The Regional Municipality of Peel
Bovaird Drive (Regional Road 107) Transportation Corridor
from Lake Louise Drive/Worthington Avenue
to 1.45 km west of Heritage Road
in the City of Brampton
Class Environmental Assessment

ENVIRONMENTAL STUDY REPORT

VOLUME 1 OF 3

April 2013

Submitted to:
Peel Region
Public Works Department
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Brampton ON L6T 4B9

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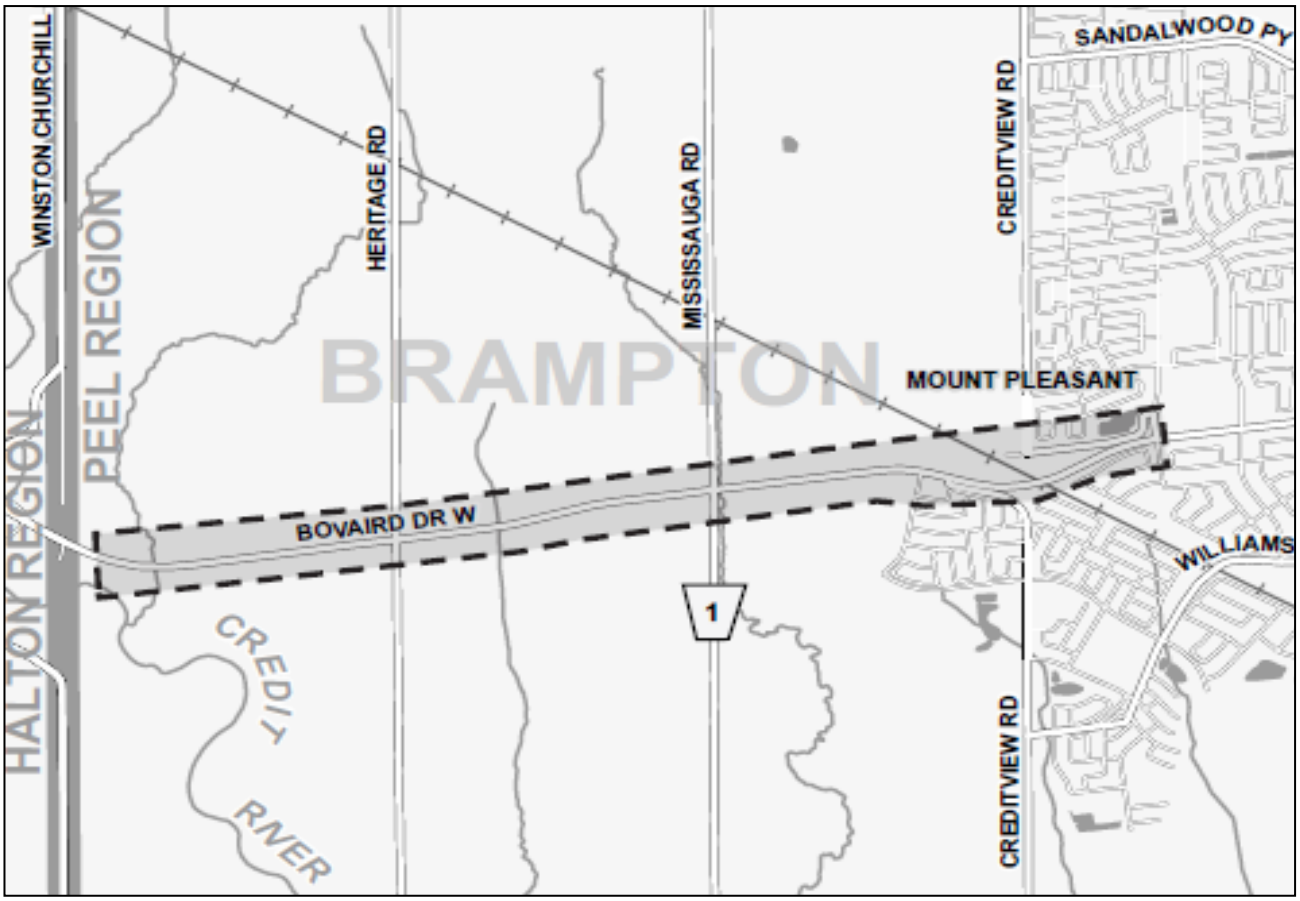


EXECUTIVE SUMMARY

Environmental Study Report

The Regional Municipality of Peel has completed a Schedule C Municipal Class Environmental Assessment (Class EA) Study for planned transportation corridor improvements to satisfy future travel demands on Bovaird Drive (Regional Road 107), from Lake Louise Drive/ Worthington Avenue to 1.45 km west of Heritage Road in the City of Brampton. This Environmental Study Report documents the background to the study, existing and future conditions within the study area, the need and justification for the project, the planning, design and consultation process leading to the preferred alternative, anticipated positive and negative impacts, and proposed mitigation.

This project is planned in accordance with the requirements of the Municipal Class Environmental Assessment (October 2000, as amended 2011), Schedule C.

Background to the Study

Bovaird Drive (Regional Road 107) is an important roadway link in Peel Region in the City of Brampton. The road provides an east – west connection through Brampton to the Halton / Peel boundary.

