conflicts and relocation requirements for roadways, property limits, sanitary sewers, watermains, and utilities.

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) .

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Matrix Solutions Inc.
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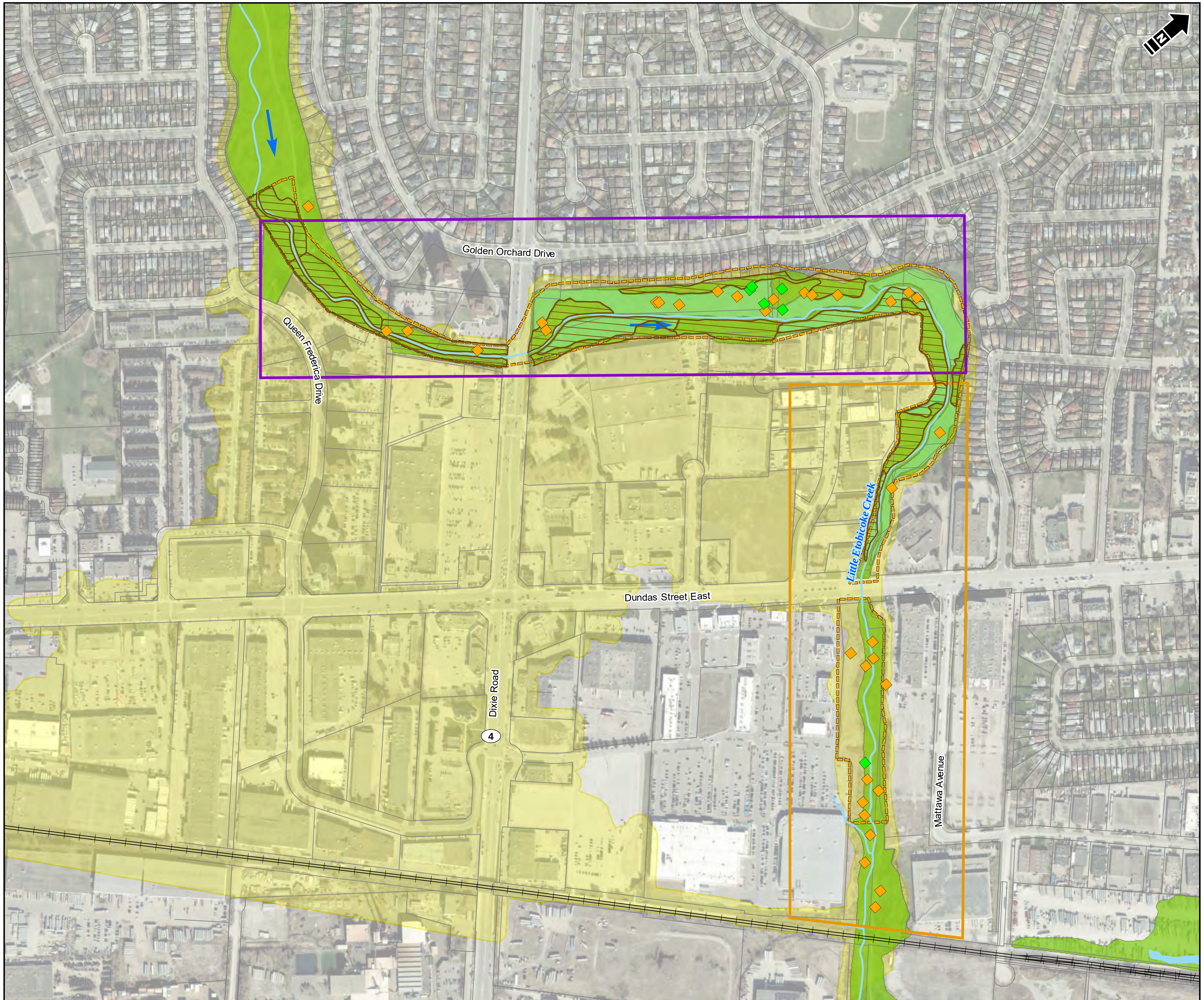
City of Mississauga
Dixie-Dundas Flood Mitigation Project - Environmental Study Report

Constraints Mapping Infrastructure

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 7



DRAFT

- Dixie Area
- Dundas Area
- Natural Heritage Study Area
- TRCA Regulation Limit
- Significant Wildlife Habitat
- Significant Natural Areas and Natural Green Spaces
- Water Body
- Watercourse
- Flow Direction
- CN Railway
- Property Boundary
- Potential SAR Bat Habitat - Snag
- Potential SAR Bat Habitat - Oak Tree
- Potential SAR Bat Habitat - Maple Trees

1. Significant areas are defined by the Ministry of Natural Resources and Forestry (2019).
2. The constraints are detailed in the Natural Heritage Assessment (Appendix C).
3. Base digital information obtained from the City of Mississauga (SHP and DGN format).

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City of Mississauga
Dixie-Dundas Flood Mitigation Project - Environmental Study Report

Constraints Mapping
Natural Heritage

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 8

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DRAFT

Archaeology Stage 2 Test Pit (see notes)
Water Body
Watercourse
Flow Direction
CN Railway
Property Boundary

1. The Stage 2 test pit locations are identified in the Stage 1 Archaeological Assessment (Appendix D).
2. Test pits are required in previously undisturbed areas that will be disturbed as part of the flood mitigation.
3. Slopes in excess of 20 degrees are not considered to have archaeological potential and therefore do not require test pits.
4. Base digital information obtained from the City of Mississauga (SHP and DGN format).

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Dixie-Dundas Flood Mitigation Project - Environmental Study Report

Constraints Mapping
Stage 2 Archaeology - Test Pit Requirements

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 9

5.8.1 Property

Residential, commercial, and industrial properties are adjacent to the channel corridor in the study area. Immediately upstream of Dixie Road, parking lots abut the creek along both the north and south sides. These parking lots have been identified as property constraints to be considered within the investigation of flood mitigation solution and are summarized as follows:

- Dixie Area north of Little Etobicoke Creek: Along the north side of the creek and within 100 m upstream of Dixie Road, surface parking for the nearby apartment towers is located approximately 10 m from the creek bank, and an underground parking structure is located approximately 20 m from the creek bank.

- Dixie Area south of Little Etobicoke Creek: Within 190 m upstream of Dixie Road, the surface parking of the commercial plaza is typically 20 m to 30 m from the creek bank. Between 190 m and 400 m upstream of Dixie Road, the surface parking for the nearby apartment towers is within 10 m from the creek bank.

Commercial and industrial properties abut the Little Etobicoke Creek corridor within the Dundas Area. These parking lots have been identified as property constraints to be considered within the investigation of flood mitigation solution and are summarized as follows:

- Dundas Area upstream (north) of Dundas Street: The creek valley is particularly narrow over its 150 m section upstream of Dundas Street East. The total valley width in this area is typically only 25 m wide compared to a typical valley width of 90 m in the 500 m downstream of Dixie Road and 60 m over the 550 m downstream Dundas Street East. The parking lots of adjacent properties are within about 5 m of creek and buildings are located within about 20 m. Of note is a private commercial property 1607 Dundas Street East which is located on the east side of the creek. Portions of this property are currently located in the floodplain but is functionally protected by a berm. Affective use of this property including a parking lot and loading dock access must be maintained.

- Dundas Area downstream (south) of Dundas Street: The creek valley widens compared to the upstream area to a typical width of 60 m from Dundas Street East to the CP rail crossing located approximately 550 m downstream. The parking lot of the commercial property along the east side of the creek is within approximately 12 m of the channel.

Property impacts will be mitigated to the extent possible.

5.8.2 Dixie Road

The Dixie Road bridge was identified as undersized and contributing to spills from Little Etobicoke Creek (i.e., due to backwater impacts) in previous studies (AECOM 2019, MMM 2015). Bridge replacement has been anticipated to be required as part of any flood mitigation before the start of this current project. Dixie Road has a relatively low elevation at the Little Etobicoke Creek crossing likely requiring the road to be raised to some degree to accommodate the new bridge structure. Significantly raising the road profile (i.e., greater than 1 m) would impact the intersection 150 m north of the bridge at Golden Orchard Drive. This road raise would likely require the construction of retaining walls along much of Dixie Road to avoid property impacts.

5.8.3 Dundas Street

Containing the flood spill in the Dixie Area requires mitigation measures in the Dundas Area to accommodate the increased flood flows. The Dundas Street bridge presents a significant hydraulic constraint to the increased flows. Larger bridge spans and channel/valley regrading configurations are required to provide conveyance improvements.

The Dundas Area is also currently affected by plans associated with the City's BRT project. An opportunity exists to align the BRT's construction plans for an expanded Dundas Street bridge at the Little Etobicoke Creek with the objectives of the Project. Accordingly, the BRT requirements were woven into the Project, with the BRT project recognized as an important stakeholder.

5.8.4 Utilities and Water Infrastructure

Key linear infrastructure crossing Little Etobicoke Creek within the Dixie Area are identified as follows:

- 400 m upstream of Dixie Road: A 2,100 mm feeder main crosses the creek with approximately 2 m of cover between pipe obvert and the existing channel bed.
- Dixie Road RoW: A 900 mm diameter sanitary sewer crosses the creek with approximately 0.5 m of cover depth and a 400 mm watermain with approximately 1.9 m of cover; a concrete utility conduit is exposed (CH2M Hill 2013). A 2,400 mm diameter feeder main crosses below the creek at this location with over 20 m of cover depth (CH2M Hill 2013) and is not considered a constraint to flood mitigation solution.

- 550 m downstream of Dixie Road: The fluvial geomorphology assessment (Appendix C) and a TRCA (2018a) infrastructure hazard monitoring record identified a 450 mm sanitary sewer that is exposed.
- Storm outlets: ten storm sewer outlets discharge into the creek within the study area.
- Overhead utilities include power lines that cross the creek along the east (downstream) side of Dixie Road and run parallel along the south side of the creek from 300 m downstream of Dixie Road to 180 m upstream.

Key linear infrastructure crossing Little Etobicoke Creek within the Dundas Area are identified as follows:

- Proposed watermain: Peel Region is planning to install a 200 mm diameter watermain along Dundas Street East, which will cross approximately 1.8 m below Little Etobicoke Creek.
- Sanitary sewer: Peel Region is currently installing a trunk sanitary immediately east of the Little Etobicoke Creek. The sewer will proceed down Mattawa Avenue to join an existing trunk sewer located approximately 150 m upstream of the CP crossing. The sewer will cut off an existing sanitary siphon under Little Etobicoke Creek and provide relief to sewers located downstream.
- Siphon sanitary sewer: An existing sanitary sewer siphon structure comprised of a 200 mm, a 450 mm, and a 600 mm diameter pipe crosses under Little Etobicoke Creek at Dundas Street bridge. To allow flexibility for Peel Region’s operations, this siphon will be required to remain in service despite construction of the above-referenced cut off at Mattawa Avenue.
- Storm outlets: There are three storm outlets along Dundas Street that outlet at the bridge. There is one storm outlet each on the west side of the upstream and downstream banks.

5.8.5 Natural Heritage and Archaeology

The natural heritage and archaeology studies identified the following key flood mitigation constraints:

- The Significant Natural Area including the SWH for the confirmed eastern wood-pewee (SAR) and potential bat maternity roosting (SAR).
- A minimum 25 m radius around the butternut (if it is confirmed to be a pure species) downstream of Dixie Road.

- The requirements for a Stage 2 archaeology assessment with test pits at previously undisturbed areas that would potentially be disturbed as part of the flood mitigation. No further action is required in the Dundas Area for the archaeology assessment.

6 Long List of Alternative Solutions and High-level Screening

Matrix, TRCA, and the City collaboratively identified high-level alternative solutions, which include new options as well as those presented in the *Dundas Street Transportation Master Plan* (AECOM 2019). High-level alternative solutions considered for screening in this Municipal Class EA include:

- conveyance improvement
- flood containment
- flow diversions
- Regional flood control (upstream storage)
- policy alternatives

Hydraulic modelling using a 1D HEC-RAS model was completed to assess preliminary high-level alternative solutions. The 1D-2D MIKE FLOOD model Matrix previously developed (Section 5) is a better tool for assessing flood risk within the complex Project study area. However, the long run times and complex nature of model setup made the MIKE FLOOD model impractical to complete a screening-level assessment. Matrix developed a HEC-RAS model for existing conditions using background information and data from previously completed models. The existing HEC-RAS model was then adjusted to assess the various high-level alternative solutions. The results of the hydraulic screening is provided in Appendix G (Hydraulic Modelling Report).

The high-level screening process reviewed the technical feasibility of each potential alternative solution (i.e., whether the alternative solution could mitigate the flooding issue). Several variations of each potential high-level alternative solution were screened for feasibility. Note that while the high-level alternative solutions presented in Sections 6.1 to 6.5 initially focused on the Dixie Area, the results of the high-level screening are considered appropriate for the Dundas Area, as discussed in Section 6.2.

6.1 Conveyance Improvement

Conveyance improvements consist of alternative solutions that increase the hydraulic conveyance capacity of the existing riverine system through the Project study area, which can mean widening/lowering the channel. The existing channel directly upstream of Dixie Road ranges from approximately 5 to 8 m wide with nearly vertical banks lined with armourstone. Downstream of Dixie Road, the channel is slightly wider (8 to 10 m) with vertical banks. There is noted erosion in some areas, including areas lined with armourstone.

Matrix conducted analyses to determine feasible conveyance improvements for the Project study area. If one type of conveyance improvement was found ineffective in mitigating the spill, Matrix analyzed combinations of that conveyance improvement with other alternatives, including other conveyance improvement techniques, such as channel widening and bridge replacement. This ensured that all possible solutions were analyzed to fully mitigate the spill in a feasible manner.

6.1.1 Channel Widening

Land availability for potential widening of the channel corridor is more limited upstream of the Dixie Road bridge than downstream. Besides the bridge itself, the upstream channel is a hydraulic pinch point where flow is significantly restricted. Widening the area upstream of Dixie Road would improve conditions at the main spill location at Queen Frederica Drive in the Applewood SPA.

During Milestone Meeting No. 1 held on June 27, 2019, the Project team noted that if the spill upstream of Dixie Road is mitigated, the corresponding flood risks downstream of Dixie Road will likely increase. Notably, the existing spill located approximately 350 m downstream of Dixie Road could be subject to greater flows and flood risk. To mitigate a potential increase in the downstream spill, the feasibility of increasing channel capacity downstream of Dixie Road was also examined.

The corridor for channel widening downstream of Dixie Road is significantly wider than in the upstream reach. Widening the reach downstream of Dixie Road would not only improve the conditions in the area downstream of Dixie Road (i.e., in the Dixie-Dundas SPA) but also at the main spill location in the Applewood SPA by a reducing tailwater conditions at the Dixie Road bridge. For the high-level screening, a widened channel was considered.

Matrix reviewed a range of channel widening options for hydraulic benefits. The range of options considered widths that could most reasonably fit within the existing public corridor, thereby limiting property takings. Property encroachments were considered when seen as hydraulically advantageous and at required transition reaches (i.e., at larger bridges [Section 6.1.1.3]).

6.1.2 Channel Lowering

The existing channel profile throughout the Project study area includes drops in bed elevation, including one at the Dixie Road bridge. Additionally, the steepness of the channel bed slope approximately 500 m downstream of Dixie Road increases, which continues all the way to Dundas Street. Hydraulic benefits could likely be realized by removing the channel elevation drops and grading back the channel at a milder slope in the upstream direction to provide a smoother channel profile through the Dixie Road bridge. Importantly, these works would also lower the channel at the spill location upstream of Dixie Road. Channel lowering would be gradually transitioned to tie into the existing channel within the upstream portion of the Project study area.

Matrix reviewed a range of channel lowering options for hydraulic benefits. The range considered new channel bed configurations that could feasibly transition to existing conditions both upstream and downstream of the Project study area.

6.1.3 Bridge Replacement

6.1.3.1 Dixie Road Bridge

The existing Dixie Road bridge is a 12 m span concrete arch bridge. Due to the nature of the watercourse and spill location in the Project study area, the existing bridge does not overtop during the modelled storm events because the spill elevation near Queen Frederica Drive is lower than the bridge deck elevation. Nonetheless, the existing bridge presents a hydraulic restriction, and widening the bridge in conjunction with channel widening was considered. A range of bridge sizes were modelled to determine the potential limits of hydraulic constraints and to determine ranges of openings to be considered alongside channel widening and lowering as a part of the high-level alternative solutions.

6.1.3.2 Dundas Street Bridge

The existing 6 m Dundas Street bridge does not currently overtop during the modelled Regional event. However, if the spill is mitigated in the Dixie Area, an additional 130 m^3/s of flow would be conveyed in the Little Etobicoke Creek channel to the Dundas Area. This increased flow, if left unmitigated, would result in increased flood levels in the Dundas Area, including overtopping of the existing Dundas Street bridge. Therefore, the high-level screening alternatives include widening the Dundas Street bridge. Similar to the Dixie Road bridge, a range of bridge sizes were modelled to determine the potential limits of hydraulic constraints and to determine ranges of openings to be considered alongside channel widening and lowering as a part of the high-level alternative solutions.

6.2 Flood Containment

For this Project, flood containment refers to preventing spill from the channel by constructing flood barriers, commonly known as dykes or berms, at key spill locations. Under current MNRF policy, flood barriers are assumed to fail under Regulatory flow conditions and cannot be considered permanent flood protection measures. An exception to this policy is an FPL, which is constructed with certain conservatively designed characteristics (Section 6.1.2.3).

In addition to Regulatory challenges, flood containment alternatives typically increase upstream flood water levels because flows are forced to stay in the channel corridor. Therefore, the flood containment alternatives must be considered only in conjunction with conveyance improvements to mitigate the increased water levels. Matrix considered three potential flood barrier alternatives and methods to estimate design requirements: floodwall, berm/dyke, and FPLs.

6.2.1 Floodwall

An existing concrete floodwall is located approximately 200 m upstream of Dixie Road. The existing floodwall provides some functional flood protection; however, it cannot be considered a permanent flood protection under current MNRF policy. Accordingly, the potential for floodwall expansion, and use in general, was excluded.

Although excluded as a potential alternative solution to achieve flood mitigation at the Regional storm level, a floodwall could be considered for control of lesser storms (e.g., 50-year storm) in some cases. A floodwall could also provide additional resilience above the Regional storm flooding level, although it would be uncredited under MNRF policy. The existing floodwall could be left in place and potentially repaired or modified with the understanding that it would only be considered a further measure of resilience and a non-permanent measure.

6.2.2 Berm/Dyke

An existing flood control berm is located on the right bank of Little Etobicoke Creek, just downstream of the Dixie Road bridge, and extends approximately 400 m downstream. The existing berm provides some functional flood protection; however, as previously noted, this berm cannot be considered a permanent flood protection within current MNRF policy for

Regulatory flooding. Accordingly, potential expansion, and the use of berms in general, was excluded as an alternative solution.

Although excluded as a potential alternative solution to achieve flood mitigation at the Regional storm level, a berm could still be considered for control of lesser storms (e.g., 50-year storm) in some cases. A berm could also provide additional resilience above the Regional storm flooding level, although it would be uncredited under MNRF policy. The existing berm could be left in place and potentially repaired or modified, with the understanding that it would only be considered a further measure of resilience and a non-permanent measure.

It should be noted that the existing berm located at 1607 Dundas Street East will continue to be considered a non-permanent measure for flood mitigation. This is discussed in Section 11.1.6. Even if modified, the existing berm could not be considered a permanent measure for flood mitigation and would maintain its existing status. Consistent with other berms in the Project study area, this berm was excluded as a potential permanent alternative solution for flood containment. However, specific modifications to this berm are noted in Section 11.1.6. in terms of its maintained function/increased resilience to flooding.

6.2.3 Flood Protection Landform

An FPL is a berm-like structure that incorporates design features to protect against structural failure due to water seepage and erosion. TRCA developed the FPL Guidelines (AECOM 2018a) for the siting and structural design components, such that structures could be recognized as providing permanent flood protection. The FPL Guidelines are based in part on an existing implementation of an FPL within TRCA jurisdiction. The key design features that improve the structural integrity of FPLs include:

- a clay core with an elevation 0.5 m above the Regional storm elevation
- a wide crest width ranging from 3 to 5 m
- maximum 5% to 10% slopes on the wet side
- shallow slopes of 1.5% to 2.5% on the dry side
- no hydraulic connection through the FPL
- no structures or foundations within the FPL

Due to the grading requirements for FPLs, a large footprint is required for construction; therefore, this alternative solution should also consider available lands.

6.3 Flow Diversions

Under existing conditions, approximately 60% of the Regional flow spills from Little Etobicoke Creek at Queen Frederica Drive. Various flow diversion alternatives were considered to reduce the amount of flow in Little Etobicoke Creek at the spill location, thereby reducing the spill. Alternatives include diversions upstream and downstream of Dixie Road and both piped and overland flow diversion options.

6.3.1 Upstream Flow Diversion

During Milestone Meeting No. 1 held on June 27, 2019, TRCA inquired about the feasibility of diverting flow upstream of the Project study area to an open corridor that may be available at Eastgate Parkway, in an attempt to reduce the peak flows in Little Etobicoke Creek. The diverted flow could be directed to the main branch of Etobicoke Creek, which is located just east of the Project study area.

Matrix revisited the Etobicoke Creek Visual OTTHYMO hydrology model to determine whether enough flow could be diverted at Eastgate Parkway to limit Regional flow at Dixie Road to below 86 m^3/s, as this flow could then be contained within the existing channel and completely mitigate the existing spill. For the Regional storm event, approximately 130 m^3/s of flow would have to be directed toward the Etobicoke Creek system, leaving 20 m^3/s in the Little Etobicoke Creek system at Eastgate Parkway. Additional flows added to Little Etobicoke Creek downstream of Eastgate Parkway would then accumulate to produce a Regional storm peak flow of 82 m^3/s at the spill location upstream of Dixie Road.

To effectively divert the required peak flow of 130 m^3/s at Eastgate Parkway to Etobicoke Creek would require a very large pipe. A review of the topography in this area suggests that a diversion pipe could be up to 20 m deep in some locations.

Upstream flow diversion is feasible from a purely theoretical standpoint. However, a detailed review would be required to determine the size of the diversion system, whether it would be an open channel or pipe, utility conflicts, the presence of underpasses, and the ecological impacts associated with diverting a significant amount of flow from Little Etobicoke Creek at Eastgate Parkway. Accordingly, upstream flow diversion was not pursued as a potential alternative solution for flood control, as it is deemed impractical and infeasible from a cost, utility, and ecological standpoint.

6.3.2 Local Flow Diversion

A flow diversion conduit was considered in the *Dundas Street Transportation Master Plan* study (AECOM 2019) to convey the 130 m^3/s of spilled flow. The diversion conduit outlined in AECOM (2019) would be constructed in the vicinity of the Project study area and potentially eliminate riverine spill upstream of Dixie Road. The diversion conduit would require a 530 m long 7.5 m width × 2.5 m height box conduit along Queen Frederica Drive and a 930 m long 10 m with × 2.5 m height box conduit along Dundas Street, which would outlet back to Little Etobicoke Creek at the Dundas Street bridge. Although the option is theoretically feasible, it was excluded as an alternative solution for flood control based on practical considerations, such as extensive utility relocation requirements (including associated costs and disruptions) in the existing RoW associated with such a massive conduit construction program.

6.4 Regional Flood Control – Upstream Storage

Matrix completed a basic hydrologic analysis for the Little Etobicoke Creek to determine the potential feasibility of using flood control storage to mitigate flooding in the Project study area. The Regional storm peak flow in the Project study area is approximately 215 m^3/s based on TRCA's approved existing condition Visual OTTHYMO hydrology model. To mitigate the spill through Regional flood control storage, Matrix estimated the required volume needed to attenuate the peak flow enough to prevent the spill. Through the Visual OTTHYMO analysis, the resultant storage volume was determined to be approximately 227 ha-m (2,270,000 m^3, or approximately 900 Olympic sized swimming pools). The land requirements, logistics, and costs associated with a storage volume this large were sufficient reasons to exclude this option as a potential alternative solution for further consideration.

Additionally, MNRF policy does not generally consider flood control storage a permanent flood protection. Like berms and floodwalls, which MNRF considers to be non-permanent measures, upstream storage is also subject to concerns from MNRF regarding ongoing upkeep and maintenance. Therefore, the large volume of storage required excluded this option from further consideration.

MNRF policy would also consider online storage, which is achieved by decreasing conveyance through the bridges, an unacceptable methodology for permanent flood mitigation works. Additionally, online storage is not typically available/feasible in urbanized areas due to the land required for storage. Therefore, this option was also excluded from further consideration.

6.5 Policy Alternatives

Two policy-based alternatives were considered in case a viable solution could not be accommodated to reduce the current riverine spill and remove the SPA designations. Approximately 1,000 buildings are estimated to be located within the existing Regional storm flood risk zone north of the QEW. The boundary of the hydraulic model for the spill terminates at the QEW, and the number of additional buildings impacted by the riverine spill south of QEW is unknown. Of the approximately 1,000 structures, 461 buildings are located in a high-risk flood zone. Floodproofing or acquiring these buildings would remove the hazard for residents and business owners.

Floodproofing and land acquisitions are not considered viable alternatives on their own, as neither meet the primary objective of this Project. These measures would only be implemented if the riverine spill could not feasibly be eliminated. In this case, the SPA designations would remain, and the envisioned growth for the Dixie-Dundas Area could not be fully realized due to development restrictions. Accordingly, floodproofing and land acquisition have not been considered further as potential alternative solutions for this Municipal Class EA because they would not achieve the Project objectives. Implementing policy adjustments to the existing SPAs associated with the Municipal Class EA (including a potential significant expansion of the Applewood SPA extent to address an additional 1,000 structures) would instead be a potential fallback position, if the Municipal Class EA process cannot otherwise successfully identify flooding mitigation alternative solutions that would eliminate the spill.

6.5.1 Floodproofing

Floodproofing includes a combination of structural changes, design adjustments, or construction or alteration of buildings, structures, or properties subject to flooding to reduce flood damages (MNR 2002). MNRF categorizes floodproofing as being active or passive and providing either wet or dry protection:

- Active floodproofing measures require action and advance warning to be effective and may include placing sandbags or sealing doors, windows, and other openings.
- Passive floodproofing measures do not require additional actions and may include building structures above the flood elevation/constructing berms, floodwalls, etc.
- Dry floodproofing measures are intended to keep buildings and their contents completely dry though installation of watertight doors, windows, etc.

- Wet floodproofing measures allow building contents to get wet, and require basements and lower levels to be uninhabited and unfinished to minimize damages.

6.5.2 Land Acquisition

Land acquisition was considered as a means of reducing flood risk to residents and businesses through property purchase/expropriation. Considering that approximately 1,000 buildings are currently in the floodplain, it is not realistic to acquire/expropriate all these buildings, even over a long time period. Accordingly, this alternative approach could not realistically be considered for further consideration as an alternative solution. Similar to the floodproofing alternative, details of land acquisition requirements in this context would depend on the resulting flood risk that remains after implementing the preferred flood mitigation alternative solution.

Property acquisition could still be considered in key areas to accommodate various other flood mitigation alternative solutions (i.e., channel widening, FPL, berm, etc.). Property acquisition required for various other alternative solutions is a separate issue and is addressed as part of the consideration of individual alternative solutions.

6.6 High-level Screening of Alternative Solutions for Dundas Street

The high-level screening process included a technical review as to whether the alternative solution could reasonably mitigate the flooding issue. Several variations of each potential high-level solution were reviewed for feasibility. The high-level alternative solutions presented in Section 6.1 initially focused on the Dixie Area. When the Project study area was expanded to also include the Dundas Area, the high-level screening of long-list alternative solutions was revisited to ensure the long-list alternatives were also appropriate for the Dundas Area. In all cases, the high-level alternative solutions examined and described in Section 6.1 are applicable to the Dundas Area with the adjustment of small site-specific descriptions. The same analyses of high-level solutions examined in Section 6.1 adapted well to issues specific to Dundas Street, as the same reasoning for screening methodology continue to apply.

It should be noted that the existing berm located at 1607 Dundas Street East will continue to be considered a non-permanent measure for flood mitigation. Accordingly, it has been excluded as a potential permanent alternative solution for flood containment. Specific modifications to this berm are discussed in later portions of this report with respect to maintaining its existing function and its potential to increase resilience to flooding.

6.7 Recommended Short List of Alternative Solutions

Table 5 summarizes the results of the high-level screening. The short-list of alternative solutions put forward have, through high-level examination, demonstrated a technical ability to effectively mitigate flooding in the Project study area and were also considered to be reasonably feasible to implement. Alternative solutions measured against anticipated social, economical, and environmental criteria were also considered in formulating the short-listed alternative solutions.

The following generalized approaches were chosen to be carried forward and formulated into alternative solutions for the next phase of this Municipal Class EA:

- Conveying flows within the Little Etobicoke Creek valley corridor is the best mitigation approach to fit the land constraints imposed by the highly urbanized watershed. The assessed channel conveyance improvement alternatives are not effective at mitigating all of the spill and therefore combination with other alternatives is required.
- The Dixie Road bridge and Dundas Street bridges should both be replaced with larger span bridges that complement channel conveyance improvement recommendations. The larger bridges must be able to convey the Regional flow.
- Evaluation of flood containment alternatives should include a combination of associated conveyance improvements. Flood containment alternatives are not feasible on their own due to upstream impacts and policy limitations.

The following options were screened out in the high-level screening technical assessment:

- Upstream flow diversion to Etobicoke Creek is feasible in theory; however, review of practical feasibility and impacts indicates it should not be assessed further.
- Regional flood control is not feasible on its own due to significant storage volume requirements. Regional flood control is also not considered permanent flood protection under the current MNRF guidelines, and therefore this option was ruled out.
- Similar to the point above, online storage through a reduction in bridge capacity introduces significant policy implications and is not currently acceptable in Ontario. This option has been excluded from further analysis.
- Floodproofing and land acquisition on their own does not meet the objectives of the project and therefore they have been screened out.

Table 5 High-level Alternative Solutions Summary

Solution No.	High-level Solution	Screening Criteria	Screening Approach	Screening Outcome
Conveyance Improvement				
1	Increase Channel Conveyance	• determine appropriate channel width and limits of widening to mitigate spill	• model various channel widths with no bridges • review additional widening options downstream of Dixie Road to minimize widening requirements upstream of Dixie Road where land availability is an issue • review effectiveness of widening upstream of Dundas Street	• widening upstream of Dixie Road and Dundas Street does not mitigate the spill on its own • widening upstream (to 10 m) and downstream (to 10 or 15 m) of Dixie Road and Dundas Street does not mitigate the spill on their own • would have to be combined with other alternatives
1b	Channel Lowering	• review infrastructure and bathymetry in channel corridor to determine feasibility	• lower channel to remove drop through Dixie Road bridge • modelled in combination with widening as appropriate	• channel lowering combined with 10 m bottom width upstream and 10 or 15 m bottom downstream in Dixie Area mitigates upstream spill with adequate freeboard (assumes bridge replacement) • channel lowering in Dundas Area is not feasible

Solution No.	High-level Solution	Screening Criteria	Screening Approach	Screening Outcome
2	Bridge Replacement	• determine appropriate bridge dimensions and associated channel widening (width and limits of widening) to mitigate spill	• model this after solution no. 1. • increase bridge at Dixie Road and Dundas Street to match selected width	• bridge replacements combined with other conveyance improvements mitigates spill at both Dixie and Dundas areas • proposed bridges will be sized to span Regional flow for selected widening scenario and will consider potential utility conflicts
Flood Containment				
3	Flood Protection Landform (FPL)	• FPL would be considered in combination with conveyance improvements if these solutions are not sufficient on their own	• estimate FPL heights using model results from solution nos. 1 and 2	• not feasible on its own due to significant footprint requirements • requires combination with conveyance improvements
4	Floodwall	• a floodwall would be considered in combination with conveyance improvements if these solutions are not sufficient on their own	• estimate floodwall heights using model results from solution nos. 1 and 2	• not a permanent solution; therefore, not recommended and excluded from further analysis

Solution No.	High-level Solution	Screening Criteria	Screening Approach	Screening Outcome
5	Berm/Dyke	• berm/dyke would be considered in combination with conveyance improvements if these solutions are not sufficient on their own	• estimate berm/dyke heights using model results from solution nos. 1 and 2	• not a permanent solution; therefore, not recommended and excluded from alternative solutions • localized berms can be used as a residual mitigation measure or to add additional resiliency
Diversions				
6	Upstream Flow Diversion	• flow diversion system to direct flows to Etobicoke Creek may be considered in combination with conveyance improvements if these solutions are not sufficient on their own	• review hydrology to determine whether enough flow can be diverted to Etobicoke Creek to maintain Regional flows at Dixie Road below 86 m^3/s to mitigate spill	• feasible in theory, but not practical due to impacts and cost • not recommended and excluded from further analysis
7	Local Flow Diversion	• not feasible on its own • flow diversion system may be considered in combination with conveyance improvements if these solutions are not sufficient on their own • review potential locations for overland flow (e.g., north side of rail).	• if required, estimate required size of flow diversion channel or conduit/tunnel based on remaining spill rate (in combination with other solutions)	• not feasible on its own due to significant land and pipe size requirements • not practical due to utility conflicts • not recommended and excluded from further analysis

Solution No.	High-level Solution	Screening Criteria	Screening Approach	Screening Outcome
Storage				
8	Regional Flood Control	• identify potential pond/tank locations (as close to project area as possible) • reduce conveyance of upstream bridges to provide online storage	• confirm storage volume required to reduce peak regulatory flow to prevent spill using Visual OTTHYMO model	• not a permanent solution; therefore, not recommended and excluded from further analysis • not feasible on its own due to significant storage volume requirements
9	Online Storage	• reduce conveyance of upstream bridges to provide online storage • decrease each upstream bridge conveyance by approximately 10%	• significant policy implications • not acceptable in Ontario	• not suitable for urbanized areas • not recommended; therefore, excluded from further analysis
Policy Measures				
10	Floodproofing	• confirm number of properties in flood risk zones • provide commentary on flood proofing requirements	• confirm number of properties in existing flood risk zones and in combination with other solutions	• over 1,000 homes in the existing Regional floodplain would require floodproofing • does not achieve the objectives of the Municipal Class EA study • not recommended; therefore, excluded from further analysis

Solution No.	High-level Solution	Screening Criteria	Screening Approach	Screening Outcome
11	Land Acquisition	• confirm number of properties in flood risk zones and quantify costs	• confirm number of properties in existing flood risk zones and in combination with other solutions	• does not achieve the objectives of the Municipal Class EA study • not recommended; therefore, excluded from further analysis

7 Alternative Solutions

Due to the distance and elevation difference between the Dixie Area and the Dundas Area, the alternative solutions identified for the Dundas Area (downstream) will not impact the alternative solutions identified for the Dixie Area. As the Dixie and Dundas areas are hydraulically independent, the assessment of alternative solutions for each area was completed independently. The upstream Dixie Area was assessed first, followed by the Dundas Area.

The do nothing alternative is a required solution as part of the Municipal Class EA process, to provide a reference comparison for the other alternative solutions. The do nothing alternative is typically selected when the benefits do not outweigh the potential costs or impacts.

7.1 Dixie Area Alternative Solutions

Based on the conclusions of the high-level screening, three alternative solutions, each representing a different approach to keep flow within the valley corridor, were identified and developed for the Dixie Area:

- Alternative Solution 1 (Dixie AS1): improved conveyance with a minimized footprint
- Alternative Solution 2 (Dixie AS2): improved conveyance by making room for Little Etobicoke Creek
- Alternative Solution 3 (Dixie AS3): flood containment with mitigation for upstream impacts

Each alternative solution combines flood mitigation channel work with the replacement of the Dixie Road bridge. The Dixie Area alternative solutions are illustrated in plan, profile, and cross-section format in Appendix H.

The flood mitigation channel and bridge replacement concepts were advanced into conceptual designs by R.V. Anderson Associates Limited (RVA) for the new larger bridge structures. The changes to Dixie Road required to accommodate each alternative solution are summarized in Appendix I.

7.1.1 Dixie Area Alternative Solution 1: Improved Conveyance with a Minimized Footprint

Dixie AS1 (Figures 10 and 11) centres around an oversized and incised channel from 500 m upstream of Dixie Road to 700 m downstream of Dixie Road. Dixie AS1 includes lowering 600 m of the channel length by approximately 1 m, on average, from the upstream existing pedestrian bridge to approximately 100 m downstream of Dixie Road. The channel would be made wider but would not have a well-connected floodplain and would resemble more of a gully-like configuration where it would be lowered. At the upstream tie-in, a steeper transition would be made to the existing channel.

The combination of lowering and widening the channel (including implementing the wider Dixie Road bridge) would achieve the objective of containing the spill at Queen Frederica Drive by lowering the channel bed and water levels upstream of Dixie Road. Beyond 100 m downstream of Dixie Road, the channel bed profile for Dixie AS1 would connect with the existing channel slope.

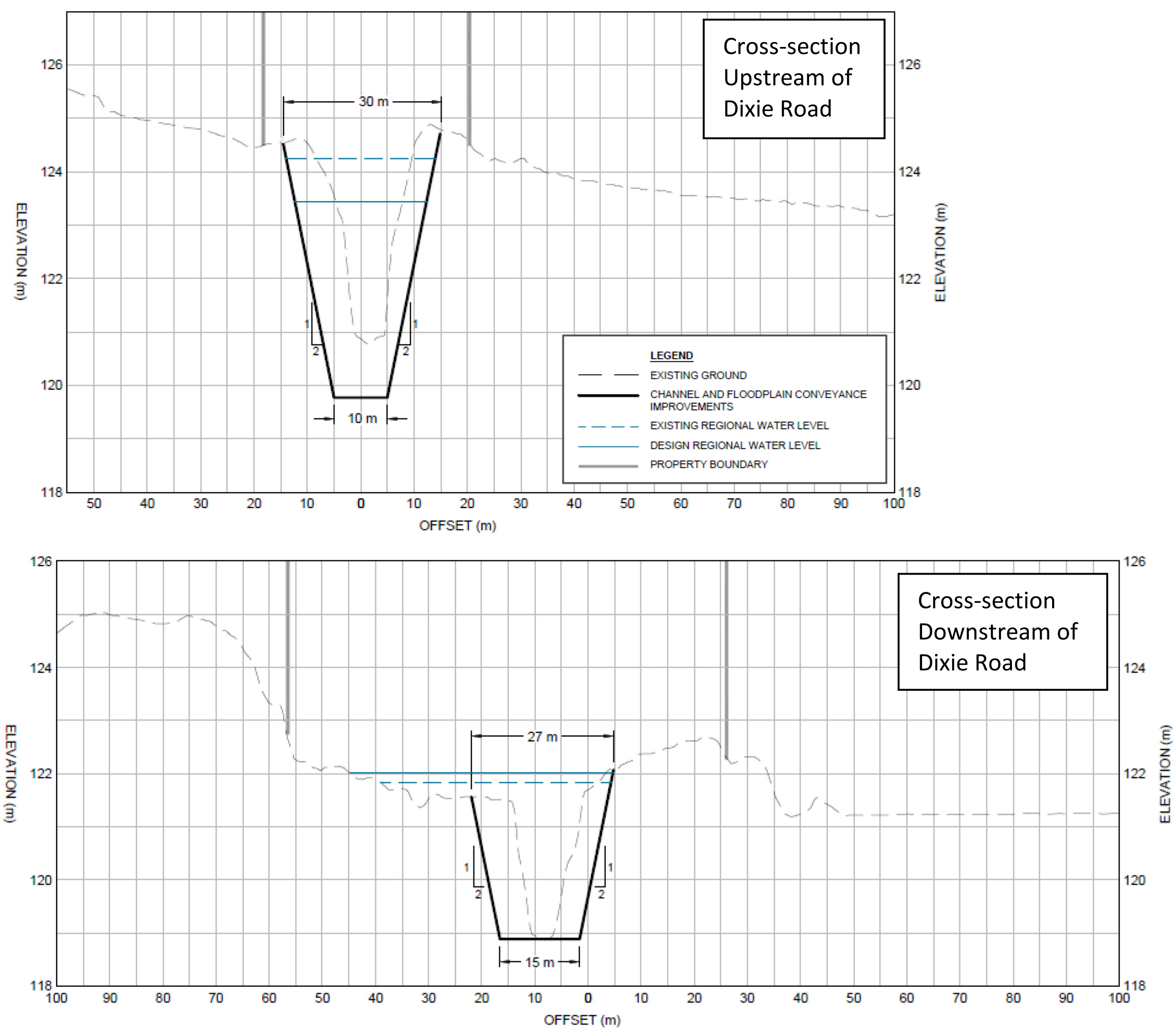

Figure 10 **Dixie Area Alternative Solution 1: Typical Cross-sections Upstream and Downstream of Dixie Road**

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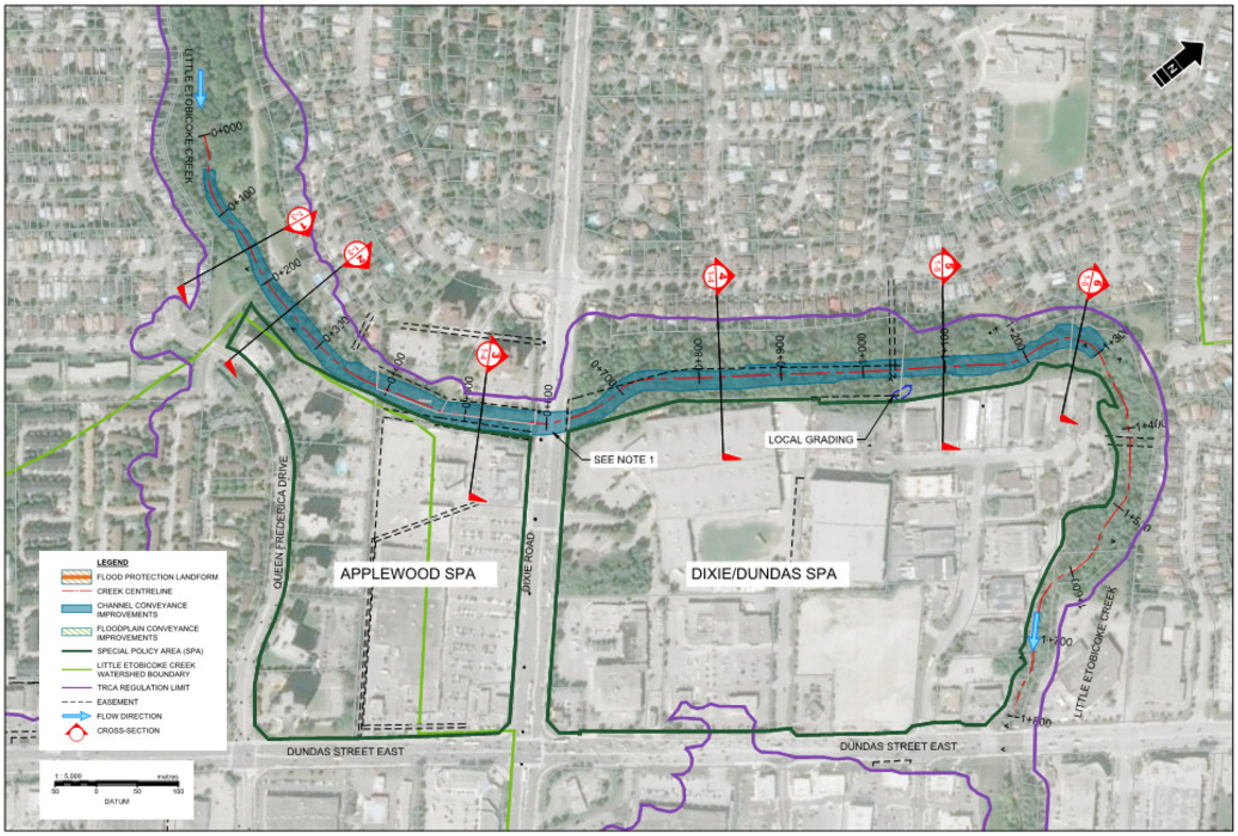


Figure 11 Dixie Area Alternative Solution 1: Planform Concept

The Dixie AS1 channel design is configured to include a 10 to 15 m bottom width with 2H:1V side slopes. The channel would have a wider and deeper footprint than the existing conditions channel (refer to Drawings 1-1 to 1-5 in Appendix H for additional cross-sections and plan and profile drawings).

Dixie AS1 would require the new bridge span at Dixie Road to be approximately 26 m. Dixie Road would also need to be raised approximately 1.7 m to accommodate the required vertical alignment of the proposed bridge. The significant road raise would impact the Dixie Road profile up to the intersection at Golden Orchard Drive and potentially the intersection itself. The road raise would also require construction of retaining walls along much of Dixie Road near the bridge, as the roadway there is already raised and the grade difference could not be accommodated in the boulevards using typical methods. Dixie AS1 would also affect existing utilities, requiring some relocation or vertical reconfiguration.