The portion of Bovaird Drive being studied has varied characteristics. The section from Lake Louise Drive to Ashby Field Road, including the CNR overpass is generally urban and has three lanes eastbound and two lanes westbound. From Ashby Field Road to Mississauga Road there are two lanes eastbound and one lane westbound. The area from Mississauga Road to the western limit of the study area is rural and the roadway currently has two core lanes, with an eastbound truck climbing lane leaving Norval.

A number of related studies and other related information are available, which have significance to the Bovaird Drive Class Environmental Assessment Study, and which have been reviewed by Study Team members. These include:

- Region of Peel Long Range Transportation Plan, September 2005 and Draft Report Update, June 2011;
- City of Brampton's Transportation and Transit Master Plan, 2009;
- City of Brampton’s Pathways Master Plan, developed in 2002 and subsequently updated in 2006;
- Halton-Peel Boundary Area Transportation Study (HP-BATS), April 2010;
- Region of Peel Official Plan, Office Consolidation, 2008;
- City of Brampton Official Plan Creditview Road and Sandalwood Parkway Transportation Master Plan;

- Digital colour aerial photography;
- Existing legal surveys and reference plans, and
- Region of Peel - Regional Official Plan Amendment ROPA 22), Draft Transportation Technical Report.

Existing and Future Conditions

As part of the study, a review of existing and future conditions was completed. The objective of the review was to confirm the need and justification for improvement and expansion of the roadway, as well as identify environmental constraints and sensitivities. Investigations have been completed for the following:

- land use
- roadway geometric design
- traffic volume/congestion
- utilities
- geotechnical/pavement
- hydrogeology/well water
- stormwater drainage
- natural environment
- archaeology
- built heritage
- pedestrian/cyclist access
- traffic noise
- structures

Problem/Opportunity Definition

Based on a review of existing and future conditions, as well as preliminary consultation with stakeholders, it has been determined that improvements are needed along the Bovaird Drive corridor in order to:

- Accommodate existing and future traffic growth resulting from development and population increases;
- Accommodate pedestrian and cyclist movements through the corridor;
- Accommodate future transportation network improvements such as the North-South Transportation Corridor (NSTC), GTA West, and the Norval By-Pass;
- Accommodate transit system expansion along the corridor, and;
- Address drainage deficiencies identified by this study and opportunities for Stormwater Management.

Development and Evaluation of Alternative Planning Solutions:

Six (6) alternative solutions were investigated to address the year 2031 traffic volumes as follows:

- **Alternative 1**
  Do Nothing
  This alternative is used as a benchmark against which other alternatives are compared. The 'Do Nothing" alternative would not accommodate the proposed growth. This alternative does not provide any roadway or traffic control improvements. This alternative will result in unacceptable levels of service at some intersections and it will not address several Regional transportation objectives.

- **Alternative 2**
  Improve other Roads
  Improve adjacent parallel arterial roadways to accommodate the projected future traffic demand for Bovaird Drive.

- **Alternative 3**
  Transit Service Improvements
  Improve existing public transit service within the City of Brampton, and connect to the major activity areas of the Greater Toronto Area (GTA), to encourage a shift in modal choice from automobile to public transit modes.

- **Alternative 4**
  Travel Demand Management (TDM)
  TDM measures are aimed at shifting travel behaviour to reduce peak hour vehicular traffic demand. Such measures may include increasing the number of car-pool parking facilities, creating high occupancy vehicle (HOV) lanes, introduction of flexible work hours by major employers and facilitating active modes of transportation such as walking and cycling.

- **Alternative 5**
  Widen Bovaird Drive with Intersection Improvements
  Addition of through traffic lanes (6 lanes from Lake Louise Dr. to the Halton-Peel Freeway and 4 lanes from the NSTC to the access to the Northwest Brampton Secondary Plan Area) including intersection improvements, to increase traffic capacity along the corridor.

- **Alternative 6**
  Combination
  Combine alternatives 3-5 to increase the overall effectiveness of individual alternatives and reduce environmental impacts.

Based on input provided by stakeholders including representatives of the new developments, technical agencies, and public participants, as well as based on a formal assessment by the study team, the preferred planning alternative is Alternative 6: A combination of Alternative 3-5. This alternative will address the problem statement developed for the Bovaird Drive corridor, while minimizing environmental impacts.

Description of Preferred Planning Solution

The preliminary design is documented in detail in Section 6 of the Environmental Study Report. The following is a brief summary of some key aspects of the preferred alternative:

- Key elements of the proposed cross-section of Bovaird Drive include the following:
    - Urbanization of the corridor, including concrete curb and gutter and storm sewer;
    - Six (6) 3.65 m lanes (3.75 m adjacent to curb) through lanes east of the North-South Transportation Corridor;
    - Four (4) 3.65 m lanes (3.75 m adjacent to curb) through lanes west of North-South Transportation Corridor;
    - 5.50 m raised median island midblock, tapering to 2.0 m at intersections;
    - 3.0 m multi-use path – north side of Bovaird Drive;
    - 1.5 m sidewalk – south side of Bovaird Drive;
    - 1.0 m splash strip;
    - 3.50 m left and right turn lanes as required at all intersections, and
    - Illumination on both sides.