7.1.2 Dixie Area Alternative Solution 2: Improved Conveyance by Making Room for the Creek

Dixie AS2 (Figures 12 and 13) is based on natural channel design concepts, with a lowered and widened channel and a connected and lowered floodplain adjacent to the channel. The channel and valley configuration would be implemented from 500 m upstream of Dixie Road to approximately 700 m downstream of Dixie Road. The Dixie AS2 design includes lowering 600 m of the channel length approximately 0.5 m, on average, to drop water levels at Dixie Road and upstream. The lowered watercourse invert profile for Dixie AS2 is the same as Dixie AS1.

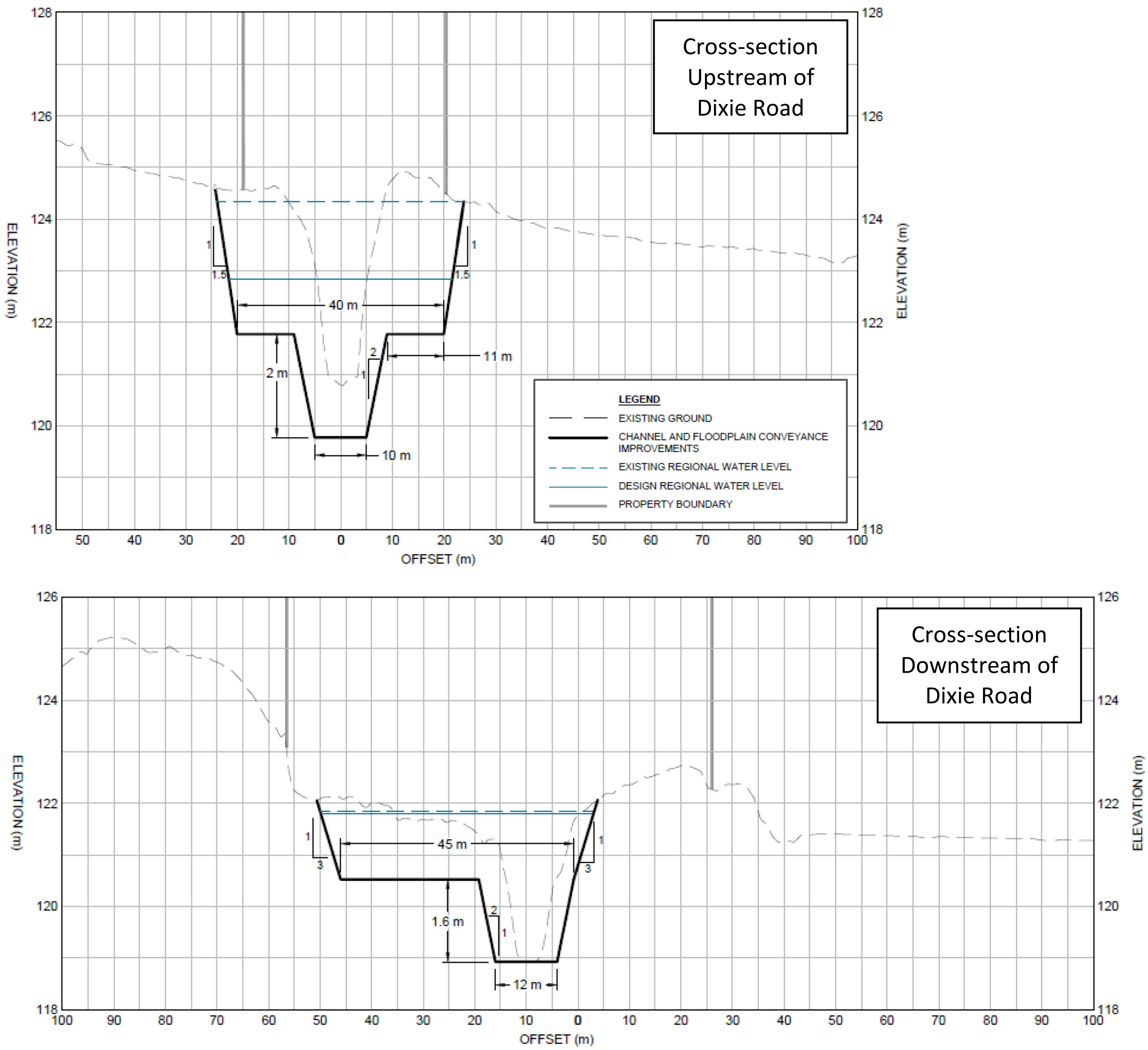


Figure 12 Dixie Area Alternative Solution 2: Typical Cross-sections Upstream and Downstream of Dixie Road

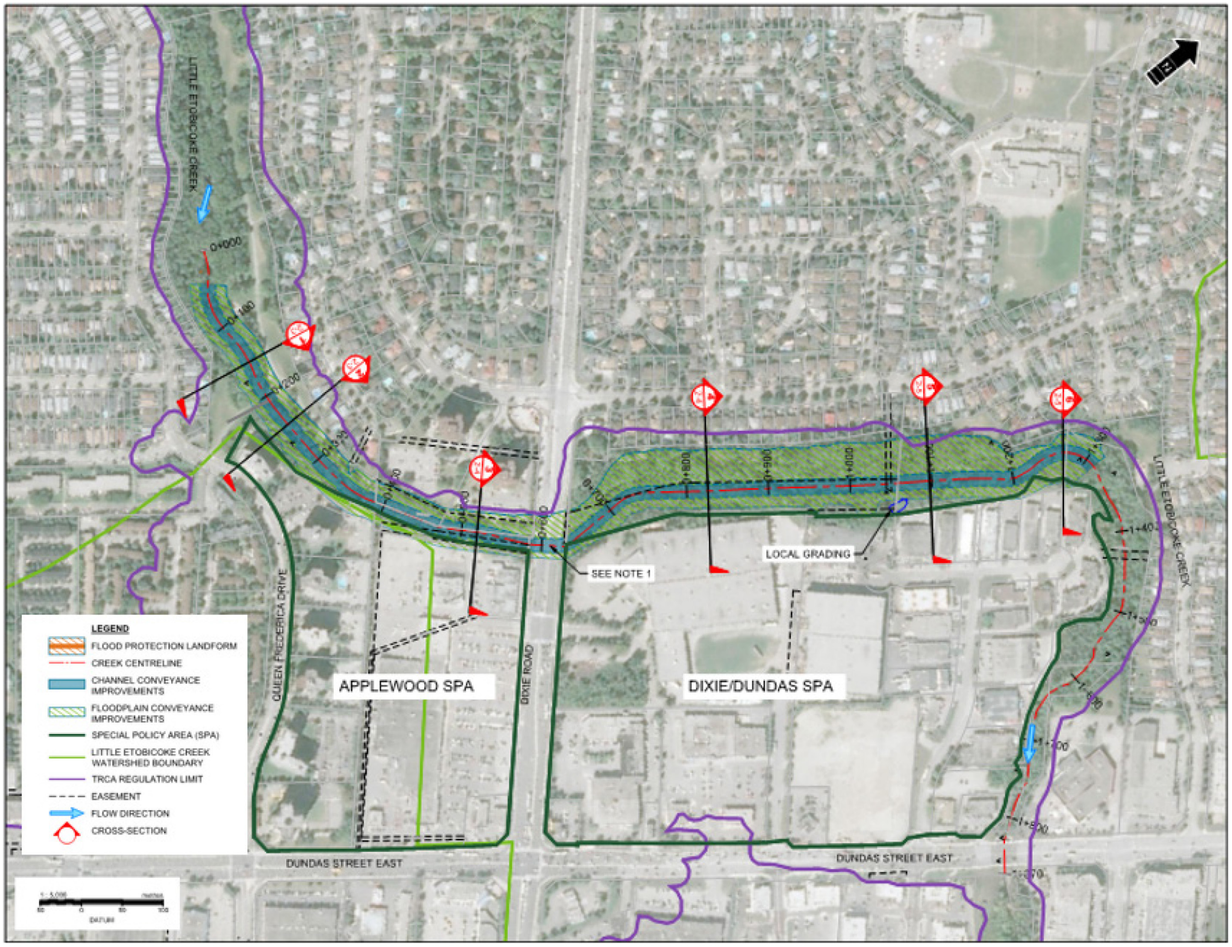


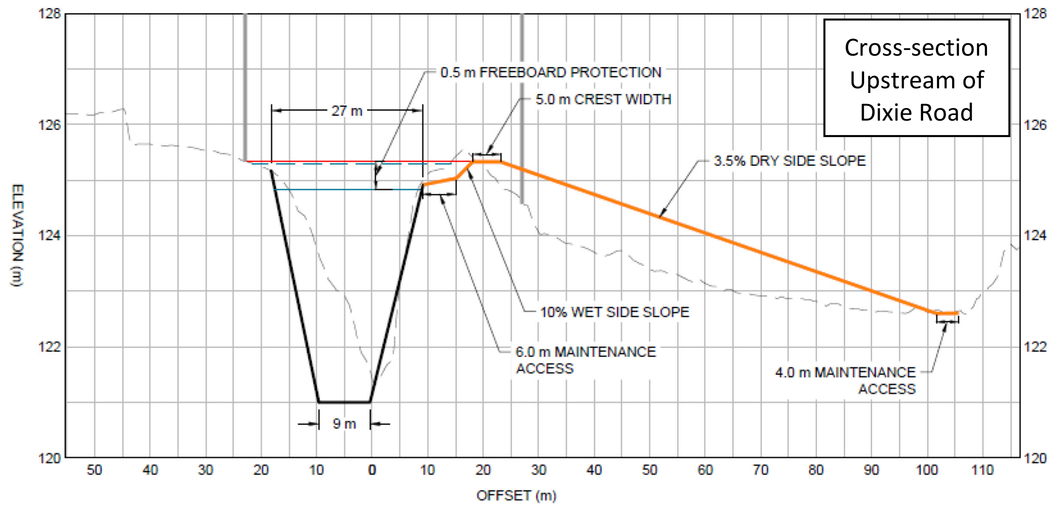
Figure 13 **Dixie Area Alternative Solution 2: Planform Concept**

The channel design includes a low-flow channel with a depth of 1.6 to 2.0 m, a 10 to 12 m bottom width, and 2H:1V side slopes. This designed channel includes floodplain shelves above the low-flow channel to allow for additional conveyance when the low-flow channel capacity is exceeded. The side slopes for the wider floodplain section are generally matched back to existing valley extents with 3H:1V side slopes, with some steeper sections nearer to property constraints. The channel design has a wider and deeper footprint than the existing condition channel, to accommodate the required flow and reduce erosion during high flow. The proposed bankfull channel geometry is conservative from a modelling perspective; it is anticipated that the low-flow and bankfull channel will be optimized (e.g., width to depth ratios) if Dixie AS2 is carried forward through to the Municipal Class EA Phase 3 (refer to Drawings 2-1 to 2-5 in Appendix H for additional cross-sections and plan and profile drawings).

For Dixie AS2, the new bridge at Dixie Road would require at least two spans, approximately 45 m in total length. To accommodate this bridge configuration, Dixie Road would need to be raised by approximately 0.4 m to accommodate the anticipated top-of-bridge elevation. The raised road profile would tie-into the existing grade well south of Golden Orchard Drive, thereby avoiding impacts to the intersection. Additionally, the roadway profile associated with Dixie AS2 would have little, if any, requirement for new retaining walls for Dixie Road. Existing utilities would be affected by this alternative, requiring some relocation or vertical reconfiguration.

7.1.3 Dixie Area Alternative Solution 3: Flood Containment

Dixie AS3 (Figures 14 and 15) would contain the Regional storm within the existing valley corridor by using an FPL (a permanent massive earthen structure with a highly constrained and specialized configuration, including an engineered clay core and a requirement that no services cross the FPL). The FPL would extend from 500 m upstream of Dixie Road to 750 m downstream. Dixie AS3 would include minor channel widening for the 500 m upstream of Dixie Road. Channel widening was added to this alternative to offset the backwater impacts caused by flow containment by the FPL and minimize water level increases upstream.



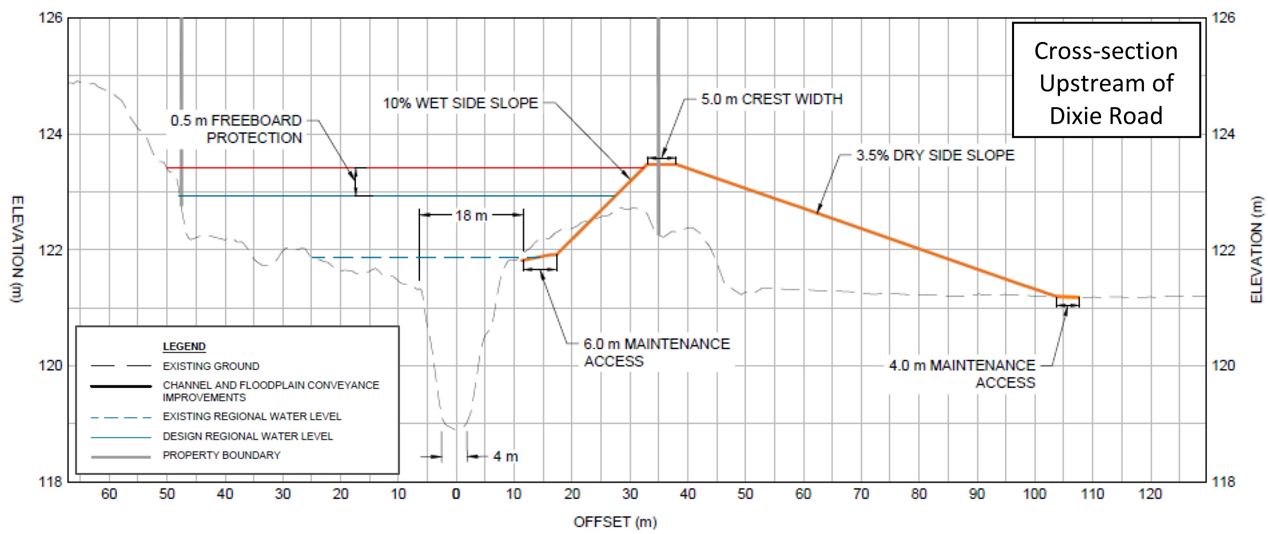


Figure 14 Dixie Area Alternative Solution 3: Cross-sections Upstream and Downstream of Dixie Road

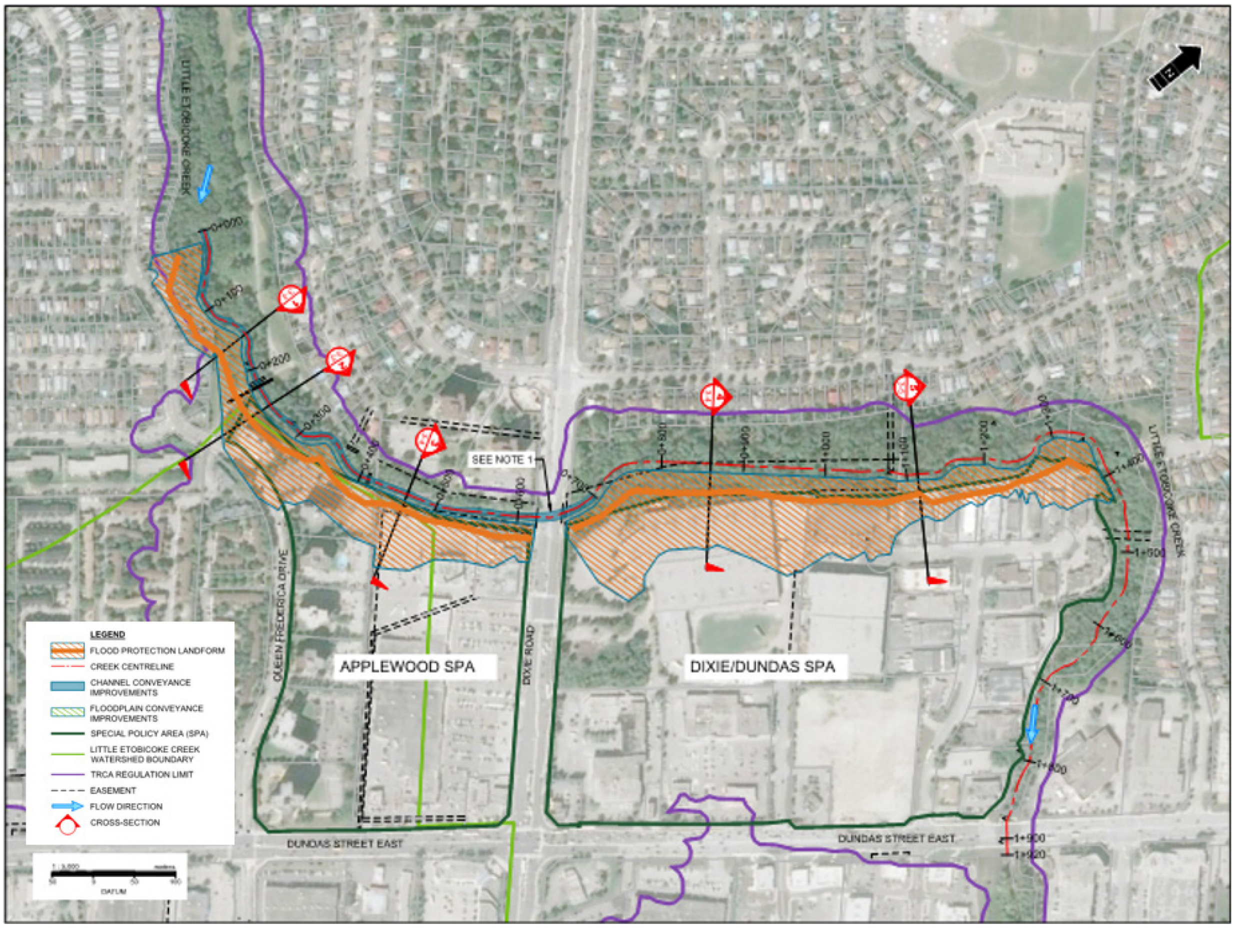


Figure 15 **Dixie Area Alternative Solution 3: Planform Concept**

The Dixie AS3 design maintains the existing channel invert (no lowering required). The channel would be widened upstream of the Dixie Road bridge to have a 4 to 10 m bottom width. There would be no conveyance improvements or channel widening downstream of the Dixie Road bridge. The FPL design includes a 6 m maintenance access strip adjacent to the channel right bank, a 10% grade on the wet side slope, a 5 m crest width, a 3.5% dry side slope, and a 4 m maintenance access strip located at the dry side toe. The top of the FPL is designed 0.5 m above the Regional water level to provide a measure of freeboard. The footprint of the FPL would be approximately 90,000 m^2 (refer to Drawings 3-1 to 3-5 in Appendix H for additional cross-sections and plan and profile drawings).

Dixie AS3 would require a Dixie Road bridge span of approximately 28 m and raising the road profile by approximately 2.5 m. The raised road would require major construction works on Dixie Road, including significant modifications to the Golden Orchard Drive intersection.

Consideration of Dixie AS3 must also include recognition that the Province of Ontario has not approved the technical guidelines for FPLs and has not indicated whether FPLs would be accepted as permanent flood mitigation measures. The FPL design for this solution is based on the current version of the FPL Guidelines (AECOM 2018b) and also incorporates design approaches developed for the existing FPL constructed along the Don River in Toronto. Applying the FPL Guidelines (AECOM 2018b) to the Dixie Area would result in a large footprint area with significant property impacts. The large footprint is caused by the estimated height of the FPL needed to contain flows, coupled with the minimum shallow dry-side slope requirement (3.5%). Furthermore, the use of an FPL has, to date, only been accepted by the MNRF on the Don River in Toronto; therefore, its proposed use would have to acknowledge a significant regulatory risk (i.e., may not be approved).

7.2 Dundas Area Alternative Solutions

The results of mitigating the flood spill in the Dixie Area will require mitigation measures in the Dundas Area to accommodate the increased flows that no longer spill out of the floodplain. Alternative solutions were identified in the Dundas Area, specifically for the Dundas Street bridge, which presents a significant hydraulic constraint to the increased flows. The Project team chose three bridge alternatives for Dundas Street that include different bridge spans and downstream regrading configurations to provide the required conveyance improvements.

The Dundas Area work must be completed prior to the Dixie Area work. Although work completed at Dundas Street does not have a hydraulic effect on the Dixie Area work, hydraulic conditions at the Dundas Street crossing will be significantly impacted by the construction of mitigation work in the Dixie Area. Therefore, the Dundas Area conveyance improvements must be constructed before the Dixie Area solution can be implemented.

The Dundas Area is also currently affected by plans associated with the City's BRT project. The Project team and the City's BRT have worked to coordinate opportunities to align the BRT's construction plans for an expanded Dundas Street bridge at Little Etobicoke Creek with the objectives of the Project. Accordingly, the BRT requirements were woven into the Project, with the BRT project recognized as an important stakeholder; moreover, the BRT project team also obtained information from this Project.

A hydraulic assessment of the existing conditions at Dundas Street indicates that improving hydraulic conveyance at the Dundas Street bridge, and in some portions of channel near the Dundas Street bridge, would be necessary to ensure no adverse impacts result from the increased flow from upstream. The hydraulic assessment confirmed that the Dundas Street bridge is the primary flow constraint within the Dundas Area. By replacing the Dundas Street bridge crossing with a larger one, along with some associated channel improvements, the increased flows can be accommodated. The following alternative solutions have been identified to increase conveyance in the Dundas Area and to mitigate potential adverse effects of flooding or spill nearby:

- Dundas Area Alternative Solution 1 (Dundas AS1): 25 m single-span bridge with downstream floodplain conveyance improvements
- Dundas Area Alternative Solution 2 (Dundas AS2): 38 m two-span bridge without downstream floodplain conveyance improvements
- Dundas Area Alternative Solution 3 (Dundas AS3): 38 m two-span bridge with downstream floodplain conveyance improvements

An evaluation of these alternatives was completed and included considerations for BRT, utilities, infrastructure, ecology, and geomorphology. The Project team's review of these considerations indicate that the three different bridge alternatives represent appropriate approaches to increase hydraulic conveyance at Dundas Street. Each of the alternative solutions was discussed with the BRT project team and other key stakeholders. RVA developed conceptual designs for the bridge replacements and associated roadway transitions to accommodate the bridges (Appendix I).

7.2.1 Dundas Area Alternative Solution 1: 25 m Single-span Bridge with Downstream Floodplain Conveyance Improvements

Dundas AS1 (Figure 16) includes a 25 m single-span bridge with downstream floodplain conveyance improvements. The 25 m span was deemed the smallest appropriate alternative, as it just spans the existing valley at Dundas Street. Smaller bridges were excluded as potential conceptual options, as they would continue to create a hydraulic pinch point at this location. Additionally, a smaller-span bridge structure would require a higher soffit elevation to provide the same flow area to convey the Regional flood. The bridge soffit, deck thickness, and extent of road profile impacted by Dundas AS1 are detailed on Figure 16.

The 25 m bridge opening design has 2H:1V side slopes that are consistent with the adjacent existing channel valley. Additional conveyance improvements, including floodplain improvements and channel widening, are included downstream to further reduce water levels through the Dundas Street bridge and to allow for a lower road profile. The Dundas AS1 bridge replacement would require the Dundas Street East roadway to be raised approximately 0.75 m at the crossing location, which would result in an overall road disturbance length of 190 m.

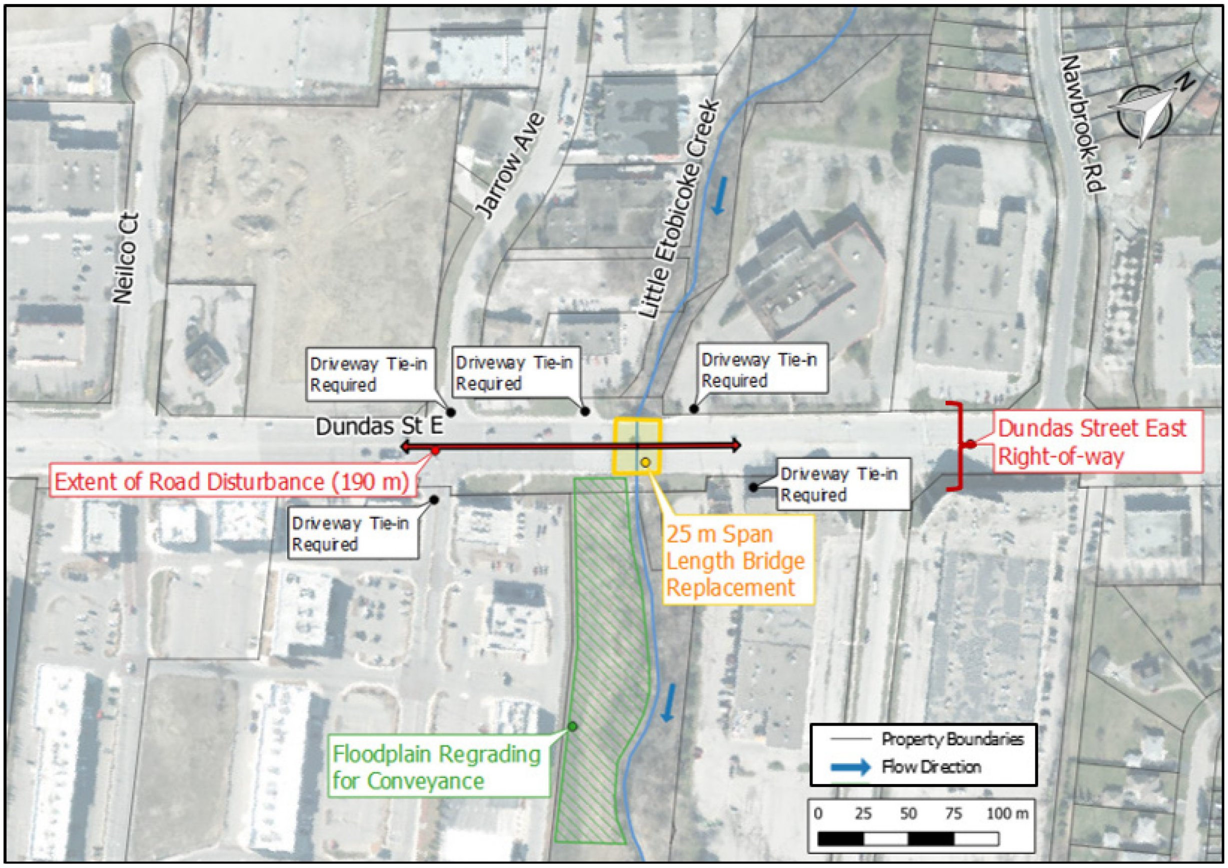


Figure 16 **Dundas Area Alternative Solution 1: 25 m Single-span Bridge with Downstream Floodplain Conveyance Improvements**

7.2.2 Dundas Area Alternative Solution 2: 38 m Span Bridge without Downstream Floodplain Conveyance Improvements

The Dundas AS2 (Figure 17) design includes a 38 m bridge span without downstream floodplain conveyance improvements. A 38 m bridge was the largest span assessed due to limited additional hydraulic benefits beyond the 38 m span due to a narrow channel valley upstream of the bridge and the additional property takings that would be required for a larger span. The bridge soffit, deck thickness, and extent of road profile impacted for the 38 m bridge are detailed on Figure 17.

The bridge design opening includes a low-flow channel within the concrete piers. The bridge opening has 2H:1V side slopes through the main section. The longer span bridge associated with Dundas AS2 has a lower soffit elevation and less road disturbance extents than Dundas AS1 due to lower water levels upstream of the bridge. The Dundas AS2 bridge replacement option would require Dundas Street East to be raised 0.5 m at the crossing location. This elevation increase corresponds to 140 m of road disturbance.

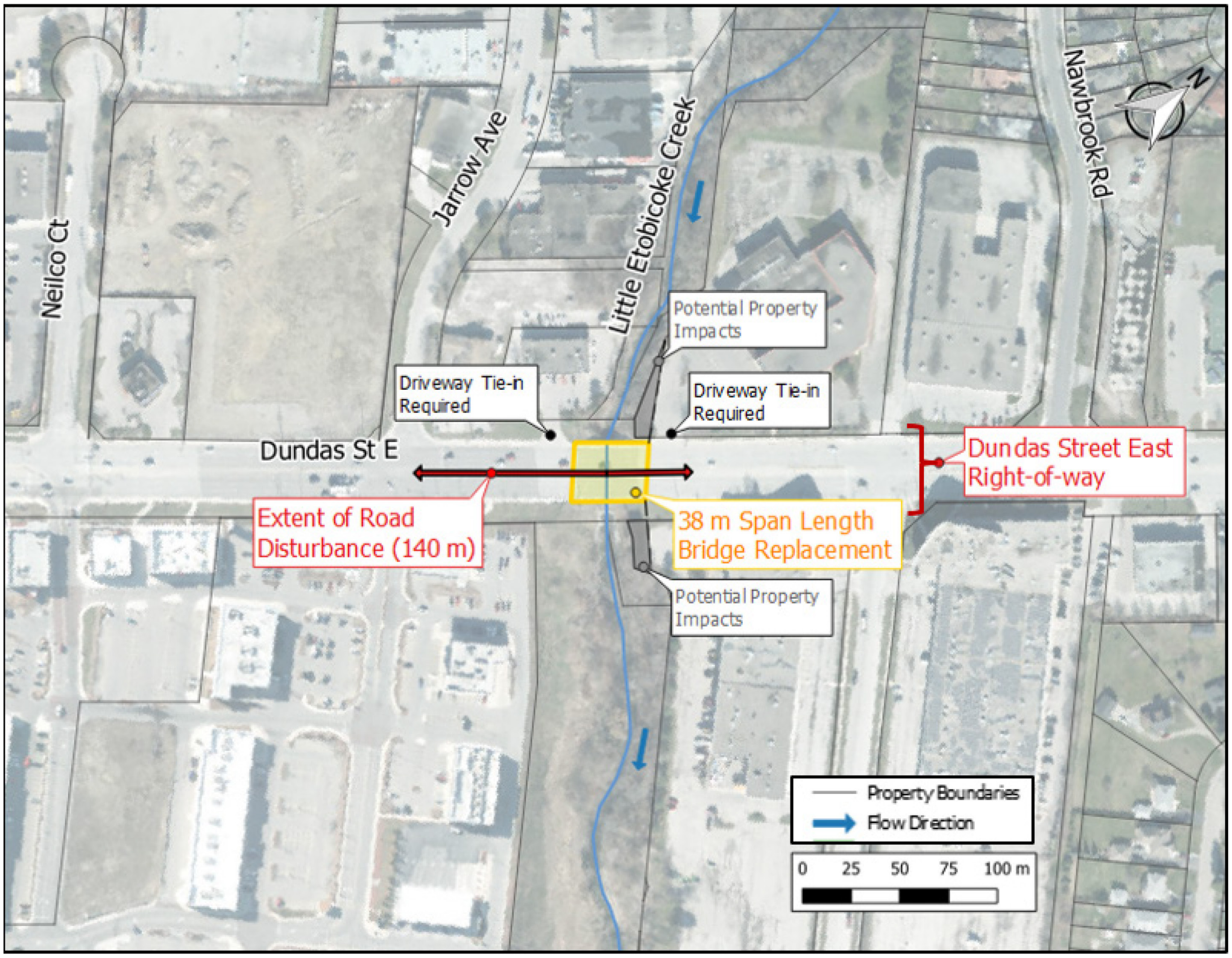


Figure 17 **Dundas Area Alternative Solution 2: 38 m Span Bridge without Downstream Floodplain Conveyance Improvements**

7.2.3 Dundas Area Alternative Solution 3: 38 m Span Bridge with Downstream Floodplain Conveyance Improvements

The Dundas AS3 design combines the downstream floodplain conveyance improvements from Dundas AS1 with the 38 m span bridge design from Dundas AS2. The reduced water levels from the downstream conveyance improvements relative to Dundas AS2 would result in a slightly lower bridge soffit and reduced road disturbance extents identified for Dundas AS3.

The bridge replacement for Dundas AS3 would require raising the Dundas Street roadway profile by approximately 0.2 m at the crossing location, which corresponds to a road disturbance length of 70 m. The bridge soffit, deck thickness, and extent of road profile impacted by Dundas AS3 are detailed on Figure 18.

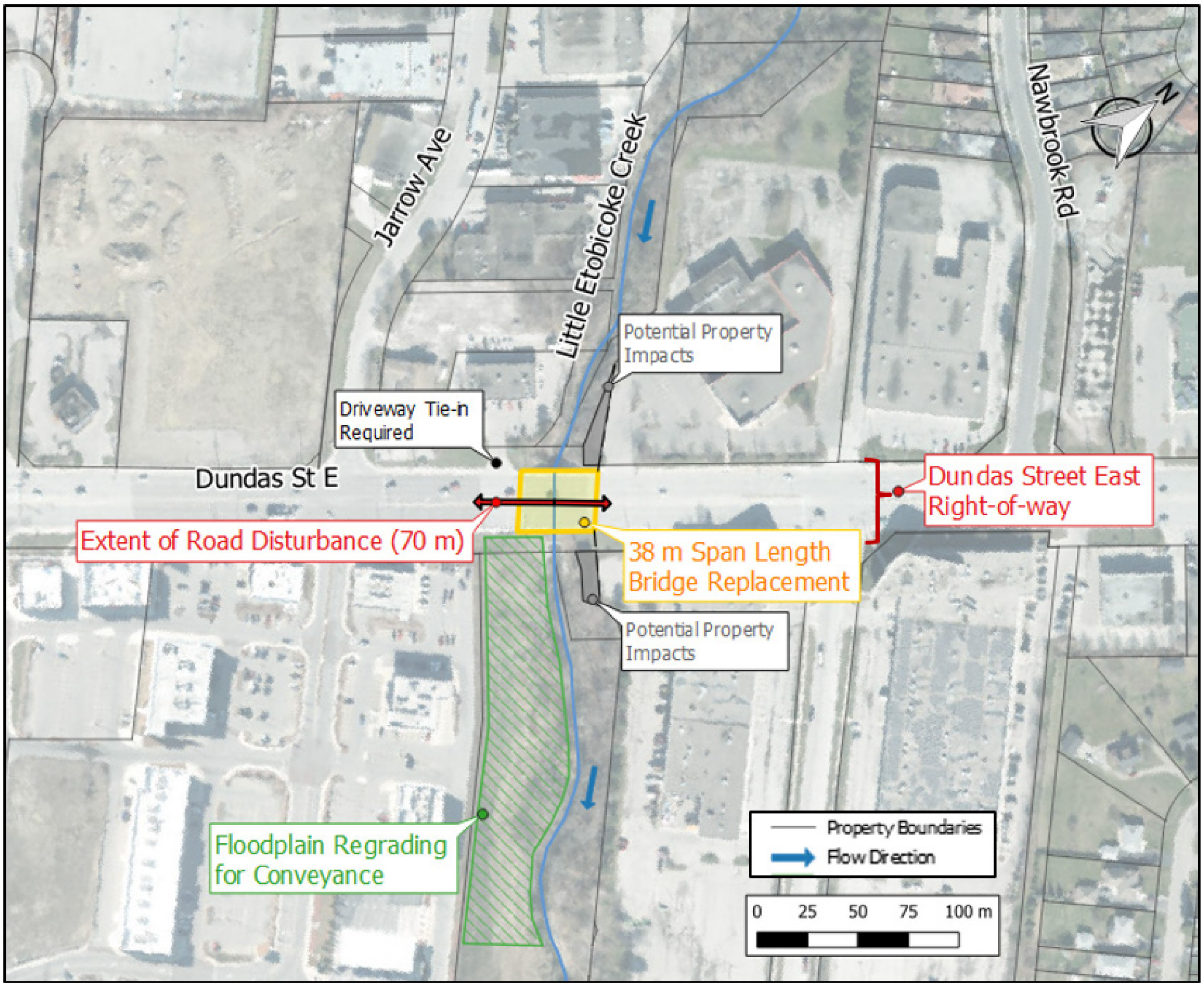


Figure 18 **Dundas Area Alternative Solution 3: 38 m Span Bridge with Downstream Floodplain Conveyance Improvements**

7.2.4 Dundas Area Channel Configuration

Channel configuration through the Dundas Area focused on facilitating a functional bankfull and flood conveyance geometry for each larger bridge span. The current structure at Dundas Street is only a 6 m span, and both the channel and the surrounding valley would need to be widened to accommodate a widened bridge.

It is not possible to maintain the 3H:1V valley slopes due to the confined corridor and property constraints in this area. The proposed valley side slopes average 2H:1V, which is similar to the existing conditions downstream of Dundas Street. A geotechnical investigation will be conducted during the detailed design phase, once the preferred alternative solution has been selected, to determine stability of the natural soils and to assess the need for structural slope reinforcement.

The proposed channel and valley works to accommodate the proposed bridge spans would extend from approximately 200 m upstream of Dundas Street to 400 m downstream. This represents the extent of areas where existing erosion issues have been identified and would benefit from the widened channel (Appendix C). The proposed extents also align with a natural transition in the existing channel geometry.

8 Evaluation Framework and Criteria

The various alternative solutions were assessed based on project-specific criteria developed in consultation with the City. The criteria follow MCEA Manual (MEA 2015) from four main evaluation categories: technical, economic, environmental, and social. Detailed criteria descriptions are provided in Table 6.

Table 6 High-level Project-specific Alternative Solution Criteria

Category	Criterion	Criterion Description
Technical	Regional Storm Flood Risk Reduction	Ability for the alternative solutions to remove the two SPAs (i.e., remove the spill upstream of Dixie Road at Queen Frederica Drive and the smaller spill downstream of Dixie Road). Removing the SPAs in their entirety will ensure safe access and egress to these lands during the Regional flood event.
Technical	Water Levels	Ability to reduce upstream and downstream water levels within Little Etobicoke Creek during the Regional event.
Technical	Urban Drainage	Impact to the urban drainage system. High water levels in Little Etobicoke Creek create backwater conditions at the storm outfalls, which limit the ability for the storm sewers to flow by gravity.
Technical	Erosion Potential	Ability for the alternative to reduce/limit erosion within the creek corridor.
Technical	Constructability and Infrastructure Conflicts	Complexity of construction for implementing proposed works. Preference is generally given to accepted construction/engineering practices, traffic considerations, and implementation times.
Technical	Resiliency including Climate Change	Measure of resiliency against future climate change (e.g., meeting a 0.5 m freeboard/clearance targets at specified low points).

Category	Criterion	Criterion Description
Economic	Capital Costs	Relative measure of the initial costs to install/construct the proposed works, including the channel works, road/bridge improvements, and landscape costs.
Economic	Operation and Maintenance Costs	Relative measure of the ongoing maintenance and operational costs following implementation.
Economic	Urban Development Considerations	Ability of the proposed alternative to allow future urban development plans to move ahead without impacts (e.g., Dundas Connects Master Plan).
Economic	Municipal Servicing	Effect on existing and proposed municipal servicing and private utility infrastructure.
Environment	Aquatic Ecology	Effect on fisheries/aquatic habitat, connectivity, habitat sources, diversity, food sources, and fish passage.
Environmental	Terrestrial Ecology	Effects on ground cover vegetation, trees, and shrubs that influence connectivity, diversity, and quality and provide habitat to wildlife.
Environmental	Geomorphology	Ability to improve channel morphology, stability, as well as sediment transport function and erosive resilience.
Social	Planning and Policy	Measure of the potential acceptance by approving/interested agencies.
Social	Public Input	Measure of the public response and acceptance of the proposed alternative.
Social	Property Acquisitions	Measure of the impact to adjacent private properties (i.e., loss of property, access to property, and aesthetics).
Social	Disruptions during Construction	Potential disruptions during construction to the adjacent property owners, businesses, and the surrounding local community.
Social	Parks and Recreational Amenities	Potential for future trails and trail connections, improving public access, and aesthetics.
Social	Cultural Heritage and Archaeology	Potential impact to cultural heritage or archaeological resources.
Social	First Nations	Initial acceptance of proposed works by First Nations.

Notes: SPA - Special Policy Area

8.1 Technical Assessment Methods

8.1.1 Hydraulic Modelling Methods

The Project team selected MIKE FLOOD modelling software to assess alternative solutions. MIKE FLOOD is an appropriate model for the Project due to its ability to address the hydraulically complex Project study area flooding mechanisms resulting from the Little Etobicoke Creek spills. The MIKE FLOOD model can accommodate and process the complex interaction between Little Etobicoke Creek and the urban area above watercourse banks by combining a MIKE 11 1D riverine model and a MIKE 21 2D overland flood model. Matrix assessed the alternative solutions using the MIKE FLOOD hydraulic model originally created by MMM (2015) and more recently updated by TRCA (2020). The extended MIKE FLOOD model created for the FESMP (Matrix 2021) was not used for the Project. The extended model was created to understand the extents and impacts of the overland spill after it leaves Little Etobicoke Creek. The purpose of the current Project is to eliminate the spill; therefore, tracking the spill extents over a larger area is not required for the Project. The larger model area would not benefit the Project and would have led to increased computation times.

All analyses completed for the Project are based in North America Datum (NAD)83 Zone 17 and Canadian Vertical Geodetic Datum 1928 with 1978 adjustment (CVGD 28:78). The MIKE 21 2D model used in this study is based on 2012 LiDAR data provided by TRCA and CVC. A review of the local topography and development was completed for the Project to ensure the continued appropriateness of the data. No hydraulically significant changes have occurred within the Project study area since 2012. Accordingly, the 2012 LiDAR data was determined to be sufficient for use in the Project.

The 1D riverine model comprises channel cross-sections that are coupled at the top of bank to a 2D model surface. The 2D portion allows for a detailed representation of spill locations along the channel and spill flow paths throughout the Project study area by providing a detailed representation of the bank profile, overland flow paths, and obstructions. Figure 19 illustrates the MIKE FLOOD model setup, including 2D model domain and 1D cross-sections.

The boundary condition for the 1D riverine portion of the MIKE FLOOD model is consistent with the approved HEC-RAS model (TRCA 2016) for Etobicoke Creek, which includes Little Etobicoke Creek. The existing MIKE 11 1D model extends from approximately 450 m south of Bloor Street at the upstream end and downstream to the confluence with the main branch of Etobicoke Creek. The MIKE 11 1D model extents are sufficient to represent the spill from Little Etobicoke Creek. The flow from flow node 12.12 at the confluence with Etobicoke Creek (Table 2, Section 5) was applied at the upstream extent of the Project study area to provide a conservative peak flow throughout the Project study area. The model was run to represent a steady-state flow in accordance with MNRF policy.

The MIKE 21 2D model does not include the existing floodwall located upstream of Dixie Road, nor does it include the existing berms located downstream of Dixie Road or at 1607 Dundas Street East, to ensure adherence to MNRF flood plain policy at the Regional storm event. Accordingly, these existing flood barriers were removed from the model and replaced with elevations representing assumed natural ground conditions. MNRF policy is to assume flood barriers could fail during the Regional event (i.e., non-permanent solutions; MNR 2002). Therefore, alternative solutions evaluated in this Project also do not rely on the existing, non-permanent flood protection to prevent spill into the SPAs. The primary goal of the hydraulic assessment in the Municipal Class EA is to evaluate the alternative solutions for capability and feasibility to address the spill resulting from the Regional storm. Additional flow event simulations (i.e., for the 2- through 350-year return period storms) were completed for the preferred alternative.

The hydraulic modelling methods are further described in Appendix G.