- A grade change is recommended for Bovaird Drive and Heritage Road in order to address safety and drainage concerns.
- In order to communicate the recommended lane configuration in the preferred alternative, the North-South Transportation Corridor (NSTC) is assumed to cross Bovaird Drive east of Heritage Road. However, if future Environmental Assessments conclude that the crossing location be west of Heritage Road, an addendum to the Bovaird Drive Class EA will be undertaken.
- A detailed assessment of the Huttonville Creek crossing was presented to key stakeholders, CVC, and MNR for approval. After their concerns were addressed, the CVC and MNR agreed to a minimum 3.66m x 14.6m x 83.0m open-footing precast culvert to replace the existing crossing. A Fisheries Act authorization may be required, and an Endangered Species Act 17C permit will be required, for this crossing. The 17C permit, which is issued by the Ministry of Natural Resources, will require that a Redside Dace Overall Benefit proposal be developed prior to its issue.

- The westbound crossing of the CNR tracks east of Ashby Field Road is recommended to be replaced with a new structure. Key elements include:
    - Three (3) lanes of westbound traffic;
    - Adequate sight lines for a 90 km/h design speed;
    - 2.5 m sidewalk;
    - Provisions for a fourth track;
    - Vertical clearances for future electrification, and
    - Two metre clearance between the structures.
- Stormwater quality management will be provided by oil/grit separators, with the exception of the drainage east of the future Creditview Road/James Potter Road intersection, where drainage will be contained within the existing stormwater management facilities.
- Stormwater quantity management requires three cross culverts be widened, one west of Heritage Road, another between Heritage Road and Mississauga Drive, and a third at the Huttonville Creek crossing.

1.0 INTRODUCTION AND BACKGROUND

1.1 Introduction

The Regional Municipality of Peel has undertaken a Schedule 'C' Municipal Class Environmental Assessment Study, to review the need for transportation corridor improvements on Bovaird Drive (Regional Road 107), from Lake Louise Drive/ Worthington Avenue to 1.45 km west of Heritage Road, in the City of Brampton (ref. Figure 1.1: Key Plan / Study Area). AMEC Environment & Infrastructure (AMEC) has been retained by the Regional Municipality of Peel to complete the study.

This Environmental Study Report (ESR) documents the background to the study and existing and future conditions within the study area, and examines the need and feasibility for widening and improvements on Bovaird Drive to address short and long term issues related to planned future growth, operational, capacity and storm drainage deficiencies. In order to best address these deficiencies, the study has explored a number of road improvement alternatives, including the widening of the roadway and transit improvements, as well as the impact of such improvements on social and natural environments. This report chronicles the planning, design and consultation process leading to the preferred alternative, anticipated positive and negative impacts, and proposed mitigation.

1.2 Purpose of the Project

The purpose of this project is to examine existing and future deficiencies along Bovaird Drive within the study limits, and evaluate options to address the deficiencies identified. A major objective of the study is to undertake consultation with a wide range of stakeholders, in order to identify and resolve or mitigate issues of concern, while meeting the requirements of the Municipal Class EA process, permitting the Region of Peel to proceed to detail design, and ultimately, construction.

Based on a review of existing and future conditions, as well as preliminary consultation with stakeholders, it has been determined that improvements are needed along the Bovaird Drive corridor in order to:

- Accommodate existing and future traffic growth resulting from development and population increases;
- Accommodate pedestrian and cyclist movements through the corridor;
- Accommodate future transportation network improvements such as the North-South Transportation Corridor (NSTC), GTA West, and the Norval By-Pass;
- Accommodate transit system expansion along the corridor, and;
- Address drainage deficiencies identified by this study and opportunities for Stormwater Management.

1.3 Project Background

Bovaird Drive (Regional Road 107) is an important roadway link and is a major east-west arterial roadway in the City of Brampton. The portion of Bovaird Drive being studied has varied characteristics. The section from Lake Louise Drive to Ashby Field Road, including the CNR overpass, is generally urban, and has three lanes eastbound and two lanes westbound. From Ashby Field Road to Mississauga Road there are two lanes eastbound and one lane westbound. The section from Mississauga Road to the western limit of the study area is rural and the roadway currently has two core lanes, with an eastbound truck climbing lane leaving Norval.

A number of recent studies and other related information are available, which have significance to the Bovaird Drive EA Study, and which have been reviewed by Study Team members. These include:

- Region of Peel Long Range Transportation Plan, September 2005 and Draft Report Update, June 2011;
- City of Brampton's Transportation and Transit Master Plan, 2009;
- City of Brampton's Pathways Master Plan, developed in 2002 and subsequently updated in 2006;
- Halton-Peel Boundary Area Transportation Study (HP-BATS), April 2010;
- Region of Peel Official Plan, Office Consolidation, 2008;
- City of Brampton Official Plan Creditview Road and Sandalwood Parkway Transportation Master Plan;
- Digital colour aerial photography;
- Existing legal surveys and reference plans, and
- Region of Peel - Regional Official Plan Amendment ROPA 22), Draft Transportation Technical Report.

Generally, these studies project significant increases in population and traffic in northwest Brampton and indicate that the Bovaird Drive corridor in its current state will be inadequate to support projected development and increases in traffic.