8.1.1.1 Modelling of Alternative Solutions

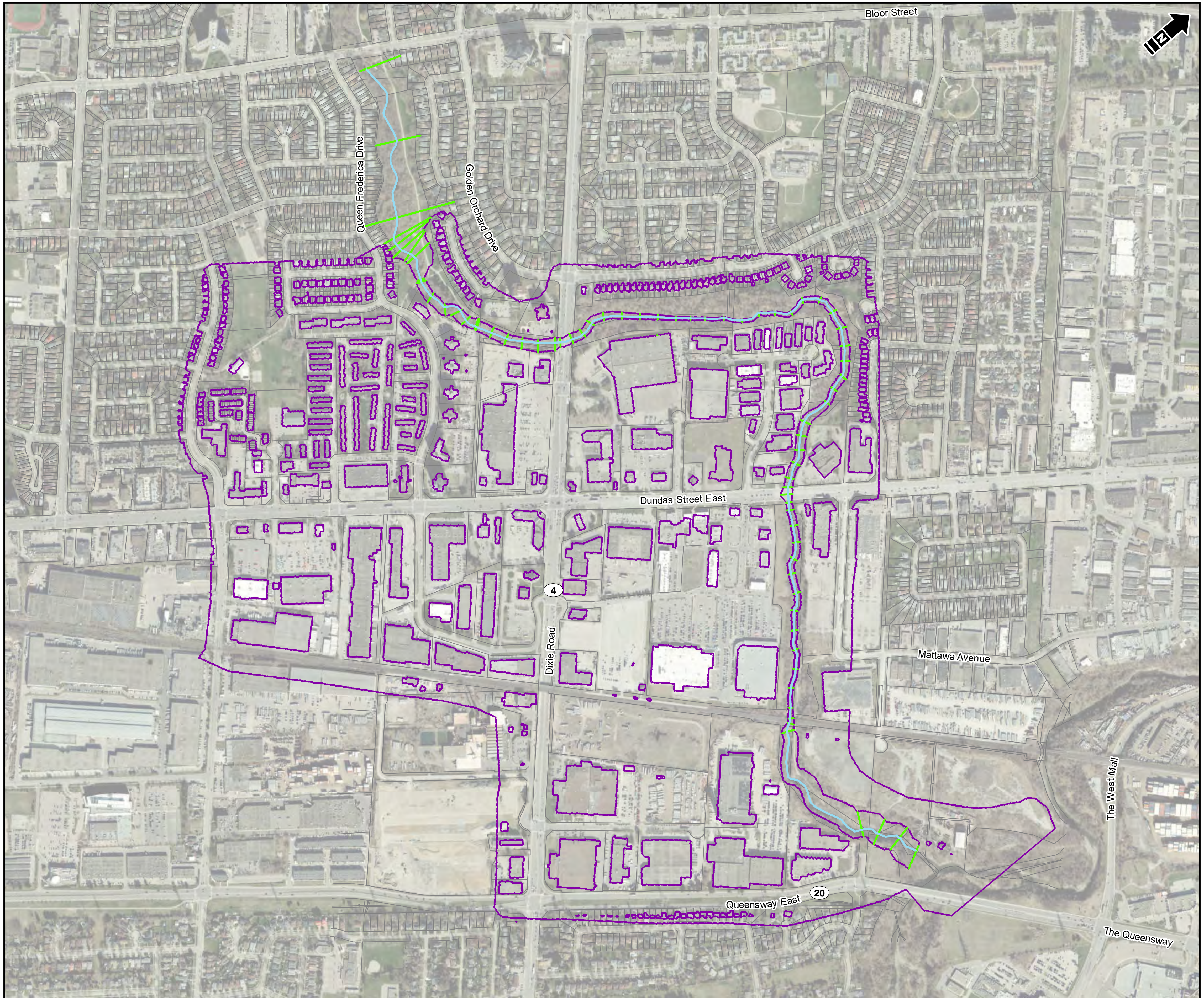
For the Dixie Area, modifications were made to the existing MIKE FLOOD model to represent each of the alternative solutions being considered. Model changes were made to channel cross-sections, coupling locations, 2D surfaces within the floodplain, and bridges. For some alternative solutions, the Dixie Road bridge was removed conceptually from the model to allow assessment of idealized conditions. If a clear span bridge design could not be achieved within an alternative solution being evaluated, instream piers were represented in the model. Additionally, the two existing pedestrian bridges within the Dixie Area were removed from the model to accommodate channel widening. It is assumed that pedestrian bridges incorporated into the future design will be designed and modelled to align with the flood mitigation objectives.

8.1.2 Hydraulic Evaluation Methods

Matrix used the MIKE FLOOD model to assess the alternative solutions described in Section 6 (Dixie Area) and Section 7 (Dundas Area). Due to the distance and elevation difference between the two areas, the alternative solutions at the Dundas Area (downstream) do not impact the alternative solutions identified for the Dixie Area. As the areas are hydraulically independent, the assessment of alternative solutions at each area were completed independently. The upstream Dixie Area was assessed first followed by the Dundas Area.

The results of the hydraulic modelling were used in the evaluation of alternative solutions according to the following criteria:

- Regional storm flood risk reduction: the measure of how much flood risk is removed by reducing or eliminating the spill(s).
- Water levels: the measure of how upstream and downstream water levels are affected by implementing the alternative solution. A higher ranking is given to alternative solutions that reduce water levels, and a lower ranking is given to alternative solutions that increase water levels relative to the existing condition.
- Urban drainage: the impact to the storm sewer system relative to the existing condition. Note, this criterion is measured using the 100-year design storm simulation and the resulting backwater effects.
- Resiliency, including climate change: the measure of how much flexibility and additional capacity is built into the alternative solution. This is measured based on the freeboard or clearance provided at various low points in the Project study area. The greater the difference between the Regional water level and the low point elevation, the higher resiliency there is in the alternative solution and the higher the evaluation ranking.



- Model Domain
- Property
- Watercourse
- Cross-section

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

1:10,000 metres
100 0 100 200
NAD 1983 UTM Zone 17N

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Dixie-Dundas Flood Mitigation Project – Environmental Study Report

MIKE Flood Model Setup

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 19

8.1.3 Erosion Potential

High-flow events create high velocities and shear stresses in Little Etobicoke Creek, which can cause erosion along the banks and beds. The more well-connected a channel is to the floodplain, and the more robust surface materials are along the bed and banks, the less potential for erosion. Increases in erosion potential could also occur when increases in flow are left unmitigated. For the alternative solutions assessment, erosion risk was evaluated qualitatively based on geomorphic and hydraulic properties relative to the baseline of these risks at existing conditions. The erosion criteria scored highest for alternative solutions that result in the lowest potential erosion risk within the Project study area and downstream of the proposed works in Little Etobicoke Creek.

8.1.4 Constructability and Infrastructure Conflicts

Constructability and infrastructure conflicts are a major concern along the busy Dixie Road and Dundas Street corridors and throughout the urbanized areas of Dixie-Dundas. There are several key infrastructure constraints identified through the background review that need to be considered in the evaluation. Alternative solutions that are the most straightforward to construct using typical methods were given a higher ranking than more complex solutions or solutions that would require significant infrastructure removals/reconfigurations. The alternative solutions were evaluated semi-quantitatively and relative to each other.

8.2 Economic Assessment Methods

The economic criteria were assessed based on the costs of implementing (or not implementing) the alternative solutions. Economic criteria considered capital costs, which includes the cost to construct all the components of the proposed works and the operations and maintenance costs, which are the cost to upkeep the alternative solutions once implemented. The economic assessment also looked qualitatively at the urban development considerations and if the alternative solution would facilitate the removal of the SPA and allow for the future economic vision for the area to be realized. The last economic criteria examined was municipal servicing, which looks at the cost/economic impact of needing to relocate or adjust various services within the area. Capital costs were estimated for each alternative solution. The other economic criteria were reviewed semi-quantitatively and score/ranked relative to each other.

8.3 Environmental Assessment Methods

Environmental criteria included the aquatic environment and geomorphology of Little Etobicoke Creek and the terrestrial environment of the surrounding valley corridor. The evaluation was based on the background findings summarized in Section 5. The evaluation considered the impacts during the short-term construction period and the long-term impacts once the alternative solutions are implemented and vegetation is re-established. The alternative solutions were evaluated semi-quantitatively and relative to each other.

8.4 Social Assessment Methods

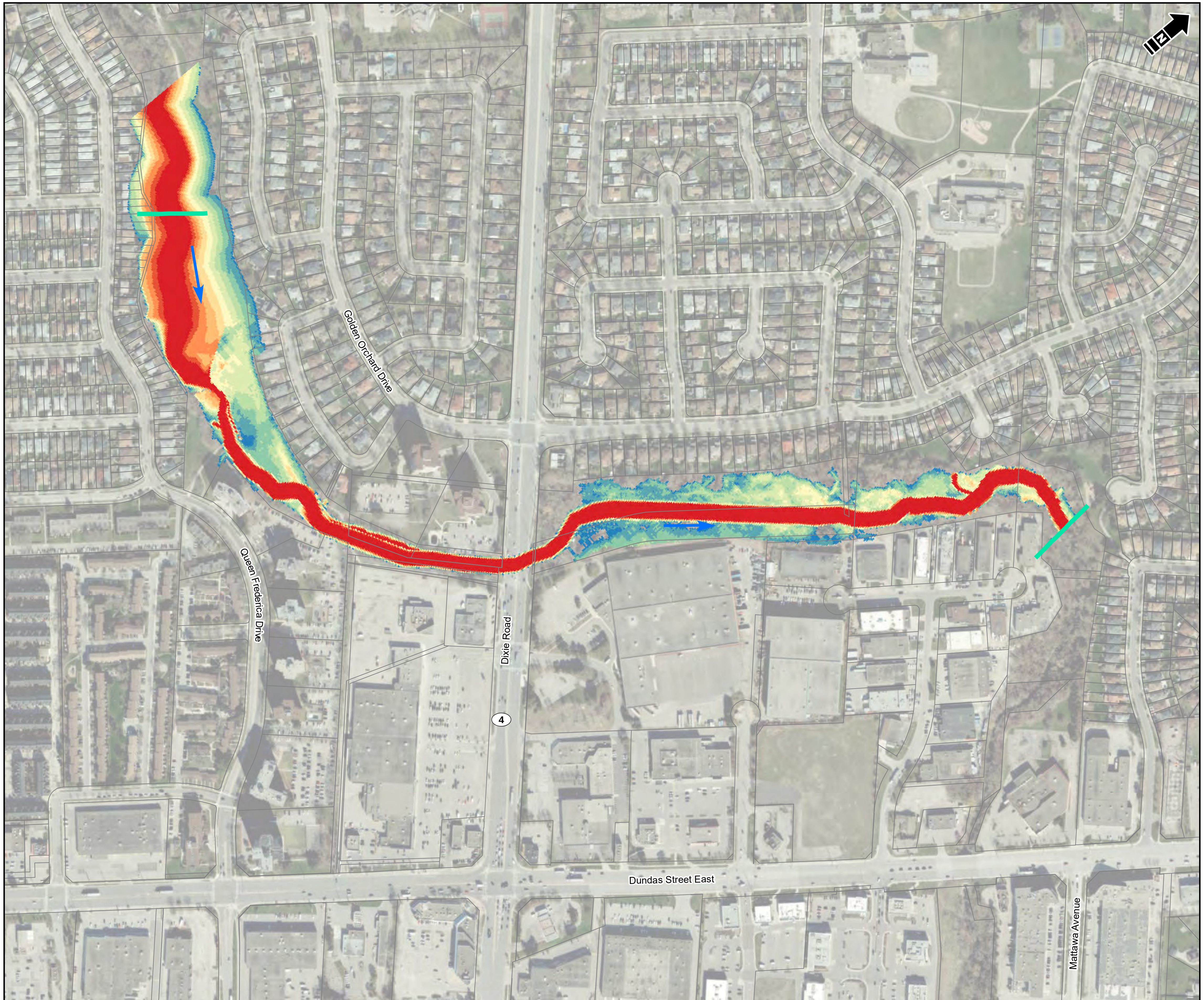
The social evaluation criteria looked at the impacts of the alternative solutions from the view of various stakeholders and the public. Social criteria address how the alternative solutions align with current planning and policy documents, how local landowners and residents near the Project study area will be affected both during construction and once the alternative solution has been implemented, feedback from the public and First Nations during engagement activities, and potential cultural heritage and archaeological concerns. The alternative solutions were evaluated qualitatively, with some semi-quantitative considerations, and relative to each other.

9 Dixie Area Alternative Solution Evaluation

9.1 Technical Analysis to Support Evaluation

9.1.1 Spill Mitigation

The three Dixie Area alternative solutions were designed to contain the spills from Little Etobicoke Creek at Queen Frederica Drive and downstream of Dixie Road during the Regional storm. Maps of the Regional flood depths for the three Dixie Area alternative solutions are shown on Figures 20 to 22. A comparison of the modelled Regional storm water levels for each of the alternative solution is shown on Figure 23 along with the recognized “permanent” existing conditions bank elevations where spill occurs along the right (i.e., south) channel bank. This right bank elevation does not include the berm elevations downstream of Dixie Road, nor the floodwall upstream of Dixie Road, as both measures are considered non-permanent protection.



DRAFT

Flow Direction
Property Boundary
Study Area Extents (500 m upstream of the Dixie Road Bridge to the channel bend)

Alternative Solution 1 - Regional Flood Depths (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: April 22nd, 2020

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m³/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. The conceptual channel plan, profile, and cross-sections are detailed in Drawings 1-1 to 1-5.
4. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

1:5,000 metres
50 0 50 100
NAD 1983 UTM Zone 17N

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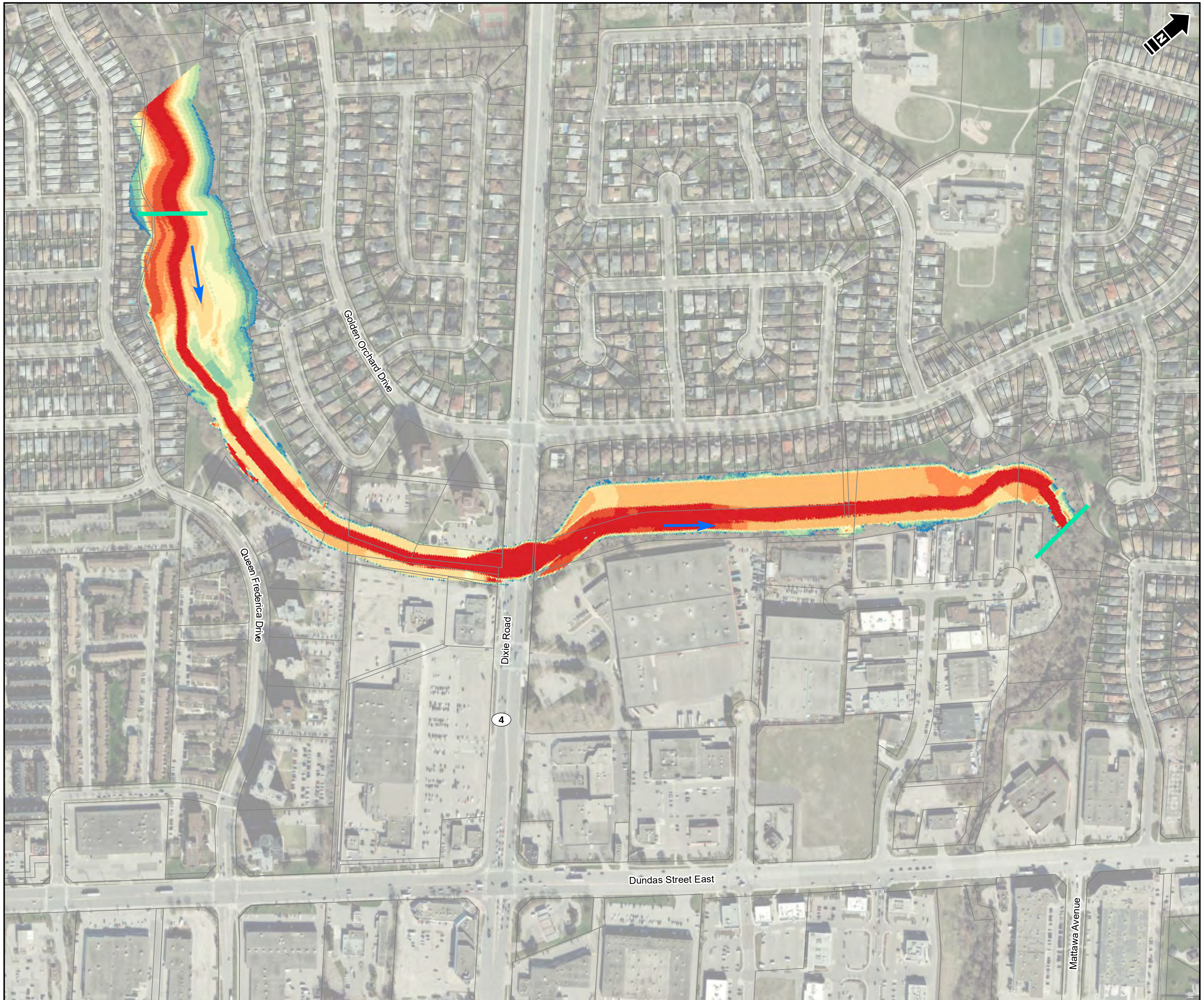
Dixie Road: Alternative Solution 1 - Minimized Footprint Conceptual Regional Flood Depths

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 20



DRAFT

Flow Direction
Property Boundary
Study Area Extents (500 m upstream of the Dixie Road Bridge to the channel bend)

Alternative Solution 2 - Regional Flood Depths (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: March 31st, 2020

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m^3/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. The conceptual channel plan, profile, and cross-sections are detailed in Drawings 2-1 to 2-5.
4. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

1:5,000 metres
50 0 50 100
NAD 1983 UTM Zone 17N

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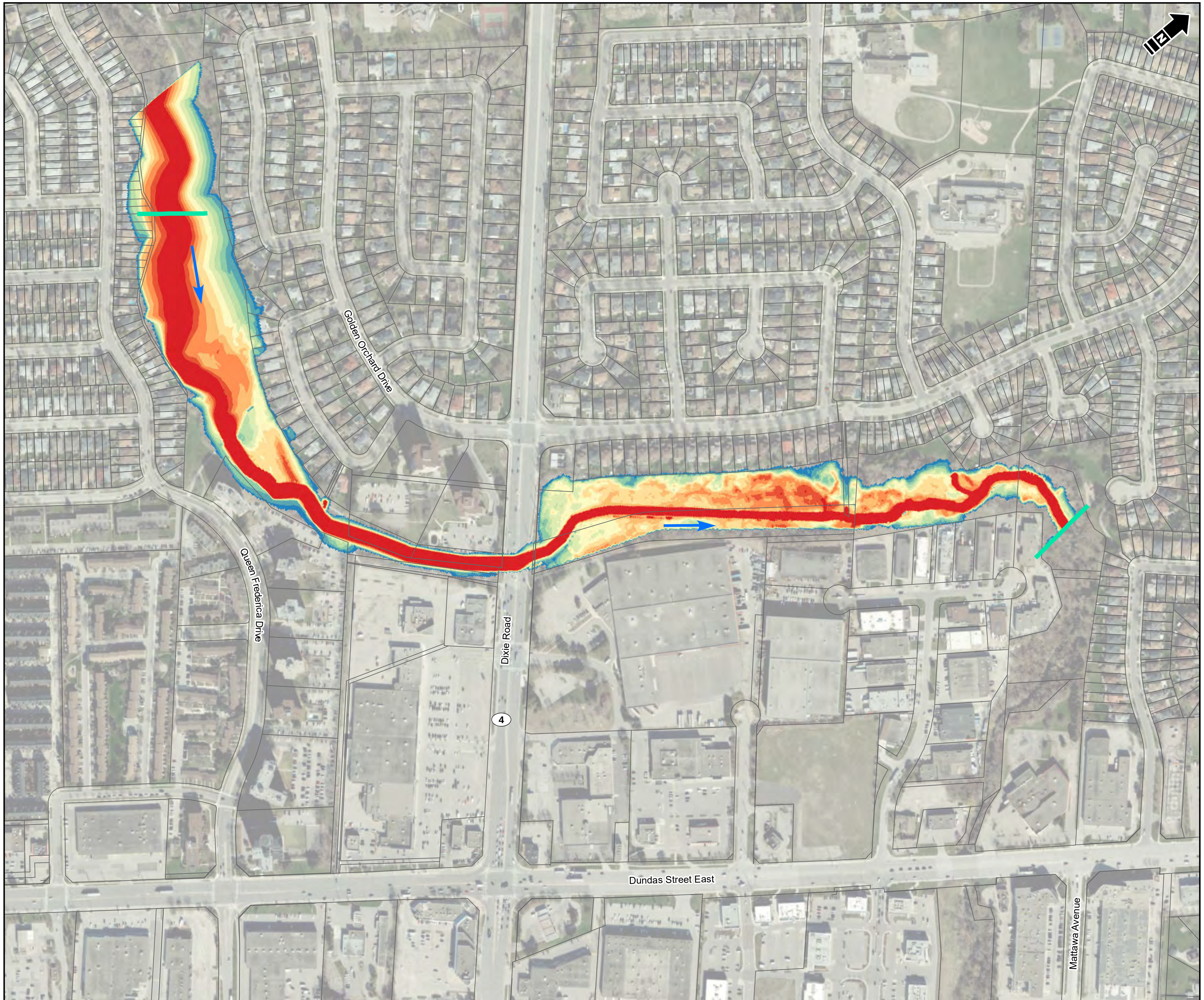
Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Dixie Road: Alternative Solution 2 - Making Room for the Creek Conceptual Regional Flood Depths

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 21



DRAFT

Flow Direction
Property Boundary
Study Area Extents (500 m upstream of the Dixie Road Bridge to the channel bend)

Alternative Solution 3 - Regional Flood Depths (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: March 29th, 2020

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m^3/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. The conceptual channel plan, profile, and cross-sections are detailed in Drawings 3-1 to 3-5
4. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

1:5,000 metres
50 0 50 100
NAD 1983 UTM Zone 17N

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Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Dixie Road: Alternative Solution 3 - Flood Containment Conceptual Regional Flood Depths

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 22

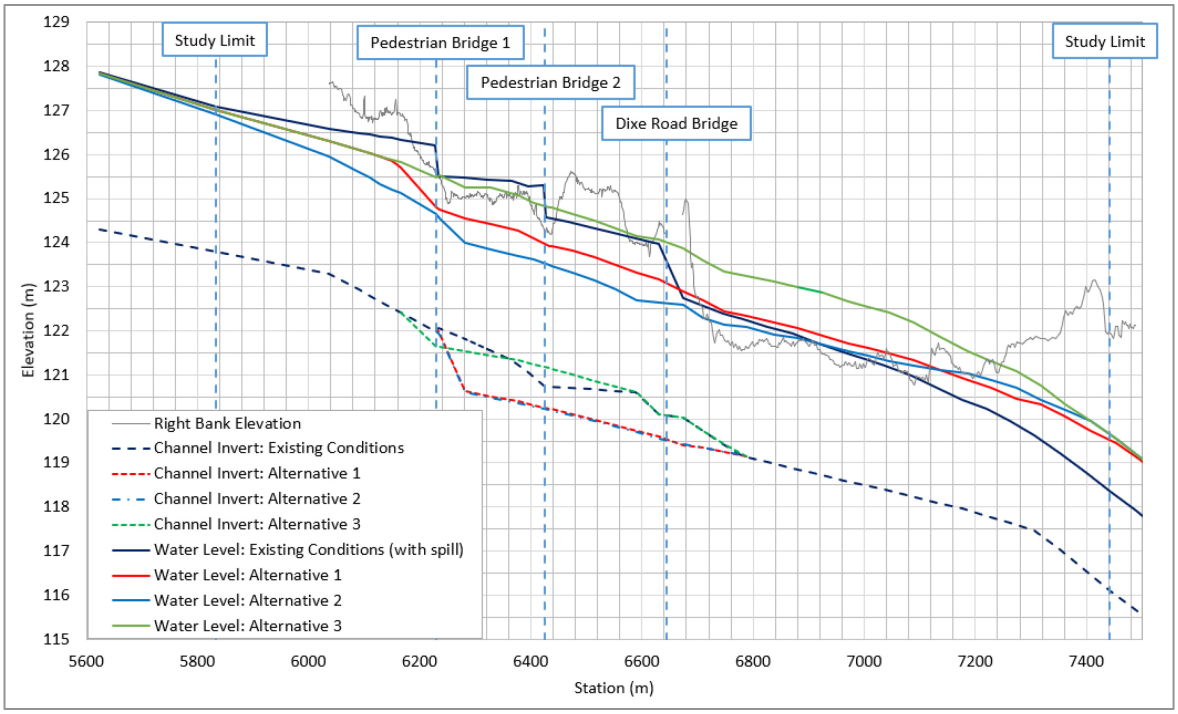

Figure 23 Dixie Alternative Solutions: Regional Water Level Profiles Throughout the Dixie Area

Under existing conditions, water levels exceed the right bank (looking downstream) at several locations within the Project study area, resulting in a spill condition. The three undersized crossings (Dixie Road and the two pedestrian bridges) also contribute to the spill due to backwater impacts caused by the crossings. The two pedestrian bridges are only present in the existing conditions model, as it is assumed that their replacements within each alternative solution would support the achievement of the flood mitigation objectives.

Dixies AS1 and AS2 achieve similar water levels downstream of Dixie Road; however, Dixie AS2 water levels are approximately 0.5 m lower than Dixie AS1 levels upstream of Dixie Road. The lower water levels of Dixie AS2 in the area upstream of Dixie Road, where the primary spill occurs, can provide additional freeboard to provide further resilience. Dixie AS3 aims to contain the spill through a permanent FPL and only provides channel widening upstream of Dixie Road to mitigate against increased upstream flood elevations that result from forcing the flow to stay in the channel.

All three alternative solutions result in water levels downstream of Dixie Road that would continue to exceed the natural watercourse bank/valley elevation. Following mitigation of the upstream spill near Queen Frederica Drive, the watercourse downstream of Dixie Road would be subject to increased flows. The higher flood elevations at this location predicted for Dixie

AS3 would be contained within the FPL design, with levels increased by approximately 1 m relative to existing conditions for this solution.

Dixie AS1 and AS2 can accommodate the increased flows, with resulting predicted water levels similar to existing conditions downstream of Dixie Road. As previously mentioned, the existing berm downstream of Dixie Road was removed from consideration because it is not considered a permanent flood protection measure by MNRF standards. The assessment of flood conditions for Dixie AS1 and AS2 assumes some small portions of localized grading occurring to re-establish the original native ground location (i.e., heights less than 0.5 m). In this manner, both Dixie AS 1 and AS2 could eliminate the relatively small existing areas of spill downstream of Dixie Road.

9.1.2 Dixie Road Bridge Design Considerations

The proposed bridge replacement at Dixie Road needs to fit within the constraints of the surrounding road network. A key consideration is the top-of-road elevation of the bridge. As outlined in previous sections, changes in road profile at the bridge could impact the nearby intersections. The closest intersections are Golden Orchard Drive, 200 m to the north, and Dundas Street, approximately 400 m to the south. Any profile changes must also comply with Peel Region and City standards.

The top-of-road elevation at the Dixie Road bridge is a factor of bridge deck thickness and the soffit (underside of bridge deck) elevation. For arterial roads like Dixie Road, CSA S6:19, Canadian Highway Bridge Design Code (CSA Group 2019) requires 1 m of clearance from the 100-year water level to the bridge soffit. For this Project, there is also a requirement for the soffit to be above the Regional water level (Table 7), to provide a more robust solution for upstream water levels. In recognition of the impacts the bridge currently has, and could have in the future, on the spill location immediately upstream, the additional clearance requirement has been set to 0.5 m above the predicted Regional storm level to provide resilience against potential climate change effects.

Table 7 Hydraulic Requirements for the Dixie Area Alternative Solutions

Alternative Solutions	100-year (1) Water Surface Elevation (m)	Regional Water Surface Elevation (m)	Bridge Soffit(2)	Required Road Raise (m)
Dixie AS1	122.1	123.2	123.7	1.7
Dixie AS2	121.8	122.7	123.1	0.4
Dixie AS3	123.2	124.1	124.5	2.5

Notes:
(1) Preliminary numbers were provided to RVA for use in Dixie Road Feasibility Review (Appendix I). These values have since been updated.
(2) Rounding may show that the alternative solution does not meet the current clearance criteria of 0.5 m; however, this will be revised during detailed design.

Conceptual bridge designs for the Dixie Road crossing were prepared for all three alternative solutions, with design guidance obtained through hydraulic modelling. Conceptual Dixie Road bridge design drawings are provided in Appendix I. Dixie AS1 requires a single-span, 26 m long bridge; Dixie AS2 requires a two-span bridge, with a total span of 45 m; and AS3 requires a single-span 28 m bridge.

The wider span for Dixie AS2 (two-span bridge vs. single span for Dixie AS1 and AS3), results in a much larger hydraulic opening (113.4 m^2 compared to 74.8 m^2 for Dixie AS1 and 83.5 m^2 for Dixie AS3). The three alternative solutions would raise the current road elevation on the Dixie Road bridge itself by 1.7 m, 0.4 m, and 2.5 m for Dixie AS1, AS2, and AS3, respectively (Appendix I, RVA 2020). Dixie AS2 has the lowest water levels throughout the bridge, which translates to the lowest bridge soffit elevation requirement.

9.1.3 Sewer System Outfall Impacts

Municipal storm sewers are hydraulically connected to Little Etobicoke Creek at their outlets; therefore, changes made to the watercourse must consider potential impacts to the connected infrastructure. High water levels in the watercourse where storm sewers outlet can prevent the sewer from functioning as intended. This can result in reduced sewer capacity, sewer backup, and basement flooding.

There are 11 storm sewer outlets to Little Etobicoke Creek within the Dixie Area portion of the Project study area. Table 8 summarizes the modelled 100-year water levels at each sewer outlet for the existing conditions and the alternative solutions. Alternative solution water levels that are higher than the existing condition level at that location are noted.

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Table 8 Dixie Area 100-year Water Levels at Storm Sewer Outfalls

Outfall City ID	Outfall Location	Storm Sewer Outfall Invert[1] Elevation (m)	100-year Water Surface Elevation Existing Condition (m)	100-year Water Surface Elevation Dixie AS1 (m)	100-year Water Surface Elevation Dixie AS2 (m)	100-year Water Surface Elevation Dixie AS3 (m)
11263	Bloor Street, 1,000 m upstream of Dixie Road	124.6	127.1	127.0	127.0	127.0
11264	Bloor Street, 1,000 m upstream of Dixie Road	124.8	127.1	127.0	127.0	127.0
11305	Flagship Drive outfall, 600 m upstream of Dixie Road	123.4	125.9	125.8	125.6	125.7
11304	Westerdam Road outfall, 430 m upstream of Dixie Road	122.2	125.5	124.3	124.1	124.6
11301	Downstream pedestrian bridge 330 m upstream of Dixie Road	121.7	125.2	123.3	123.1	124.2
11302	Downstream pedestrian bridge 270 m upstream of Dixie Road	121.9	125.1	123.1	122.8	124.0
11312	At Dixie Road	121.7	122.6	121.9	121.7	123.0[2]
11309	Goldmar Drive outfall, 390 m downstream of Dixie Road	119.5	120.8	120.4	120.3	121.2[2]
11308	Taviton Court outfall, 520 m downstream of Dixie Road	119.3	120.0	119.7	119.8	120.3[2]
11307	Willowcreek Park, 630 m downstream of Dixie Road	119.1	119.1	119.1	119.2[2]	119.4[2]
11306	Willowcreek Park, 680 m downstream of Dixie Road	118.6	118.7	118.9[2]	119.0[2]	119.1[2]

Notes:
(1) Invert is the bottom of the pipe opening.
(2) Water levels indicate an increase from existing conditions.

The results in Table 8 demonstrate that under existing conditions and each alternative solution, the 100-year water levels in Little Etobicoke Creek are above the current sewer system outfall invert elevations. Upstream of Dixie Road, the existing conditions 100-year water levels are above the sewer outfalls by to 2.2 to 3.5 m. A comparison of each of the alternative solutions to the baseline existing conditions reveal an overall decrease in the 100-year water levels in Little Etobicoke Creek at most of the storm sewer outfalls, with a few exceptions, as noted in Table 8.

Dixie AS2 results in the overall lowest creek 100-year water levels at the sewer outfalls. Water levels decrease through most of the Dixie Area, to a maximum of 2.3 m above the outfall. The increases in water levels downstream of Dixie Road are due to the increased flows in Little Etobicoke Creek associated with upstream spill mitigation. These increases are relatively minor and range between +0.1 and 0.3 m and can be mitigated using passive measures such as flap gates or through active management measures (such as manually operated valves). Among the alternative solutions, Dixie AS2 would have the lowest risk of sewer backup and associated basement flooding relative to existing conditions.

9.1.4 Municipal Servicing and Utilities

Key municipal services (e.g., sewers and watermains) and utilities (e.g., gas mains, hydro) were identified for the Dixie Area (Section 5). The municipal servicing relocations anticipated to be required to accommodate each of the alternative solutions are described in Table 9. Dixie AS3 would require the greatest number of relocations, as utilities and municipal services are not allowed underneath the FPL, thereby requiring extensive rerouting to the east or west. Dixie AS1 has the least impact on servicing, and Dixie AS2 requires a few more relocations than Dixie AS1, due to its widening of the valley corridor. For both Dixie AS1 and AS2, relocations/ modifications would be required at the Dixie Road bridge and the two existing sanitary sewers that are currently not meeting the Peel Region standard cover requirement under Little Etobicoke Creek. Little Etobicoke Creek works in this area would provide an opportunity to modify these sewer crossings to more closely align with Peel Region standards.

Table 9 Dixie Area Alternative Solutions Servicing and Utility Conflicts

Municipal Service/Utility	Existing Conditions	Dixie AS1	Dixie AS2	Dixie AS3
900 mm Diameter Sanitary Sewer	• approximately 0.5 m of existing cover depth	• the sanitary sewer needs to be lowered to facilitate channel lowering	• the sanitary sewer needs to be lowered to facilitate channel lowering	• the sanitary sewer may need to be lowered to achieve adequate cover depth
400 mm Diameter Watermain	• approximately 1.9 m of existing cover depth	• watermain modifications will likely be required to facilitate the bridge replacement. • the flood mitigation design will consider long-term adjustments to the channel grade to maintain adequate cover depth over utilities including this watermain	• watermain modifications will likely be required to facilitate the bridge replacement. • the flood mitigation design will consider long-term adjustments to the channel grade to maintain adequate cover depth over utilities including this watermain	• watermain modifications will likely be required to facilitate the bridge replacement. • the flood mitigation design will consider long-term adjustments to the channel grade to maintain adequate cover depth over utilities including this watermain
Exposed Utility Conduit	• at Dixie Road bridge	• the utility conduit needs to be lowered or otherwise modified (e.g., attached to the bridge instead of crossing below Little Etobicoke Creek)	• the utility conduit needs to be lowered or otherwise modified (e.g., attached to the bridge instead of crossing below Little Etobicoke Creek)	• the utility conduit needs to be lowered or otherwise modified (e.g., attached to the bridge instead of crossing below Little Etobicoke Creek)
2,400 mm Diameter Feedermain (Watermain)	• at Dixie Road bridge • over 20 m of cover depth	• no impacts anticipated	• no impacts anticipated	• no impacts anticipated

Municipal Service/Utility	Existing Conditions	Dixie AS1	Dixie AS2	Dixie AS3
2,100 mm Diameter Feedermain (watermain)	• 400 m upstream of Dixie Road • approximately 2 m of existing cover depth	• the alternative solutions maintain the existing channel bed elevation at this crossing • the flood mitigation design will consider long-term adjustments to the channel grade to maintain adequate cover depth	• the alternative solutions maintain the existing channel bed elevation at this crossing • the flood mitigation design will consider long-term adjustments to the channel grade to maintain adequate cover depth	• the alternative solutions maintain the existing channel bed elevation at this crossing • the flood mitigation design will consider long-term adjustments to the channel grade to maintain adequate cover depth
450 mm Diameter Sanitary Sewer	• 550 m downstream of Dixie Road • no existing cover depth	• the alternative solutions maintain the existing channel bed elevation at this crossing • the sanitary sewer should not remain in its current condition, as it has no cover and is acting as a weir to flow in the creek. Other mitigation work associated with the project will provide the opportunity to address this issue	• the alternative solutions maintain the existing channel bed elevation at this crossing • the sanitary sewer should not remain in its current condition, as it has no cover and is acting as a weir to flow in the creek. Other mitigation work associated with the project will provide the opportunity to address this issue	• the alternative solutions maintain the existing channel bed elevation at this crossing • the sanitary sewer should not remain in its current condition, as it has no cover and is acting as a weir to flow in the creek. Other mitigation work associated with the project will provide the opportunity to address this issue

Municipal Service/Utility	Existing Conditions	Dixie AS1	Dixie AS2	Dixie AS3
Storm Sewers	• ten outlets discharge into Little Etobicoke Creek within the Dixie Area	• eight storm sewer outlets may need to be modified to facilitate channel widening	• eight storm sewer outlets may need to be modified to facilitate channel widening	• five storm sewers need to be adjusted and/or relocated to facilitate channel widening and implementation of the FPL
Overhead Utilities	• throughout the valley corridor and Dixie Road	• power line relocation likely required to raise Dixie Road	• power line relocation may be required for channel and floodplain works immediately upstream of Dixie Road	• power line relocation likely required to raise Dixie Road • any utilities underneath the FPL will need to be relocated
Gas Main	• along Dixie Road	• to be reviewed at detailed design; may require relocation	• to be reviewed at detailed design; may require relocation	• to be reviewed at detailed design; may require relocation

Notes:
FPL - flood protection landform
AS - alternative solutions

9.1.5 Geomorphology, Aquatic Habitat, and Erosion

Erosion in Little Etobicoke Creek throughout the Project study area is prominent due to the vertical banks and disconnected floodplain throughout the valley corridor (Section 5.2). Dixie AS1 would require lowering the channel and increasing the vertical banks, which would result in higher flow velocities. Dixie AS3 would require some channel lowering and modifications upstream of Dixie Road but would leave the existing eroded conditions downstream of Dixie Road to continue. Dixie AS2 would follow geomorphic design principles by giving Little Etobicoke Creek more natural bankfull dimensions and connecting it to a widened valley, which would allow high flows to dissipate and reduce the energy along the bed and banks (Figure 24). Dixie AS2 was determined to have a decrease in erosion potential and the most benefit from a geomorphic and aquatic habitat perspective. Dixie AS1 and AS3 would increase erosion potential within the channel, further degrading the aquatic/geomorphic condition. Erosion risk and related mitigation measures were reviewed in detail during Phase 3 of the Municipal Class EA process.

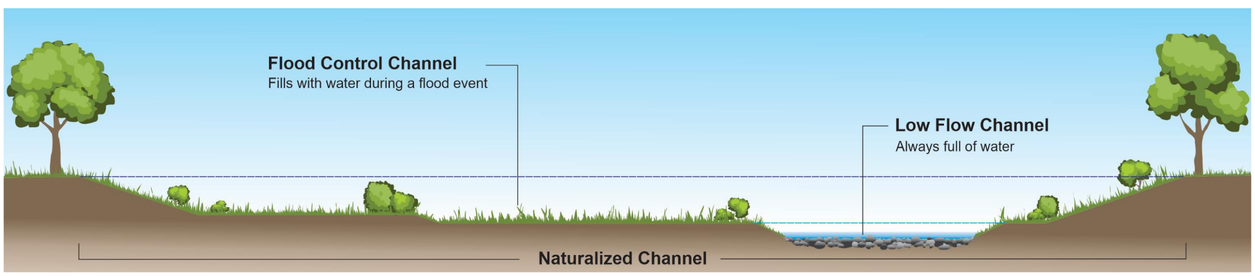

Figure 24 Making Room for the Creek Conceptual Cross-section (Dixie Area Alternative Solution 2)

9.1.6 Terrestrial Environment, Parks, and Recreation

Background studies (Appendix D) determined that the existing valley corridor mainly consists of ash, willow, and Manitoba and Norway maple forest communities. Just over half the vegetation is considered native to the Mississauga area, with the remaining vegetation classified as non-native (or unclassified). In terms of recreation, currently there are formal trails/pathways upstream of Dixie Road that include two pedestrian bridge crossings. Trails downstream of Dixie Road are informal through the dense vegetation, with occasional access to the surrounding streets.

Dixie AS1 would have the least impact to the terrestrial environment. Overlaying the alternative solution area (2.89 ha) with the ELC mapping (Appendix D) shows 2.27 ha of disturbance to the mapped forest communities. In the areas directly adjacent to the existing Creek, some trees would need to be removed to reconstruct the Dixie Road bridge and lower the channel.

Vegetation along the valley would remain. Dixie AS1 would not provide additional opportunity for recreational amenities within the valley corridor east of Dixie Road.

Overlaying the Dixie AS2 area (7.09 ha) with the ELC mapping (Appendix D) shows 3.77 ha of disturbance to the mapped forest communities. As such, Dixie AS2 would require tree removals throughout the Project study area to complete the earthworks required to widen the valley and channel corridor. Vegetation removals could negatively impact SAR habitat, particularly bat roosting trees, which will require mitigation. The butternut tree identified in the Dixie Area is not anticipated to be directly impacted; however, the 25 m surrounding buffer would be infringed upon. Therefore, a mitigation plan for this tree would be required. The removal of vegetation and reshaping of the corridor would present an opportunity for Dixie AS2 to increase recreational amenities. It would also facilitate new trail connections and greater access for the public. Dixie AS2 would also allow for the planting of more native and higher-quality vegetation species. Although this revegetation with native species will provide a long-term positive impact, a medium-term loss of ecological function will be experienced in the years that it takes for the newly planted forest to mature.

Overlaying the Dixie AS3 area (9.64 ha) with the ELC mapping (Appendix D) shows 2.38 ha of disturbance to the mapped forest communities. Dixie AS3 would require tree/vegetation removals along the south bank to accommodate the FPL. Once the FPL is in place, specific landscaping requirements would need to be followed to ensure the integrity and function of the FPL is not compromised (AECOM 2018a). The FPL would likely encroach onto existing trails, requiring their possible relocation to the north side of Little Etobicoke Creek or their removal entirely. Dixie AS3 would not provide additional recreational opportunities throughout the Project study area.

9.1.7 Climate Change Resiliency

The resiliency evaluation criteria focused on the ability of an alternative solution to protect against larger rainfall events associated with increased riverine flooding, providing protection beyond the design condition. Currently, the Dixie Area experiences a spill due to riverine flooding during storms that are roughly the size of the 5-year event, with the spill impacting residents along Queen Frederica Drive and further south. The three Dixie Area alternative solutions were developed to address this existing flooding and provide added protection up to the Regional event. By providing flood protection to the Regional-event level, the alternative solutions provide significantly more flood resiliency than experienced by existing conditions.

For this evaluation, resiliency was measured using the resulting water levels at key locations throughout the Dixie Area and how much freeboard or clearance (i.e., extra vertical room) there is between the peak water level and the potential spill or low point. A key objective for all alternative solutions was to provide 0.5 m freeboard above the Regional storm water level at the key locations within the Dixie Area (Figure 25). To support meeting the freeboard objective upstream and downstream of Dixie Road, a 0.5 m clearance requirement was added to the Dixie Road bridge soffit above the Regional water level.

Table 10 shows that Dixie AS2 would provide the highest level of resiliency since there is the most freeboard at the major spill point on Queen Frederica Drive in the Dixie Area when compared with the other alternatives. Dixie AS1 would provide less resiliency than Dixie AS2; water levels meet most of the freeboard objectives but are higher upstream of Dixie Road than Dixie AS2. Dixie AS3 would provide similar resiliency to Dixie AS2 in terms of freeboard depth above flooding, but it would have higher water levels due to the natural FPL design. Dixie AS1 and AS2 would require localized grading to meet the freeboard objective downstream of Dixie Road. Measures to mitigate this issue were addressed in Phase 3 of the Municipal Class EA process (Section 6.2).

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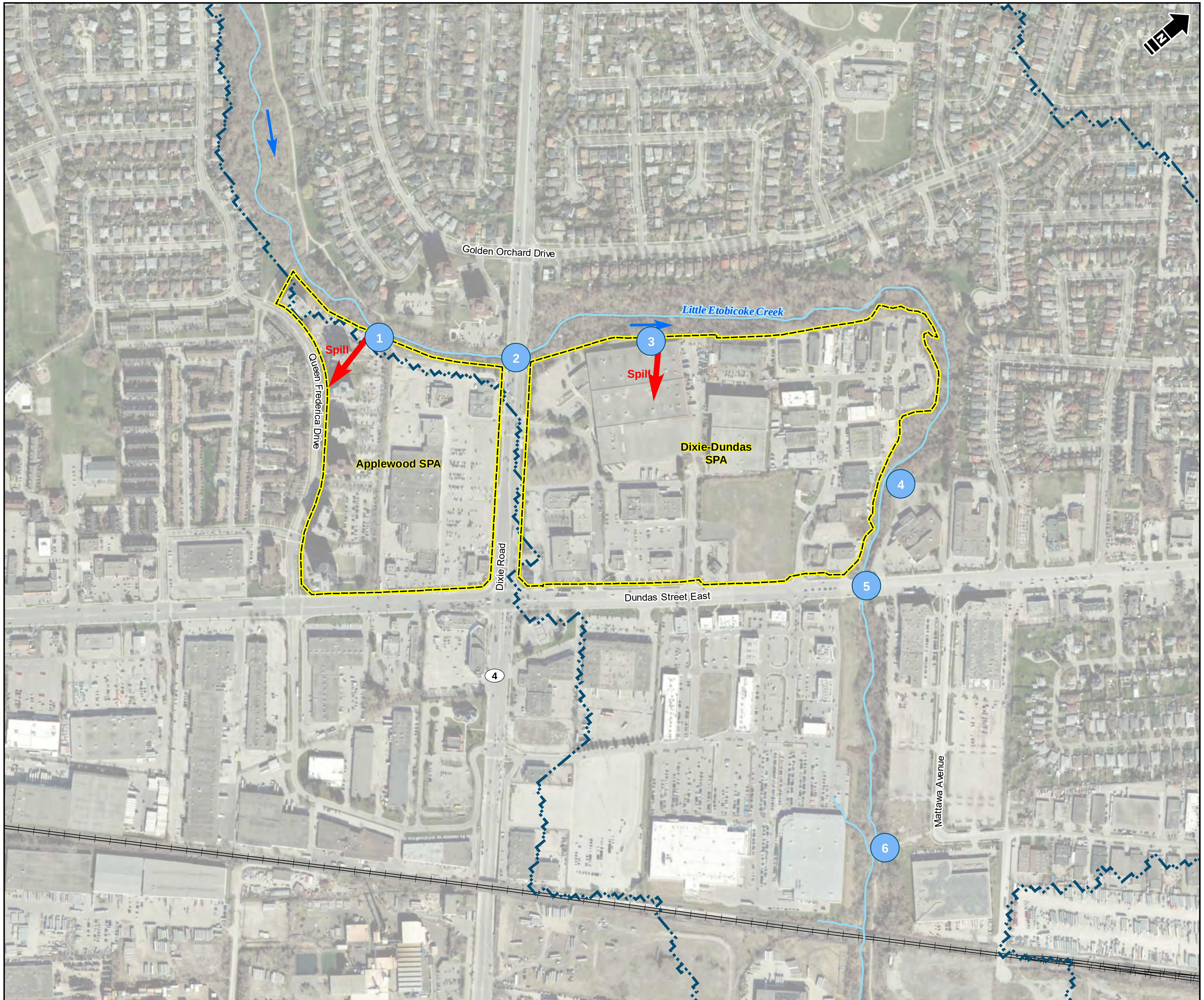
Table 10 Dixie Area Alternative Solutions Resiliency Assessment

Key Location ID	Key Spill /Low Point Location Description	Regional Water Level Existing Conditions (m)	Regional Water Level Dixie AS1 (m)	Regional Water Level Dixie AS2 (m)	Regional Water Level Dixie AS3 (m)
1	Queen Frederica Drive Spill Point (300 m Upstream of Dixie Road)	125.2 (-0.5)	124.4 (0.5)	123.8 (1.1)	125.2 (0.8)
2	Dixie Road Bridge Soffit	124.0 (0.2)	123.2 (0.5)	122.7 (0.4)[1]	124.1 (0.4)[1]
3	Second Spill Point (250 m Downstream of Dixie Road)	121.5 (-0.2)	121.6 (-0.3)[2]	121.7 (-0.4)[2]	122.6 (0.5)

Notes:
(XX) denotes the amount of freeboard or clearance (i.e., extra vertical room) there is between the peak water level and the potential key spill or low point. The low point elevation may differ between alternatives (e.g. bridge soffits). Negative values indicate overtopping or surcharge conditions, positive numbers indicate freeboard/clearance.
(1) Rounding may show that the alternative solution does not meet the current clearance criteria of 0.5 m; however, this will be revised during detailed design.
(2) The assessment of flood conditions assumes some small portions of localized grading within existing or newly acquired City easement will occur to re-establish the original native ground location (i.e., heights less than 0.5 m) such that the spill could be eliminated.



Special Policy Area (SPA)
Little Etobicoke Creek Watershed Boundary
Spill Direction
Flow Direction
Watercourse
CN Railway
Resiliency Assessment Location

1. Base digital information obtained from the City of Mississauga (SHP and DGN format).

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

1:6,500 metres
50 0 50 100
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
A Montrose Environmental Company

City of Mississauga
Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Resiliency Assessment Locations throughout the Project Area

Date: March 2024	Project: 24603	Submitter: A. McKay	Reviewer: S. Braun

Figure 25

9.1.8 Stakeholder, Public, and Agency Input

Project objectives, background, alternative solutions, and proposed evaluation criteria were presented to stakeholders, agencies, and the public through meetings, phone calls, and the Public Information Centre (PIC) No. 1 held online on August 7, 2020. Detailed comments received from stakeholders during Phase 2 of the Municipal Class EA process are documented in Appendix A. Input received related to the evaluation of the alternative solutions is summarized in Table 11.

Table 11 Dixie Area Summary of Stakeholder Input from Public Information Centre No. 1

Stakeholder	Stakeholder Commentary	Project Team Response
Community Services Department, City of Mississauga	Community Services Department expressed that the design should improve connectivity of the trail to parks and amenities.	One of the alternative solutions includes an increased floodplain area that also includes a trail connecting existing parks.
Peel Region	Peel Region indicated that the design should aim for minimal road raise and traffic disruptions. Two lanes must be kept open to traffic at all times during construction. Bridge construction should aim to keep four lanes open during most times.	Peek Region was recognized as an active partner in the Project. Matrix has evaluated several options with consideration to minimizing the existing road elevation. Future disruptions caused by construction will be coordinated with Peel Region. A detailed record of Peel Region's participation is included in the Dixie-Dundas Consultation Report (Matrix 2023; Appendix A).
TRCA	TRCA provided a letter outlining standards and guidelines with which the Project should comply, including suggestions for investigations (e.g., identification of natural heritage features). An exposed sanitary sewer was identified downstream of the Dixie Road bridge and it was hoped this could be mitigated through the Municipal Class EA Project efforts.	TRCA has been an active partner in the Project. Matrix made sure to consider the comments provided by TRCA and integrate these into the evaluation. Exploration to lower the sanitary sewer was discussed with TRCA and Peel Region. A detailed record of the TRCA's comments is included in the Dixie-Dundas Consultation Report (Matrix 2023; Appendix A).

Stakeholder	Stakeholder Commentary	Project Team Response
MECP	As a response to the Notice of Commencement, MECP provided a list of items the Municipal Class EA should address, including source water protection, climate change considerations, excess soil removal, etc.	Matrix has incorporated the comments provided by MECP and integrated these into the evaluation. The MECP letter is included in the Dixie-Dundas Consultation Report (Matrix 2023), and the ESR has been tailored to address each item (Appendix A).
MNRF	MNRF provided a letter of advice, which referred Matrix to their technical guidance and policy documentation for assessing flood plain and associated designs. They outlined that berms cannot be considered a permanent flood protection solution. MNRF indicated that more discussion will be required should the FPL be chosen.	Matrix used the MNRF technical guidance document in formulating alternative solutions. The issues of approval regarding the FPL were considered in the evaluation of alternative solutions. MNRF's letter is included in the Dixie-Dundas Consultation Report (Matrix 2023; Appendix A).
First Nations and Indigenous Peoples	Some First Nations had not responded at the time of this writing. The Mississaugas of the Credit First Nation and Six Nations of the Grand River have indicated that they would like to be involved when the Stage 2 archaeology study is conducted.	CIPS have been in consistent communication with the potentially impacted/interested First Nations. These groups will continue to receive Project updates. The City acknowledges that the Mississaugas of the Credit First Nation and the Six Nations of the Grand River should be involved during Stage 2 archaeology study, which will be carried out in future stages of this Project. A detailed record of the engagement with First Nations is included in the Dixie-Dundas Consultation Report (Matrix 2023; Appendix A).
Public	Minimal input was provided from the public following PIC No. 1. Several stakeholders indicated that a flood mitigation solution should be pursued. There were no negative responses to the alternative solutions presented.	No change was made to the alternative solutions following PIC No. 1. A detailed record of the public's responses is included in the Dixie-Dundas Consultation Report (Matrix 2023; Appendix A).

Stakeholder	Stakeholder Commentary	Project Team Response
Other	Utility groups circulated on the stakeholder list did not provide comments regarding any adverse impacts/issues associated with proposed works in the Project study area.	Matrix has included the identified utility lines as constraints, and utility companies will be contacted at detailed design and prior to construction, as necessary.

Notes:
TRCA - Toronto and Region Conservation Authority
MECP - Ministry of Environment, Conservation and Parks
EA - Environmental Assessment
ESR - Environmental Study Report
MNRF - Ministry of Natural Resources and Forestry
FPL - flood protection landform
CIPs - Cambium Indigenous Professional Services
PIC - Public Information Centre

9.2 Dixie Area Alternative Solutions Evaluation Table

Table 12 presents the evaluation details and description for each of the evaluation criteria for the Dixie Area. The scoring ranged from 0 (least preferred) to 4 (most preferred). The evaluation was weighted evenly between each criterion and evenly between each of four broad categories (a value of 25% each).

Table 12a Dixie Area Phase 2 Alternative Solutions Analysis - Technical Criteria

Criteria	Description	Ranking Descriptions	Dixie AS1	Dixie AS1 Rank	Dixie AS2	Dixie AS2 Rank	Dixie AS3	Dixie AS3 Rank	Do Nothing	Do Nothing Rank
Regional Storm Risk Reduction	Ability for the alternative to remove the Special Policy Area, i.e., remove the spill upstream of Dixie Road at Queen Frederica Dr.	0 - no 4 - yes	Highly improved flood risk. Flow is contained within the valley corridor.	4	Highly improved flood risk. Flow is contained within the valley corridor.	4	Highly improved flood risk. Flow is contained within the valley corridor.	4	No flood improvement. Extensive flooding is left to continue impacting over 1,000 properties.	0
Upstream Water Levels during Regional Event	Ability to reduce water levels upstream of Dixie Road during the Regional Event.	0 - increase in water levels 2 - no change 4 - decrease in water levels	Some improvements upstream.	3	Additional improvements upstream.	4	Some improvements upstream.	3	No change to existing water levels upstream. Spill is left to continue.	2
Downstream Water Levels during Regional Event	Ability to reduce water levels downstream of Dixie Road during the Regional Event	0 - increase in water levels 2 - no change 4 - decrease in water levels	Additional flows from contained spill raise water levels downstream, mitigation required at Dundas Street.	1	Additional flows from contained spill raise water levels downstream, mitigation required at Dundas Street.	1	Additional flows from contained spill raise water levels downstream but are contained within the valley corridor. Larger flood extent downstream than Alternatives 1 and 2.	0	No change to existing water levels downstream. Spill is left to continue.	2
Urban Drainage	Impact to the urban drainage system. High water levels in the Creek create backwater conditions at the outfalls which limits the ability for the storm sewers to flow by gravity.	0 - negative impact on urban drainage 2 - no change 4 - positive impact on urban drainage	Most outfalls have improved backwater conditions	3	Outfalls have improved backwater conditions. Most improvement upstream of Dixie Road.	4	Outfalls upstream and downstream of Dixie Road are negatively affected.	0	No change to water levels upstream or downstream of Dixie Road.	2
Erosion Potential	Ability to mitigate erosion potential	0 - increase in erosion potential 2 - no change 4 - decrease in erosion potential	Increased erosion potential during typical and flood flow conditions	0	Reduced erosion potential during typical (in-channel) flow conditions, increased risk downstream during flood flow conditions.	3	No change to erosion potential, no change in typical (in-channel) flow conditions, increased risk during flood flow conditions.	1	No change to erosion potential.	2

Criteria	Description	Ranking Descriptions	Dixie AS1	Dixie AS1 Rank	Dixie AS2	Dixie AS2 Rank	Dixie AS3	Dixie AS3 Rank	Do Nothing	Do Nothing Rank
Constructability and Infrastructure Conflicts	Complexity of construction for implementing proposed works. Consideration is given to accepted construction/ engineering practices, traffic considerations, and implementation time.	0 - most challenging to implement 4 - least challenging to implement	Highly constructable. Fits within the existing valley corridor, some challenges associated with construction around Dixie Road.	3	Moderate constructability. Requires re-shaping within and outside of the valley corridor, some challenges associated with construction around Dixie Road.	2	Low constructability. Requires significant works outside of the valley, more significant challenges associated with construction around Dixie Road.	0	No change, no works proposed.	4
Resiliency including Climate Change	Measure of resiliency against future climate change (e.g., meeting a 0.5 m free board at the primary spill location)	0 - does not include resiliency measures 4 - includes resiliency measures	Some opportunity for design to withstand and protect against larger storm events. Bridge modifications would be required to increase capacity in the future, if needed.	3	Most opportunity for design to withstand and protect against larger storm events. Low effort to increase the floodplain capacity in the future, if needed.	4	Minimal opportunity for design to withstand and protect against larger storm events. Significant effort to raise the FPL crest in the future if needed.	2	Current design is unable to protect against larger storm events.	0

Technical Screening Result

Dixie AS1	Dixie AS1 Rank	Dixie AS2	Dixie AS2 Rank	Dixie AS3	Dixie AS3 Rank	Do Nothing	Do Nothing Rank
High Preference	2.4	Highest Preference	3.1	Low Preference	1.4	Moderate Preference	1.7

Table 12b Dixie Area Phase 2 Alternative Solutions Analysis - Economic Criteria

Criteria	Description	Ranking Descriptions	Dixie AS1	Dixie AS1 Rank	Dixie AS2	Dixie AS2 Rank	Dixie AS3	Dixie AS3 Rank	Do Nothing	Do Nothing Rank
Economic: Capital Costs	Relative measure of the initial costs to install/construct the proposed works including the channel works, road/bridge improvements, and landscape costs	0 - most expensive 4 - least expensive	Lowest estimated capital cost of the three alternatives.	3	Medium estimated capital cost of the three alternatives.	2	Highest estimated capital cost of the three alternatives.	0	No capital costs.	4
Operation and Maintenance (O&M) Costs	Relative measure of the ongoing maintenance and operational costs following implementation.	0 - most expensive 4 - least expensive	Similar O&M costs to existing, inspections of structural integrity of channel walls and downstream erosion required.	3	Lower O&M costs than existing due to naturalized channel.	4	Similar O&M costs to existing channel, additional structural inspections of the FPL required.	0	O&M costs associated with inspections of structural integrity of channel walls and existing erosion locations.	1
Urban Development Considerations	Ability of the proposed alternative to allow future urban development plans to move ahead without impacts (e.g., Dundas Connects Master Plan).	0 - impedes future development plans 4 - promotes future development plans	Enables future removal of the Special Policy Area.	4	Enables future removal of the Special Policy Area.	4	Enables future removal of the Special Policy Area, size of FPL footprint may reduce development opportunity.	2	Development in the Dixie-Dundas area must conform to existing Special Policy Area restrictions.	0
Municipal Servicing	Effect on existing and proposed municipal servicing and private utility infrastructure.	0 - significant effects municipal servicing 4 - no effects on municipal servicing	Some impacts to municipal servicing, adjustments/relocations are required.	3	Some impacts to municipal servicing, larger footprint requires additional adjustments/relocations.	2	Large FPL footprint has significant impacts on existing utilities.	0	No change to municipal servicing.	3

Economic Screening Result

Dixie AS1	Dixie AS1 Rank	Dixie AS2	Dixie AS2 Rank	Dixie AS3	Dixie AS3 Rank	Do Nothing	Do Nothing Rank
Highest Preference	3.3	High Preference	3.0	Low Preference	0.5	Moderate Preference	2.0

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Table 12c Dixie Area Phase 2 Alternative Solutions Analysis - Environmental Criteria

Criteria	Description	Ranking Descriptions	Dixie AS1	Dixie AS1 Rank	Dixie AS2	Dixie AS2 Rank	Dixie AS3	Dixie AS3 Rank	Do Nothing	Do Nothing Rank
Aquatic Ecology	Effect on fisheries/aquatic habitat, connectivity, habitat sources, diversity, food sources, and fish passage.	0 - negative effects 2 - no change 4 - positive effects	Some impact during construction, no long-term effects once the watercourse has stabilized after construction. No potential fish habitat improvements.	1	Some impact during construction, no long-term effects once the watercourse has stabilized after construction. Highest opportunity for improved fish habitat.	4	Some impact during construction, no long-term effects once the watercourse has stabilized. No potential fish habitat improvements.	1	Erosive forces left to continue will further degrade the aquatic habitat.	1
Terrestrial Ecology	Effects on ground cover vegetation, trees, and shrubs, which influence connectivity, diversity, and quality and provide habitat to wildlife as well as recreational and aesthetic value.	0 - negative effects 2 - no change 4 - positive effects	Moderate initial site disturbance due to tree removals (2.27 ha). Terrestrial habitats have decreased access to the channel.	1	High initial site disturbance due to tree removal (3.77 ha). Must protect Butternut tree (Species at Risk) within disturbed area. Opportunity for improved vegetation quality and corridor development.	0	Moderate initial site disturbance within the existing valley due to tree removal (2.38 ha). No change to existing terrestrial access to channel.	1	No change (no disturbance).	2
Geomorphology	Ability to improve channel morphology, stability, as well as sedimentation and erosion.	0 - negative effects 2 - no change 4 - positive effects	Further entrenched, highly engineered channel within the study area. Reduced access to the floodplain.	1	Naturalized channel design with well connected floodplain.	4	Current engineered channel with minimal floodplain connectivity left to continue.	2	Current minimal floodplain connectively left to continue.	2

Environmental Screening Results

Dixie AS1	Dixie AS1 Rank	Dixie AS2	Dixie AS2 Rank	Dixie AS3	Dixie AS3 Rank	Do Nothing	Do Nothing Rank
Low Preference	1.0	Highest Preference	2.7	Moderate Preference	1.3	High Preference	1.7

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Table 12d Dixie Area Phase 2 Alternative Solutions Analysis - Social Criteria

Criteria	Description	Ranking Descriptions	Dixie AS1	Dixie AS1 Rank	Dixie AS2	Dixie AS2 Rank	Dixie AS3	Dixie AS3 Rank	Do Nothing	Do Nothing Rank
Planning and Policy	Measure of the potential acceptance by approving/interested agencies.	0 - low acceptance/approval 4 - high acceptance/approval	General acceptance and approval anticipated.	3	High acceptance and approval anticipated.	4	Approval of FPL requires special application. Footprint of the FPL may affect other planning initiatives.	1	Special Policy Area and associated restrictions will remain, limiting provincial policy and municipal objectives for urbanization.	0
Public Input to Date	Measure of the initial public response and acceptance of the proposed alternative.	0 - low acceptance 4 - high acceptance	No specific comment from the public following the online Public Information Centre.	4	No specific comment from the public following the online Public Information Centre.	4	No specific comment from the public following the online Public Information Centre.	4	Low public acceptance. Prior to the study, residents have expressed a desire to implement a mitigation solution (not specific) to address the flooding.	0
Property Acquisitions	Measure of the impact to adjacent private properties (i.e., loss of property, access to property, and aesthetics).	0 - most impact 4 - least impact	Limited property acquisition anticipated around Dixie Road.	3	Property acquisition anticipated upstream of and around Dixie Road.	2	High property acquisition required south of the Creek on both sides of Dixie Road.	0	No impacts to property and landowners.	4
Disruptions during Construction	Potential disruptions during construction to the adjacent property owners, businesses, and the surrounding local community.	0 - most impact 4 - least impact	Some disruption within the valley and at Dixie Road anticipated. More disruption to Dixie Road than Alternative #2.	2	Some disruption within the valley and at Dixie Road anticipated. More disruption within the Valley corridor than Alternative #1.	2	Extensive disruption anticipated outside of valley corridor.	0	No change.	4
Parks and Recreational Amenities	Potential for future trails and trail connections, improving public access, and aesthetics.	0 - least improvement 4 - most improvement	Minimal impacts to existing trail and park system. Some potential for recreational improvements.	2	Highest potential for recreational improvements and trail connections downstream of Dixie Road.	4	Minimal impacts to existing trail and park system. Low potential for recreational improvements.	1	No change, no recreational improvements.	0
Cultural Heritage and Archaeology	Potential impact to cultural heritage or archaeological resources.	0 - high likelihood 4 - no disturbance	Low overlap between the projected construction area and areas with cultural heritage or archaeologic potential.	3	High overlap between the projected construction area and areas with cultural heritage or archaeologic potential.	1	Medium overlap between the projected construction area and areas with cultural heritage or archaeologic potential.	2	No cultural heritage or archaeological disturbance.	4

Criteria	Description	Ranking Descriptions	Dixie AS1	Dixie AS1 Rank	Dixie AS2	Dixie AS2 Rank	Dixie AS3	Dixie AS3 Rank	Do Nothing	Do Nothing Rank
First Nations	Acceptance of proposed works by First Nations.	0 - low likelihood 4 - high likelihood	Initial acceptance of concept.	3	Initial acceptance of concept.	3	Initial acceptance of concept.	3	Existing conditions preserved.	4

Social Screening Result

Dixie AS1	Dixie AS1 Rank	Dixie AS2	Dixie AS2 Rank	Dixie AS3	Dixie AS3 Rank	Do Nothing	Do Nothing Rank
High Preference	2.9	High Preference	2.9	Low Preference	1.6	Moderate Preference	2.3

Table 12e Dixie Area Phase 2 Alternative Solutions Analysis - Overall Screening Result

Dixie AS1	Dixie AS1 Rank	Dixie AS2	Dixie AS2 Rank	Dixie AS3	Dixie AS3 Rank	Do Nothing	Do Nothing Rank
High Preference	2.4	Highest Preference	2.9	Low Preference	1.2	Moderate Preference	1.9

9.3 Dixie Area Alternative Solution Evaluation Summary

Table 13 summarizes the evaluation of the Dixie Area alternative solutions under the four broad criteria categories. Overall, Dixie AS2 is preferred because it can contain the spill, provides the most potential improvements from a social and environmental perspective compared to the other alternatives, and is a similar cost to Dixie AS1. A summary of the criteria is listed in Sections 9.3.1 to 9.3.4.

Table 13 Dixie Area Summary of Alternative Solutions Evaluation

Criteria Category	Dixie AS1	Dixie AS2	Dixie AS3	Do Nothing
Technical	High Preference	Highest Preference	Low Preference	Moderate Preference
Economic	Highest Preference	High Preference	Low Preference	Moderate Preference
Environmental	Low Preference	Highest Preference	Moderate Preference	High Preference
Social	High Preference	High Preference	Low Preference	Moderate Preference
Overall	High Preference	Highest Preference	Low Preference	Moderate Preference

9.3.1 Technical Screening Summary

- Dixie AS1, AS2, and AS3 remove the spills in the Dixie Area; the do nothing scenario does not.
- Dixie AS1 and AS2 decrease upstream water levels, where Dixie AS3 and the do nothing scenario do not change upstream water levels. Conversely, Dixie AS1, AS2, and AS3 all increase water levels downstream, due to the higher flows being contained within the valley.
- Dixie AS2 generates the lowest in-channel flow velocities, minimizing the risk of bank erosion. Dixie AS1 creates higher velocities than the existing condition and increases erosion potential throughout Little Etobicoke Creek. There is no/minimal change in the channel geometry for Dixie AS3 and the do nothing scenario, leaving the current level of erosion left to continue.

- Dixie AS1 and AS2 are easier to construct and require fewer modifications to the surrounding area, whereas Dixie AS3 has the lowest construction feasibility given the large footprint and property constraints. Note, all three alternatives would require replacement of the Dixie Road bridge and associated roadworks.

- Dixie AS2 has the highest opportunity for climate change resiliency and adaptability due to the natural channel design concepts and better-connected floodplain. Additionally, the lower water level (i.e., higher freeboard) at the upstream existing spill point provided by Dixie AS2 during the Regional flood means additional resiliency against potential future increased flows.

- Overall, Dixie AS2 has the highest preference for technical criteria, and Dixie AS3 has the lowest preference.

9.3.2 Economic Screening Summary

- Dixie AS3 has the highest capital cost mainly due to the extent of property acquisition required. Dixie AS1 and AS2 have similar capital costs to construct.

- Dixie AS1 and AS2 have lower long-term operational and maintenance (O&M) costs than the do nothing scenario. Dixie AS3 has the highest long-term O&M costs due to the structural inspections and maintenance that are required for an FPL.

- Dixie AS1, AS2, and AS3, allow future removal of the SPA designation, which will enable development in the area, as planned in the Dundas Connects Master Plan (City of Mississauga et al. 2018).

- Dixie AS1, AS2, and AS3 all require some adjustments/relocations to municipal servicing infrastructure, with Dixie AS1 needing the least amount and Dixie AS3 requiring the most adjustments.

- Overall, Dixie AS1 has the highest preference for economic criteria, and Dixie AS3 has the lowest preference.

9.3.3 Environmental Screening Summary

- Dixie AS2 has the greatest opportunity to improve channel morphology as it implements natural channel design principals which will enhance fish/aquatic habitat.

- Dixie AS2 follows natural channel principals and provides floodplain connectivity for the flow above bankfull. Dixie AS1 deepens the channel, further disconnecting it from the floodplain. There is no/minimal change in the channel geometry for Dixie AS3 and the do nothing scenario, leaving the current engineered channel corridor.

- Dixie AS1, AS2, and AS3 will all require trees removal as part of construction. Dixie AS2 will require the most tree removals but also has the most opportunity to improve terrestrial habitat by providing an aquatic/terrestrial interface with the channel. Revegetation would improve vegetation quality in the long-term, although a net loss would be experienced in the medium-term until the plantings become established.

- Overall, Dixie AS2 has the highest preference for environmental criteria, and Dixie AS1 has the lowest preference.

9.3.4 Social Screening Summary

- Dixie AS1 and AS2 are anticipated to be received well by planning agencies and the public. Dixie AS3 would have regulation resistance as Ontario floodplain policy is not clear in its approach to considering FPL solutions as permanent flood solutions. The policy on FPLs is currently in the midst of being better defined by policy makers.

- Dixie AS1, AS2, and AS3 all require some property acquisition, particularly in the area surrounding Dixie Road. Dixie AS3 has the largest footprint and will require extensive property acquisition. The public may oppose the extent of property acquisition required to construct the FPL.

- Dixie AS1, AS2, and AS3 will all have impacts to the public during construction. Dixie AS1 will have more impact than Dixie AS2 due to the higher road raise to Dixie Road. Dixie AS2 will have higher impacts to the public who use the vegetated area located east of Dixie Road. Dixie AS3 will have the most impact as it affects the largest area outside the valley corridor.

- Dixie AS2 has the highest potential for recreational improvements within the valley corridor such as trails, connections through the bridge and formal park areas.

- Dixie AS2 has the most potential to impact cultural heritage/archaeology due to the extensive construction area; however, most of the corridor has already been impacted through past infrastructure works (i.e., through sanitary sewer construction and storm sewer outlets).

- Input from First Nations has been received for the alternative solutions. No objections were indicated but a preference of continued involvement, especially with respect to future archeological investigations and for disturbance in general were identified.
- Overall, Dixie AS2 has the highest preference for social criteria, and Dixie AS3 has the lowest preference.

9.4 Dixie Area Selection of the Preferred Solution

For the Phase 2 Municipal Class EA evaluation, all criteria and their resulting rankings through the evaluation process were thoughtfully considered. Based on the evaluation, Dixie AS2 "Making Room for the Creek" was selected as the preferred alternative solution because it contains the spill, it provides the most improvements from a social and long-term environmental perspective compared to the other alternatives, and it has a low cost similar to Dixie AS1. Dixie AS2 incorporates natural channel design concepts, creates a wider and better-connected floodplain, and replaces Dixie Road bridge with larger, two-span structure.

10 Dundas Area Alternative Solution Evaluation

Mitigating the spills in the Dixie Area will increase flood flows downstream to the Dundas Area. The increase in flows is the anticipated and unavoidable outcome of implementing solutions for containing the flood spill in the Dixie Area, including the preferred alternative solution. The resulting increased flood flows downstream in the Dundas Area must be mitigated to ensure no adverse effects are caused by works at Dixie Area, and by extension, ensure overall Project success. Accordingly, alternative solutions for the Dundas Area needed to be evaluated as part of the overall flood improvement strategy.

Three different conveyance improvement alternative solutions were explored for the Dundas Area. These alternatives are described in Section 7.2. The following subsections outline the analysis and evaluation completed for the alternative solutions to mitigate flooding at the Dundas Area.

10.1 Technical Analysis to Support Alternative Solution Evaluation

10.1.1 Flood Risk Assessment

Three alternative solutions that included progressively larger bridge spans at Dundas Street and the downstream floodplain conveyance improvement works were assessed and compared against existing conditions. Maps of the Regional flood depths for the three alternative solutions are shown on Figures 26 to 28. The Regional water levels in profile view are shown on Figure 29 through the Dundas Area.

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25 m Span Length Bridge Replacement
Floodplain Regrading
Flow Direction
Extent of Road Disturbance (190 m)
Property Boundary
Driveway Tie-in Required

Alternative Solution 1 - Regional Flood Depth (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: December 3rd, 2021

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m^3/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

1:2,250 metres
20 0 20 40
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

Matrix Solutions Inc.
A Montrose Environmental Company

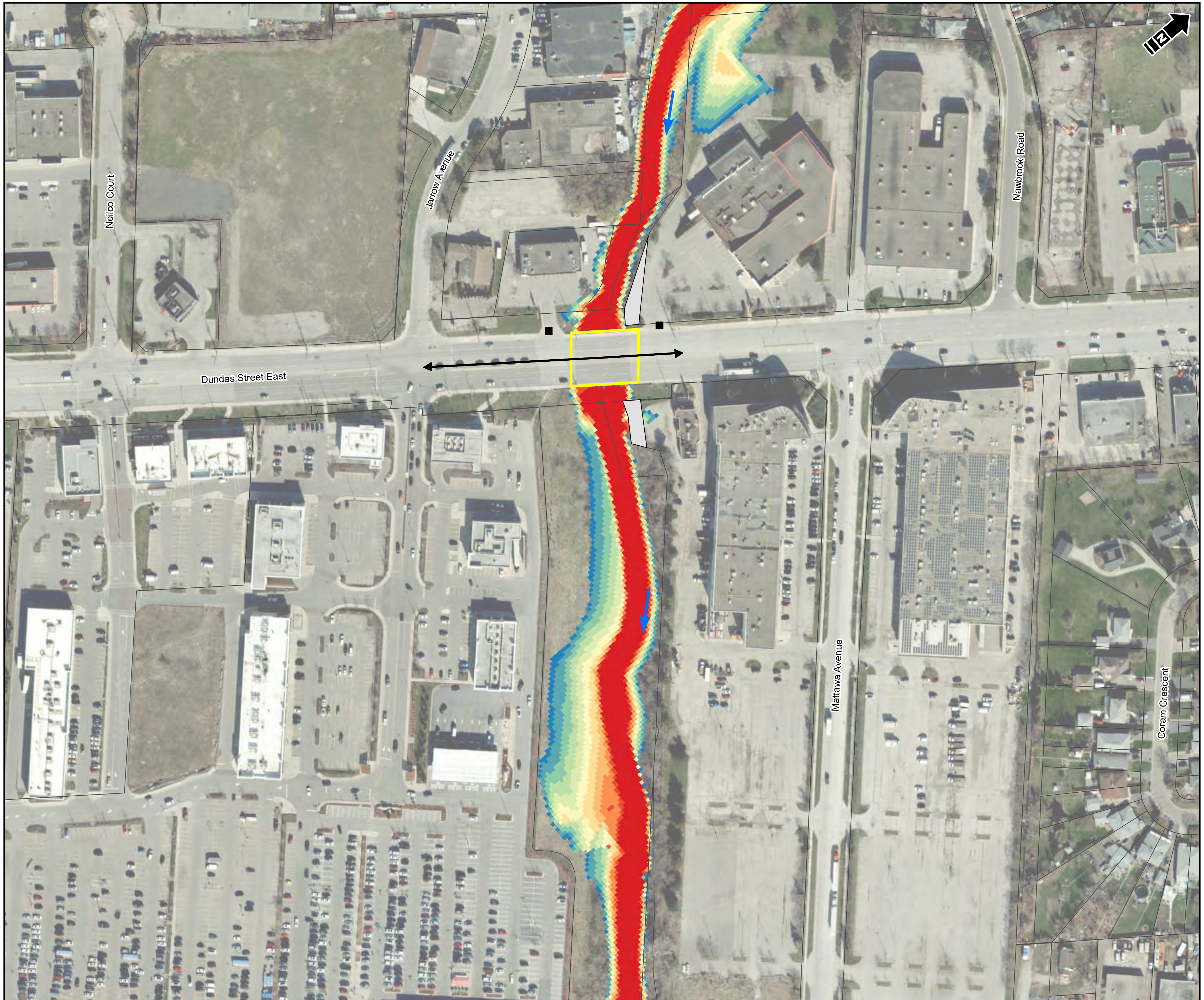
City of Mississauga
Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Dundas Street: Alternative Solution 1 - 25 m Span Length Bridge with Downstream Floodplain Conveyance Improvements

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 26

I:\City\Mississauga\24603\FiguresandTables\HYD\2023\Report\Figure-26-Alternative_1_25m_Span_Length_Bridge_with_Downstream_Floodplain_Conveyance_Improvements.mxd - Tabloid_L - 21-Mar-24, 10:30 AM - sylam - TID005



38 m Span Length Bridge Replacement
Potential Property Impact
Flow Direction
Extent of Road Disturbance (140 m)
Property Boundary
Driveway Tie-in Required

Alternative Solution 2 - Regional Flood Depth (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: December 14th, 2021

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m^3/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

1:2,250 metres
20 0 20 40
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

Matrix Solutions Inc.
A Montrose Environmental Company

City of Mississauga
Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Dundas Street: Alternative Solution 2 - 38 m Span Length Bridge without Downstream Floodplain Conveyance Improvements

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 27

DRAFT

- 38 m Span Length Bridge Replacement
- Potential Property Impact
- Floodplain Regrading
- Flow Direction
- Extent of Road Disturbance (70 m)
- Property Boundary
- Driveway Tie-in Required

Alternative Solution 3 - Regional Flood Depth (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: December 14th, 2021

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m^3/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

1:2,250 metres
20 0 20 40
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

Matrix Solutions Inc.
A Montrose Environmental Company

City of Mississauga
Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Dundas Street: Alternative Solution 3 - 38 m Span Length Bridge with Downstream Floodplain Conveyance Improvements

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 28

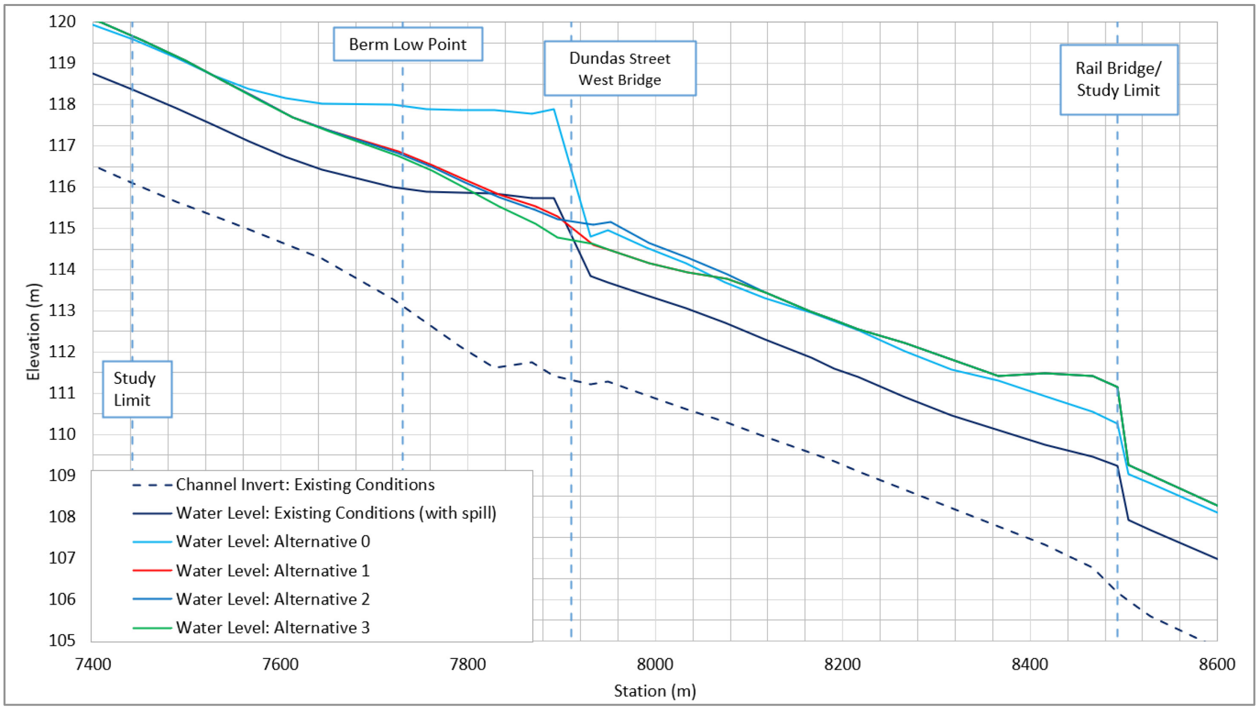


Figure 29 Regional Water Level Profiles for the Dundas Area Alternative Solutions

The existing conditions results shown on Figure 29 do not include the mitigated 130 m^3/s of flow that currently spills from the Dixie Area during a Regional storm event. The spilled flow is currently lost from Little Etobicoke Creek and conveyed away from its watershed to the adjacent Applewood Creek watershed. Therefore, existing conditions are representative of current flood flows being conveyed to the Dundas Area, not the future full flow conditions in the watercourse resulting from the Dixie Area alternative solutions. For comparison, water levels that result from the full flow condition with the existing Dundas Street bridge and channel/valley geometry are shown in the Figure 29 as “Alternative 0.” The assessment of all three Dundas Area alternative solutions also includes the full flow condition (i.e., with the upstream spill at the Dixie Area fully mitigated).

Hydraulic modelling of existing conditions indicates an approximate 2 m head loss (i.e., backwater effect) would be present throughout the existing Dundas Street bridge, even with the lower existing flood flows. This highlights the flow constriction caused by the existing Dundas Street bridge. As a result, the current floodplain in the upstream Dundas Area is impacted by this undersized bridge.

The higher water levels evident for each of the alternative solutions are an anticipated result of the higher or “full flow” condition in the Dundas Area caused by spill mitigation works upstream. The larger bridge spans proposed for all three alternative solutions would eliminate any significant backwater effect at the Dundas Street crossing by improving the hydraulics. Flood levels are shown to be lower than existing levels throughout the Dundas Street crossing itself for all three alternative solutions, although they remain higher than existing levels both upstream and downstream.

Dundas AS1 results in a slightly higher water level upstream of Dundas Street than Dundas AS2. Dundas AS1 and AS3, which include downstream floodplain conveyance improvements, result in approximately 0.5 m lower water levels downstream of Dundas Street compared to Dundas AS2. The benefits of downstream flood plain modification and associated conveyance improvement are observed with Dundas AS3, which indicates a 0.5 m lower water level than Dundas AS2 can be achieved immediately upstream of Dundas Street. Moving upstream from the bridge crossing, all three alternative solutions are seen to converge to a similar elevation differential.

A key location for hydraulic analysis exists on a commercial private property (1607 Dundas Street East), approximately 200 m upstream of the Dundas Street bridge. A low point is evident on the existing berm, which is situated on the east side of the watercourse. All three alternative solutions are predicted to have similar water levels at this location. The existing berm upstream of Dundas Street currently provides non-permanent flood protection to the commercial development and private lands that are situated in the floodplain behind the berm. This property currently has a “hazard” zoning designation and is not within one of the two existing SPAs associated with this Project.

An increase in Regional water levels upstream of Dundas Street is a result of the full flow condition associated with spill containment mitigation works in the Dixie Area. Although none of the three alternative solutions proposed for the Dundas Area would sufficiently mitigate this increased flooding, further mitigation for 1607 Dundas Street East is considered in Phase 3 of the Municipal Class EA process (Section 11). Mitigation proposed in Phase 3 will indicate the flood protection for the property can be acceptably achieved by ensuring works are implemented that provide similar or better levels of flood risk.

10.1.2 Dundas Street Bridge Design Considerations

The top-of-road elevation at the Dundas Street bridge is a factor of the required bridge deck thickness and the allowable soffit (underside of bridge deck) elevation. For arterial roads such as Dundas Street, CSA S6:19, Canadian Highway Bridge Design Code (CSA Group 2019) specifies 1 m of clearance be maintained from the 100-year water level to the bridge soffit. For this

Project, a requirement for the soffit to be above the Regional water level was established to ensure a robust solution is achieved. The water levels at the Dundas Street bridge and required soffit elevation for each alternative are summarized in Table 14. For comparison, the resulting water levels from the do nothing or full flow condition with no mitigation to the Dundas Street bridge is provided.

Table 14 Hydraulic Requirements for the Dundas Area Alternative Solutions

Alternative Solution	Water Surface Elevation 100-year (m)	Water Surface Elevation Regional (m)	Bridge Soffit (m)	Required Road Raise (m)
Dundas AS1	114.1	115.3	115.3	0.75
Dundas AS2	114.2	115.2	115.2	0.50
Dundas AS3	113.8	114.8	114.8	0.20
Do Nothing	116.4	117.9	115.4	N/A

Notes:
N/A - not applicable

Works within the Dundas Street RoW are being coordinated with the requirements of the City's BRT project. Initial coordination discussions with the BRT project team indicate that a road raise of up to 0.5 m would be acceptable; however, after further evaluation, the BRT project team confirmed that a road raise of 0.75 m was deemed to be acceptable throughout the bridge section and on either side of the watercourse crossing.

10.1.3 Sewer System Outfall Impacts

Within the Dundas Area, there are six municipal storm sewer outlets that discharge to Little Etobicoke Creek. The existing Little Etobicoke Creek water levels are generally above the sewer invert. Table 15 summarizes the 100-year water levels at each sewer outlet for the existing conditions and for the three alternative solutions.

The results indicate 100-year water levels that vary slightly (within 0.3 m) for each of the alternative solutions, but are predicted to all be lower compared to existing conditions, except in one case upstream. The higher water levels at this one upstream location (City ID 11296, Table 7) can be attributed to higher "full flows" during the 100-year storm. The levels at this location are similar for all three alternative solutions: only 0.2 m above existing; however, the resulting water level is below the invert of the storm sewer and this increase will not affect the sewer outfall. Water levels also increase at the outfall downstream of Dundas Street (City ID 11298) due to the full flows during the 100-year storm. The levels at this location are the same for all three alternative solutions (0.6 m above existing). However, the resulting water level is below the invert of the storm sewer on Mattawa Ave (111.15 m asl) and this increase will not affect the function of the sewer outfall.

The do nothing alternative increases water levels at all the outfalls in the Dundas Area. Riverine water levels are shown to affect the capacity of the sewers along Dundas Street (Matrix, 2021) and if the “full flow” condition is left unmitigated, could further reduce the capacity of the storm sewer system as far as Dixie Road and even further west along Dundas Street (inverts of the storm sewers on Dundas Street at Dixie Road are approximately 114 masl).

10.1.4 Municipal Servicing

Key municipal servicing (e.g., sewers and watermains) and utilities were identified for the Project study area (Section 5). Anticipated municipal servicing relocations required to accommodate the Dundas Area alternative solutions are outlined in Table 16. Each of the alternative solutions requires similar servicing/utility relocations, except for a 200 mm Peel Region watermain at Dundas Street. The Dundas AS1 bridge span aligns with the planned construction of the 200 mm Peel Region watermain, whereas Dundas AS2 and AS3 conflict with that planned watermain construction due to the abutment locations of the larger bridge span.

Another difference in alternative solutions is evident in which one storm sewer outfall downstream of Dundas Street would not require modification if Dundas AS2 were to be implemented.

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Table 15 Dundas Area 100-year Water Levels at Storm Sewer Outfalls

Outfall City ID	Outfall Location	Storm Sewer Outfall Invert(1) Elevation (m)	100-year Water Surface Elevation Existing Conditions (m)	100-year Water Surface Elevation Dixie AS1 (m)	100-year Water Surface Elevation Dixie AS2 (m)	100-year Water Surface Elevation Dixie AS3 (m)	100-year Water Surface Elevation Do Nothing (m)
11296	275 m upstream of Dundas Street	116.9	116.6	116.8(1)	116.8(1)	116.8(1)	117.0(1)
11297	90 m upstream of Dundas Street	113.4	115.5	114.9	114.9	114.8	116.5(1)
11295	10 m upstream of Dundas Street	112.7	115.4	114.2	114.3	114.0	116.4(1)
11294	Dundas Street	112.2	114.6	113.9	114.1	113.8	115.3(1)
11328	Dundas Street	113.2	114.6	113.9	114.1	113.8	115.3(1)
11298	400 m downstream of Dundas Street, 150 m upstream of CPR	109.9	110.1	110.5(1)	110.5(1)	110.5(1)	110.1

Note:
(1) Water levels indicate an increase from existing conditions.

A private outfall is located approximately 250 m downstream of Dundas Street on the west side of the Creek. Impacts and mitigations will be confirmed during the next phase.

Table 16 Dundas Area Alternative Solutions Servicing and Utility Conflicts

Municipal Service/Utility	Existing Conditions	Dixie AS1	Dixie AS2	Dixie AS3
Sanitary Siphon	• minimal cover, concrete encasement	• bridge replacement as well as planned BRT work requires sanitary siphon relocation	• bridge replacement as well as planned BRT work requires sanitary siphon relocation	• bridge replacement as well as planned BRT work requires sanitary siphon relocation
Planned Construction of a 200 mm Diameter Watermain	-	• aligns with planned watermain alignment	• conflicts with planned watermain alignment	• conflicts with planned watermain alignment
Exposed Utility Conduit	• under the creek along Dundas Street	• the utility conduit needs to be lowered or otherwise modified (e.g., attached to the bridge instead of crossing below Little Etobicoke Creek)	• the utility conduit needs to be lowered or otherwise modified (e.g., attached to the bridge instead of crossing below Little Etobicoke Creek)	• the utility conduit needs to be lowered or otherwise modified (e.g., attached to the bridge instead of crossing below Little Etobicoke Creek)
Storm Sewers	• six outlets discharge into Little Etobicoke Creek within the study area	• six storm sewer outlets may need to be modified to facilitate channel widening	• five storm sewer outlets may need to be modified to facilitate channel widening	• six storm sewer outlets may need to be modified to facilitate channel widening
Overhead Utilities	• along Dundas Street and on the east side of the valley corridor	• power line relocation likely required due to road raise as well as planned BRT works	• power line relocation likely required due to road raise as well as planned BRT works	• power line relocation likely required due to road raise as well as planned BRT works
Gas Main	• under the creek along Dundas Street, noted as abandoned	• to be reviewed at detailed design; may have to be relocated.	• to be reviewed at detailed design; may have to be relocated.	• to be reviewed at detailed design; may have to be relocated.