The Region of Peel's Long Range Transportation Plan identifies the need for widening Bovaird Drive from Lake Louise Drive/Worthington Avenue to 1.45 km west of Heritage Road, to meet the existing and future traffic demand for this corridor. The Long Range Transportation Plan suggests widening this section of Bovaird Drive to six lanes.

2.0 CLASS ENVIRONMENTAL ASSESSMENT APPROACH

2.1 Class Environmental Assessment Process

The Class Environmental Assessment process is a mechanism by which the provision of municipal servicing is provided in an efficient, timely, economical and environmentally responsible manner. It represents a consistent, streamlined and easily understood process for planning and implementing municipal infrastructure projects. Under the Provincial Environmental Assessment Act, projects are classified as approved, subject to screening, subject to a Class Environmental Assessment (Class EA), or subject to a full Environmental Assessment. This project is classified as being subject to the Class EA process. It is being conducted according to the requirements outlined in the Municipal Engineers Association document titled *Municipal Class Environmental Assessment (October 2000, as amended 2011).*

Consistent with the Municipal Class EA, the study approach has been designed to meet the following objectives:

i. Protection of the environment, including natural, social and economic components of the environment.

ii. Participation of a broad range of stakeholders in the study process to allow for sharing of ideas, education, testing of creative solutions and developing alternatives.

iii. Documentation of the study process in compliance with all phases of the Municipal Class EA process.

The Class EA process classifies projects according to their level of complexity and potential environmental impacts. These are termed “Schedules” and are summarized below:

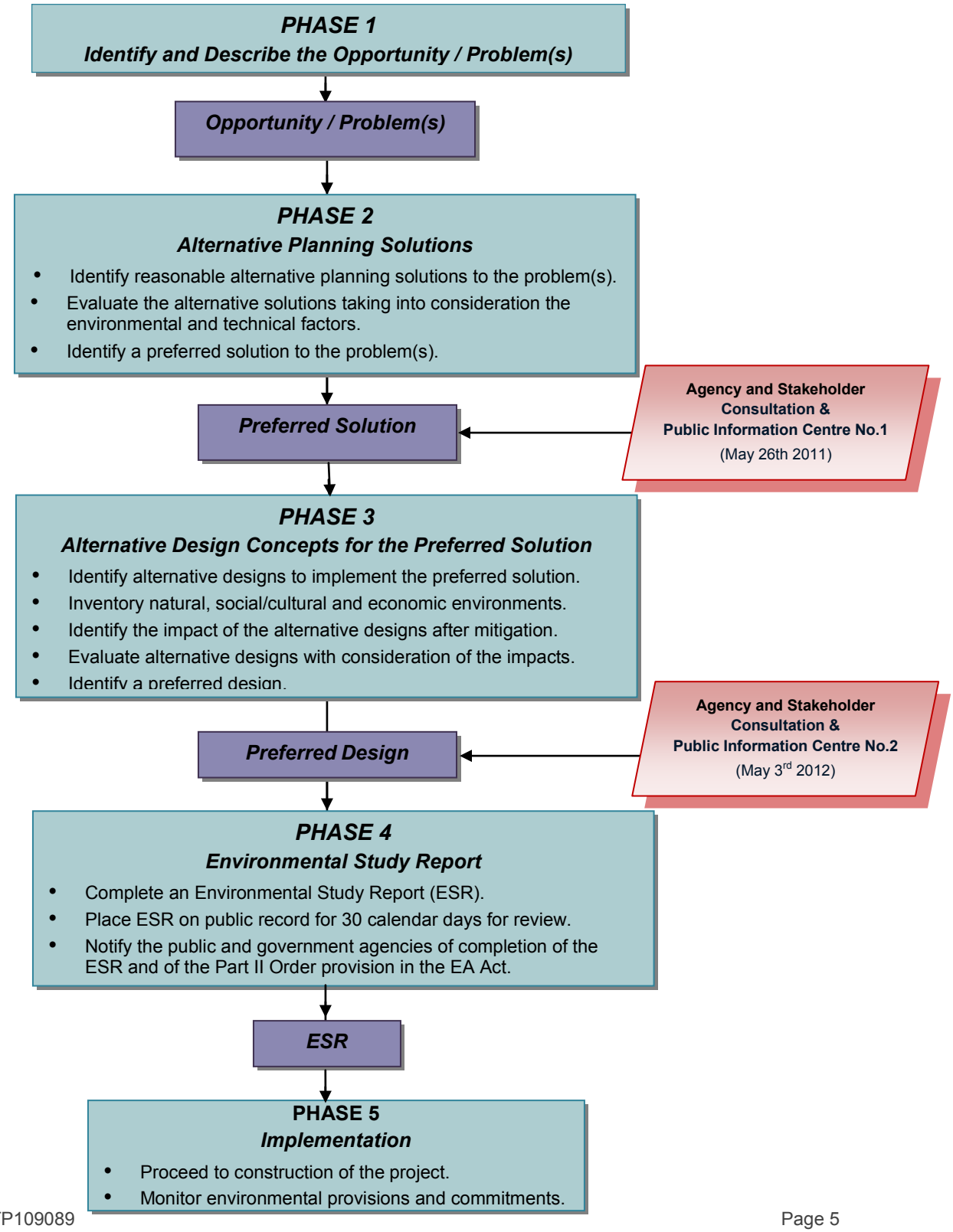
- ***Schedule ‘A’ and ‘A+’*** projects involve minor modifications to existing facilities. Environmental effects of these projects are generally small; therefore, the projects are considered pre-approved.
- ***Schedule ‘B’*** includes improvements and minor expansion to existing facilities. There is a potential for some adverse environmental impacts and, therefore, the proponent is required to proceed through a screening process, including consultation with those affected. Schedule ‘B’ projects are required to proceed through Phases 1, 2 and 5 of the Municipal Class EA process.
- ***Schedule ‘C’*** includes the construction of new facilities and major expansion of existing facilities. These projects proceed through the environmental assessment planning process outlined in the Municipal Class EA document. These projects are required to fulfill the requirements of all five phases of the Municipal Class EA process.

This project is being completed under the requirements of a Schedule 'C' Class EA activity. The following Schedule 'C' trigger applies to this project:

- Reconstruction or widening where the reconstructed road or other linear paved facilities (e.g. HOV lanes will not be for the same purpose, use, capacity or at the same location as the facility being reconstructed (e.g. additional lanes, continuous centre turn lane) with a construction value greater than $2.7 million.

The Municipal Class EA requires notification of, and consultation with, relevant stakeholders. The Project Team has ensured that stakeholders were notified early in the planning process, and throughout the study. Should stakeholders raise issues that cannot be resolved through discussion, these concerns would be referred to the Ministry of Environment for resolution. Figure 2.1 (General Municipal Class Environmental Assessment Process) illustrates a simplified version of the Municipal Class EA process for this project.

Figure 2.1: General Municipal Class Environmental Assessment Process



2.2 Schedule

The study was initiated in October 2009. Project milestones are as follows:

July 22, 2009 ..... Start up meeting.

October 16, 2009 ..... Notice of Commencement published in newspaper – Brampton Guardian.

March 2010..... Completion of traffic study, profile of study area and identification of need and justification for improvements.

April 14, 2010..... Agency meeting with Region of Peel and City of Brampton, Credit Valley Conservation Authority and the Ministry of Natural Resources.

May 2010 ..... Identification of Planning Alternatives and hosting of Public Information Centre No. 1.

September 2010 ..... Agency meeting with Region of Peel, City of Brampton, CNR and GO Transit.

January 2011 ..... Identification and assessment of Design Alternatives.

February 9, 2011..... Agency meeting with Region of Peel and Ministry of Natural Resources.

October 26, 2011 ..... Agency meeting with Region of Peel, Ministry of Natural Resources, Credit Valley Conservation, City of Brampton, and Hydro One Brampton.

May 3, 2012..... Hosting of Public Information Centre No. 2.

May 2012..... Completion of preferred design. Completion of environmental mitigation plans, surface water hydraulic, hydrology modelling and Geomorphological study.

August 2012..... Documentation of Preferred Design. Complete Environmental Study Report (ESR) and provide for 30 day public review.

April 2013 ..... Notice of Completion and Filing Environmental Study Report (ESR).

2.3 Project Organization

The Project Team consisted of staff from the following organizations:

Proponent: **Region of Peel**
Steve Ganesh, Manager
Neal Smith, Project Manager
Hitesh Topiwala, Project Manager
Liz Brock, Technical Analyst
Laverne Soodeen, Technical Analyst

Prime Consultant: **AMEC Environment & Infrastructure**
David Sinke, Project Manager
Jason Stahl, Roadway Design Engineer
Steven Chipps, Drainage Engineer
Derk Meyer, Structural Engineer
Nancy Saxberg, Archaeologist
Barbara Slim, Archaeologist
Shaun Austin, Archaeologist
Dirk Gevaert, Hydrogeologist
Mohammad Mollah, Geotechnical Engineer
Kevin Warner, Traffic Noise Assessment
Steve Lamming, Air Quality Assessment
Danny Stone, Environmental Planner

Sub Consultants: C. Portt & Associates, Cam Portt
Dougan & Associates Inc., Jim Dougan and Steven Hill
Genivar, Derek Dalgleish and Anil Seegobin
Intus Road Safety Engineering Inc., Gerry Forbes
Parish Geomorphic, John Parish and Joanna Eyquem
McWilliam & Associates, James McWilliam

2.4 Stakeholder and Agency Consultation

2.4.1 Phase 1 Consultation

A Notice of Study Commencement, detailing the study area, summarizing the objectives of the study and requesting comments, was submitted to relevant stakeholders, property owners and organizations by mail, in September 2009. In addition, a Notice of Study Commencement was published in the Brampton Guardian on October 16 and 23, 2009.

Responses were received from several stakeholders and agencies. Additionally, consultation meetings were held with agency representatives from the Credit Valley Conservation Authority, the City of Brampton and the Ontario Ministry of Natural Resources. Copies of the newspaper

advertisement, letters to stakeholders and agencies and copies of all comments received and written responses are contained in Appendix 'A' - Notice of Study Commencement.