Notes:
BRT - bus rapid transit

10.1.5 Geomorphology, Aquatic Habitat, and Erosion

There is less opportunity at the Dundas Area than the Dixie Area for alternative solutions to improve aquatic and geomorphic conditions of Little Etobicoke Creek. The channel is highly confined by the existing valley through the Dundas Area, and the available land corridor is much more constrained than in the upstream Dixie Area. However, channel widening still has to accommodate the larger bridge spans. All three alternative solutions will locally improve geomorphic conditions by reducing erosive channel velocities during high-flow events, particularly through the Dundas Street bridge. The downstream floodplain improvements that are incorporated as part of Dundas AS1 and AS3 will further improve the localized geomorphic and aquatic habitat.

10.1.6 Terrestrial Environment, Parks, and Recreation

Background studies (Appendix D) determined that the existing valley corridor mainly consists of narrow ash, willow, and Manitoba and Norway maple forest communities, with some mixed meadow along the south bank of the downstream end. All three alternative solutions will require the same amount of tree removal for the bridge replacement and channel widening upstream and in the immediate vicinity of the crossing (0.6 ha). AS1 and AS3 will require an additional 0.94 ha of tree removal to accommodate the floodplain improvements downstream. This floodplain area will then be regraded and revegetated, providing an opportunity to improve the quality of vegetation within it. All three alternative solutions will also provide terrestrial connectivity and fish habitat improvements through the widening of the corridor, although these benefits will be greatest with AS1 as it will not have a pier obstructing fish habitat within the creek.

10.1.7 Climate Change Resiliency

As outlined in Section 9.1.7, resiliency criteria focused on the ability of alternative solutions to protect against larger rainfall events caused by climate change that would lead to increased riverine flooding. Currently, flooding in the Dundas Area does not spill during the Regional event and has approximately 0.3 m of freeboard to the low point on Dundas Street. However, the Dundas Street bridge would be overtopped and flow would spill from Little Etobicoke Creek when the full flow condition is realized following mitigation in the Dixie Area (Figure 29).

For the Dundas Area evaluation of resiliency, the Regional storm flood levels for each of the three alternative solutions are measured at key locations (Figure 25) to calculate how much freeboard (or space) there is between the peak water level and the associated low point. The minimum freeboard/clearance of 0.5 m applied in the Dixie Area was not applied to the Dundas

Street bridge soffit due to the lower risk associated with a potential spill (Section 4.2). Any clearance/freeboard above the Regional water level and the associated low points is considered additional resiliency.

Table 17 outlines the Regional water level profile through the Dundas Area for the existing condition, the do nothing full flow condition with no mitigation in the Dundas Area, and all three alternatives solutions. All three alternative solutions have similar water levels and, therefore, have similar resiliency in the Dundas Area.

Table 17 Dundas Area Alternative Solutions Resiliency Assessment

Key Location ID	Key Spill /Low Point Location Description	Regional Water Level Existing Conditions (m)	Regional Water Level Do Nothing (m)	Regional Water Level Dixie AS1 (m)	Regional Water Level Dixie AS2 (m)	Regional Water Level Dixie AS3 (m)
4	1607 Dundas Street East(1) (135 m Upstream of Dundas Street)	115.9 (0.5)	118.0 (-1.6)	116.7 (-0.3)	116.7 (-0.3)	116.6 (-0.2)
5	Dundas Street Low Point(2)	115.7 (0.3)	117.9 (-1.9)	115.3 (1.2)	115.2 (1.0)	114.8 (1.2)
8	Mattawa Storm Sewer Outlet (400 m Downstream of Dundas Street)	110.3 (4.5)	111.3 (3.5)	111.8 (3.0)	111.8 (3.0)	111.8 (3.0)

Notes:
(XX) denotes the amount of freeboard or clearance (i.e., extra vertical room) there is between the peak water level and the potential key spill or low point. The low point elevation may differ between alternatives (e.g., bridge soffits). Negative values indicate overtopping or surcharge conditions, positive numbers indicate freeboard/clearance.
(1) Does not consider existing berm.
(2) Measured from the Dundas Street road low point, west of the Little Etobicoke Creek crossing.

10.1.8 Stakeholder, Public, and Agency Input

The Project objectives, background, alternative solutions, and proposed evaluation criteria for the Dundas Area were presented to stakeholders, agencies, and to the public through meetings, phone calls, and the Project Bulletin posted online on October 29, 2021. Comments received from stakeholders during Phase 2 of the Municipal Class EA process are documented in Appendix A.

The responses from stakeholders about the recommended improvements to the Dundas Area were similar to those for the Dixie Area. Input, as it relates to the evaluation of the alternative solutions is consistent with the Dixie Area input (summarized in Section 9.1.8, Table 11. Additional comments pertaining to the Dundas Area are summarized in Table 18.

Table 18 Dundas Area Summary of Additional Stakeholder Input

Stakeholder	Stakeholder Commentary	Matrix Response
City of Mississauga	Recommendations for the Dundas Street bridge will need to be coordinated with the City's BRT project team and their external consultant. Additionally, the sanitary siphons running through the bridge will also need to consider the proposed changes to the bridge presented in this study.	Matrix worked closely with the City to provide design details to the BRT project team so that the projects align.
TRCA and the Landowner/Tenant at 1607 Dundas Street East	The existing berm would need to be altered to continue serving its purpose in protecting 1607 Dundas Street East.	Several alternative solutions were evaluated for the existing berm and vetted with TRCA and the landowner/tenant. A detailed record of the discussions for the berm at this property is included in the Dixie-Dundas Consultation Report (Matrix 2023; Appendix A).
Public	No public input was received after the Project Bulletin was released.	No change was made to the alternative solutions.

Notes:
See Table 11 for additional comments applicable to the Dundas Area alternative solutions.
BRT - Bus Rapid Transit
TRCA - Toronto and Region Conservation Authority

10.2 Dundas Area Alternative Solutions Evaluation Table

Table 19 presents the evaluation details and description for each of the evaluation criterion for the Dundas Area alternative solutions. The scoring ranged from 0 (least preferred) to 4 (most preferred), with the highest scoring being the most preferred. The evaluation was weighted evenly between criteria and evenly between each of four broad categories (a value of 25% each).

Table 19a Dundas Area Phase 2 Alternative Solutions Analysis – Technical Criteria

Criteria	Description	Ranking Descriptions	Dundas AS1	Dundas AS1 Rank	Dundas AS2	Dundas AS2 Rank	Dundas AS3	Dundas AS3 Rank	Do Nothing	Do Nothing Rank
Regional Storm Risk Reduction	Ability for the alternative to remove the Special Policy Area	0 - no improvement 4 - most improvement	Flow is contained within the valley corridor. No overtopping of Dundas Street.	4	Flow is contained within the valley corridor. No overtopping of Dundas Street.	4	Flow is contained within the valley corridor. No overtopping of Dundas Street.	4	Flood risk and overtopping at Dundas Street remains.	0
Upstream Water Levels during Regional Event	Ability to mitigate increased water levels upstream of Dundas Street during the Regional Event.	0 - increase in water levels 2 - no change 4 - decrease in water levels	Some reduction in upstream water levels.	3	Some reduction in upstream water levels.	3	Most reduction in upstream water levels.	4	No change to existing water levels upstream. Overtopping is left to continue.	2
Downstream Water Levels during Regional Event	Ability to mitigate increased water levels downstream of Dundas Street during the Regional Event.	0 - increase in water levels 2 - no change 4 - decrease in water levels	Some increase in in downstream water levels.	1	Most increase in downstream water levels.	0	Some increase in in downstream water levels.	1	No change in downstream water levels.	2
Urban Drainage	Impact to the urban drainage system. High water levels in the Creek create backwater conditions at the outfalls which limits the ability for the storm sewers to flow by gravity.	0 - negative impact on urban drainage 2 - no change 4 - positive impact on urban drainage	Outfalls upstream of Dundas Street have improved backwater conditions, outfalls downstream of Dundas Street are negatively affected.	3	Outfalls upstream of Dundas Street have improved backwater conditions, outfalls downstream of Dundas Street are negatively affected.	3	Outfalls upstream of Dundas Street have improved backwater conditions, outfalls downstream of Dundas Street are negatively affected.	3	Most outfalls are negatively affected due to increased water levels.	0
Erosion Potential	Ability to mitigate erosion potential	0 - increase in erosion potential 2 - no change 4 - decrease in erosion potential	Reduced erosion potential downstream due to larger bridge span and floodplain conveyance improvements.	4	Some reduction in erosion potential through the new wider bridge crossing.	3	Reduced erosion potential downstream due to larger bridge span and floodplain conveyance improvements.	4	No change to erosion potential.	2

Criteria	Description	Ranking Descriptions	Dundas AS1	Dundas AS1 Rank	Dundas AS2	Dundas AS2 Rank	Dundas AS3	Dundas AS3 Rank	Do Nothing	Do Nothing Rank
Constructability and Infrastructure Conflicts	Complexity of construction for implementing proposed works. Consideration is given to accepted construction/engineering practices, traffic considerations, and implementation time.	0 - most challenging to implement 4 - least challenging to implement	Requires coordination with BRT; no conflicts with Region of Peel watermain projects, requires largest road raise.	2	Requires coordination with BRT, some, constructability conflicts with adjacent Region of Peel watermain projects. Increased construction time relative to Alternative 1, requires road raise.	1	Requires coordination with BRT, some, constructability conflicts with adjacent Region of Peel watermain projects. Increased construction time relative to Alternative 1, requires road raise.	1	No change, no works proposed.	4
Resiliency including Climate Change	Measure of resiliency against future climate change.	0 - does not include resiliency measures 4 - includes resiliency measures	Opportunity for design to withstand and protect against larger storm events. Bridge/channel modifications would be required to increase capacity in the future, if needed	4	Opportunity for design to withstand and protect against larger storm events. Bridge/channel modifications would be required to increase capacity in the future, if needed	4	Opportunity for design to withstand and protect against larger storm events. Bridge/channel modifications would be required to increase capacity in the future, if needed	4	Current design is unable to protect against larger storm events.	0

Technical Screening Result

Dundas AS1	Dundas AS1 Rank	Dundas AS2	Dundas AS2 Rank	Dundas AS3	Dundas AS3 Rank	Do Nothing	Do Nothing Rank
High Preference	3.0	Moderate Preference	2.6	High Preference	3.0	Low Preference	1.4

Table 19b Dundas Area Phase 2 Alternative Solutions Analysis – Economic Criteria

Criteria	Description	Ranking Descriptions	Dundas AS1	Dundas AS1 Rank	Dundas AS2	Dundas AS2 Rank	Dundas AS3	Dundas AS3 Rank	Do Nothing	Do Nothing Rank
Capital Costs	Relative measure of the initial costs to install/construct the proposed works including the channel works, road/bridge improvements, and landscape costs	0 - most expensive 4 - least expensive	Lowest estimated capital cost of the three alternatives.	3	Medium estimated capital cost of the three alternatives.	2	Highest estimated capital cost of the three alternatives.	1	No capital costs.	4
Operation and Maintenance (O&M) Costs	Relative measure of the ongoing maintenance and operational costs following the implementation.	0 - most expensive 4 - least expensive	Low O&M costs associated with regular clean out.	4	Low O&M costs associated with regular clean out. Increased O&M costs due to piers.	3	Low O&M costs associated with regular clean out. Increased O&M costs due to piers.	3	Low O&M costs associated with regular clean out. Increase erosion due to higher flows would require repair.	2
Urban Development Considerations	Ability of the proposed alternative to allow future urban development plans to move ahead without impacts (e.g., Dundas Connects Master Plan).	0 - impedes future development plans 4 - promotes future development plans	Could enable future removal of the Special Policy Area. Comparatively the least amount of potential impact to concurrent projects.	4	Could enable future removal of the Special Policy Area. Moderate impact to concurrent infrastructure projects.	3	Could enable future removal of the Special Policy Area. Moderate impact to concurrent infrastructure projects.	3	Development in the Dixie-Dundas area must conform to existing Special Policy Area restrictions.	0
Municipal Servicing	Effect on existing and proposed municipal servicing and private utility infrastructure.	0 - significant effects municipal servicing 4 - no effects on municipal servicing	Some impacts to municipal servicing including sanitary siphon, less impact to planned watermain project.	2	Some impacts to municipal servicing including sanitary siphon and watermain.	1	Some impacts to municipal servicing including sanitary siphon and watermain.	1	No change to municipal servicing.	4

Economic Screening Result

Dundas AS1	Dundas AS1 Rank	Dundas AS2	Dundas AS2 Rank	Dundas AS3	Dundas AS3 Rank	Do Nothing	Do Nothing Rank
Highest Preference	3.3	Moderate Preference	2.3	Low Preference	2.0	High Preference	2.5

Table 19c Dundas Area Phase 2 Alternative Solutions Analysis – Environmental Criteria

Criteria	Description	Ranking Descriptions	Dundas AS1	Dundas AS1 Rank	Dundas AS2	Dundas AS2 Rank	Dundas AS3	Dundas AS3 Rank	Do Nothing	Do Nothing Rank
Aquatic Ecology	Effect on fisheries/aquatic habitat, connectivity, habitat sources, diversity, food sources, and fish passage.	0 - negative effects 2 - no change 4 - positive effects	Most potential for fish habitat improvements through widening of the corridor and improvements to floodplain. No pier will obstruct creek.	4	Some fish habitat improvements through widening of the corridor, no improvements to floodplain. Pier will cause localized loss of fish habitat.	3	Some fish habitat improvements through widening of the corridor and improvements to floodplain. Pier will cause localized loss of fish habitat.	3	No change.	2
Terrestrial Ecology	Effects on ground cover vegetation, trees, and shrubs, which influence connectivity, diversity, and quality and provide habitat to wildlife as well as recreational and aesthetic value.	0 – negative effects 2 – no change 4 – positive effects	Some potential terrestrial connectivity improvement in valley corridor with downstream floodplain improvements. Tree removals required (1.55 ha). Revegetation opportunities present.	2	Some potential terrestrial connectivity improvement in valley corridor with larger bridge span. Some tree removals required in the vicinity of the channel widening and bridge replacement (0.6 ha). Least revegetation opportunities present.	1	Most potential terrestrial connectivity improvement in valley corridor with larger bridge span and downstream floodplain improvements. Tree removals required (1.55 ha). Revegetation opportunities present.	2	No change (no disturbance or improvements).	2
Geomorphology	Ability to improve channel morphology, stability, as well as sedimentation and erosion.	0 – negative effects 2 – no change 4 – positive effects	Improved geomorphology through the bridge, increased floodplain connectivity downstream.	4	Improved geomorphology through the bridge, piers are constraining.	3	Improved geomorphology through the bridge, increased floodplain connectivity downstream, piers are constraining.	3	Current minimal floodplain connectively left to continue. Constrained bridge size.	2

Environmental Screening Result

Dundas AS1	Dundas AS1 Rank	Dundas AS2	Dundas AS2 Rank	Dundas AS3	Dundas AS3 Rank	Do Nothing	Do Nothing Rank
Highest Preference	3.3	Moderate Preference	2.3	High Preference	2.7	Low Preference	2.0

Table 19d Dundas Area Phase 2 Alternative Solutions Analysis – Social Criteria

Criteria	Description	Ranking Descriptions	Dundas AS1	Dundas AS1 Rank	Dundas AS2	Dundas AS2 Rank	Dundas AS3	Dundas AS3 Rank	Do Nothing	Do Nothing Rank
Planning and Policy	Measure of the potential acceptance by approving/interested agencies.	0 – low acceptance/approval 4 – high acceptance/approval	High acceptance and approval anticipated.	4	Not preferred by external agency due to conflicting municipal projects.	1	Not preferred by external agency due to conflicting municipal projects.	1	No change. Special Policy Area and associated restrictions will remain.	0
Public Input to Date	Measure of the initial public response and acceptance of the proposed alternative.	0 – low acceptance 4 – high acceptance	No specific comment from the public following the online bulletin.	4	No specific comment from the public following the online bulletin.	4	No specific comment from the public following the online bulletin.	4	Low public acceptance. Residents have expressed a desire to implement a mitigation solution (not specific) to address the flooding.	0
Property Acquisitions	Measure of the impact to adjacent private properties (i.e., loss of property, access to property, and aesthetics).	0 – most impact 4 – least impact	Temporary easements required for downstream works. Property acquisition required adjacent to Dundas Street.	2	More property acquisition required adjacent to Dundas Street to accommodate the larger span.	1	Temporary easements required for downstream works. More property acquisition required adjacent to Dundas Street to accommodate the larger span.	0	No construction impacts, however, some properties are now impacted by flooding due to increased Regional flows from upstream	3
Disruptions during Construction	Potential disruptions to the adjacent property owners and businesses, and the surrounding local community.	0 – most impact 4 – least impact	Most disruption to adjacent businesses and traffic due to road raise. However, work will be done concurrently with planned BRT project.	1	Some disruption to adjacent businesses and traffic. However, work will be done concurrently with planned BRT project.	2	Some disruption to adjacent businesses and traffic. However, work will be done concurrently with planned BRT project.	3	No change.	4
Parks and Recreational Amenities	Potential for future trails and trail connections, improving public access, and aesthetics.	0 – least improvement 4 – most improvement	Moderate improvement, particularly on the west side of valley if recreational trails are explored in the future. Visible improvement from existing culvert.	3	Some potential improvement, if recreational trails are explored in the future. Visible improvement from existing culvert.	2	Moderate Improvement, particularly on the west side of valley if recreational trails are explored in the future. Visible improvement from existing culvert.	3	No change.	0
Cultural Heritage and Archaeology	Potential impact to cultural heritage or archaeological resources.	0 – high likelihood 4 – no disturbance	Low archaeologic potential in construction area, some potential in downstream floodplain.	2	Low archaeologic potential in construction area.	3	Low archaeologic potential in construction area, some potential in downstream floodplain.	2	No archaeological disturbance.	4
First Nations	Acceptance of proposed works by First Nations.	0 – low likelihood 4 – high likelihood	Initial acceptance of concept	3	Initial acceptance of concept.	3	Initial acceptance of concept.	3	Existing conditions preserved.	4

Social Screening Result

Dundas AS1	Dundas AS1 Rank	Dundas AS2	Dundas AS2 Rank	Dundas AS3	Dundas AS3 Rank	Do Nothing	Do Nothing Rank
High Preference	2.7	Moderate Preference	2.3	Moderate Preference	2.3	Low Preference	2.1

Table 19e Dundas Area Phase 2 Alternative Solutions Analysis – Overall Screening Result

Dundas AS1	Dundas AS1 Rank	Dundas AS2	Dundas AS2 Rank	Dundas AS3	Dundas AS3 Rank	Do Nothing	Do Nothing Rank
Highest Preference	3.0	Moderate Preference	2.4	High Preference	2.5	Low Preference	2.0

10.3 Dundas Area Alternative Solution Evaluation Summary

Table 20 summarizes the evaluation of the Dundas Area alternative solutions under the four broad categories. Overall, Dundas AS1 is preferred because it effectively conveys the Regional flow, it has the most improvements from an environmental perspective, it is the lowest cost, and it has similar social impacts as observed for Dundas AS2 and AS3.

Table 20 Dundas Area Summary of Alternative Solutions Evaluation

Category	Dundas AS1	Dundas AS2	Dundas AS3	Do Nothing
Technical	High Preference	Moderate Preference	High Preference	Low Preference
Economic	Highest Preference	Moderate Preference	Low Preference	High Preference
Environmental	Highest Preference	Moderate Preference	High Preference	Low Preference
Social	High Preference	Moderate Preference	Moderate Preference	Low Preference
Overall	Highest Preference	Moderate Preference	High Preference	Low Preference

10.3.1 Summary of Technical Screening

- Dundas AS1, AS2 and AS3 contain the Regional flood within the valley corridor. “Do Nothing” does not under full-flow conditions.
- Dundas AS1, AS2 and AS3 show similar water level reductions upstream of Dundas Street, with Dundas AS3 showing the most reduction.
- Dundas AS1, AS2 and AS3 have higher water levels downstream of the Dundas Street crossing, as the flow from upstream is contained within the valley corridor. Dundas AS2 has the highest water levels downstream due to lower floodplain conveyance (does not include floodplain conveyance improvements).
- Dundas AS1 and AS3 provide the greatest reduction in erosion potential downstream of Dundas Street due to the proposed floodplain conveyance improvements. Upstream of Dundas Street, all three of the alternative solutions result in similar amounts of decreased erosion potential.

- Dundas AS1 has less construction requirements for the bridge but requires the most road disturbance. Dundas AS1 aligns with current municipal projects while Dundas AS2 and AS3 conflict with the Region's watermain project.

- Dundas AS1, AS2 and AS3 all provide opportunity for climate change resiliency and adaptability.

- Overall, Dundas AS1 and AS3 have the highest preference for technical criteria and "Do Nothing" has the lowest preference.

10.3.2 Summary of Economic Screening

- Dundas AS1 has the lowest capital cost and lowest operations and maintenance costs due to the smaller bridge span.

- Dundas AS1, AS2 and AS3 all enable the works at Dixie Area to proceed and therefore enable future removal of the special policy area (SPA). "Do Nothing" limits the ability to implement the works in the Dixie Area and thereby preventing the removal of the SPAs.

- Dundas AS1, AS2 and AS3 all require some adjustments/relocations to municipal servicing infrastructure.

- Overall, Dundas AS1 has the highest preference for economic criteria and Dundas AS3 has the lowest preference.

10.3.3 Summary of Environmental Screening

- Dundas AS1 has the greatest opportunity to improve channel morphology and aquatic habitat. The bridge pier in Dundas AS2 and AS3 has potential to impact long-term geomorphic stability and it occupies space that would otherwise be fish habitat.

- Dundas AS1, AS2 and AS3 will require tree removals, with Dundas AS1 and AS3 requiring the most. All three alternatives will provide some potential for improving terrestrial connectivity through the wider bridge span.

- Overall, Dundas AS1 has the highest preference for environmental criteria and "Do Nothing" has the lowest preference.

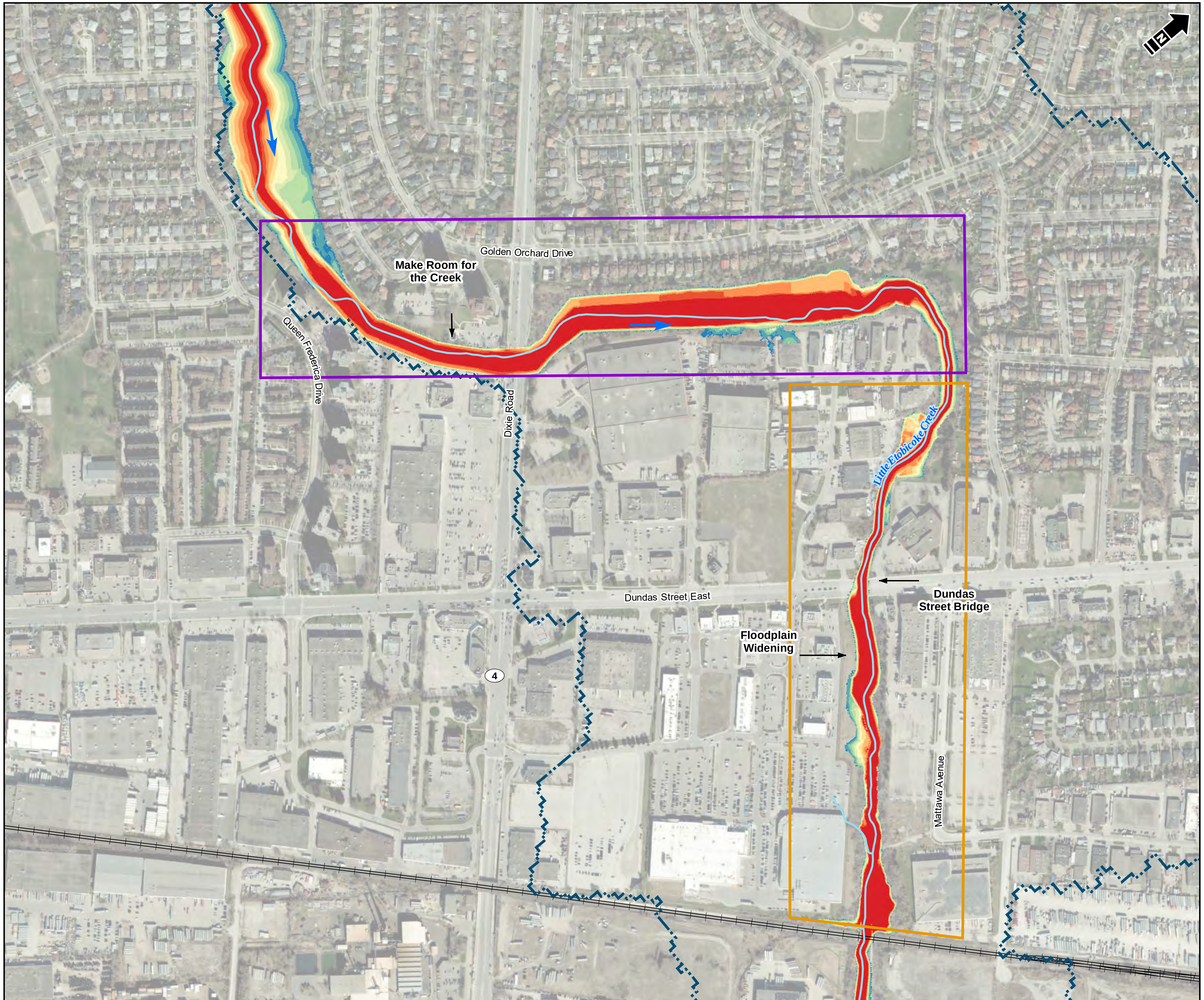
10.3.4 Summary of Social Screening

- Dundas AS1 is most preferred by agencies as it most aligns with ongoing municipal projects. Dundas AS2 and AS3 are not preferred by an external agency due to conflicting municipal projects.
- Dundas AS1, AS2 and AS3 all require some property acquisition with AS2 and AS3 requiring the most due to the larger bridge span. Temporary easements are requirement for Dundas AS1 and AS3 on the west valley bank.
- Dundas AS1, AS2 and AS3 will all have impacts to the public during construction, however the work will be coordinated with the BRT project which is already anticipated to disrupt Dundas Street. Dundas AS1 will have more impact than AS2 and AS3 due to the higher road raise required.
- Dundas AS1, AS2 and AS3 all create potential for future recreational improvements within the valley corridor such as trails, connections through the bridge.
- Dundas AS1, AS2 and AS3 all have low archeologic potential in the construction areas due to being previously disturbed.
- Input from First Nations has been received for the Alternative Solutions. No objections were indicated but a preference of continued involvement, especially with respect to future archeological investigations and for disturbance in general were identified.
- Overall, Dundas AS1 has the highest preference for social criteria and “Do Nothing” has the lowest preference.

10.4 Dundas Area Selection of Preferred Solution

The Phase 2 Municipal Class EA evaluation process for the Dundas Area resulted in AS1 being selected as the preferred alternative solution. Dundas AS1 includes is a 25 m single span bridge with downstream floodplain conveyance improvements. Dundas AS1 is preferred because it effectively conveys the Regional flow, has the lowest costs, has the most improvements from an environmental perspective, and has similar social impacts to AS2 and AS3. Dundas AS1 replaces the Dundas Street bridge with a wider, single span bridge, creating a wider and better-connected floodplain downstream of Dundas Street. Dundas AS1 effectively mitigates the full-flow condition that will result in the Little Etobicoke Creek channel by future implementation of the upstream Dixie Area spill mitigation works (Section 9).

Design considerations for the implementation of Dundas AS1 were explored and developed as part of the of the alternative design concepts during Phase 3 of the Municipal Class EA (Section 11).



DRAFT

Little Etobicoke Creek Watershed Boundary
Dixie Area
Dundas Area
Flow Direction
Watercourse
CN Railway

Regional Flood Depth (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

1. Base digital information obtained from the City of Mississauga (SHP and DGN format).

1:6,500 metres
50 0 50 100
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

Matrix Solutions Inc.
A Montrose Environmental Company

City of Mississauga
Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Preferred Alternative Solutions for the Dixie and Dundas Areas

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 30

11 Alternative Design Concepts for Preferred Solutions

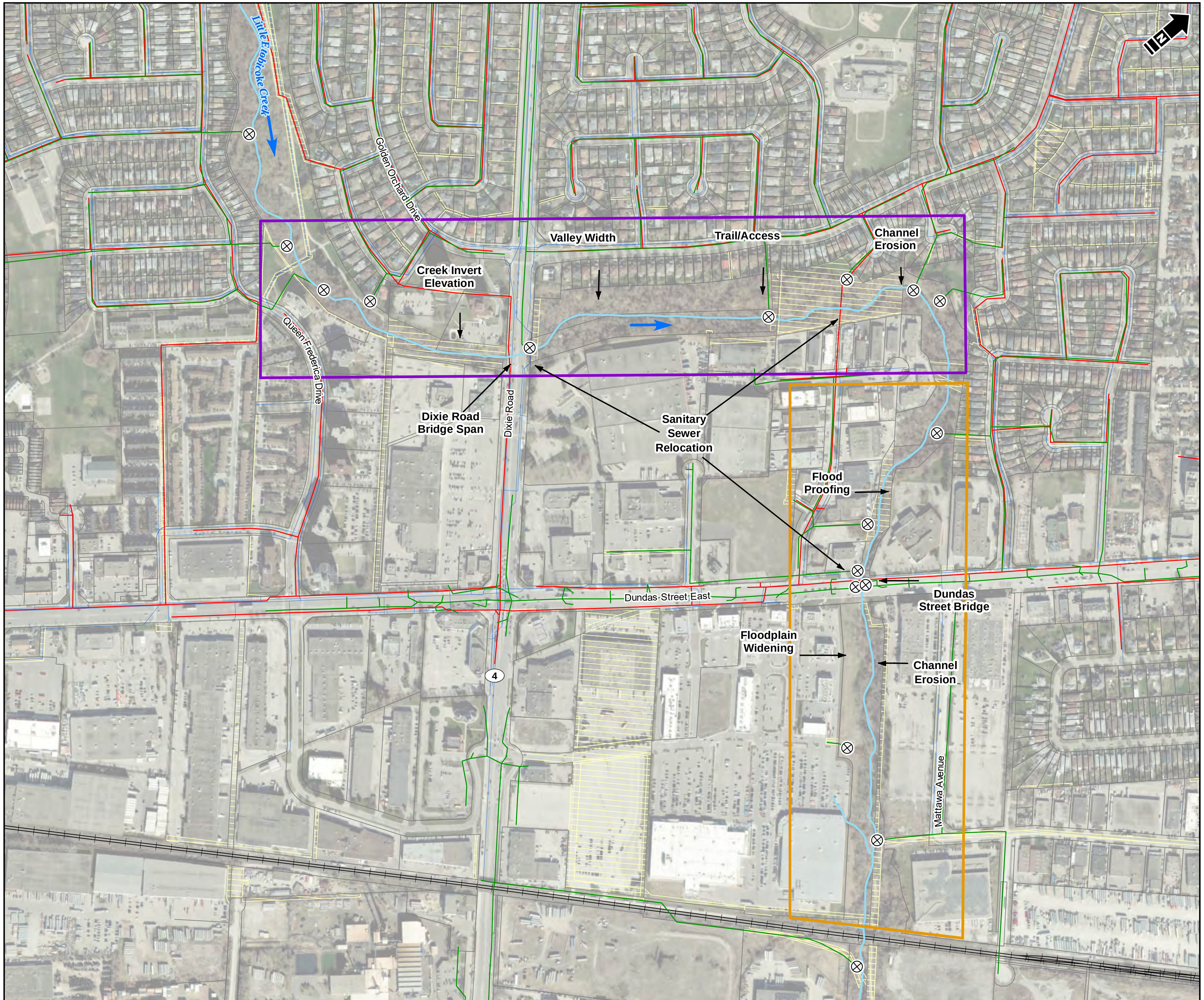
11.1 Considerations for Alternative Design Concepts

Following the selection of the preferred alternative solution, alternative design concepts were developed for each aspect of the preferred alternative solution. Discussion of alternative design concepts are provided in the sections below. Key design considerations for alternative design concepts in the Dixie Area included (Figure 31):

- creek invert elevation
- municipal servicing
- Dixie Road bridge span
- minimizing Dixie Road raise
- optimizing valley widths
- minimizing property impacts
- trail/access improvements
- addressing existing channel erosion

Key design considerations in the Dundas Area included (Figure 31):

- channel improvements
- upstream flood proofing
- floodplain widening
- municipal servicing
- minimizing property impacts
- addressing existing channel erosion
- Dundas BRT coordination



Dixie Area
Dundas Area
Easement
Sanitary Sewer
Storm Sewer
Watermain
Flow Direction
Watercourse
CN Railway
Property Boundary
Storm Sewer Outlet

1. Sanitary sewers, storm sewers, and watermains (SHP and DGN format) provided by the Region of Peel.
2. Storm easements, utility, roads, and property boundaries (SHP format) provided by the City of Mississauga.

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

1:6,500 metres
50 0 50 100
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
A Montrose Environmental Company

City of Mississauga
Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Dixie and Dundas Area Design Concept Locations

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 31

I:\CityofMississauga\24603\FiguresandTables\HYD\2023\Report\Figure-31-Dixie_and_Dundas_Area_Design_Concept_Locations.mxd - Tabloid_L - 21-Mar-24, 10:25 AM - sylam - TID005

11.1.1 Dixie Area Channel Design

The first component reviewed as part of the Dixie Area alternative design concepts was the creek invert elevation under Dixie Road. The channel invert elevation at Dixie Road bridge is a key design consideration. Therefore, this component of the Project was reviewed first in the alternative design concepts phase. The channel invert elevation has significant impacts on:

- the Dixie Road bridge design
- the existing trunk sanitary sewer under Dixie Road
- property takings required to prevent the upstream spill

Maintaining the creek invert, particularly at the Dixie Road crossing would allow Peel Region's trunk sanitary sewer to potentially remain in place. This sewer would require increased protection (e.g., additional concrete encasement) due to its minimal existing cover. Through a series of alternative design concepts that were simulated with the hydraulic model, it was determined that maintaining the creek elevation at Dixie Road (i.e., not lowering the creek invert) would not meet the freeboard objectives at the Queen Frederica Drive spill point, and this alternative design concept was excluded. The investigations reviewed a range of channel lowering up to 1.0 m and determined that a minimum lowering of 0.5 m would be required to meet the free board objectives at the spill point. Table 21 summarizes the alternative design concepts reviewed for the Dixie Area channel inverts elevations.

Table 21 Dixie Area Channel Invert Elevation Alternative Design Concepts

Concept	Brief Description	Carried Forward/Excluded	Comments
Channel Elevation at Dixie Road	Maintain the existing channel invert elevation at Dixie Road	Excluded	Assessed the amount of channel lowering required through Dixie Road bridge to achieve the free board objective (0.5 m) at the spill point; a minimum channel lowering of 0.5 m is required.
	Lowering the channel invert elevation 0.5 to 1.0 m at Dixie Road	Carried forward	

Details of the channel design will be pursued as part of Phase 5 of the Municipal Class EA process (i.e., at final design). This will include optimizing creek widths to:

- avoid/limit potential property acquisitions
- achieve naturally stable sides slopes (recommended 3H:1V from geotechnical assessment)
- incorporate natural channel design concepts (e.g., width to depth ratios) and improving existing erosion areas

Currently, it is not possible to maintain the 3H:1V valley slopes directly upstream of the Dixie Road bridge due to the limited valley corridor and property constraints. Steep sides slopes, and therefore structural reinforcement, will be required through this area pending detailed geotechnical investigation.

11.1.2 Dundas Area Floodplain Widening

The floodplain conveyance improvements downstream of Dundas Street were re-evaluated during the alternative design concept process. Although the floodplain widening did show some hydraulic improvements as part of the evaluation, its benefit is localized due to the confined valley system upstream and downstream. A more detailed evaluation of this alternative design concept was completed to confirm the benefits and potential drawbacks, as outlined in Table 22. The evaluation of the floodplain widening is provided in Section 11.4.

Table 22 Floodplain Widening Downstream of Dundas Street Alternative Design Concepts

Concept	Brief Description	Carried Forward/Excluded	Comments
Downstream Floodplain Conveyance Improvements	Floodplain has been maximized on the City-owned land along the west side of the creek. The concept provides 25 m of floodplain adjacent to a 1 m channel.	Evaluated as Design Concept	Intended to reduce energy and water levels during high-flow conditions to improve geomorphic and aquatic habitat conditions.
	Existing conditions downstream of Dundas Street remain in place.	Evaluated as Design Concept	If floodplain conveyance improvements are not carried out, erosion mitigation can be carried out as isolated works as required.

11.1.3 Municipal Servicing

There are two pieces of critical infrastructure that were examined for incorporation as part of the Phase 3 alternative design concepts. Design options for the trunk sanitary sewer at Dixie Road and the 450 mm sanitary sewer are provided in the following subsections. Additional municipal services that will require relocation or adjustment as part of the preferred design include:

- 400 mm watermain at Dixie Road bridge
- exposed concrete utility box at Dixie Road bridge
- sanitary siphon at Dundas Street bridge (to be incorporated as part of the BRT design)
- 16 storm sewer outlets (10 in the Dixie Area and 6 in the Dundas Area)
- planned 200 mm diameter watermain along Dundas Street to be accommodated at the 25 m bridge being proposed; the watermain is not anticipated to cause future constraints in the Dundas Area flood works
- varies other utilities (e.g., cable, hydro, gas, etc.)

11.1.3.1 Trunk Sanitary Sewer at Dixie Road

Minimizing impacts to municipal servicing was an objective of the alternative design concepts. Specifically, the impacts to the 900 mm sanitary trunk sewer that crosses under Dixie Road. The trunk sanitary sewer is currently within 0.6 m of the creek bed. As the channel invert needs to be lowered by at least 0.5 m to achieve the main objectives of the Municipal Class EA, leaving the sanitary trunk sewer in place is not possible and the design consideration to lower the 900 mm sanitary trunk sewer was carried forward as part of the preferred design. Some preliminary analysis was completed to determine how far the sewer could be lowered and connected into the existing system above Dundas Street. This analysis is included in Appendix J along with a figure showing the potential lowering. Table 23 summarizes the alternative design concepts considered for the 900 mm trunk sanitary sewer at Dixie Road.

Table 23 Dixie Road 900 mm Trunk Sanitary Sewer Alternative Design Concepts

Concept	Brief Description	Carried Forward/Excluded	Comments
Municipal Servicing 900 mm Sanitary Trunk Sewer at Dixie Road	Leave 900 mm sanitary trunk sewer at Dixie Road in place	Excluded	Current cover on the sewer is less than 0.6 m and lowering the creek elevation by a minimum of 0.5 m necessitates relocation.
	Lower 900 mm sanitary trunk sewer at Dixie Road	Carried Forward	

11.1.3.2 Sanitary Sewer at Jarrow Avenue

Another key piece of municipal servicing is the 450 mm sanitary sewer that crosses Little Etobicoke Creek near Jarrow Avenue. The 450 mm sanitary sewer is currently visible along the creek bed which leaves it open to environmental risk. Maintaining the sewer as-is for an undetermined amount of time is not a feasible option according to Peel Region. Leaving the sewer in place also limits the opportunity for improved floodplain and channel conveyance. Therefore, the option of leaving the existing sewer as-is was excluded (Table 24).

Two alternative design concepts were reviewed to relocate the 450 mm sanitary sewer. The first concept was to realign the sewer through the Little Etobicoke Creek floodplain along the north side and connect it into the lowered trunk sanitary sewer at Dixie Road. This alternative was ultimately excluded, as it would require additional lowering of the 900 mm sanitary trunk sewer and future maintenance and access within the floodplain would be an issue. The second alternative design concept was lowering the 450 mm sanitary sewer under Little Etobicoke Creek, maintaining it’s current alignment through Jarrow Avenue, and reconnecting it to the existing sewer before reaching Dundas Street. The analysis (provided in Appendix J) showed that this lowering would be possible and is the most feasible concept. This concept was carried forward as part of the preferred alternative design concept (Section 12).

Table 24 Jarrow Avenue 450 mm Sanitary Sewer Alternative Design Concepts

Concept	Brief Description	Carried Forward/Excluded	Comments
Municipal Servicing 450 mm Sanitary Sewer at Jarrow Avenue	Leave current 450 mm sanitary sewer in place (open to environmental risk) and provide protection.	Excluded	Peel Region does not consider keeping the sewer as is for an undetermined amount of time a feasible option. Limits the opportunity for improved floodplain and channel design.
	Realign sewer through floodplain and connect to lowered Dixie Road sanitary truck sewer.	Excluded	Requires additional lowering of 900 mm diameter sanitary trunk sewer. Issues with future maintenance and access within the floodplain. Logistics are more difficult and expensive than other concepts.
	Lower 450 mm sanitary trunk sewer and connect to Jarrow Avenue near Dundas Street.	Carried forward	Most feasible solution, maintains the same sewer alignment, supported by Peel Region.

11.1.4 Dixie Road Bridge

The preferred alternative solution, evaluated as part of the Phase 2 Municipal Class EA process, used a 45 m two-span bridge with the channel invert lowered by 0.5 m. The proposed bridge span was re-evaluated compared to new concepts to optimize opportunities/reduce potential impacts during the alternative design concept process.

Table 25 shows the bridges considered through the alternative design concept process. The new concepts take advantage of the potential to lower the channel by up to 1 m at Dixie Road. The first alternative design concept evaluated was a 38 m two-span bridge; this option is the minimum span that would meet the hydraulic requirements. The second alternative design concept evaluated was a 45 m two-span bridge a lower channel invert than considered during Phase 2 of the Municipal Class EA process. The third alternative design concept evaluated was a 50 m three-span bridge, which is the most technically feasible three-span bridge option. A 55 m three-span bridge was also evaluated; however, it would provide no additional hydraulic benefits and would cost more than the 50 m three-span bridge, which lead it to being excluded. The remaining four bridge alternative design concepts were evaluated (Section 11.3).

Table 25 Dixie Road Bridge Alternative Design Concepts

Concept	Brief Description	Carried Forward/Excluded	Comments
Dixie Road Bridge and Channel Lowering	45 m, two-span bridge with invert lowered 0.5 m	Evaluated as Design Concept	Carried forward from the Phase 2 alternatives
	45 m, two-span bridge with invert lowered 1.0 m	Evaluated as Design Concept	Preferred alternative solution with channel invert lowered 1.0 m
	38 m, two-span bridge with invert lowered 1.0 m	Evaluated as Design Concept	Minimum span that would meet hydraulic requirements
	50 m, three-span bridge with invert lowered 1.0 m	Evaluated as Design Concept	Technically feasible three-span bridge concept
	55 m, three-span bridge with invert lowered 1.0 m	Excluded	No additional benefits and higher cost than 50 m, three-span bridge concept.

11.1.5 Dundas Street Bridge

The preferred alternative solution for the Dundas Street bridge includes a 25 m single-span bridge (Section 10.3). No refinements of this Dundas Street bridge were assessed as part of the Phase 3 alternative design concepts.

11.1.6 Dundas Area Upstream Floodproofing

The preferred alternative solution will increase flows at the Dundas Area by eliminating the spill in the Dixie Area and conveying flood flows in the channel under future conditions. The preferred alternative solution reduces the impacts of the increased flow in the Dundas Area; however, hydraulic analysis shows that water levels upstream of the Dundas Street bridge would still be up to 1 m higher than in existing conditions (Figure 29).

A private property on the east side of Little Etobicoke Creek upstream of Dundas Street is currently situated in the floodplain with a “hazard” designation. There is an existing berm protecting the property; however, this is considered a non-permanent flood solution under Ontario regulations. Since the berm is considered non-permanent flood protection it is not considered when assessing Regional flood conditions. However, if the current berm could structurally withstand a Regional event (not determined within this study), the property would be protected. By increasing the channel flows in this area, the private property is at increased risk of berm overtopping or failure. Three alternative design concepts were assessed to provide equivalent or better flood protection for the affected property upstream of Dundas Street. The alternative design concepts for the berm in this area are as follows and are illustrated in Figure 32.