Region of Peel departmental staff, agency staff and stakeholders who actively participated in consultation include the following individuals:

Damian Albanese	Region of Peel
Kathy Cater (retired)	Region of Peel
Bishnu Parajuli	City of Brampton
Tahar Singh	City of Brampton
John Allison	City of Brampton
Susan Jorgenson	City of Brampton
Compton Bobb	City of Brampton
Liam Marray	Credit Valley Conservation Authority
Jakub Kilis	Credit Valley Conservation Authority
S.M. Bahar	Credit Valley Conservation Authority
Alejandro Cifuentes	Ministry of Tourism and Culture
Arbinder Hundal	The Municipal Infrastructure Group
Darlene Presley	TransCanada Pipelines Limited
David Stowe	Brampton Transit
Diane Beaulne	Enbridge Gas Distribution Inc.
Jim Arnott	Enbridge Gas Distribution Inc.
Robert Evangelista	Hydro One Brampton
Diane Sheridan and Lori Ritter	Hiawatha First Nation
Don Boswell	Specific Claims Branch Indian and Northern Affairs Canada
Heather Levecque	Ministry of Aboriginal Affairs
Mark Heaton	Ministry of Natural Resources

2.4.2 Phase 2 and 3 Consultation

Consultation with agencies and the public in Phases 2 and 3 of the Class EA process included several meetings with stakeholders and agencies and two Public Information Centres. PIC No.1, (May 18, 2010) and PIC No. 2 (May 3, 2012) were held at the Peel Region Police Association on Mississauga Road. Members of the public, agencies and stakeholders were notified of the opportunity for consultation by letter and newspaper advertisement. Results of the consultation with various stakeholders are discussed in more detail in Sections 4.0 and 5.0 of this report.

2.4.3 Filing of the Environmental Study Report

All parties having expressed an interest in the project have been notified by letter, regarding the completion of the project and filing of the ESR. In addition, a Notice of Study Completion has been placed in the local newspaper, Brampton Guardian, in accordance with the requirements

of the Class EA. Copies of the Environmental Study Report were made available at the following locations:

The Region of Peel
Clerk's Desk
10 Peel Centre Drive, Suite A
Brampton, Ontario
Hours: Mon-Fri: 8:30 a.m. to 4:30 p.m.

City Clerk's Office
Brampton City Hall
2 Wellington Street West
Brampton, Ontario
Hours: Mon-Fri: 8:30 a.m. to 4:30 p.m.

City of Brampton
City of Brampton Library
Mount Pleasant Village Branch
100 Commuter Drive
Brampton, Ontario
Monday - Thursday -2:00 p.m. to 9:00 p.m.
Friday - 2:00 p.m. to 6 p.m.
Saturday - 10:00 a.m. to 5:00 p.m.
Sunday - 1:00 p.m. to 5:00 p.m.

A review period of not less than thirty (30) days will be provided, during which comments will be received from stakeholders and agencies. Should stakeholders raise issues that cannot be resolved through discussion with Region of Peel and Consultant staff, the stakeholder may request the Minister to require the Region of Peel to complete an individual EA in accordance with Part II of the EA Act. This is known as a "Part II Order" (formerly known as a 'Bump-up'). However, it is anticipated that all concerns will be resolved through discussion between the Region of Peel and the concerned party.

3.0 EXISTING CONDITIONS

The existing conditions for Bovaird Drive are documented on Drawing 1 – Existing Conditions (ref. rear pocket).

3.1 Study Area

The study area for this Class Environmental Assessment (Class EA) is located within the City of Brampton, in Peel Region, and extends along Bovaird Drive (Regional Road 107), from Lake Louise Drive/ Worthington Avenue to 1.45 km west of Heritage Road (ref. Figure 1.1 - Key Plan / Study Area).

3.2 Land Use and Development Plans

3.2.1 Existing Land Use

Within the study area, the land use contiguous to Bovaird Drive is a mix of urban and rural land use, as follows:

- *Lake Louise Drive to Ashby Field Road* - a mix of residential and commercial land use, as well as the Mount Pleasant GO Station.
- *Ashby Field Road to Mississauga Road* - mainly rural but with proposed urban development and existing commercial development at Mississauga Road.
- *Mississauga Road to Caseley Street* - agricultural with some existing residential, commercial and institutional development.
- *Just west of the west project limit is the Hamlet of Norval* – a rural settlement/community in the Town of Halton Hills.

3.2.2 Existing Land Use Designation

City of Brampton Official Plan

The City of Brampton Official Plan designates lands along the Bovaird Drive study corridor as a mixture of residential, open spaces and urban development area. There is also a *Corridor Protection Area* for the future North-South Transportation Corridor (NSTC) in the west end of the City (ref. Figure 3.1: General Land Use Designations, City of Brampton Official Plan).

The Fletcher's Meadow, Mount Pleasant, Credit Valley and Huttonville North Secondary Plan Areas are all traversed by the study corridor, and there are five Special Land Use Policy Areas adjacent to the subject roadway. The study area is also within the North West Brampton Urban Development Area, which is being planned as a "compact, complete and connected community." The Urban Development Area is planned for mixed-use development including a range of housing types, and densities as well as employment lands.

The Mount Pleasant Transit Oriented Community Secondary Plan has been identified by City Council as the first phase of development in North West Brampton. Construction has commenced on this development. This secondary plan area is intended to be a residential precinct that will also include significant retail and commercial opportunities, in the vicinity of Mississauga Road and Bovaird Drive. The Mount Pleasant Secondary Plan Area is being planned to encourage a transit oriented, mixed-use community.