- Dundas Berm Concept 1: raise the existing berm
- Dundas Berm Concept 2: additional valley widening downstream of the berm
- Dundas Berm Concept 3: move the berm further away from the creek

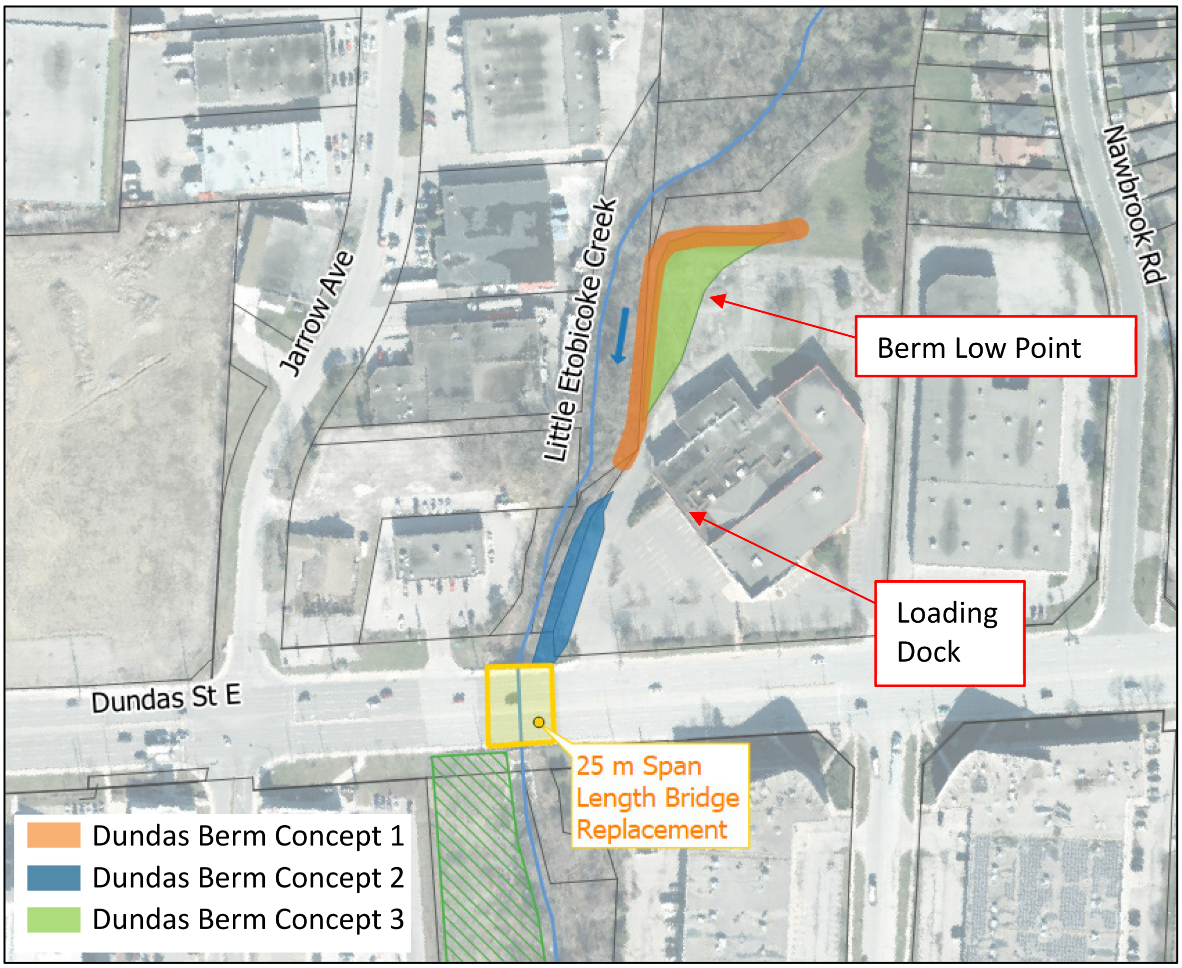


Figure 32 Dundas Berm Alternative Design Concepts

The existing berm follows the channel and parking lot boundary and extends from between the channel bend and the north edge of the parking lot, for approximately 50 m upstream of Dundas Street. The narrow valley corridor in this area limits the potential alternative design concepts. The loading dock on the existing building has been identified as a key constraint as access needs to be maintained for the current business operation. The existing loading dock is located at a pinch point in the channel. The proximity of the loading dock access to the existing berm limits widening potential in this area.

Dundas Berm Concept 1 maintains the current berm location and alignment. The berm's existing low point would be raised by 1 m to provide 0.5 m freeboard above the Regional water level. The objective is to match the freeboard available at this location under existing conditions.

Dundas Berm Concept 2 includes further widening of the valley downstream of the berm in the parking lot area immediately adjacent to Dundas Street. Additional valley widening opportunity is limited to maintain driveway access to Dundas Street East and maintain access to the loading dock area. A single row of parking spaces would need to be removed to allow the valley to be widened approximately 5 m at the top of bank.

Dundas Berm Concept 3 includes relocation of the berm approximately 20 m further away from the creek at the upstream corner of the property. This enables some additional floodplain widening below the berm. This option would require removing existing parking in the northwest corner of the property but would maintain access to the loading dock.

The Regional water levels resulting from the three alternative design concepts are compared to the existing conditions water level and the berm elevation in Figure 33. The berm low spot, the hydraulic restriction near the loading dock, and the Dundas Street bridge are highlighted for reference.

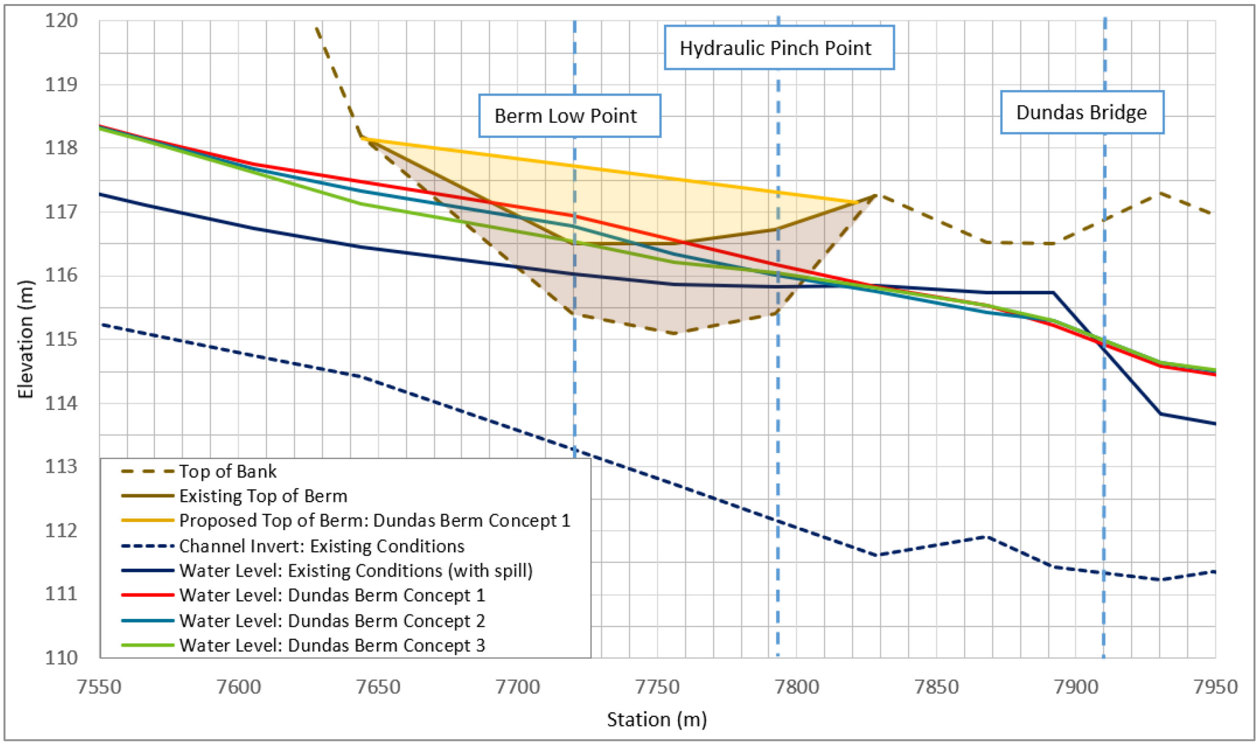


Figure 33 Regional Event Water Level Profiles Upstream of Dundas Street

Dundas Berm Concept 3 and Dundas Berm Concept 2 do not significantly lower water levels due to the hydraulic restriction adjacent to the loading dock in the area downstream of the existing berm. Overtopping of the berm during the Regional event would continue with these concepts. Dundas Berm Concept 1 would contain the flood flows in the valley; therefore, Dundas Berm Concept 1 was carried forward (Table 26).

The required top of berm is anticipated to be up to 1.0 m higher than the existing berm. This elevation includes freeboard to provide resiliency to climate change and maintain the level of freeboard provided under existing conditions. Agreements and easements will be required to allow this berm work. The current structural integrity of the berm will also need to be reviewed.

Table 26 Dundas Berm Alternative Design Concepts

Concept	Brief Description	Carried Forward/ Excluded	Comments
Upstream Flood Proofing 1607 Dundas Street East Property	Raise the berm to prevent overtopping	Carried Forward	Contains Regional storm flow within the valley corridor under providing resiliency to flood risk and protects property from flooding.
	Widen the channel immediately upstream Dundas Street East	Excluded	Does not reduce water levels sufficiently to prevent property flooding.
	Move the berm 20 m and widen channel	Excluded	

11.2 Evaluation Framework and Criteria

The alternative design concepts were assessed and evaluated based on specific criteria developed in consultation with the City. The general categories are consistent with those used for the alternative solutions and include the four main evaluation categories of technical, economic, environment, and social criteria. The criteria generally follow the same descriptions outlined in Table 6 (Section 8), with some minor modifications to make the criteria more applicable to the specific alternative design concepts. Each evaluation table for the alternative design concepts includes a description of the criteria and evaluation ranking/scoring. The criteria assessment methods generally follow the same approaches outlined in Section 8.1.

11.3 Dixie Road Bridge Alternative Design Concept Evaluation

11.3.1 Technical Analysis to Support Evaluation

Four alternative design concepts were reviewed for the Dixie Road bridge. The objective of these alternative design concepts is to develop a bridge concept that minimizes the impacts to top of road elevation, while providing a bridge soffit that is 0.5 m above the Regional water level to provide climate change resiliency. The following concepts were developed with the input of the Project’s structural engineer (RVA).

- Dixie Road Bridge Alternative Design Concept 1 (Dixie ADC1): 45 m span, single 1 m pier, lowered 0.5 m invert
- Dixie Road Bridge Alternative Design Concept 2 (Dixie ADC2): 45 m span, single 1 m pier, lowered 1.0 m invert
- Dixie Road Bridge Alternative Design Concept 3 (Dixie ADC3): 38 m span, single 1 m pier, lowered 1.0 m invert
- Dixie Road Bridge Alternative Design Concept 4 (Dixie ADC4): 50 m span, two 1 m piers, lowered 1.0 m invert

Components of the Dixie Road bridge concepts, such as number of piers, will affect water levels upstream of the bridge. Hydraulic assessment was required to confirm that the alternative design concepts comply with the overall goal of the Project to prevent flood spill upstream of Dixie Road. The Regional water level results from the hydraulic assessment also provide input to the required bridge soffit elevation. Each of the Dixie Road bridge concepts was assessed using the MIKE FLOOD model, as described in Section 8. The results presented in Table 27 show that the Regional water levels in the reach upstream of the bridge only vary by a few centimeters between Dixie ADC2, ADC3, and ADC4.

Table 27 Regional Water Levels Upstream of Dixie Bridge Design Concepts

Design Concept	Water Surface Elevation Upstream of Bridge (1)	Results in Spill Upstream	Minimum Soffit Elevation (2)	Hydraulic Opening (m^2)	Required Road Raise (m)
Dixie ADC1	122.70	No	123.10	113	0.4
Dixie ADC2	122.39	No	122.79	194	-
Dixie ADC3	122.46	No	122.81	162	-
Dixie ADC4	122.37	No	122.80	211	-

Notes:
(1) Water surface elevations from model cross-section 6588, approximately 40 m upstream of Dixie Road bridge.
(2) Region water level at upstream bridge face plus 0.5 m freeboard
ADC - alternative design concept

Dixie Road bridge conceptual design drawings are provided in Appendix I. The wider span for Dixie ADC4 results in the largest hydraulic opening (Table 27) compared to the other design concepts and almost doubles the hydraulic opening of Dixie ADC1. Only the original alternative solution (Dixie ADC1) requires a raise to the current road elevation at the Dixie Road bridge (RVA 2020).

11.3.2 Dixie Road Bridge Evaluation Table

Table 28 presents the evaluation of the Dixie Road bridge alternative design concepts. The scoring ranged from 0 (least preferred) to 4 (most preferred), with highest scoring being the most preferred. The evaluation was weighted evenly between each criteria and evenly between each of the four broad categories (a value of 25% each).

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Table 28a Dixie Road Bridge Phase 3 Design Concepts Evaluation– Technical Criteria

Criteria	Description	Ranking Descriptions	Dixie ADC1	Dixie ADC1 Rank	Dixie ADC2	Dixie ADC2 Rank	Dixie ADC3	Dixie ADC3 Rank	Dixie ADC4	Dixie ADC4 Rank
Upstream Water Levels during Regional Event	Ability to reduce water levels upstream of Dixie Road during the Regional Event.	0 - least improvement 4 - most improvement	Least improvement to water levels upstream of Dixie Road.	2	Most improvement to water levels upstream of Dixie Road. Same as ADC #4.	4	Moderate improvement to water levels upstream of Dixie Road. (between ADC #1 and 2).	2	Most improvement to water levels upstream of Dixie Road. Same as ADC #2.	4
Downstream Water Levels during Regional Event	Ability to reduce water levels downstream of the study area during the Regional Event	0 - increase in water levels 2 - no change 4 - decrease in water levels	Additional flows from contained spill raise water levels downstream but are contained within the valley corridor.	2	Additional flows from contained spill raise water levels downstream but are contained within the valley corridor.	2	Additional flows from contained spill raise water levels downstream but are contained within the valley corridor.	2	Additional flows from contained spill raise water levels downstream but are contained within the valley corridor.	2
Urban Drainage	Impact to the urban drainage system. High water levels in the Creek create backwater conditions at the outfalls which limits the ability for the storm sewers to flow by gravity.	0 - negative impact on urban drainage 2 - no change 4 - positive impact on urban drainage	Outfalls upstream of Dixie Road are least improved backwater conditions, outfalls downstream of Dixie Road are affected negatively.	1	Outfalls upstream of Dixie Road are most improved backwater conditions, outfalls downstream of Dixie Road are affected negatively.	3	Outfalls upstream of Dixie Road are improved backwater conditions, outfalls downstream of Dixie Road are affected negatively.	3	Outfalls upstream of Dixie Road are most improved backwater conditions, outfalls downstream of Dixie Road are affected negatively.	3
Erosion Potential	Erosion potential downstream of the proposed works.	0 - increase in erosion potential 2 - no change 4 - decrease in erosion potential	Reduced erosion potential during typical flow conditions due to wider bridge span, single pier poses increase erosion potential.	3	Reduced erosion potential during typical flow conditions due to wider bridge span, single pier poses increase erosion potential.	3	Reduced erosion potential during typical flow conditions due to wider bridge span, single pier poses increase erosion potential.	3	Reduced erosion potential during typical flow conditions due to wider bridge span, double pier reduces erosion potential	4
Constructability and Infrastructure Conflicts	Complexity of construction for implementing proposed works. Consideration is given to accepted construction/engineering practices, traffic considerations and implementation time.	0 - most challenging to implement 4 - least challenging to implement	Moderate constructability. Fits within the existing valley corridor, challenges associated with raising the profile of Dixie Road.	2	Highly constructable. Fits within the existing valley corridor, no road raise required, some challenges associated with infrastructure, utilities, and construction on Dixie Road.	3	Highly constructable. Fits within the existing valley corridor, no road raise required, some challenges associated with infrastructure, utilities, and construction on Dixie Road.	3	Highly constructable. Fits within the existing valley corridor with some adjustments, no road raise required, some challenges associated with infrastructure, utilities, and construction on Dixie Road.	2

Criteria	Description	Ranking Descriptions	Dixie ADC1	Dixie ADC1 Rank	Dixie ADC2	Dixie ADC2 Rank	Dixie ADC3	Dixie ADC3 Rank	Dixie ADC4	Dixie ADC4 Rank
Resiliency Including Climate Change	Measure of resiliency against future climate change (e.g., meeting a 0.5 m free board at the primary spill location)	0 - does not include resiliency measures 4 - includes resiliency measures	Some opportunity for design to withstand and protect against larger storm events. The 0.5 m freeboard requirement is not met at Dixie Road bridge but is met at the spill point upstream.	1	More opportunity for design to withstand and protect against larger storm events. Lowered channel provides higher level of resiliency than ADC #1 but less than ADC #4 to accommodate future flood flows.	3	More opportunity for design to withstand and protect against larger storm events. Lowered channel provides higher level of resiliency than ADC #1 but less than ADCs #2 and #4 to accommodate future flood flows.	2	Most opportunity for design to withstand and protect against larger storm events. Additional span and hydraulic capacity can accommodate future flood flows.	4

Technical Screening Result

Dixie ADC1	Dixie ADC1 Rank	Dixie ADC2	Dixie ADC2 Rank	Dixie ADC3	Dixie ADC3 Rank	Dixie ADC4	Dixie ADC4 Rank
Low Preference	1.8	High Preference	3.0	Moderate Preference	2.5	Highest Preference	3.2

Table 28b Dixie Road Bridge Phase 3 Design Concepts Evaluation– Economic Criteria

Criteria	Description	Ranking Descriptions	Dixie ADC1	Dixie ADC1 Rank	Dixie ADC2	Dixie ADC2 Rank	Dixie ADC3	Dixie ADC3 Rank	Dixie ADC4	Dixie ADC4 Rank
Capital Costs	Relative measure of the initiation costs to install/construct the proposed bridge works including road improvements.	0 - most expensive 4 - least expensive	Highest capital cost. Includes bridge structure and road/civil works.	1	Medium capital cost. Includes bridge structure and road/civil works.	3	Lowest Capital cost. Includes bridge structure and road/civil works.	4	Secondary highest capital cost. Includes bridge structure and road/civil works.	2
Operation and Maintenance (O&M) Costs	Relative measure of the ongoing maintenance and operational costs following the implementation.	0 - most expensive 4 - least expensive	Typical O&M costs associated with regular clean out. Single pier may result in increase cost of maintenance due to debris/ice jams.	2	Typical O&M costs associated with regular clean out. Single pier may result in increase cost of maintenance due to debris/ice jams.	2	Typical O&M costs associated with regular clean out. Single pier may result in increase cost of maintenance due to debris/ice jams.	2	Typical O&M costs associated with regular clean out.	3
Municipal Servicing	Effect on existing and proposed municipal servicing and private utility infrastructure.	0 - significant effects municipal servicing 4 - no effects on municipal servicing	Some impacts to municipal servicing, adjustments/relocations are required.	2	Some impacts to municipal servicing, adjustments/relocations are required.	2	Some impacts to municipal servicing, adjustments/relocations are required.	2	Some impacts to municipal servicing, larger span may require additional adjustments/relocations to 400 mm watermain.	1

Economic Screening Result

Dixie ADC1	Dixie ADC1 Rank	Dixie ADC2	Dixie ADC2 Rank	Dixie ADC3	Dixie ADC3 Rank	Dixie ADC4	Dixie ADC4 Rank
Low Preference	1.7	High Preference	2.3	Highest Preference	2.7	Moderate Preference	2.0

Table 28c Dixie Road Bridge Phase 3 Design Concepts Evaluation– Environmental Criteria

Criteria	Description	Ranking Descriptions	Dixie ADC1	Dixie ADC1 Rank	Dixie ADC2	Dixie ADC2 Rank	Dixie ADC3	Dixie ADC3 Rank	Dixie ADC4	Dixie ADC4 Rank
Aquatic Ecology	Effect on fisheries/aquatic habitat, connectivity, habitat sources, diversity, food sources, and fish passage.	0 - least improvement 4 - most improvement	Some potential fish habitat improvements, single pier is constraining.	2	More potential fish habitat improvements due to additional invert lowering, single pier is constraining.	3	More potential fish habitat improvements due to additional invert lowering, single pier is constraining.	3	Most potential fish habitat improvements due to additional invert lowering, double pier is less constraining.	4
Terrestrial Ecology	Effects on ground cover vegetation, trees and shrubs, which influence connectivity, diversity, and quality and provide habitat to wildlife as well as recreational and aesthetic value.	0 - least improvement 4 - most improvement	Some potential terrestrial connectivity improvement through bridge corridor due to increased bridge span.	3	Some potential terrestrial connectivity improvement through bridge corridor due to increased bridge span.	3	Least potential terrestrial connectivity improvement through bridge corridor due to smaller bridge span.	2	Most potential terrestrial connectivity improvement through bridge corridor due to larger bridge span.	4
Geomorphology	Ability to improve channel morphology, stability, as well as sedimentation and erosion.	0 - least improvement 4 - most improvement	Improved geomorphology through the bridge, single pier is constraining	2	More potential geomorphic improvements due to additional invert lowering, single pier is constraining.	3	More potential geomorphic improvements due to additional invert lowering, single pier is constraining.	3	More potential geomorphic improvements due to additional invert lowering, double pier is less constraining to channel form.	4

Environmental Screening Result

Dixie ADC1	Dixie ADC1 Rank	Dixie ADC2	Dixie ADC2 Rank	Dixie ADC3	Dixie ADC3 Rank	Dixie ADC4	Dixie ADC4 Rank
Low Preference	2.3	High Preference	3.0	Moderate Preference	2.7	Highest Preference	4.0

Table 28d Dixie Road Bridge Phase 3 Design Concepts Evaluation– Social Criteria

Criteria	Description	Ranking Descriptions	Dixie ADC1	Dixie ADC1 Rank	Dixie ADC2	Dixie ADC2 Rank	Dixie ADC3	Dixie ADC3 Rank	Dixie ADC4	Dixie ADC4 Rank
Planning and Policy	Measure of the potential acceptance by approving/interested agencies.	0 - low acceptance/approval 4 - high acceptance/approval	Not preferred by external agency due to road raise.	2	High acceptance and approval anticipated.	4	High acceptance and approval anticipated.	4	High acceptance and approval anticipated.	4
Public Input to Date	Measure of the initial public response and acceptance of the proposed design concept.	0 - low acceptance 4 - high acceptance	No specific feedback on Design Concept.	2	No specific feedback on Design Concept.	2	No specific feedback on Design Concept.	2	No specific feedback on Design Concept.	2
Property Acquisitions	Measure of the impact to adjacent private properties (i.e., loss of property, access to property, and aesthetics).	0 - most impact 4 - least impact	Temporary easements and property acquisition may be required on the north and south banks.	2	Temporary easements and property acquisition may be required on the north and south banks.	2	Temporary easements and property acquisition may be required on the north and south banks. Potential for less property acquisition due to smaller bridge span.	3	Temporary easements and property acquisition may be required on the north and south banks. Potential for more property acquisition due to larger bridge span.	1
Disruptions during Construction	Potential disruptions to the adjacent property owners and businesses, and the surrounding local community.	0 - most impact 4 - least impact	Most disruption to adjacent businesses and traffic due to road raise.	1	Some disruption to adjacent businesses and traffic during bridge replacement.	3	Some disruption to adjacent businesses and traffic during bridge replacement.	3	Some disruption to adjacent businesses and traffic during bridge replacement. Potential for higher disruption due to larger span/structure.	2
Parks and Recreational Amenities	Potential for future trails and trail connections, improving public access, and aesthetics.	0 - least improvement 4 - most improvement	Low potential for trail connections through the bridge due to higher channel invert elevation.	1	High potential for trail connections through the bridge due to lower channel invert elevation and larger bridge span.	3	Moderate potential for trail connections through the bridge due to lower channel invert elevation with smaller bridge span.	2	Highest potential for trail connections through the bridge due to lower channel invert elevation and larger bridge span.	4
Cultural Heritage and Archaeology	Potential impact to cultural heritage or archaeological resources.	0 - high likelihood 4 - no disturbance	Low archaeologic potential in construction area.	3	Low archaeologic potential in construction area.	3	Low archaeologic potential in construction area.	3	Low archaeologic potential in construction area.	3
First Nations	Acceptance of proposed works by First Nations.	0 - low likelihood 4 - high likelihood	Initial acceptance of concept.	3	Initial acceptance of concept.	3	Initial acceptance of concept.	3	Initial acceptance of concept.	3

Social Screening Result

Dixie ADC1	Dixie ADC1 Rank	Dixie ADC2	Dixie ADC2 Rank	Dixie ADC3	Dixie ADC3 Rank	Dixie ADC4	Dixie ADC4 Rank
Low Preference	2.0	High Preference	2.9	High Preference	2.9	Moderate Preference	2.7

Table 28e Dixie Road Bridge Phase 3 Design Concepts Evaluation– Overall Screening Result

Dixie ADC1	Dixie ADC1 Rank	Dixie ADC2	Dixie ADC2 Rank	Dixie ADC3	Dixie ADC3 Rank	Dixie ADC4	Dixie ADC4 Rank
Low Preference	2.0	High Preference	2.8	Moderate Preference	2.7	Highest Preference	3.0

11.3.3 Dixie Road Bridge Alternative Design Concept Evaluation Summary

Table 29 summarizes the evaluation of the Dixie Road bridge alternative design concepts under the four broad categories. Dixie ADC4 is preferred because it provides the most potential for environmental improvements with similar social benefits to Dixie ADC2. Dixie AD 4 costs more than Dixie ADC2 and Dixie ADC3 but is the most resilient and adaptable solution which provides some flexibility to vary the channel invert during detailed design.

It should be noted that the scoring difference between Dixie ADC2, ADC3, and ADC4 is minimal (overall scoring of 2.8, 2.7, and 3.0 respectively). Should issues arises as the design of the preferred design concept (i.e., Dixie ADC4) progresses, implementing Dixie ADC2 or ADC3 could be considered.

Table 29 Dixie Road Bridge Summary of Alternative Design Concept Evaluation

Criteria Category	Dixie ADC1	Dixie ADC2	Dixie ADC3	Dixie ADC4
Technical	Low Preference	High Preference	Moderate Preference	Highest Preference
Economic	Low Preference	High Preference	Highest Preference	Moderate Preference
Environmental	Low Preference	High Preference	Moderate Preference	Highest Preference
Social	Low Preference	High Preference	High Preference	Moderate Preference
Overall	Low Preference	High Preference	Moderate Preference	Highest Preference

11.3.3.1 Technical Screening Summary

- All four alternative design concepts remove the spill at Queen Frederica Drive.
- Dixie ADC2 and ADC4 show the most improvement in upstream water levels, and thus the most improvement to urban drainage.
- All alternative design concepts reduce erosion potential through the channel due to the lowered invert and larger span, with Dixie ADC4 showing the most improvement.
- Dixie ADC2, ADC3, and ADC4 are easier to construct as they do not require Dixie Road to be raised. Dixie ADC4 may be slightly more complex to implement due to the large span and additional pier.

- Dixie ADC4 has the highest opportunity for climate change resiliency and adaptability due to the large span which provides increased flexibility.

11.3.3.2 Economic Screening Summary

- Dixie ADC1 has the highest capital cost due to the required road raise; Dixie ADC4 is the highest cost bridge.
- All design concepts require similar operation and maintenance with Dixie ADC1, ADC2, and ADC3, requiring potentially more due to debris/ice jam potential from the single pier.
- All design concepts will impact municipal servicing and require re-location of the 900 mm trunk sanitary sewer, the 400 mm watermain, and various other utilities. Dixie ADC4 may require additional adjustments due to its larger span.

11.3.3.3 Environmental Screening Summary

- All alternative design concepts have the potential to improve aquatic and terrestrial habitat by improving connectivity through the larger bridge span. Dixie ADC4 provides the most potential improvement.
- Dixie ADC4 is the most preferred from an environmental perspective as it has the largest span to accommodate habitat and two piers which is preferred for channel morphology.

11.3.3.4 Social Screening Summary

- Dixie ADC2, ADC3, and ADC4 are anticipated to be the most accepted by agencies; Dixie ADC1 is likely to be the least accepted due to the required road raise.
- All design concepts will require property acquisition, with Dixie ADC3 potentially requiring less property takings through the valley and Dixie ADC4 potentially requiring more property takings to accommodate the channel alignment through the bridge.
- All design concepts will cause public disruptions during construction. Dixie ADC1 will cause the most disruption due to the road raise construction.
- Dixie ADC4 provides the highest potential for trail connections through the bridge on either side of the valley.
- All design concepts have the same cultural heritage, archaeological and First Nations acceptance rankings.

11.4 Floodplain Widening Alternative Design Concept Evaluation

11.4.1 Technical Analysis to Support Evaluation

The existing creek valley downstream of Dundas Street is relatively narrow with steep slopes below the Regional water level. In this area the channel is confined without functional access to its floodplain. Confined channels have limited ability to dissipate energy during high flow conditions, which can result in erosion and reduce the quality of aquatic habitat. There are locations along the creek corridor downstream of Dundas Street with existing erosion concerns and stream restoration opportunities. The preferred alternative solution includes floodplain widening downstream of the proposed bridge at Dundas Street with the intent of reducing energy and water levels during high flow conditions thereby improving geomorphic and aquatic habitat conditions. Two design concepts were considered for the downstream floodplain improvements as follows.

- Dundas Downstream Alternative Design Concept 1 (Dundas ADC1): Maximized floodplain area downstream of Dundas Street
- Dundas Downstream Alternative Design Concept 2 (Dundas ADC2): No floodplain improvements downstream of Dundas Street

The City owns lands within the Creek corridor on the west side of the channel (refer to Figure 34). This land is currently higher than the Regional water level. Dundas ADC1 has been developed to maximize the potential floodplain within the available property, while providing a 6 m offset from the property line. Dundas ADC1 provides approximately 25 m of floodplain width adjacent to a 1 m deep low flow channel.

Dundas ADC 2 is representative of a do nothing alternative for this portion of the project. Therefore, Dundas ADC2 is the same as existing conditions downstream of Dundas Street. The channel would still be widened to accommodate the 25 m bridge span, but the new crossing would tie into the existing valley. With this alternative design concept in place, any erosion sites downstream of Dundas Street could be completed as isolated local repairs. Figure 35 shows the Regional water level comparison for Dundas ADC1 and ADC2 and existing conditions.

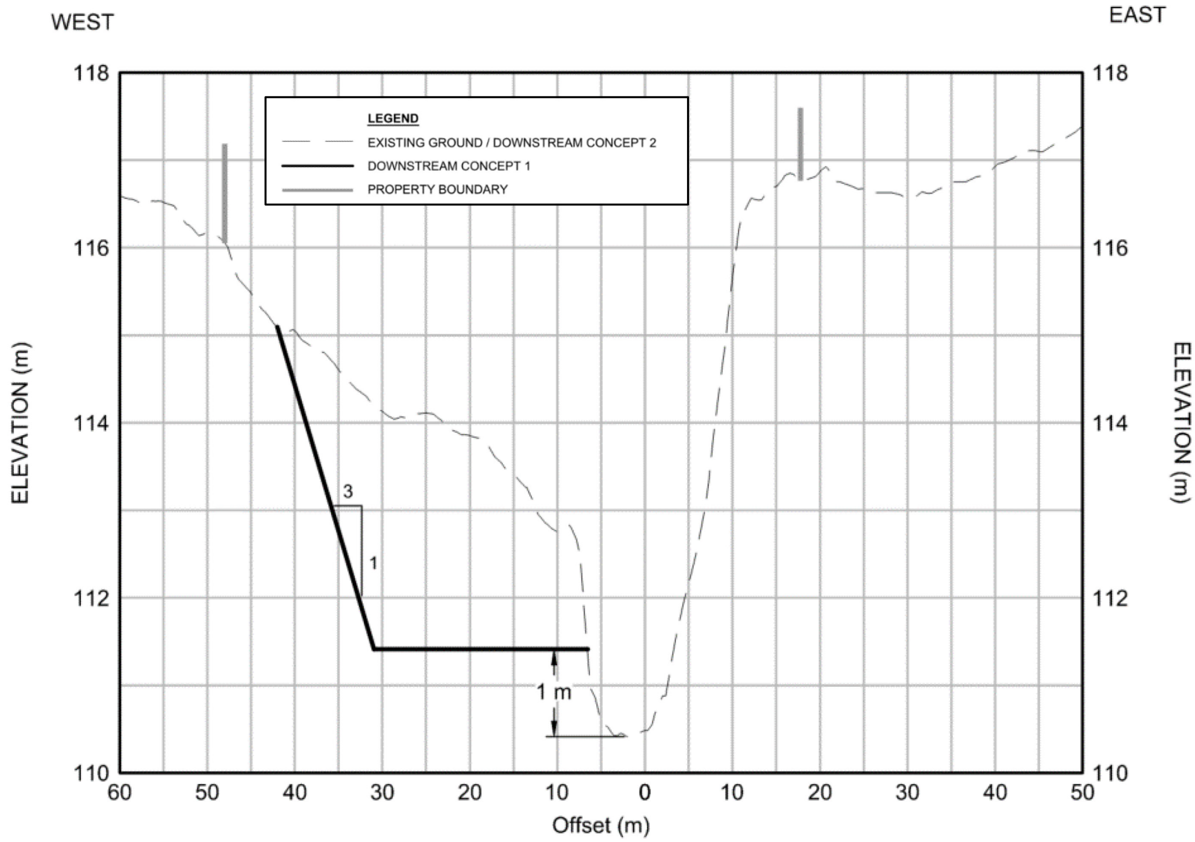

Figure 34 **Cross-section - Dundas Downstream Alternative Concept 1 and Dundas Downstream Alternative Concept 2**

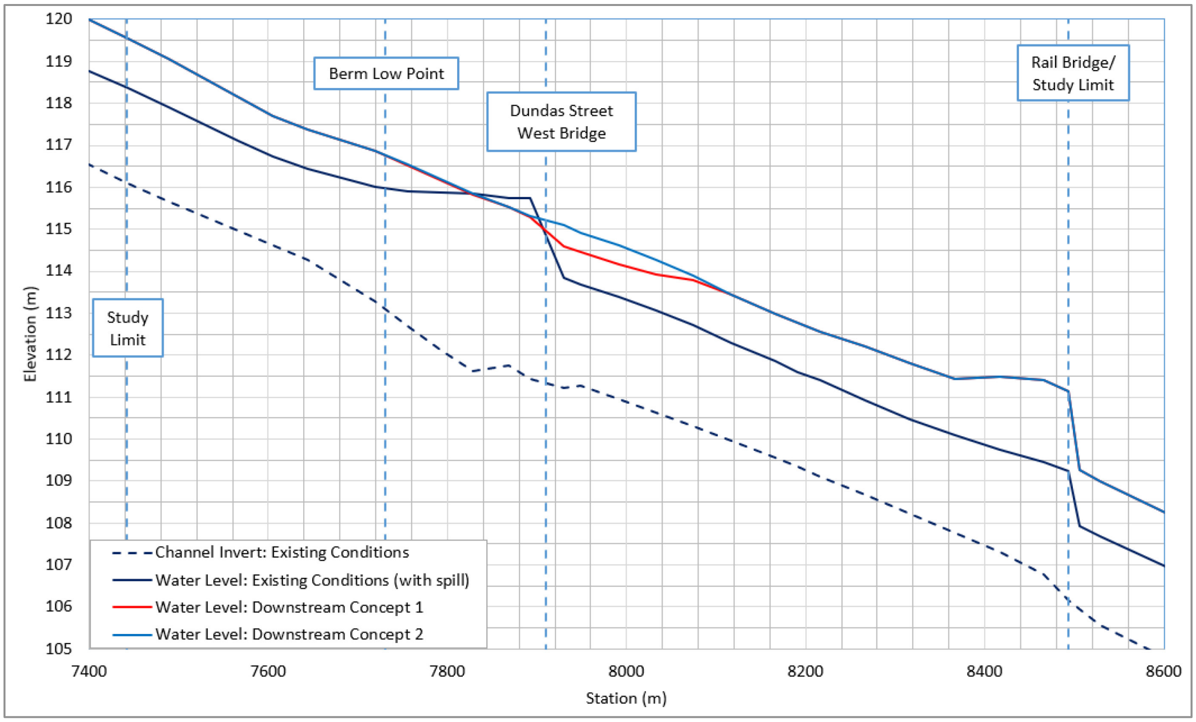

Figure 35 Floodplain Widening Alternative Design Concepts - Regional Water Levels

Both alternative design concepts result in Regional water levels higher than existing conditions. This is due to the preferred alternative solution being implemented in the Dixie Area to mitigate the existing spill. There are minimal risks related to the higher water levels Downstream of Dundas Street as the flows in this area do not spill from the valley and do not encroach on private property. Dundas ADC1 reduces Regional water levels by up to 0.5 m downstream of Dundas Street. The reduced water levels downstream of Dundas Street don't provide much additional flood risk protection as the risk was already low. Dundas ADC1 reduces Regional water levels only 2 cm at the upstream side of Dundas Street and provides no flood risk benefit at the low point in the berm at 1607 Dundas Street. Therefore, Dundas ADC1 does not provide enough hydraulic benefit at key locations to warrant a preference based on flood risk reduction alone.

As outlined in Section 10.1.6, the floodplain widening will require an additional 0.94 ha of tree removal. This floodplain area will then be regraded and revegetated, providing an opportunity to improve the quality of vegetation within it. ADC1 will also provide terrestrial connectivity and fish habitat improvements through the widening of the corridor.

A full evaluation of the two alternative design concepts based on broader criteria is provided in the following subsection.

11.4.2 Floodplain Widening Evaluation Table

Table 30 presents an evaluation of the floodplain widening alternative design concepts under the four broad categories. The scoring ranged from 0 (least preferred) to 4 (most preferred) with highest scoring being the most preferred. The evaluation was weighted evenly between each criteria and evenly between each of the four broad categories (a value of 25% each).

Table 30a Floodplain Widening Downstream of Dundas Street Phase 3 Alternative Design Concept Evaluation - Technical Criteria

Criteria	Description	Ranking Descriptions	Dundas ADC1	Dundas ADC1 Rank	Dundas ADC2	Dundas ADC2 Rank
Upstream Water Levels during Regional Event	Ability to mitigate increased water levels upstream of Dundas Street during the Regional event.	0 - increase in water levels 2 - no change 4 - decrease in water levels	Minor improvement to upstream water levels. Flow contained in the valley.	3	No improvement to upstream water levels. Flow contained in the valley.	2
Downstream Water Levels during Regional Event	Ability to mitigate increased water levels downstream of Dundas Street during the Regional event.	0 - increase in water levels 2 - no change 4 - decrease in water levels	Some improvement to water levels immediately downstream of Dundas Street. Flow contained in the valley.	4	No change in water levels downstream of Dundas Street. Flow contained in the valley.	2
Urban Drainage	Ability to mitigate impacts to the urban drainage system. High water levels in the creek create backwater conditions at the outfalls which limits the ability for the storm sewers to flow by gravity.	0 - negative impact on urban drainage 2 - no change 4 - positive impact on urban drainage	Some improvement to outfalls that outlet directly at Dundas Street.	3	No improvement to urban drainage.	2
Erosion Potential	Ability to mitigate erosion potential.	0 - increase in erosion potential 2 - no change 4 - decrease in erosion potential	Some localized improvements in the area of floodplain widening.	4	No change to erosion potential.	2
Constructability and Infrastructure Conflicts	Complexity of construction for implementing proposed works. Consideration is given to accepted construction/engineering practices, traffic considerations and implementation time.	0 - most challenging to implement 4 - least challenging to implement	Some challenges with access and steep valley grades will make implementation difficult.	0	No change, no works proposed.	4
Resiliency including Climate Change	Measure of resiliency against future climate change.	0 - does not include resiliency measures 4 - includes resiliency measures	Some opportunity for design to withstand and protect against larger storm events. Additional bridge/channel modifications would be required to increase capacity in the future, if needed.	4	Minimal opportunity for design to withstand and protect against larger storm events. Additional bridge/channel modifications would be required to increase capacity in the future, if needed.	0

Technical Screening Result

Dundas ADC1	Dundas ADC1 Rank	Dundas ADC2	Dundas ADC2 Rank
High Preference	3.0	Low Preference	2.0

Table 30b Floodplain Widening Downstream of Dunas Street Phase 3 Alternative Design Concept Evaluation - Economic Criteria

Criteria	Description	Ranking Descriptions	Dundas ADC1	Dundas ADC1 Rank	Dundas ADC2	Dundas ADC2 Rank
Capital Costs	Relative measure of the initiation costs to install/construct the proposed works including the channel works, and landscape costs	0 - highest capital cost 4 - lowest capital cost	Highest capital cost.	0	No capital costs.	4
Operation and Maintenance (O&M) Costs	Relative measure of the ongoing maintenance and operational costs following the implementation.	0 - most expensive 4 - least expensive	Less localized erosive potential over time, less need for future erosion works.	4	No change, erosion would be left to continue within the confined valley system and isolated works would need to be carried out.	0
Municipal Servicing	Effect on existing and proposed municipal servicing and private utility infrastructure.	0 - significant effects municipal servicing 4 - no effects on municipal servicing	Will affect and existing stormwater outfall along the west bank. Could be opportunity to facilitate a maintenance /access route.	2	No effects to municipal servicing.	4

Economic Screening Result

Dundas ADC1	Dundas ADC1 Rank	Dundas ADC2	Dundas ADC2 Rank
Low Preference	2.0	High Preference	2.7

Table 30c Floodplain Widening Downstream of Dunas Street Phase 3 Alternative Design Concept Evaluation - Environmental Criteria

Criteria	Description	Ranking Descriptions	Dundas ADC2	Dundas ADC2 Rank	Dundas ADC1	Dundas ADC1 Rank
Aquatic Ecology	Improvement on fisheries/aquatic habitat, connectivity, habitat sources, diversity, food sources and fish passage.	0 - negative effects 2 - no change 4 - positive effects	Some improvement to aquatic ecology due to decreased velocities and floodplain connections.	4	No change to existing conditions.	2
Terrestrial Ecology	Improvements on terrestrial ecology post-construction. (ground cover vegetation, trees and shrubs, which influence connectivity, diversity, and quantity/quality and provide habitat to wildlife as well as recreational and aesthetic value)	0 - negative effects 2 - no change 4 - positive effects	0.94 ha of tree removal required, Some improvement to riparian ecology due to created floodplain. Revegetation opportunities present.	1	No change to existing conditions.	2
Geomorphology	Ability to improve channel morphology, stability as well as sedimentation and erosion.	0 - negative effects 2 - no change 4 - positive effects	Improved channel morphology in the localized area. Ability to provide a better transition of the channel through the bridge area.	4	No change to existing conditions.	2

Environmental Screening Result

Dundas ADC1	Dundas ADC1 Rank	Dundas ADC2	Dundas ADC2 Rank
High Preference	3.0	Low Preference	2.0

Table 30d Floodplain Widening Downstream of Dunas Street Phase 3 Alternative Design Concept Evaluation - Social Criteria

Criteria	Description	Ranking Descriptions	Dundas ADC1	Dundas ADC1 Rank	Dundas ADC2	Dundas ADC2 Rank
Planning and Policy	Measure of the potential acceptance by approving/interested agencies	0 - low acceptance/approval 4 - high acceptance/approval	High acceptance anticipated. Will require temporary easement and excavated material will have to be disposed off.	3	High acceptance anticipated, no permits needed, less temporary ecologic disturbance	4
Public Input to Date	Measure of the initial public response and acceptance of the proposed alternative.	0 - low acceptance 4 - high acceptance	No specific feedback on Design Concept.	2	No specific feedback on Design Concept.	2
Property Acquisitions	Measure of the impact to adjacent private properties (i.e., loss of property, access to property and aesthetics).	0 - most impact 4 - least impact	Temporary easement required during construction. No property acquisitions.	3	No easements or property required, however if erosion is left to continue there could be impacts to the adjacent properties.	3
Disruptions during Construction	Potential disruptions to the adjacent property owners and businesses, and the surrounding local community.	0 - most impact 4 - least impact	Some disruption to adjacent landowners during construction.	2	No disruption.	4
Parks and Recreational Amenities	Potential for future trails and trail connections, improving public access, and aesthetics.	0 - least improvement 4 - most improvement	Minimal recreational opportunities within the current valley and land us setting. Would improve the aesthetics and view from the bridge and adjacent properties.	2	No change/improvements.	0
Cultural Heritage and Archaeology	Potential impact to cultural heritage or archaeological resources.	0 - high likelihood 4 - no disturbance	No archaeological disturbance.	4	No archaeological disturbance.	4
First Nations	Acceptance of proposed works by First Nations.	0 - low likelihood 4 - high likelihood	Initial acceptance of concept.	3	Initial acceptance of concept.	3

Social Screening Result

Dundas ADC1	Dundas ADC1 Rank	Dundas ADC2	Dundas ADC2 Rank
Low Preference	2.7	High Preference	2.9

Table 30e Floodplain Widening Downstream of Dunas Street Phase 3 Design Concept Evaluation - Overall Screening Result

Dundas ADC1	Dundas ADC1 Rank	Dundas ADC2	Dundas ADC2 Rank
High Preference	2.7	Low Preference	2.4

11.4.3 Floodplain Widening Design Concept Evaluation Summary

Table 31 summarizes the evaluation of the floodplain widening alternative design concepts under the four broad categories. Dundas ADC1 is preferred because it reduces water levels downstream of Dundas Street bridge and improves the environment including localized erosion issues.

There is minimal difference in the evaluation results of the two alternative design concepts. Not including this alternative design concept in the future detail design will not compromise the objectives of this project. It may be omitted from the preferred design if the City encounters any unforeseen issues when pursuing the floodplain widening.

Table 31 Summary of Design Concept Evaluation Floodplain Widening

Criteria Category	Dundas ADC1	Dundas ADC2
Technical	High Preference	Low Preference
Economic	Low Preference	High Preference
Environmental	High Preference	Low Preference
Social	Low Preference	High Preference
Overall	High Preference	Low Preference

11.4.3.1 Summary of Technical Screening

- Dundas ACD1 shows some water level reduction downstream of Dundas Street, this improves the backwater conditions at local stormwater outfalls.
- Dundas ACD1 decreases the localized erosion potential through the widened floodplain and channel works.
- Dundas ACD1 is more challenging to implement as additional construction and soil removal is required to widen the valley.
- Dundas ACD1 provides more opportunity for climate change resiliency as it reduces water levels in the local area.

11.4.3.2 Summary of Economic Screening

- Dundas ACD1 has the highest capital costs, but less future operation and maintenance costs. Dundas ACD1 would also reduce the need to complete the erosion repair works in isolated projects.
- Dundas ACD1 will impact an existing stormwater outfall which will need to be adjusted.

11.4.3.3 Summary of Environmental Screening

- Dundas ACD1 creates improved geomorphic and aquatic conditions.

11.4.3.4 Summary of Social Screening

- Both alternative design concepts are anticipated to have high acceptance by planning and policy agencies.
- Dundas ACD1 will require a temporary easement during construction but no property acquisitions. There could be some disruption to adjacent landowners during construction, however this is expected to be minimal compared to the planned BRT construction.
- Dundas ACD1 will improve aesthetics and leave some potential for trail access/connections in the future.

11.5 Stakeholder, Public, and Agency Input

The Project objectives, background, evaluation criteria, alternative solutions, alternative design concepts, and preliminary evaluation results were presented to stakeholders, agencies, and the public through PIC No. 2 which was posted online on May 19, 2023. Detailed comments received from stakeholders are documented in Appendix A. Input and comments on the evaluation of the alternative solutions and alternative design concepts are summarized in Table 32.

Table 32 Summary of Stakeholder Input During Public Information Centre No. 2

Stakeholder	Stakeholder Commentary	Matrix Response
Peel Region	If there are any impacts to regional roads or within the right-of-way, please advise traffic staff beforehand. Ensure Book 7 is adhered to during construction.	Peel Region has been involved in the planning process and will be notified prior to initiation of any works.
MNRF	Cautioned that berms are not considered to provide permanent flood protection based on existing MNRF technical guidance.	Matrix acknowledged that berms are not considered to provide permanent flood protection and agreed that the land remaining behind the berm at 1607 Dundas Street will continue to be considered floodplain. Matrix has engaged TRCA as well as the landowner and tenant of this property throughout the project and have made this constraint clear.
Public	Suggestion of an alternative method for a flood flow diversion.	The flow diversion path was reviewed in work completed in a previous study and was determined to be infeasible.
	A few affirmations that the work needs to be done to mitigate flooding.	The project team agreed and noted that flooding should be addressed.
	Comments regarding the project not being needed and geared towards development.	The project team provided the background context to show the risk of widespread flooding (e.g., July 8, 2013 storm).
	Request to begin to plan for development prior to the removing the SPA.	Development opportunities are to be discussed with the City outside of this project.
	Some residents adjacent to the creek were not supportive of the project.	The project team discussed the importance of balancing a net benefit for all residents in the area, and the downstream neighbours are currently subjected to intense flooding.
	Questions regarding timing and cost.	The project team provided direct answers about the schedule and where the project is at in terms of cost.

Notes:
MNRF - Ontario Ministry of Natural Resource and Forestry
SPA - Special Policy Area
TRCA - Toronto and Region Conservation Authority

11.6 Selection of the Preferred Design Concepts

The Phase 3 Municipal Class EA evaluation process of the alternative design concepts resulted in the following elements being selected as part of the preferred design concept:

- Lower the channel invert at Dixie Road by a minimum of 0.5 m, with 1.0 m being preferred. Maintain 3:1 valley side slopes where possible.
- Replace Dixie Road bridge with a 50 m three-span bridge
- Lower the trunk sanitary sewer at Dixie Road and lower the sanitary sewer that crosses Little Etobicoke Creek at Jarrow Avenue.
- Raise the existing berm at a private property upstream of Dundas Street.

Further description of the preferred design is provided in the following Section (Section 12).

12 Description of the Preferred Design

12.1 Project Components

The preferred design is comprised of works proposed within the Dixie Area and the Dundas Area together. This design satisfies the Project goal of mitigating Regional storm flood conditions, such that the two existing SPAs can ultimately be removed. The preferred design accomplishes the flood mitigation objectives with additional resiliency and has been guided by many considerations and constraints identified during the process. The design notably addresses the existing hydraulic pinch point at the Dixie Road bridge as well as the increased full flow condition that will occur downstream at the Dundas Street bridge once the existing spill at Queen Frederica Drive is contained within the creek valley. The preferred design includes an engineered but natural channel inspired design principals, lowering of the channel, increased floodplain connectivity, and larger bridges.

Figure 36 display plans for the preferred design for the Dixie and Dundas areas. A summary of the key components of the preferred design is outlined in Table 33 and detailed in the following subsections.

Table 33 Summary of Main Components in the Combined Preferred Design

Design Component	Dixie Area	Dundas Area
Channel Conveyance	Widen the channel valley from approximate 500 m upstream of Dixie Road to 600 m downstream of Dixie Road. Lower the channel invert by 0.5 to 1.0 m.	Widen the channel and valley corridor from approximately 200 m upstream of Dundas Street to 400 m downstream of Dundas Street.
Bridge Spans	50 m	25 m
Floodplain	Improve the floodplain downstream of Dixie Road bridge.	Improve the floodplain downstream of Dundas Street bridge for approximately 300 m.
Berms (recognized as non-permanent measures)	Maintain existing earthen berm downstream of Dixie Road bridge.	Raise existing earthen berm upstream of Dundas Street bridge.
Sanitary Sewers	Lower sanitary sewers at Dixie Road bridge and Jarrow Avenue.	Relocate the sanitary siphons at Dundas Street (completed through the BRT project).
Trail/Recreation	Improved trail and access in reconstructed floodplain	Some potential trail and access in reconstructed floodplain.

Notes:
BRT - bus rapid transit
N/A - not applicable

The recommended construction sequencing of the various works associated with this preferred design has been determined according to a logical framework that reflects currently anticipated requirements and challenges. Most importantly, the execution of the preferred design requires that works for the Dundas Area be completed prior to completing the works in the Dixie Area.

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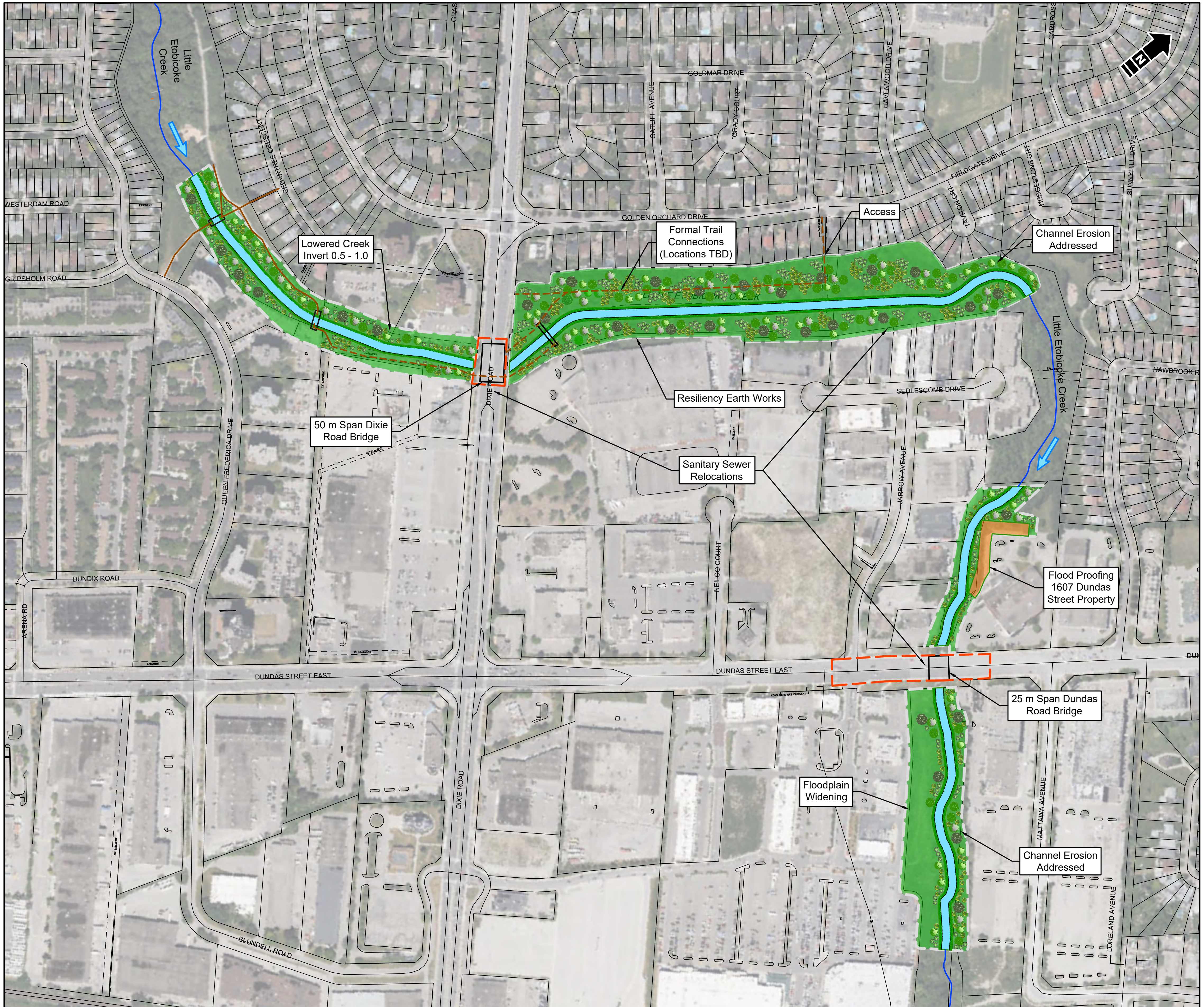

Legend

- Creek Centreline
- Property Line
- Channel Conveyance Improvements
- Floodplain Conveyance Improvements
- Easement
- Existing Trail
- Proposed Trail (TBD)
- Potential Pedestrian Bridge (TBD)
- Existing Pedestrian Bridge
- Road Grading Limits
- Flow Direction

NOT FOR CONSTRUCTION

1 : 5,000 metres
50 0 50 100
CSRS.UTM-17N

Matrix Solutions Inc.
A Montrose Environmental Company

City of Mississauga
Dixie Dundas Flood Mitigation Environmental Study Report

Preferred Design

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
October 2023	A. McKay	K. Hofbauer	G. Evenson
PROJECT: 24603-531		REVISION:	DRAWING: 36

12.1.1 Channel Conveyance

The channel conveyance improvements recommended throughout Little Etobicoke Creek vary in width and depth in an effort to optimize the valley slopes and minimize impacts to existing property while conveying the Regional flood with some resiliency. A preferred channel design has been determined for four different reaches of Little Etobicoke Creek through the Project study area. The preferred design for each reach has been evaluated using hydraulic modelling to confirm the flood flows will be contained and that the designs will satisfactorily address the other components described in this section. An overview of the preferred average dimensions and channel designs for each of the reaches that comprise the preferred design are described below along with brief explanations.

- **500 m Upstream of Dixie Road:** This section of Little Etobicoke Creek includes wider and lower channel configuration with approximately 3H:1V to 2H:1V side slopes (Figures 37 and 38). This preferred design will improve upon the existing sinuosity of the creek where possible and will replace any failed armourstone. Adjacent residential properties constrain widening opportunities for Little Etobicoke Creek, with some required property acquisition proposed for parking lots located immediately south of the creek. Property at this location is required to accommodate a widened channel entrance to the Dixie Road bridge, releasing the existing hydraulic pinch point.

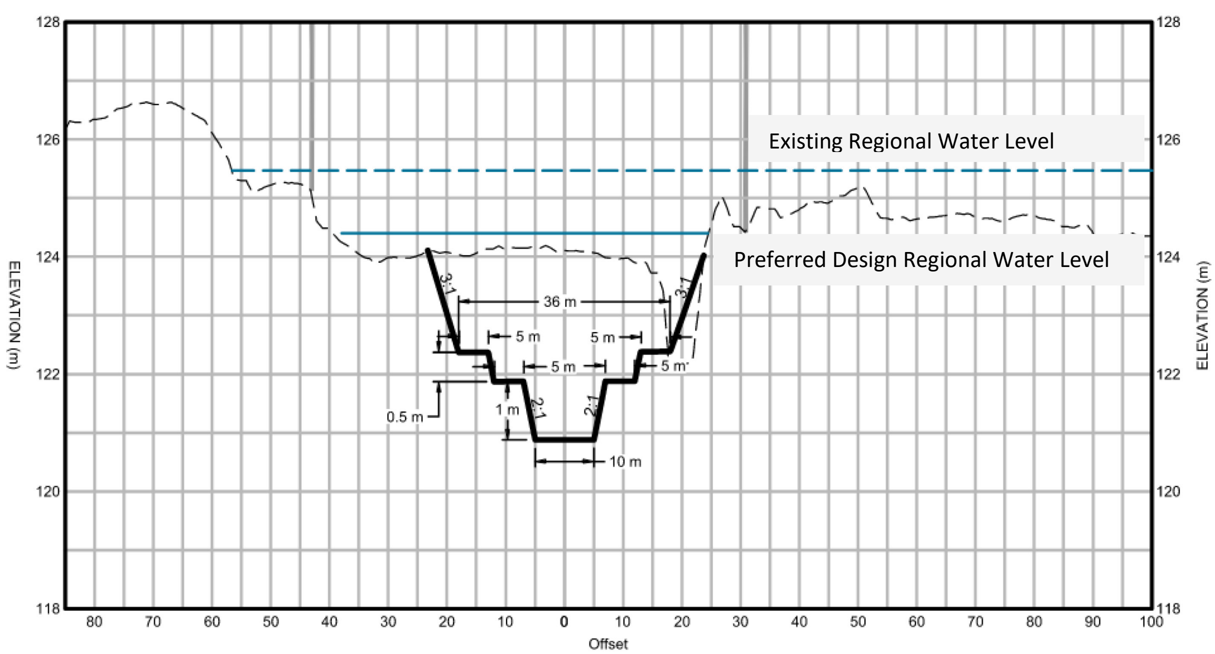

Figure 37 **Preferred Design Creek Cross-section: - 200 m upstream of Dixie Road**

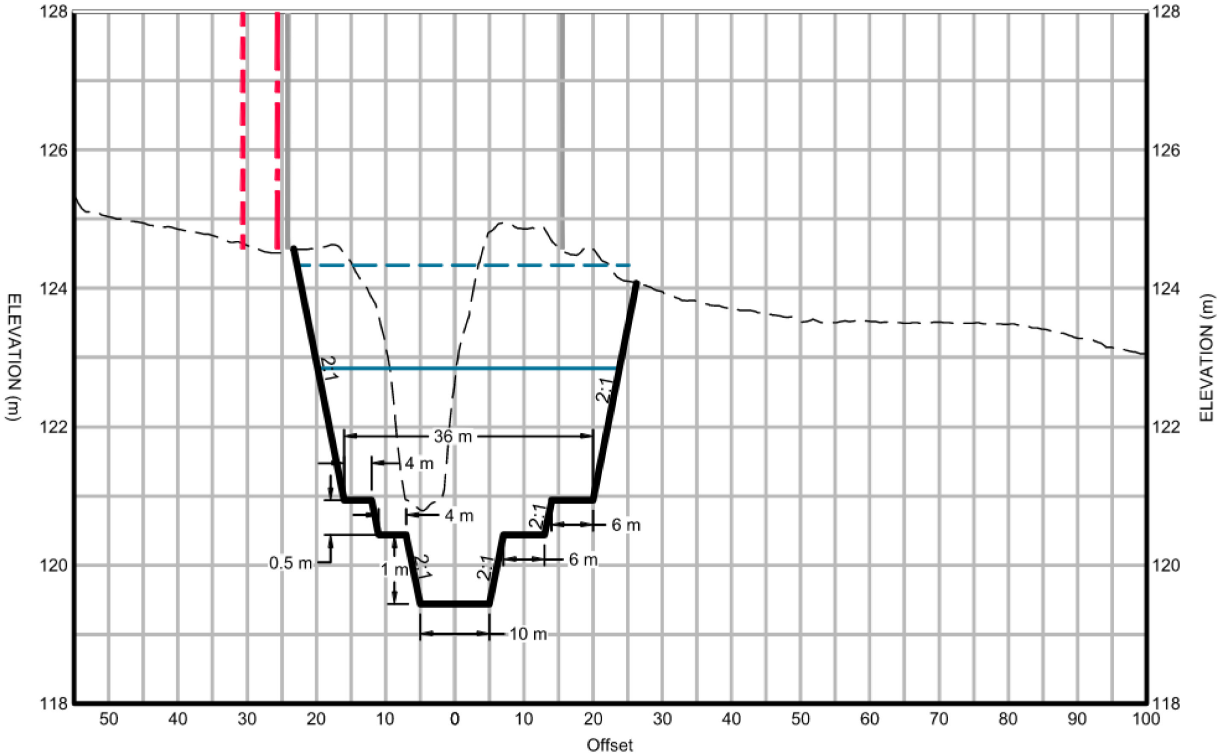

Figure 38 Preferred Design Creek Cross-section - 50 m upstream of Dixie Road

- **Dixie Road to Approximately 600 m Downstream:** This section of Little Etobicoke Creek has a history of high erosivity that has resulted in past installation of armourstone bank protection which has continued to degrade. The preferred design connects the channel to the existing 70 m valley available for floodplain, using 3H:1V side slopes, thereby improving conveyance and providing additional recreation and trail opportunities. The proposed flood plain and channel combination for this reach will require significant earthworks to implement. The channel itself is proposed to have an average width of 10 to 12 m and depth of 0.7 to 1.0 m with 2H:1V side slopes (Figure 39). Temporary and permanent easements will be required from properties immediately adjacent to the south creek bank to address potential channel configuration requirements, including works required at the existing earthen berm located along this reach (Section 12.1.4). Some property acquisition will be required from the private property abutting Dixie Road south of Little Etobicoke Creek to accommodate the widened channel and larger bridge span.

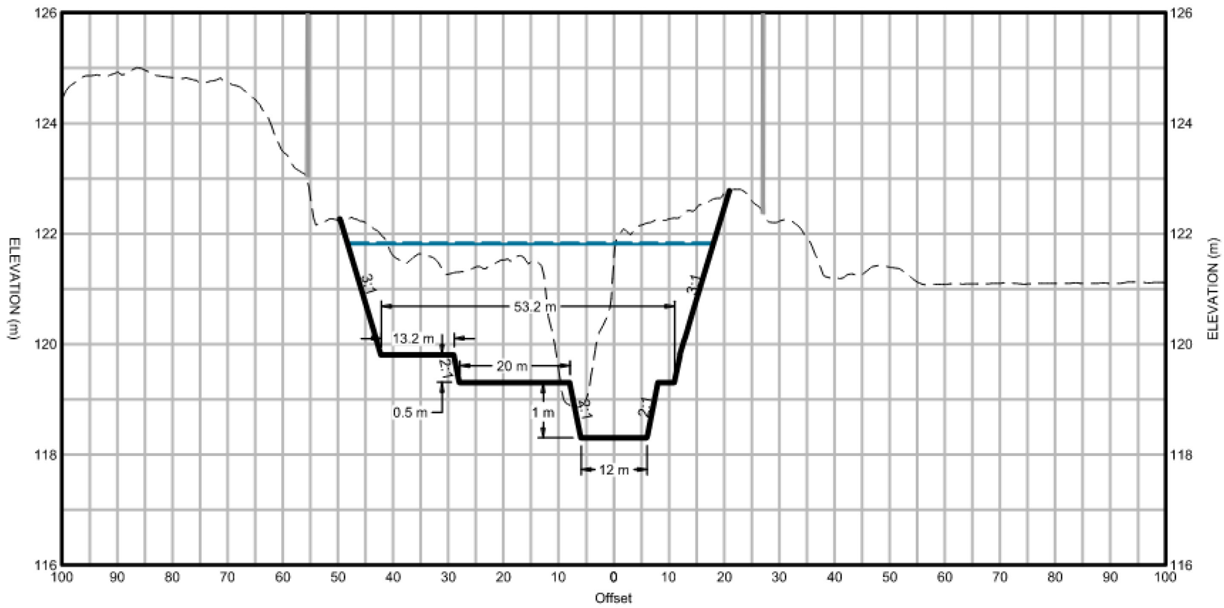

Figure 39 Preferred Design Creek Cross-section - 200 m Downstream of Dixie Road

- **200 m Upstream of Dundas Street:** The preferred design contains a widened and reconfigured channel to accommodate a larger span bridge at Dundas Street (Section 12.1.2). Reconfiguration of this reach includes works to the existing berm located on the east bank (Section 12.1.4). The channel will have an average bottom width of approximately 10 m, with an average depth of 1 m. The existing channel invert will be maintained (no deepening, Figure 40). Valley side slopes through this reach will be similar to the existing condition, averaging 2H:1V. This portion of Little Etobicoke Creek has a history of erosion; the detailed design will incorporate strategies to strengthen the banks prone to erosion. Temporary and permanent easements will be required from properties immediately adjacent to the west creek bank. Some property acquisition will be required from private properties abutting Dundas Street.

Figure 40 Dundas Area Channel Design Cross-sections

- **Dundas Street to 400 m Downstream:** The widened channel design will continue from Dundas Street bridge with a low-flow channel with an average bottom width of 10 m and depth of 1 m with 2H:1V side slopes. A 25 m wide floodplain on the west side of the valley (Section 12.1.3) is recommended to add resiliency to the design and mitigate erosion prone areas. The lands required for the increased floodplain width are owned by the City.

12.1.2 Bridges

A 50 m span bridge is recommended at Dixie Road to facilitate the channel widening and improve conveyance. Preliminary and detailed design phases for this bridge are to be completed in collaboration with the Peel Region (owners of Dixie Road), including any utilities, traffic, and drainage issues. Additional preliminary design considerations are included in Appendix I.

A 25 m span bridge is recommended for the Dundas Street bridge as it will convey the design flows, cost less than the other alternatives, and align well with other coinciding projects, including the BRT project. Preliminary design considerations have been outlined in Appendix I.

Future works at Dundas Street will be managed through the BRT project. These works include the bridge replacement, road regrading, and the channel design in the immediate vicinity of the Dundas Street bridge. Conveyance capacity and bridge span requirements will be implemented by the BRT project team, as stipulated in the Municipal Class EA process.

The required bridge replacements for the Project are located within areas known to have consistently heavy traffic: along both Dixie Road and Dundas Street. A traffic plan will be required prior to construction of each bridge.

Two pedestrian bridges upstream of the Dixie Road bridge will have to be replaced to accommodate the widened channel. It has been noted that TRCA will require that these bridges (or any additional future pedestrian bridges within the Project study area) either span the Regional water level or be included in hydraulic modelling to confirm the proposed design will not adversely increase flood levels.

12.1.3 Floodplain Improvements

The floodplain area upstream and downstream of the Dixie Road bridge is proposed to be reconfigured from its existing condition. It is recommended that the total existing valley corridor width be regraded to provide floodplain connectivity with the newly reconfigured and lowered channel. The regrading also allows for incorporation (and/or formalization) of a trail (Section 12.1.6), more recreational opportunities, and planting of higher quality and native vegetation (Figure 36). The existing butternut tree (to be determined if a pure species) should be protected throughout construction and incorporated into the detailed floodplain design.

An improved floodplain is to be incorporated into the preferred design downstream of Dundas Street bridge. The grading will include a wider floodplain for approximately 300 m downstream of the bridge, along the west side of the valley (Figure 36).

12.1.4 Berms

The existing earthen berm located downstream of the Dixie Road bridge, starting near the bridge and extending downstream 400 m on the southern bank of the watercourse, was reviewed as part of the preferred design. The existing berm currently provides some functional flood protection; but cannot be considered a permanent flood protection measure according to existing MNRF policy. However, the existing earthen berm can still provide additional flood resiliency above the Regional storm water levels.

Detailed design will need to consider geotechnical investigations. Native ground beneath the berm is shown through interpretation of existing LiDAR information to be within 0.5 m of the estimated future Regional storm (full flow) flood levels downstream of Dixie Road. Geotechnical investigations are needed to confirm the native ground elevation in this area and determine if minor grading with engineered fill is required to supplement soils beneath the berm to elevations at least or above the Regional storm water levels. It is anticipated that the berm would be reinstated to its original height with competent soil structure. The additional existing resiliency beyond the MNRF/TRCA regulation levels will be readily preserved in this manner without significant costs.

The existing berm located immediately upstream of Dundas Street on the east bank is also recommended to be retained and improved as part of the preferred design. Geotechnical investigations will be required to confirm the existing berm can maintain functional integrity against flood flows as this was not examined in detail as part of this Project. However, the geometry of the berm indicates it protects the property from flooding under Regional storm conditions. The berm is not recognized as a permanent flood control work, per MNRF policy, but nonetheless its function must be maintained or enhanced by the Project. The preferred design include maintaining the berm in its current location and alignment and raising it by 1 m at its low point (Figure 33) to protect against the future Regional storm (full flow) flood levels. Detailed design of the berm improvements will include geotechnical design to ensure the berm can structurally withstand the Regional storm flow condition.

12.1.5 Sanitary Sewers

The existing exposed 450 mm diameter sanitary sewer that crosses the watercourse approximately 400 m downstream of Dixie Road is recommended to be lowered by approximately 1.3 m. The lowering will extend from the creek along Jarrow Avenue to an existing manhole north of Dundas Street. The lowering works are not anticipated to impact BRT construction works but will need to be confirmed with the future BRT construction team. The sewer lowering, including the watercourse crossing, could be completed in advance of other works within the preferred design if the sewer exposure risks become more acute.

Sanitary sewer crossings occur at both the Dixie Road bridge and Dundas Street bridge. Both crossings are considered in the preferred design. The trunk sewer crossing at Dixie Road was the focus of coordination with Peel Region. The preferred design includes lowering this sewer crossing by approximately 1.8 m from its existing vertical position while maintaining its current horizontal alignment (or in close proximity). This lowering will facilitate the recommended channel lowering of 1.0 m at this location. The proposed combined lowering of channel and sewer will result in the sewer obvert achieving approximately 1.4 m of cover to the proposed bottom of Little Etobicoke Creek channel.

At Dundas Street, the existing sanitary siphon structure (three pipes in total) will be adjusted to suit the new Dundas Street bridge configuration being designed and constructed by the BRT project team. The work completed by BRT will include coordination with flood levels as determined through this Project and will also include extensive coordination with Peel Region.

Detailed design and construction plans for all sanitary sewer adjustments required as part of the preferred design will be completed in the next phases of the project. Designs will follow best management practices and will be required to provide ample notification to impacted residents and businesses.

12.1.6 Other Utilities and Municipal Services

Numerous other utilities (i.e., cable, hydro, gas etc.) will require relocation to implement the preferred design, including floodplain widening, channel lowering, and the bridge replacements. Preliminary analysis of required utility relocation and other municipal servicing (e.g., 400 mm watermain and storm sewer outfalls) indicates no anticipated significant constraints for completing these required works. Topographic survey and subsurface utility engineering will be conducted to support the next phase of design.

12.1.7 Trail, Recreation, and Access Improvements

Trail and access improvements were considered in the preferred design. The City would like to use the opportunities created through this project to improve formal access to the Little Etobicoke Creek corridor. Implementation of the preferred design will require tree and vegetation removals throughout the valley corridor. Landscaping these areas will restore the construction disturbance with native vegetation, particularly in Willow Creek Park, which would contribute to long-term recreation and habitat improvements.

The existing trail along the north bank of Little Etobicoke Creek through the Dixie Area will be reconstructed and may be extended through the new Dixie Road bridge if feasible. The trail will be formalized downstream (i.e., east) of the bridge, and incorporated as a feature within the improved floodplain area. Preliminary sketches of potential trail configurations are provided in Appendix K. Suitable pathway configuration decisions will be made with input from various departments at the City as well as from Peel Region, who control the Dixie Road RoW, including the new bridge during the next phase of design. The design will follow the City's urban design guidelines (City of Mississauga 2023g), which includes consideration of trail user safety and safety for residents living adjacent to the valley.

12.2 Construction Sequencing

Successful implementation of the preferred design will require components to be constructed starting at the most downstream location and work upstream. Therefore, improvements to the Dundas Area will need to be completed before those in the Dixie Area. The Dixie Area works, particularly the bridge replacement and channel/valley works, can not be constructed prior to implementing the improvements downstream at the Dundas Area, as the larger full flow conditions could not be accommodated within the existing configuration of watercourse and bridge in the Dundas Area. There is some flexibility with respect to the sequencing of the require utilities works (such as the lowering of the sanitary sewers) as they are not anticipated to impact channel conveyance directly. Table 34 lists the recommended construction sequencing for the preferred design. A comprehensive construction staging plan will be prepared during the detailed design phase.

Table 34 Construction Sequencing

Construction Phase	Project Component	Responsible Party	Required/Recommended Order of Completion	Notes
1	Dundas Street Watermain and Sanitary Diversion (Mattawa Avenue)	Peel Region	Scheduled to be completed prior to Dundas Street bridge replacement.	A single remaining section of watermain will have flexibility to be constructed during the bridge works.
2a	Sanitary Siphon Relocation	BRT	Required before the Dundas Street bridge replacement.	Could be done concurrently with the bridge and localized channel works (Phases 2b/2c).
2b	Dundas Street Bridge Replacement	BRT	Required before upstream Dixie Area construction.	Could be done concurrently with the sanitary siphon relocation and localized channel works (Phases 2a/2c).
2c	Little Etobicoke Creek Channel: Immediately Upstream and Downstream of Dundas Street	BRT/City of Mississauga	Limited interim channel works, must be done concurrently with Dundas Street bridge works.	Full channel works and downstream floodplain improvements could also be completed at this time.
3a	Jarrow Street 450 mm Sanitary Sewer Relocation (up to channel/valley)	Peel Region	Must be completed before Phase 3b.	Flexible timing: could finish just in time for connection (Phase3b). Alternatively, could be advanced as a separate project given its isolation from other project elements. Region components of Phases 3b, 4a, and 4b could be completed at the same time.

Construction Phase	Project Component	Responsible Party	Required/Recommended Order of Completion	Notes
3b	450 mm Sanitary Sewer across Valley from Taviton Court	Peel Region	Follows Phase 3a. Must be completed in advance of watercourse and valley works immediately downstream of Dixie Road.	Will be connected to the new lowered Jarrow Avenue sanitary sewer described in Phase 3a. Must be completed before Phase 5b.
4a	Watermain Relocation at Dixie Bridge	Peel Region	Must be completed before or concurrently with Dixie Road bridge replacement.	Timing will depend on the proposed construction methods (e.g., open cut vs. drilling). Region components of Phases 3a/3b, 4a/4b, and 6 could be completed at the same time.
4b	Dixie Road 900 mm Trunk Sewer Relocation	Peel Region	Before Little Etobicoke Creek channel lowering through Dixie Area (Phases 5b and 7).	Timing will depend on the proposed construction methodology (e.g., open cut vs. drilling). Can be done as separate project in advance of other Dixie Road works. Region components of Phases 3a/3b, 4a/4b, and 6 could be completed at the same time.
5a	Little Etobicoke Creek Channel Upstream of Dundas Street/Berm	City of Mississauga	All required channel works within the Dundas Area could potentially be done concurrently with Dundas Street bridge works, but must be completed prior to Dixie Road bridge replacement.	All channel works upstream of Dundas Street must be complete prior to increasing the hydraulic capacity at Dixie Road. Can be complete concurrently with Phase 5b. Downstream floodplain improvements to be completed if not completed during construction Phase 2c.

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Construction Phase	Project Component	Responsible Party	Required/Recommended Order of Completion	Notes
5b	Downstream of Dixie Road Channel and Valley Works	City of Mississauga	Must be completed prior to the Dixie Road bridge replacement (Phase 6).	Downstream valley needs increased hydraulic capacity to receive the potential increased flood flows. Lowered channel invert through valley also required to accommodate new Dixie Road bridge.
6	Dixie Road Bridge and Road Works	Peel Region	Could potentially be done concurrently with upstream channel works. Cannot be started before completion of Phases 2b or 5b.	Peel Region Phases 4a/4b must be completed prior to or concurrently with the bridge replacement. Peel Region Phases 3a/3b could be completed at the same time.
7	Upstream Dixie Road Channel and Valley	City of Mississauga	Could potentially be completed with Dixie Road bridge works. Alternatively, could be the last component of construction.	Will require consideration/redesign of pedestrian bridges and redesign of existing trail.

Notes:
BRT - bus rapid transit
EA - environmental assessment

12.3 Integration with Other Projects

12.3.1 Bus Rapid Transit Project

The City is currently leading the BRT project with Metrolinx involvement. This is part of the implementation of the City's Dundas Connects Master Plan. Several meetings were held between the Project team and the City's BRT project team during Phases 2 and 3 of the Municipal Class EA process to ensure that various design elements proposed in the BRT project coordinate with the EA project.

In particular, the BRT project team and the Project team discussed options for the Dundas Street bridge and the many variables involved in the roadway design at this location. The Project team incorporated the requirements of the BRT project into the alternative solutions and design concepts for the Dundas Street bridge. A preliminary design of the Dundas Street bridge and a conceptual cross-section upstream and downstream of Dundas Street were provided to the BRT project team to support the Dundas Street bridge replacement for the BRT. The bridge design concept incorporates the required flood conveyance.

12.3.2 Proposed and Future Development

The City corresponded with several developers (and/or their representatives) throughout the Project. Development-related questions were fielded by City staff and on occasion by the Project team in coordination with others at the City. Most enquiries related to updates on project timing and preliminary determination of potential impacts to their properties resulting from the project. In some cases, and in particular for the developer of lands located immediately west of Dixie Road and north of Little Etobicoke Creek, preliminary development plans were reviewed for their potential consideration within the Project alternatives.

12.4 Preliminary Cost Estimate

Preliminary cost estimates for the preferred design are contained in Table 35. In some cases, costs for components of the preferred design were estimated during earlier EA phases. Inflation estimates have been included (as noted in the table) to align those costs closer to current estimates. Cost estimates will continue to be refined as the City progresses through future project phases.

Table 35 Dixie-Dundas Flood Mitigation Environmental Assessment Preferred Design Cost Estimate

Capital Cost Items	Units	Amount	Unit Cost	Total Cost	Reference
1. Dixie Road	-	-	-	-	-
1.1 Land Acquisition	-	-	-	-	Not estimated
1.2 Construction Items	-	-	-	-	-
1.2.1 Bridge (50 m three-span)	ea	1	5,900,000.00	5,900,000.00	Dixie Road Bridge Feasibility Report (RVA 2023)
1.2.2 Other roadworks on Dixie Road (300 m)	ea	1	1,650,000.00	1,650,000.00	Dixie Road Bridge Feasibility Report (RVA 2020) + 20% added for inflation, + $500,000 allowance for watermain
1.2.3 Watercourse - Upstream of Dixie Road	m	600	5,000.00	3,000,000.00	Matrix estimated from previous channel design projects.
1.2.3.1 Earthworks	m^3	50,000	50.00	2,500,000.00	Matrix estimated from previous channel design projects.
1.2.4 Watercourse - Downstream of Dixie Road	m	700	5,000.00	3,500,000.00	Matrix estimated from previous channel design projects.
1.2.4.1 Earthworks	m^3	75,000	50.00	3,750,000.00	Matrix estimated from previous channel design projects.
1.2.5 All landscaping, trail, and three pedestrian bridges	l.s.	1	2,400,000.00	2,400,000.00	Matrix estimated from previous channel design projects, + $900,000 allowance for three pedestrian bridges
1.2.6 450 mm Sanitary Sewer Lowering from Taviton Court to Dundas Street via Jarrow Avenue	l.s.	1	1,975,600	1,975,600	Sanitary Sewer Addendum Report (Matrix 2022a), soft costs removed
1.2.7 900 mm Trunk Sanitary Sewer Lowering	l.s.	1	3,207,400.00	3,207,400.00	Sanitary Sewer Addendum Report Matrix 2022a), soft costs removed
Subtotal Dixie Road	**-**	-	-	**27,883,000.00**	**-**
15% Engineering and Regulatory (Other Components)	-	-	-	2,269,950.00	Assumed 10% design and approvals, 5% CA and Inspection
20% Engineering and Regulatory (Channel Design Components)	-	-	-	2,550,000.00	Assumed 14% design and approvals, 6% CA and Inspection (based on previous channel design projects)
Contingency (20%)	-	-	-	5,576,600.00	Based on the construction cost subtotal item only
Total Dixie Road (not including HST)	-	-	-	**38,279,550.00**	**-**
2. Dundas Street	-	-	-	-	-
2.1 Land Acquisition	-	-	-	-	Not estimated

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Capital Cost Items	Units	Amount	Unit Cost	Total Cost	Reference
2.2 Berm Retrofit (1607 Dundas Street East)	m	150	3,000.00	450,000.00	-
2.3 Construction Items	-	-	-	-	-
2.3.1 Bridge (25 m)	ea	1	6,800,000.00	6,800,000.00	Dundas Street Bridge Feasibility Report (RVA, 2021) + 10% added for inflation
2.3.2 Other roadworks on Dundas Street	ea	1	1,800,000.00	1,800,000.00	Dundas Street Bridge Feasibility Report (RVA, 2021) + 10% added for inflation
2.3.2.1 Allowance for San Siphon Works	ea	1	12,323,307.00	12,323,307.00	Provided by Jacobs in September 2023
2.3.3 Watercourse - Upstream of Dundas Street	m	200	5,000.00	1,000,000.00	Matrix estimated from previous channel design projects.
2.3.3.1 Earthworks	m^3	1,000	60.00	60,000.00	Matrix estimated from previous channel design projects.
2.3.4 Watercourse - Downstream of Dundas Street	m	300	5,000.00	1,500,000.00	Matrix estimated from previous channel design projects.
2.3.4.1 Earthworks	m^3	20,000	50.00	1,000,000.00	Matrix estimated from previous channel design projects.
Subtotal Dundas Street	-	-	-	**$24,933,307.00**	
15% Engineering and Regulatory (Other Components)	-	-	-	$3,205,996.05	Assumed 10% design and approvals, 5% CA and Inspection
20% Engineering and Regulatory (Channel Design Components)	-	-	-	$712,000.00	Assumed 14% design and approvals, 6% CA and Inspection (based on previous channel design projects)
Contingency (20%)	-	-	-	$4,986,661.40	Based on the Construction Cost subtotal item only
Total Dundas Street (not including HST)	-	-	-	**$33,837,964.45**	-
Total Dixie Road and Dundas Street Projects	-	-	-	**$72,117,514.00**	-

Notes:

- Values presented do not account for future inflation at the time of construction.
- Cost estimates will continue to be refined and the City progresses through future project phases.
- Earthworks does not account for potential soil contamination and proper disposal.

12.5 Implementation, Potential Impacts and Net Effects

Implementation of the preferred design is intended to have a positive net effect throughout the Project study area. Potential adverse impacts from the project have been identified and have been mitigated through the design concepts put forward for the project. Potential impacts of the project, both positive and negative, have been divided into three parts: pre-construction, construction, and post-construction. The "Pre-construction" portion describes the impacts of the immediate next steps of the project. "Construction" impacts reflects temporary impacts during the construction phase of the project, and "Post-construction" impacts are those which are long-lasting and subject to longer-term changing conditions (e.g., climate change and population growth). The goal of the project (see Section 2) can be summarized as providing flood protection to residences and businesses as well as to enable future growth. The combination of a flood free future and future growth is anticipated to have a major positive net effect for the entire study area.

Table 36 summarizes the impacts of the preferred design at the end of this section. The table is intended to outline the most significant effects associated with the preferred design. The potential impacts were divided into the same categories as found in the evaluation tables: technical, economic, environmental, and social. The order of the items in the table is arbitrary and does not represent an order based on any calculated or perceived importance.

12.5.1 Pre-construction and Detailed Design

12.5.1.1 Communications and Consultation

The City will manage this project in coordination with other projects in the area as they proceed on similar timelines. Collaboration will continue between the City, project consultants, the Region, and TRCA. Projects will be planned to minimize construction disruptions and efforts as best as possible (e.g., cutting into the road once to address two different project goals). The City will continue to listen to any concerns from the public and incorporate resolution of concerns as much as reasonably possible into the design.

12.5.1.2 Modelling and Future Studies

Detailed design of mitigation works will include further hydraulic modelling to confirm predicted flood levels, to add in details, and to integrate other elements that progress from other studies as described further below. The current hydraulic model includes the preferred Dixie Road and Dundas Street bridge spans, and the widened channel and floodplain geometry. Refinement of the model in future design phases will have to reflect final configurations of the channel and floodplain geometry, trails and pathways, replacements or additions of pedestrian bridges, and any other features that could affect Regional water levels. Hydraulic modelling refinements will not impact evaluation of the alternatives, but instead are intended to provide guidance during detailed design and construction.

The Stage 1 archaeological assessment provided insight that some archaeological potential exists within the study area. The City and future project team(s) will continue to approach the implementation of the preferred design with care around the areas identified for further assessment. At detailed design, a Stage 2 archaeological assessment (i.e., with test pits at 5 m intervals) will be completed in consultation with Indigenous groups and First Nations. In particular, the Mississaugas of the Credit First Nation have expressed interest in being present when the test pit work is carried out. Should the next stage reveal further archaeological findings, plans to execute a Stage 3 and/or Stage 4 archaeological assessment will proceed, and the preferred design must accommodate the findings.

The locations of existing infrastructure will be confirmed at detailed design using subsurface utility engineering and topographic survey. The verified location and elevations of existing infrastructure will be documented on drawings to provide the basis for detailed design and construction implementation.

12.5.1.3 Permits, Standards, and Guidelines

To make changes to and within the channel and floodplain, various permits will have to be procured. Additionally, all construction work will have to respect construction-timing windows. A full natural heritage impact assessment and tree inventory survey will need to be completed prior to construction. This study will include an assessment to confirm if the existing SAR butternut tree on-site is a pure species and develop a plan accordingly. The presence of SAR bat species within the project areas will need to be confirmed through further investigations. Bat habitat may require preservation based on the recommendations from the SAR bat surveys. A list of anticipated permits to be obtained is provided in Section 14.

The preferred design must also comply with the following standards and acts:

- Ontario Environmental Assessment Act, 1990 as amended 2023
- Clean Water Act, 2006
- Fisheries Act, 1985 as amended 2019
- Migratory Birds Act
- Provincial Policy Statement, 2020

- A Place to Grow: Growth Plan for the Greater Golden Horseshoe, 2019
- Impact Assessment Act, 2019, if applicable
- Stormwater Management Planning and Design Manual, 2003
- Region of Peel Public Works Stormwater Design Criteria and Procedural Manual, 2019
- Region of Peel Public Works Design Specifications and Procedures Manual – Linear Infrastructure – Sanitary Sewer Design Criteria, 2017
- Region of Peel Public Works Design Specifications and Procedures Manual – Linear Infrastructure – Regional Roads and Traffic, 2010
- City of Mississauga Transportation and Works Department's Development Requirements Manual, 2020
- Crossing Guideline for Valley and Stream Corridors (TRCA, 2015)
- Ministry of Transportation (MTO) Highway Drainage Design Standards (HDDS) (MTO, 2008)
- Canadian Highway Bridge Design Code (CHBDC)

The guidelines below will help direct the final design of the flood mitigation solution:

- Management of Excess Soil – A Guide for Best Management Practices
- TRCA's Erosion and Sediment Control Guide for Urban Construction (TRCA 2019)
- TRCA Strategic Plan (including the Suitable Neighbourhood Retrofit Action Plan, TRCA Conservation Land Care Program, TRCA Trails Program, TRCA Community Transformation Program, and Partners in Project Green)
- Dundas Connects Master Plan
- Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities (Cheminfo Services Inc. 2005)

12.5.1.4 Costs

The capital costs for the preferred design estimated in this report reflect the current understanding of required material and effort (see Section 12.4). Costs include estimates for the bridge replacements, floodplain improvements, conveyance improvements, replacing the trail and recreational improvement, earthworks, sanitary sewer relocations, and an allowance for engineering and regulatory fees. Land acquisition costs are not presented in this report, but instead will be reviewed and included at detailed design.