The City of Brampton has also commenced studies to establish a community vision for the Heritage Heights and Huttonville North secondary plan areas. These studies will affect the lands immediately west of the Mount Pleasant area and continue to the western boundary of the city.

Bovaird Drive is classified in the Official Plan as a primary corridor, and as such, gateways are to be provided to reinforce function and identity. One such gateway is planned for the intersection of Mississauga Road and Bovaird Drive.

Region of Peel Official Plan

The Region of Peel Official Plan projects a 40 percent growth in population for the City of Brampton between 2011 and 2031. The Northwest Brampton Policy Area, within which the study area lies, is to be developed as an urban area which will accommodate a large portion of this growth. Opportunities will be maximized for the expansion of services at the Mount Pleasant GO Station. This station is just north of the roadway at the intersection of Bovaird Drive and Ashby Field Road. The Official Plan also supports the protection of the western portion of the study area for the future NSTC.

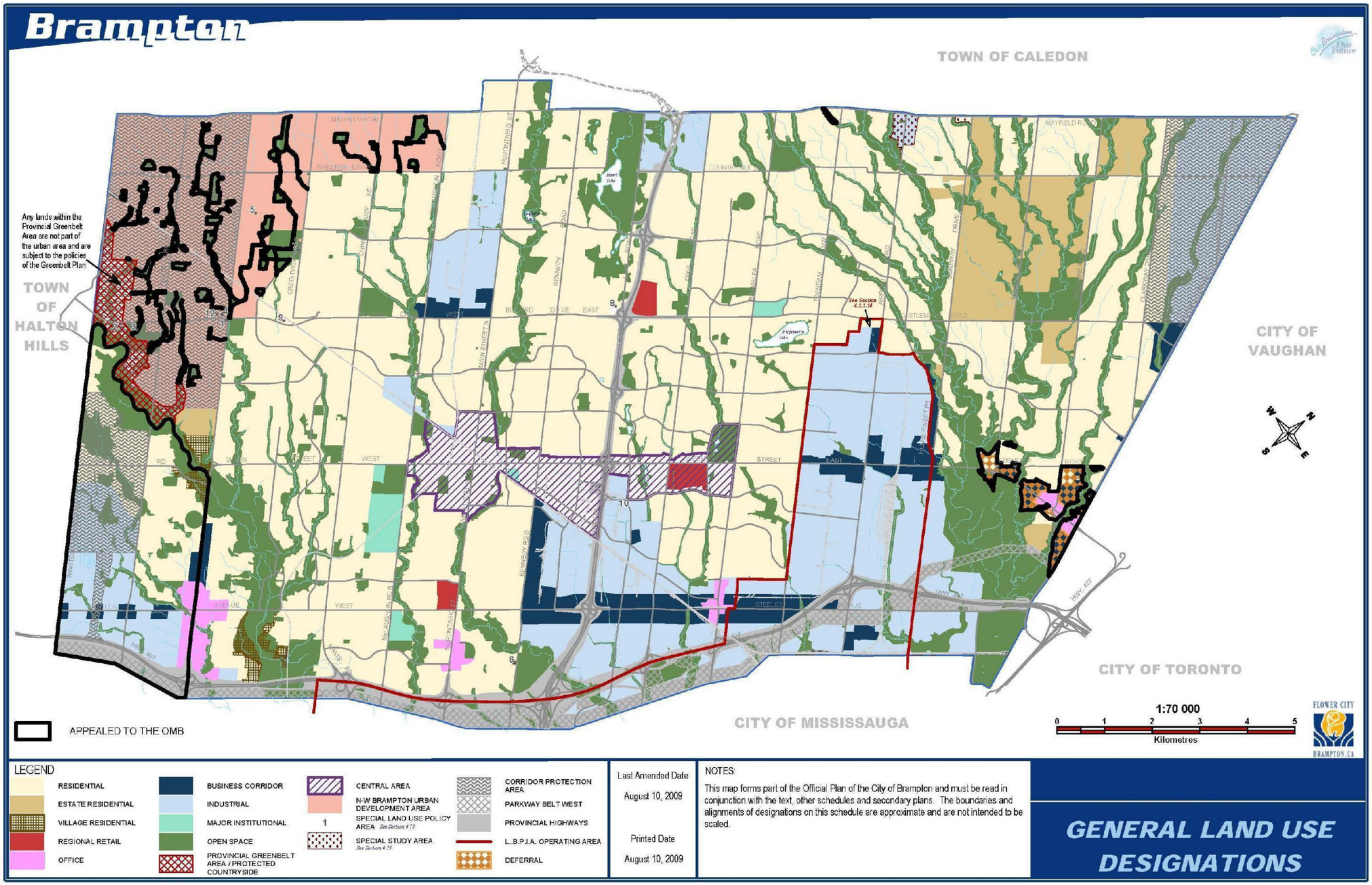
Greenbelt Protected Countryside

In accordance with the general infrastructure policies (4.2.1) of the provincial Greenbelt Plan, some areas at the western limits of the study corridor are classified as *Protected Countryside* (ref. Figure 3.1: General Land Use Designations, City of Brampton Official Plan). The rural areas of the *Protected Countryside* are intended to continue to accommodate a range of commercial, industrial and institutional uses, serving the rural resource and agricultural sectors. They are also intended to support a range of recreation and tourism uses such as trails, parks, golf courses, bed and breakfast establishments and other tourism based accommodation, serviced playing fields and campgrounds, ski hills and resorts.