12.5.1.5 Land Acquisition and Easement Requirements

Some properties within the Project study area will be impacted by the preferred design. Potentially impacted private properties were based upon a preliminary level of design only (i.e., EA level of design) and are shown on Figure 37. Impacts to properties include:

- **Permanent property acquisition or easements**: land portions that are anticipated to become physically part of the enhanced and expanded valley and floodplain area through completion of the preferred solution or areas that require permanent and unobstructed access to maintain works. Most of these lands now being used as parking lots or otherwise undeveloped and adjacent to the creek valley.

- **Temporary easements**: these areas are needed for access or other purposes during construction or in some cases are required to provide a buffer for safety during construction.

Land requirements are anticipated to be further progressed at the 30% design stage.

12.5.2 Construction

12.5.2.1 Construction Process

One of the City’s objectives during construction is reduced overall disruption. Minimizing construction impacts will require implementation of an effective construction staging plan that facilitates concurrent completion of project works. Concurrently constructed works typically lessen impacts by reducing the overall length of time for disruption. This approach is most effective when balanced with a method for maintaining a good level of service during construction activities. Construction staging is discussed in Section 12.2.

Construction will cause disruption to routes and traffic on Dixie Road and Dundas Street, as well as to the recreational trails. A traffic plan, including applicable road occupancy permits, will be prepared with the City and the Region to minimize disruptions. The Region has indicated that two lanes each way (four lanes total) and a left turning lane must be kept open most times on Dixie Road during construction. Dundas Street bridge construction will be coordinated through the BRT design team but will likely have similar constraints.

Tree removals are generally anticipated to be able to take place outside of the bird breeding window (April 1 to August 30) and the active window for bats (between early April and late October. Construction scheduling in the channel/valley will abide by the warmwater fish timing window (i.e., no in-water construction from April 1 to June 30).

Best management practices will be applied throughout construction. Proper signage and site safety signs will be posted, and construction workers will follow all safety procedures set forth by the contracting company, the consultant, and the City. Excess soil management will be completed in accordance with MECP's requirements as outlined in their document "Management of Excess Soil – A Guide for Best Management Practices."

12.5.2.2 Disruptions and Pollution

Higher traffic due to partial road closures and slow-moving construction trucks are concerns expressed by local business owners who have also indicated their struggles in the past when construction fronted their businesses. To minimize disruptions, multiple projects slated for the same area will be consolidated to the extent that is practical, as previously outlined. In the case of Dundas Area works, the flood mitigation efforts, BRT, and sanitary siphon relocation on Dundas Street are anticipated to be coordinated and constructed together. In the case of Dixie Area works, many different approaches to consolidating aspects of the preferred design are available. Works will be required to be addressed in a direction progressing from downstream to upstream. Exceptions and efficiencies may arise during planning of construction and in response to, or driven by, the construction methodology chosen. For example, the required lowering of the 975 mm dia. trunk sanitary could be completed in advance of other Dixie Area works, depending on how it will be implemented. Similarly, works on Jarrow Avenue to lower the 450 mm diameter sanitary sewer could be completed independently from other project works, which may be beneficial to reduce overall disruption. Other considerations for construction staging are contained in Section 12.2.

Service disruptions to infrastructure will be temporary during construction. Flow bypass will be provided for all flows during temporary disconnections in the sanitary sewers as they are lowered on Jarrow Avenue and at Dixie Road. Users contributing flows to the sanitary sewers will not likely notice any disruption. Reconfiguration of the sanitary siphon at the Dundas Street crossing will have less potential impact because an upstream diversion at Mattawa Avenue will have already been completed at the time of siphon construction. Watermain valves are used to isolate watermains for active construction. The impacted area during watermain relocations is dependant on valve locations. Potential service disruptions to electrical and other utilities would similarly be minimized by logical and good planning. Negligible impacts are anticipated to be associated with storm sewer outlet adjustments.

Trucks and equipment will be managed as efficiently as possible to minimize air and noise pollution. Residents and local businesses will be notified of the construction schedule. All contractors will be subject to Provincial legislation and regulation, including wearing personal protective equipment.

12.5.2.3 Terrestrial and Aquatic Wildlife and Habitats

Various changes made to the watercourse and valley will require removals of trees and other vegetation. Restoration plans will include a tree management plan to indicate which trees must be removed to accommodate proposed grading and other works. Plans will seek to preserve as many trees as reasonably possible. Soil management best practices will be implemented to protect the health of the soil and maximize the success of the restoration. This will include an erosion and sediment control plan, proper storage of topsoil for reuse, compaction avoidance measures, topsoil organic testing (if necessary), and topsoil amendments (if necessary).

A temporary diversion of the channel will be required in areas where the creek will be lowered and widened. Construction will temporarily impact fish passage; however, in-water works will abide by the warmwater fisheries timing window (no in-water works from April 1 to June 30) and comply with MNRF, TRCA, and DFO guidelines. The riparian buffer will be protected during construction where it is to remain unadjusted. Best management practices will be followed to minimize impacts to water quality and fish habitat.

12.5.2.4 Surface Water and Ground Water

The study area is within Intake Protection Zone 3 as identified in the Credit Valley-Toronto and Region-Central Lake Ontario (CTC) Source Water Protection Region (CTCSPC 2022). This indicates that the project is within the area of a highly vulnerable aquifer. No increased threats to drinking water supply are anticipated because of the proposed flood mitigation works. The City does not rely on groundwater as a drinking water source. Any impacts to groundwater flow and supply posed by construction activities are anticipated to be negligible.

12.5.3 Post-Construction and Ongoing Impacts

12.5.3.1 Flood Mitigation and Climate Change Resiliency

The preferred design will eliminate the flooding problem caused by the spill occurring upstream of Dixie Road. Proposed mitigation works include freeboard (where possible) above the modelled Regional flood level to provide resiliency. Future costs related to flood damages will be reduced substantially as a result of the preferred design. Economic analysis completed outside of this EA Study indicates a large positive return on investment associated with proposed works.

12.5.3.2 Terrestrial and Aquatic Impacts

The preferred design is seen to provide a long-term positive net impact on the study area's terrestrial and aquatic wildlife and habitat once the channel stabilizes and vegetation is re-established. The preferred design calls for a more naturalized channel and improved floodplain at both the Dixie and Dundas areas. Although there will be extensive tree removals, the removals provide an opportunity to revegetate the stream corridor with a selection of native species that provide greater ecological value than the existing tree community that is comprised of a large percentage of non-native species. Although this restoration will provide a long-term benefit to the community, it should be acknowledged that it will take several decades for the planted trees to grow to maturity and start providing the desired ecosystem services. In the interim, there will be a medium-term net loss as wildlife will not be able to utilize the young forest to the same degree as they presently use the mature, non-native forest. Fish passage and aquatic function is anticipated to improve with the preferred design.

The Natural Heritage Study (Appendix D) provides a list of the sensitive wildlife and habitats that will be protected during and post-construction. A Tree Management Plan will maximize trees that can be retained and there will be opportunity for an overall increase in vegetation quality and quantity. Best practices will be implemented in the installation of the formalized trail to mitigate the impacts of its maintenance and increased human presence through the forest community.

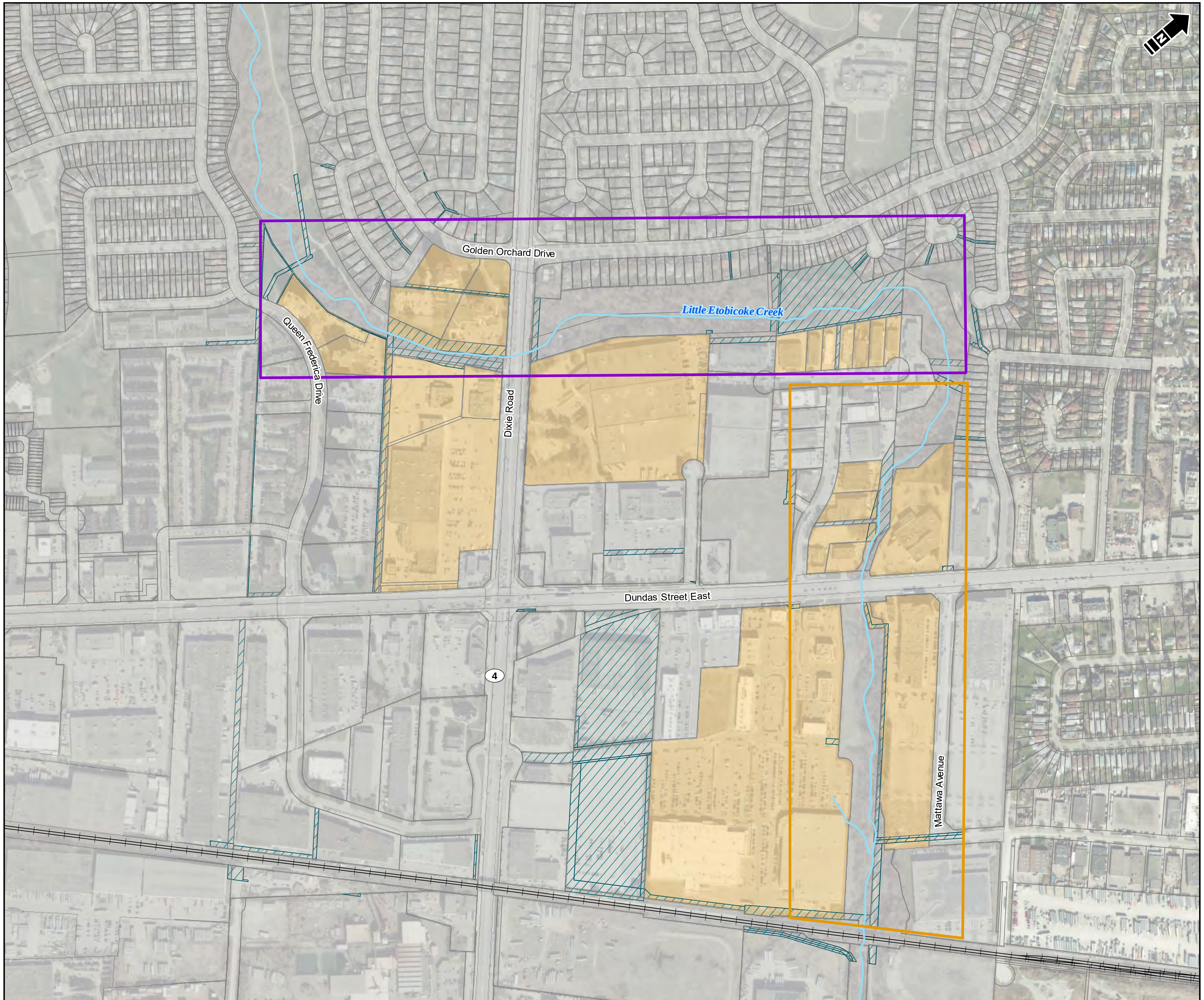
12.5.3.3 Geomorphology Impacts

The study area's existing erosion issues will be improved through provision of better floodplain connectivity and the repositioning and removal of armourstone walls. Some areas of hydraulic restriction will be relieved through the preferred channel design. Mitigating the existing spill from the creek in the Dixie Area, will not generally impact the ongoing geomorphic processes that will continue to shape downstream reaches of Little Etobicoke Creek. No measurable change in flow frequency or amount will occur for flows less than a 5-year return period. Flow below the 5-year return period are considered to influence vast majority of geomorphic 'work' on the channel and will remain unchanged. Flood flows higher than the 5-year return period will increase as the spill is contained. Geomorphic impacts from these higher flow events will be infrequent.

Improved erosion conditions provided by the preferred design will reduce the operation and maintenance costs for the City in the longer term, as the channel will be more self-sustaining. Lower requirements for sediment removal are anticipated. The infrastructure crossing the creek within the study area will have increased cover and therefore be better protected from channel erosion and freeze/thaw effects.

12.5.3.4 Potential to Remove SPAs

A key outcome of the project is the elimination of regulatory flooding within the SPAs. Ensuring that all flood flows are contained in the Little Etobicoke Creek valley will provide the opportunity to remove the Applewood and Dixie-Dundas SPA designations. This fulfills the vision outlined in the Dundas Connects Master Plan. Significant areas and structures located downstream of the existing spill would no longer be subjected to flooding, and these lands could readily provide additional homes and areas for business and industry.



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- Dixie Area
- Dundas Area
- Properties Potentially Affected
- Existing Easement
- Watercourse
- CN Railway

1. Base digital information obtained from the City of Mississauga (SHP and DGN format).

1:6,500 metres
50 0 50 100
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

Matrix Solutions Inc.
A Montrose Environmental Company

City of Mississauga
Dixie-Dundas Flood Mitigation Project – Environmental Study Report

Potentially Affected Properties

Date:	Project:	Submitter:	Reviewer:
March 2024	24603	A. McKay	S. Braun

Figure 41

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Table 36 Potential Impacts, Recommended Mitigation Measures, and Net Effects

No.	Potential Impacts	Description	Recommended Mitigation Measures	Net Effect
Technical Impacts				
1	Future flood and climate change resiliency	Elimination of flood risk over the study area. Improved flood resiliency, design exceeds the Regional storm water levels	None.	Positive: Increasing flood and climate change resiliency will keep residents, business owners, and properties safe. There will be lower costs associated with a reactive flood mitigation approach. Flood damages are described under item 8.
2	Impacts to upstream properties	Creek water levels are lowered upstream of the study area. Minimal impacts to water levels at sewer outfalls – impacting properties upstream on the sewers.	None.	Negligible.
3	Impacts to downstream properties	Completion of Dixie area works, if they were to go ahead in isolation, would result in more flow being conveyed downstream to the Dundas Area causing unacceptable impacts. Negligible impacts downstream of the CPR rail.	The preferred design at the Dundas Area mitigates the impacts from the Dixie Area. Ensure the Dundas Area works are carried out prior to the Dixie Area works	Negligible: Has been mitigated within the preferred design.

No.	Potential Impacts	Description	Recommended Mitigation Measures	Net Effect
4	Impacts to utilities and infrastructure	There will be 16 storm sewer outlets that will require shortening to accommodate the channel and floodplain works Sanitary sewers will need to be lowered and will be addressed in coordination with this project (see details in item 14). Some watermains will require repositioning to suit proposed new bridges. Other utilities such as cable, hydro and gas mains will require relocation.	Construction best practices. Communication with utility users.	Negligible Negligible user impacts are anticipated for the storm sewer outlet adjustments. Sanitary works will include bypass works to ensure users to the system are not significantly impacted. Temporary disruptions to domestic water may be experienced. Ample communication will be provided to residents and business owners. Increased traffic and business disruptions may also occur during construction.
5	Construction and schedule	Construction is extensive throughout the Creek, especially at new bridges and into watercourse areas. Coinciding projects, permits, stakeholder feedback and/or Stage 2 archaeology findings could impact the schedule.	Communications and site safety signs will be posted and coordinated according to best management practices. Other projects in the area will be coordinated to minimize construction disruption. Permits and additional studies will be submitted and conducted as early as possible to minimalize delay.	Negative: Significant disruption is anticipated during construction. Potential delays in other projects.
Economic Impacts				
6	Capital costs	The capital costs of $72 million in 2023 dollars for the preferred design include: • Bridge replacements • Floodplain improvements • Conveyance improvement • Trail • some utility relocations	Opportunity for cost savings by consolidating construction efforts with other projects such as the BRT. Cost estimates will be updated as detailed design progresses and will incorporate estimates of land acquisition costs.	Negative: A high capital cost is required to completely mitigate the flooding problem.

No.	Potential Impacts	Description	Recommended Mitigation Measures	Net Effect
7	Operation and maintenance (O&M) costs	Bridge inspections and routine repairs will be required. Ongoing watercourse monitoring and maintenance will be required, especially in the years following construction.	Implement monitoring to ensure banks are stable and there has not been accelerated erosion. Structural monitoring and as needed repairs of the bridges should continue.	Positive: Estimated O&M costs are expected to be lower than current costs (e.g., repairing failing armourstone walls).
8	Cost savings associated with flood mitigation	Average Annual Damages are estimated to be $3.8 million (direct damages). Under a Regional Event, there could be an expected $39.1 million and $30.2 million in direct and indirect damages respectively (Matrix 2022b)	None.	Positive: The implementation of the preferred design would give a positive return on investment by avoiding the ongoing direct and indirect flood damages.

No.	Potential Impacts	Description	Recommended Mitigation Measures	Net Effect
Environmental Impacts (Natural)				
9	Impact to existing vegetation and terrestrial habitat	Existing vegetation and terrestrial habitats within the area of disturbance will have to be removed and replaced. Construction will impact areas identified as significant woodland and significant valleyland. Matured trees may need to be replaced in the reconstruction of the floodplain area and residents have expressed concerned about losing the current tree coverage. There are a few Significant Wildlife Habitats (SWH) for Species of Conservation Concern (SCC) that may be impacted by construction including birds (confirmed Easter Wood-pewee), plants (confirmed Honey Locust), and butterfly (potential Monarch). Species at Risk (SAR) will need to be protected during construction including potential SAR bats and associated habitat as well as an unconfirmed Butternut Tree.	Complete a full natural heritage impact assessment. Prepare a tree management plan prior to construction that will be approved by both the City and TRCA. Conduct tree removals outside the breeding bird window (April 1 to August 30). Complete a butternut health assessment to confirm if the Butternut tree is a pure species. If confirmed, maintain a 25 m construction buffer and complete a MECP Notice of Activity. Conduct bat surveys to confirm the presence of SAR bats. If present, approval for SAR bat habitat removal from MECP will be required. Obtain a permit for any works within the regulation limit from TRCA and comply to its restrictions.	Positive: The floodplain area will be regraded in a way to accommodate flooding from the creek while also considering tree replacement that respects and fosters current wildlife and increasing the woodland's habitat quality and resiliency in the long-term. Negative: Temporary and permanent impacts to wildlife habitat. Removal of trees and replacement will be compensated elsewhere if it cannot be done within the floodplain limits in accordance with a tree management plan.

No.	Potential Impacts	Description	Recommended Mitigation Measures	Net Effect
10	Impact to aquatic systems	Improvements can be made for fish habitat and passage through the Creek corridor. There may be instances of injury or mortality to fish during construction. Temporary diversion of the channel could impact fish habitat and passage. Temporary removal of riparian buffer during construction could facilitate a faster conduit for urban runoff. Lack of shading can also increase the temperature of the creek.	Complete a full natural heritage impact assessment. Conduct in-water works outside the fisheries timing window for warm water species (April 1 to June 30). Obtain a permit for in-water works and a Request for Review to the DFO to determine if the project is in contravention of the Fisheries Act. Preserve the riparian buffer. Obtain a permit for any works within the regulation limit from TRCA and comply to its restrictions. . A fish management plan may also be required for review.	Positive: Improvement to the long-term fish habitat through the Study areas. Negative: Temporary diversion of the channel and construction will impact fish passage; however, in-water works will respect the designated fisheries timing window and comply to TRCA, MNRF and DFO guidelines and regulations.
11	Impacts to source water	According to the guidelines for the Credit Valley-Toronto and Region-Central Lake Ontario (CTC) Source Water Protection Region (CTCSPC 2022), the Project overlaps with these designated areas: • Event-based Area (EBA) • Intake Protection Zone 3 (IPZ 3) • Highly Vulnerable Aquifer (HVA) score of 6	Abide by best management practices during all future mitigation and construction activities, including spill and emergency response protocols. Weave construction phasing and general consideration for water quality of stormwater runoff into the future construction and implementation plans.	Negligible.

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No.	Potential Impacts	Description	Recommended Mitigation Measures	Net Effect
12	Air quality impacts	Air quality was not specifically assessed for the Project; however, impacts are anticipated to be low and temporary.	Follow best management during all future mitigation and construction activities.	Negligible.
13	Soil Management	Excess soils and materials such as earth, aggregate, rock, masonry and wood, generated by the project will need to be managed appropriately during construction activities in accordance with applicable legislation.	Abide by best management practices during all design and construction activities. Prepare a soils management plan that follows Ontario Reg 406/19- On-Site and Excess Soil Management, under Ontario's Environmental Protection Act, R.S.O. 1990, c. E. 19 and "Rules for Soil Management and Excess Soil Quality Standards" (the "Soil Rules") (MECP, 2019).	Positive: Improved conveyance within the valley corridor with reduce erosion potential. Negative: Soils removal and disposal is potentially costly and inherently contains risks of spills during transport.

No.	Potential Impacts	Description	Recommended Mitigation Measures	Net Effect
Social Impacts				
14	Ability to remove Special Policy Area (SPA) and execute the Dundas Connects Master Plan vision	The Applewood and Dixie-Dundas SPAs can be lifted and increase development opportunities. The removal of the flood hazard will allow the Dundas Connects Master Plan to proceed.	Continued communication with residents and stakeholders in collaboration with the TRCA and other partners.	Positive: The vision in the Dundas Connects Master Plan could be realized through the removal of the SPAs. Negative: Some residents have expressed concern of increased traffic in the area with the potential opening of development. See item 15 for more discussion.
15	Impacts to adjacent and/or coinciding projects	The preferred design has direct impacts on other construction projects occurring in the area, including the Bus Rapid Transit (BRT) project. The sanitary sewer siphon structure may be relocated at Dundas Street as part of another project but will consider the preferred design of the creek and the BRT. The exposed sanitary sewer at Jarrow Avenue was flagged by TRCA as potentially being mitigated at the same time as any reconstruction of the channel and/or floodplain.	The Project team has been communicating with the BRT team and they have relied on preliminary dimensions of the preferred design to proceed. Similarly, the preliminary proposed configuration of Little Etobicoke Creek at Dundas Street has been communicated with the City and BRT team. Options to adjust the exposed sanitary sewer at Jarrow Ave have been evaluated in this EA. Any investigations and/or construction will be made through the City and the Region, including road occupancy permits.	Negative: Projects may be delayed if reliant on others for information. Coordination efforts could also impact schedule if items should be staggered. Positive: Minimal disruptions could be achieved if efforts are consolidated, such as a one pass cut at the road.

No.	Potential Impacts	Description	Recommended Mitigation Measures	Net Effect
16	Traffic and business disruptions	The Dixie-Dundas area is in a dense and heavily urbanized area. Residents have indicated concern about increased traffic correlating to the release of the SPA and future development. Business owners have expressed concerns about impacts during construction (i.e., a significant reduction of revenue due to limited traffic).	During construction, at least two lanes each way on Dixie Road will be made available at most times. Construction stages (see Section 12.2) will be further developed during detailed design and will consider best management practices and a traffic management plan approved by both the City and the Region. Construction will aim to be as efficient as possible (see item 14). Post-construction, the goal of the Dundas Connects Master Plan and BRT is to encourage the use of public transit and thus alleviate traffic.	Negative: Construction disruptions will upset residents and business owners. A traffic plan will aim to reduce disruptions as much as possible. Positive: The long-term aim is to reduce traffic through the execution of the Dundas Connects Master Plan and BRT.
17	Impacts to private property	Portions of lands located adjacent to the creek (mostly parking lots and backs of lots) will require some measure of: • acquisition • permanent easements • temporary easements for construction	The City's realty group is looking to minimize impacts as much as possible. Preliminary estimates will be confirmed upon detailed design and will consider how land requirements can potentially be reduced.	Negative: Land acquisition will disrupt current owners and the process of acquiring these lands may take significant time and effort. Positive: Over 1,000 private properties can now be removed from the SPA, eliminating their risk to riverine flooding. Improved aesthetics and recreational access for property abutting the Creek,

No.	Potential Impacts	Description	Recommended Mitigation Measures	Net Effect
18	Impacts to public property and services	Floodplain improvements would impact TRCA regulated lands. City easements will need to be adjusted. Access to public property (e.g., parks and trails) will be restricted during construction. There may be safety concerns during construction.	The TRCA and the City have been actively engaged on the plans for floodplain improvement. The treatment of valley slopes within the floodplains and associated vegetation will comply to current standards. The City's realty team will review the expansion of easements and their designation to minimize negative impacts to the City and the public. Post signs and notices before and throughout construction to keep the public informed and safe.	Positive: The existing floodplain will be regraded to improve connectivity with the channel. Flood plain areas will be improved in function, quality and character. There is an opportunity to align the City's Dundas Connects Master Plan with TRCA's Strategic Plan when designing the floodplain areas. Negative: Temporary closure to the trail and parks may displease users.
19	Safeguard of public safety	The public will need to be kept safely away from the area during construction. Despite warnings in place, people may still cross the construction area. Contractors may be in danger as Dixie Road and Dundas Street are typically high traffic areas. The creek is a natural safety concern to the public. Ensuring the community feels safe within their neighbourhoods and while using trails and parks.	Adhere to best management practices throughout construction. Safety fences and signs will mitigate the risk as much as possible. Design the floodplain area and trail considering the safety of both trail users and residents adjacent to the trail. Avoid steep slopes as much as reasonable.	Positive: There is an opportunity to improve the safety conditions along this portion of Little Etobicoke Creek following construction. Negative: There is always a safety risk to the public during any construction project. More construction activity within the floodplain may displease residents living nearby.

No.	Potential Impacts	Description	Recommended Mitigation Measures	Net Effect
20	Impacts to cultural heritage and/or archaeology	Mature trees will be felled during construction and residents have expressed concern of a change to their current vistas. Stage 1 archaeology study indicates there is some archaeological potential.	Complete a tree management plan to minimize the impact to the mature forest (see item 9). Engage First Nations groups during the Stage 2 archaeological assessments. The City and the project team are prepared to adapt the design to accommodate archaeological potential if it is identified in the Stage 2 study.	Positive: The identified locations for Stage 2 archaeological assessment are not anticipated to impact the plans for the preferred design. Negative: The tree canopy may change during construction, altering the views for current residents. If archaeological artifacts are found, the design will need to change and/or construction may be delayed.

13 Consultation

A consultation report documenting the process, feedback, and communications that took place as part of this Municipal Class EA is provided in Appendix A. Consultation activities were undertaken in accordance with the Municipal Class EA process (MEA 2015) and the Code of Practice for Preparing, Reviewing and Using Class Environmental Assessments in Ontario (MOE 2014).

Comments received during the 30-day review of this Environmental Study Report will be documented and responded to in the final version.

14 Future Commitments

14.1 Commitment to Future Work

Some specific items to be completed during the next phases of the Project have been identified throughout this Environmental Summary Report. A summary of the items to be addressed in the design and construction stages are outlined as follows:

- Natural Environment:
  - Conduct a SAR survey for bat habitat trees. Depending on survey results, acoustic surveys may need to be completed (to be confirmed through correspondence with MECP following habitat tree survey). If required, acoustic bat surveys are to be completed between June 1 and June 30 of any given year.
  - Complete an assessment to confirm if the identified butternut tree onsite is a pure species. Develop a plan for protection accordingly.
  - Plan to carry out all vegetation removal outside of the breeding bird window. Otherwise plan for nest sweeps where that timing is not possible.
  - Plan to carry out all tree removals outside of the active window for bats (between early April and late October of any given year).
  - Develop a compensation strategy including landscape restoration plans consistent with TRCA's Guideline for Determining Ecosystem Compensation (TRCA 2018b). Offsite restoration will be identified for any compensation that cannot be implemented onsite.

- Plan to carry out all in-water works during applicable timing windows. In-water work is permitted between July 1 and March 31 for this warmwater stream, as determined through correspondence with MNRF.
- Prepare restoration plans including planting, landscaping, and naturalization detail.
- Retain an arborist to oversee a tree inventory, create an arborist report, a tree preservation plan, minimize tree removals and impacts, and provide recommendations for restoration as required by the City tree by-law.

- Social Environment:
  - Continue to assess and reduce permanent property impacts (e.g., acquisitions and easements) and consult with impacted landowners as the designs progresses.
  - Identify temporary construction easements and consult with impacted property owners.
  - Develop a landscaping plan for replacing the existing trail along Little Etobicoke Creek upstream of Dixie Road. Develop a plan for extension of the trail downstream of Dixie Road within new flood plain area and connecting back to Golden Orchard Drive. Consider extension of the informal trail network to Willowcreek Park.
  - Carry out Stage 2 archaeological investigations per the requirements identified in the Stage 1 archaeological assessment. Engage First Nations prior to undertaking.
  - Develop a traffic management plan and coordinate implementation with other area projects.
  - Consider permanent vegetative and/or other screening measures of private properties adjacent to proposed works including trails. Consult with affected landowners.
- Technical Environment:
  - Continue coordination with the BRT project on Dundas Street. Ensure survey coordinate systems being referenced are aligned and acknowledged.
  - Carry out additional geotechnical investigations to better characterize subsurface conditions to support detailed design.
  - Develop a soil management plan and undertake soil sampling investigations to further characterize soil quality to meet O. Reg. 406/19.

- Increase the setback area between the top of bank and private property/roadways where feasible.
- Consider including a pathway that connects a trail under the Dixie Road bridge. Vertical separation requirements will require consideration of acceptable flood levels for trail.
- Complete subsurface utility engineering quality level A through D investigations to confirm exact vertical and horizontal alignments as required to mitigate potential conflicts and ensure municipal servicing and utilities are protected appropriately during construction.
- Complete topographic surveys for proposed works to augment existing LiDAR data.
- Complete legal surveys at property boundaries as required.
- Consider design of temporary flow bypass methods for Little Etobicoke Creek and appropriate levels of service to minimize flood risk during construction.
- Consider further investigation of structural solutions for the reinforcement of valley slopes at constricted areas, including upstream of Dixie Road and Dundas Street bridges.
- Incorporate pedestrian safety features into the design. Safety barriers must ensure egress from the channel during potential flash flood events.
- Confirm if Permits to Take Water are required as the designs are further refined.
- Complete erosion and sediment control drawings.

14.1.1 Permits and Approvals

There are several potential permits and approvals that are required prior to construction as detailed design is being carried out. A list of the likely permits and approvals by department/agency are provided in Table 37. The list of permits will be reviewed during the detailed design stage.

Table 37 Potential Permits and Approvals

Department/Ministry/Municipality/Organization		Authorization/Approvals
Federal	Fisheries and Oceans Canada	Fisheries Act
Provincial	Ontario Ministry of the Environment, Parks, Conservation	Notice of Activity Endangered Species Act Permit to Take Water under the Ontario Water Resources Act Environmental Activity and Sector Registry, if applicable
Provincial	Ontario Ministry of Natural Resources and Forestry	Lakes and Rivers Improvement Act Fisheries and Wildlife Conservation Act
Regional	Toronto and Region Conservation Authority	Ontario Regulation 166/06: Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation
Regional	Regional Municipality of Peel	Approvals for works associated with any regional sanitary sewer, watermain, or roads (Dixie Road), including all roadway drainage works (adjustments to Consolidated Linear Infrastructure Environmental Compliance Approval (CLI ECA)) Road Occupancy Permit
Municipal	City of Mississauga	Right-of-way Construction Permit Street Occupation Permit CLI ECA Road Cut Permit Tree-removal/injury permits Various property acquisition requirements Parks Access Permit
Utility Company	Enbridge Inc. Hydro One Network Inc. Rogers Bells Other utilities	Permit for installation/relocation of public utilities (if required) Crossing agreement with Enbridge, if required

14.1.2 Lapse of Time

Section A.4.3 of the MEA (2015) states that if the period of time from filing of the Notice of Completion of the Environmental Study Report in the public record, or the MECP denial of a Part II Order request, to the proposed commencement of construction for the Project exceeds 10 years, the proponent shall review the planning and design process and the current environmental setting to ensure that the project and the mitigation measures are still valid given the current planning period.

If such a review is undertaken and recorded in an addendum to the Environmental Study Report, a Notice of Filing of Addendum shall be placed on the public record with the Environmental Study Report and shall be given to the public and review agencies, for a minimum of 30-day review period. If no Part II Order request is received, the proponent is free to proceed with implementation and construction.

15 References

AECOM Canada Ltd. (AECOM). 2019. City of Mississauga Special Policy Areas - Preliminary Flood Mitigation and Remediation Assessment, Dundas Street Transportation Master Plan. Prepared for City of Mississauga. Mississauga, Ontario. May 2019.

AECOM Canada Ltd. (AECOM). 2018a. Toronto and Region Conservation Authority Flood Protection Land Forming Technical Design Considerations. Prepared for Toronto and Region Conservation Authority. Markham, Ontario. December 2018.

AECOM Canada Ltd. (AECOM). 2018b. Toronto and Region Conservation Authority Flood Projection and Land Forming Technical Design Considerations. Mississauga, Ontario. December 2018.

Aquafor Beech Limited (Aquafor Beech). 2019. Public Works Stormwater Design Criteria and Procedural Manual. Prepared for the Region of Peel. Version 2.1. Place. June 2019.

Archaeological Services Inc. (ASI). 2022. Stage 1 Archaeological Assessment, Dixie-Dundas Flood Mitigation, Part of Lots 4-7, Concession 1 NDS and Part of Lot 4, Concession 1 SDS (Former Township of Toronto, County of Peel), City of Mississauga, Regional Municipality of Peel, Ontario. Prepared for Matrix Solutions Inc., Archaeological Licence #P1O66. Toronto, Ontario. April 2022.

CH2M Hill. 2013. Little Etobicoke Creek Erosion and Sediment Control Plan, PROP. 600 mm, CPP Watermain Replacement. August 16, 2013.

Chapman L.J. and D.F. Putnam. 2007. Physiography of Southern Ontario. Ontario Geological Survey, Miscellaneous Release Data 228. First printed in 1951. Updated in 1966 and 1984. ISBN: 978 1 4249 5158 1. 2007.

City of Mississauga. 2023a. Mississauga Official Plan. Mississauga, Ontario. March 3, 2023. https://www.mississauga.ca/projects-and-strategies/strategies-and-plans/mississauga-official-plan/

City of Mississauga. 2023b. Neighbourhood Comparison, 2016 Census Results. Accessed August 2023. https://mississauga.maps.arcgis.com/apps/MapSeries/index.html?appid=bff08f8c66d54463a3679aba79927579

City of Mississauga. 2023c. Zoning Information Map. Accessed August 2023. https://ext.maps.mississauga.ca/Html5Viewer/index.html?viewer=izbl.HTML5

City of Mississauga. 2023d. System Maps - MiWay. Accessed August 2023. https://www.mississauga.ca/miway-transit/maps/transit-system-maps/

City of Mississauga. 2023e. Station Locations - MiWay. Accessed August 2023. https://www.mississauga.ca/miway-transit/maps/station-locations/

City of Mississauga. 2023f. Noise exemptions - City of Mississauga. Accessed August 2023. https://www.mississauga.ca/services-and-programs/home-and-yard/noise-and-lighting/noise-exemptions/

City of Mississauga. 2023g. Urban Design Guidelines and Reference Notes. Accessed September 2023. Mississauga, Ontario. 2023.

City of Mississauga. 2019. Mississauga Official Plan. Mississauga, Ontario. November 22, 2019. http://www.mississauga.ca/portal/residents/mississaugaofficialplan

City of Mississauga et al. 2018. Dundas Connects Master Plan. City of Mississauga, AECOM, SvN, Swerhun. Mississauga, Ontario. May 24, 2018.

City of Mississauga. 2020. City of Mississauga Transportation and Works Department Development Requirements Manual. Mississauga, Ontario. August 12, 2020.

CSA Group. 2019. Canadian Highway Bridge Design Code. CSA S6:19. Supersedes the previous editions published in 2014, 2006 (including three supplements published in 2010, 2011, and 2013), 2000, 1988, 1978, 1974, 1966, 1952, 1938, 1929, and 1922. 2019.

CTC Source Protection Committee (CTCSPC). 2022. Approved Source Protection Plan: CTC Source Protection Region. Amendment (Version 5.0). Approved: February 23, 2022. Effective date: March 2, 2022. 2022. https://ctcswp.ca/app/uploads/2022/05/RPT_20220520_Amended_CTCSPP_v5_clean.pdf

Environmental Water Resources Group Ltd. (EWRG). 2017. Technical Guidelines for Flood Hazard Mapping. Prepared for Central Lake Ontario Conservation, Credit Valley Conservation, Ganaraska Conservation, Grand River Conservation Authority, Nottawasaga Valley Conservation Authority, and Toronto and Region Conservation Authority. March 2017.

GO Transit. 2023. GO Transit - System Map. Accessed August 2023. https://www.gotransit.com/en/system-map

Government of Ontario (Government of Ontario). 2023. Planning Act. R.S.O. 1990, c. P.13. Current to June 2023. https://www.ontario.ca/laws/statute/90p13

Government of Ontario. 2020. A Place to Grow, Growth Plan for the Greater Golden Horseshoe. August 2020.

Matrix Solutions Inc., a Montrose Environmental Company (Matrix). 2023. "Dixie-Dundas Flood Mitigation Municipal Class Environmental Assessment Consultation Report." Version 0.1. Draft prepared for the City of Mississauga. Mississauga, Ontario. August 2023.

Matrix Solutions Inc. (Matrix). 2022a. Dixie-Dundas Flood Mitigation Environmental Assessment Project Sanitary Sewer Addendum Report, Regional Municipality of Peel, Dixie Road Infrastructure. Version 1.0. Prepared for the City of Mississauga. Mississauga, Ontario. October 7, 2022.

Matrix Solutions Inc. (Matrix). 2022b. Special Policy Area Review, Phase 1: Baseline Conditions Tasks, Etobicoke-Dundas and Dixie-Dundas Areas. Version 2.0. Prepared for the City of Mississauga. Guelph, Ontario. May 2022.

Matrix Solutions Inc. (Matrix). 2021. Little Etobicoke Creek Flood Evaluation Study, Master Plan Environmental Assessment. Prepared for the City of Mississauga. Guelph, Ontario. March 2021.

Matrix Solutions Inc. (Matrix). 2020. Dixie-Dundas Flood Mitigation, Natural Heritage Study. Version 1.0. Prepared for the City of Mississauga. Guelph, Ontario. July 2020.

Matrix Solutions Inc. (Matrix). 2018. Progress Report #1 - Floodplain Spill Assessment, Flood Evaluation Study, Little Etobicoke Creek. Prepared for City of Mississauga. Guelph, Ontario. January 2018.

MMM Group Limited (MMM). 2015. Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area, Little Etobicoke Creek. Prepared for Toronto and Region Conservation Authority, Report No. 1412606-000. Mississauga, Ontario. January 2015.

MMM Group Limited (MMM). 2013. "Etobicoke Creek Hydrology Update, Draft Final Report." Draft report prepared for Toronto and Region Conservation Authority. April 2013.

Municipal Engineers Association (MEA). 2023. Municipal Class Environmental Assessment. Previous editions published in 2000,2007, 2011, and 2015. 2023. https://prod-environmental-registry.s3.amazonaws.com/2023-03/2023%20Amended%20Municipal%20Class%20Environmental%20Assessment.pdf

Municipal Engineers Association (MEA). 2015. Municipal Class Environmental Assessment. October 2000, as amended in 2015. Approved by Order-in-Council no. 1923/2000. 2015. https://www.municipalclassea.ca/manual/page1.html

Ontario Ministry of Municipal Affairs and Housing (MMAH). 2020. Provincial Policy Statement, 2020. Issued under Section 3 of the Planning Act. Queen's Printer for Ontario, 2020. Toronto, Ontario. May 1, 2020.

Ontario Ministry of Natural Resources (MNR). 2002. Technical Guide, River & Stream Systems: Flooding Hazard Limit. Water Resources Section. http://www.renaud.ca/public/Environmental-Regulations/MNR%20Technical%20Guide%20Flooding%20Hazard%20Limit.pdf

Ontario Ministry of the Environment, Conservation and Parks (MECP). 2023a. Source Protection Information Atlas. Powered by Land Information Ontario. Accessed August 2023. https://www.lioapplications.lrc.gov.on.ca/SourceWaterProtection/index.html?viewer=SourceWaterProtection.SWPViewer&locale=en-CA

Ontario Ministry of the Environment, Conservation and Parks (MECP). 2023b. Air Quality in Ontario 2020 Report. Accessed August 2023. https://www.ontario.ca/document/air-quality-ontario-2020-report

Ontario Ministry of the Environment (MOE). 2014. Code of Practice for Consultation in Ontario's Environmental Assessment Process. Environmental Assessment Act, RSO 1990, chapter E.18. January 2014. http://www.ontario.ca/environmentalassessments

Ontario Ministry of the Environment (MOE). 2003. Stormwater Management Planning and Design Manual. Queen's Printer. Ottawa, Ontario. March 2003. 2003. http://www.ontario.ca/document/stormwater-management-planning-and-design-manual

Ontario Ministry of Transportation (MTO). 2008. Highway Drainage Design Standards. Downsview, Ontario. January 2008.

Regional Municipality of Peel. (Peel Region). 2021. Region of Peel Regional Road Map. Map no. PW_IMG_GDA_347. Map created by Information Management Group, Operations Support, Public Works. Scale: 1:160,000. November 11, 2021. https://www.peelregion.ca/pw/transportation/residents/_media/regional-roads-map.pdf

Regional Municipality of Peel (Region of Peel). 2023. The Neighbourhood Information Tool. In partnership with the City of Mississauga, United Way Peel Region, Peel Regional Police, the City of Brampton, and the Town of Caledon. Accessed August 2023. https://www.peelregion.ca/planning-maps/nit/

Regional Municipality of Peel (Peel Region). 2022. Region of Peel Official Plan. Adopted by Regional Council on April 29, 2022. Brampton, Ontario. April 2022. https://www.peelregion.ca/officialplan/download/_media/region-of-peel-official-plan-april2022.pdf

Regional Municipality of Peel (Peel Region). 2013. Region of Peel's Road Characterization Study. May 2013. https://www.peelregion.ca/pw/transportation/_media/road-characterization-study.pdf

R.V. Anderson Associates Limited (RVA). 2020. "Dixie Road Bridge Feasibility Review." Draft prepared for Matrix Solutions Inc. Toronto, Ontario. April 2, 2020.

Siddiqui A. and A. Robert. 2010. "Thresholds of erosion and sediment movement in bedrock channels." Geomorphology 118 (3–4): 301–313. June 2010.

Statistics Canada. 2023. Profile Table, Census Profile, 2021 Census of Population - MIssissauga, Ontario. Accessed August 2023. https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?Lang=E&GENDERlist=1&STATISTIClist=1&HEADERlist=0&DGUIDlist=2021A00053521005&SearchText=mississauga

Thurber Engineering Ltd. (Thurber). 2023a. Final Prelimiary Geotechnical Investigation Report, Dixie-Dundas Flood Mitigation, Mississauga, Ontario. Prepared for Matrix Solutions Inc. Oakville, Ontario. August 10, 2023.

Thurber Engineering Ltd. (Thurber). 2023b. Expanded Geotechnical Desktop Study, Dixie-Dundas Flood Mitigation, Mississauga, Ontario. Prepared for Matrix Solutions Inc. Oakville, Ontario. August 10, 2023.

Thurber Engineering Ltd. (Thurber). 2020. Geotechnical Desktop Study, Dixie-Dundas Flood Mitigation, Mississauga, Ontario. Prepared for Matrix Solutions Inc. Oakville, Ontario. February 21, 2020.

Toronto and Region Conservation Authority (TRCA). 2023. Glossary - Toronto and Region Conservation Authority (TRCA). Accessed August 2023. https://trca.ca/planning-permits/glossary/#S

Toronto and Region Conservation Authority (TRCA). 2019. Erosion and Sediment Control Guidelines for Urban Construction. Sustainable Technologies Evaluation Program (STEP). Ontario. 2019. https://sustainabletechnologies.ca/app/uploads/2020/01/ESC-Guide-for-Urban-Construction_FINAL.pdf

Toronto and Region Conservation Authority (TRCA). 2018a. Infrastructure Hazard Monitoring Record. Site ID: I-106, Dixie Road and Dundas Street East. Mississauga, Ontario. August 22, 2018.

Toronto and Region Conservation Authority (TRCA). 2018b. Guideline for Determining Ecosystem Compensation (after the decision to compensate has been made). June 2018.

Toronto and Region Conservation Authority (TRCA). 2016. Etobicoke Creek HEC-RAS Model. Compiled by Toronto and Region Conservation Authority. 2016.

Toronto and Region Conservation Authority (TRCA). 2015. Crossing Guidelines for Valley and Stream Corridors. September 2015.

Toronto and Region Conservation Authority (TRCA). 2014. The Living City Policies for Planning and Development in the Watersheds of the Toronto and Region Conservation Authority. November 28, 2014.

Toronto and Region Conservation Authority (TRCA). 2012. Stormwater Management Criteria. Version 1.0. August 2012. 2012.

Toronto and Region Conservation Authority (TRCA). 2010. Etobicoke and Mimico Creeks Watersheds, Technical Update Report. 2010.