Environmentally Sensitive Areas (ESAs)

There are two ESAs which extend into the study area. The floodplain of Huttonville Creek, and a second ESA the Credit River Valley are explained in further detail in Section 3.4.

Figure 3.1: General Land Use Designations
(Source: Brampton Official Plan, 2006)



3.3 Transportation

Genivar (formerly known as Entra), a sub-consultant of AMEC, has completed a Traffic Study to investigate existing and future traffic conditions on the study corridor, assess the need for improvements to accommodate future traffic in a safe and efficient manner and provide a traffic analysis of alternative improvements (ref. Appendix 'B' - Traffic Study).

3.3.1 Existing Roadway Network

Bovaird Drive from Lake Louise Drive to Ashby Field Road has a generally urban cross section, with three lanes eastbound and two lanes westbound (ref. Figure 3.2 Bovaird Drive: Existing Lanes and Traffic Control). The CNR overpass is located within this roadway segment. The segment from Ashby Field Road to Mississauga Road has a rural cross section with two lanes eastbound and one lane westbound. Bovaird Drive from Mississauga Road to the western study limit has a two lane cross section, with the exception of the eastbound truck climbing lane leaving Norval. The posted speed limit is 70 km/h from the east project limits to 730m west of Heritage Road, and 60 km/h from this point to the west project limits.

The existing roadways connecting with Bovaird Drive within the study area include Worthington Avenue/Lake Louise Drive, Ashby Field Road, Mississauga Road, Heritage Road and Caseley Street. The characteristics of the crossing intersections are described below and illustrated in Figure 3.2 – Bovaird Drive: Existing Lanes and Traffic Control.

Worthington Avenue/Lake Louise Drive
Worthington Avenue/Lake Louise Drive is a north-south roadway under the jurisdiction of the City of Brampton. The intersection of Worthington Avenue/Lake Louise Drive with Bovaird Drive is signalized. Commercial properties are present on both the northwest and northeast quadrants of the intersection. The south leg of the intersection leads into a residential subdivision. The speed limit on Worthington Avenue/Lake Louise Drive is 50km/h.

Ashby Field Road
Ashby Field Road is a local street leading into the Mount Pleasant GO Station to the north and a residential area to the south. The intersection of Ashby Field Road with Bovaird Drive is signalized, with a dual southbound left-turn lane. The speed limit on Ashby Field Road is 50km/h.

Mississauga Road
Mississauga Road is a major arterial roadway under the jurisdiction of the Region of Peel. Mississauga Road, at the intersection with Bovaird Drive, has a two-lane cross-section with left-turn lanes on the north-south approaches to the signalized intersection. The speed limit on Mississauga Road is 80 km/h. Detail design for the widening of Mississauga Road south of Bovaird to four lanes, including the Bovaird Drive-Mississauga Road intersection, is nearing

completion. A Class EA for improvements to Mississauga Road, north of Bovaird Drive is underway.

Heritage Road

Heritage Road has a two-lane cross-section on both the north and south approaches. The intersection of Heritage Road with Bovaird Drive is signalized. The speed limit on Heritage Road is 60km/h south of Bovaird Drive and 50km/h north of Bovaird Drive.

Caseley Street

Caseley Street is a local roadway under the jurisdiction of the City of Brampton. The intersection of Caseley Street with Bovaird Drive is unsignalized with a stop sign on Caseley Street. The speed limit on Caseley Street is 50km/h.

The CN Rail

Bovaird Drive crosses over the CN railway tracks at a point approximately midway between the Lake Louise Drive/Worthington Avenue intersection and the Ashby Field Road intersection. Two separate bridge structures span the railway. The eastbound structure has three lanes and the westbound structure has two lanes. The Structural Inspection Report in Appendix 'E' provides more detail about this structure.

3.3.2 Halton-Peel Boundary Area Transportation Study

The Regional Municipalities of Peel and Halton, in conjunction with the local municipalities of Brampton, Caledon, and Halton Hills, completed the Halton-Peel Boundary Area Transportation Study (HPBATS) in May 2010. The study area extended from west of Trafalgar Road in the Town of Halton Hills to east of Chinguacousy Road in the City of Brampton, and from north of King Street in the Town of Caledon to south of Highways 401 and 407 in Mississauga (ref. Figure 3.3 - Study Area: Halton-Peel Boundary Area Transportation Study). The key findings of the HP-BATS relevant to this study were:

- There is a lack of east-west connections and continuity. East-west capacity improvements will be required between Bovaird Drive and Highway 401.
- There are north-south capacity deficiencies in Halton Hills and West Brampton. A North-South Transportation Corridor (NSTC) will be needed to support continued development in the study area.
- Suitable corridors for truck routes are required.
- More connections to freeways are needed.

Figure 3.2 - Bovaird Drive: Existing Lanes and Traffic Control

(Source: Bovaird Drive Environmental Assessment Traffic Study (ENTRA Consultants/Genivar, 2010)

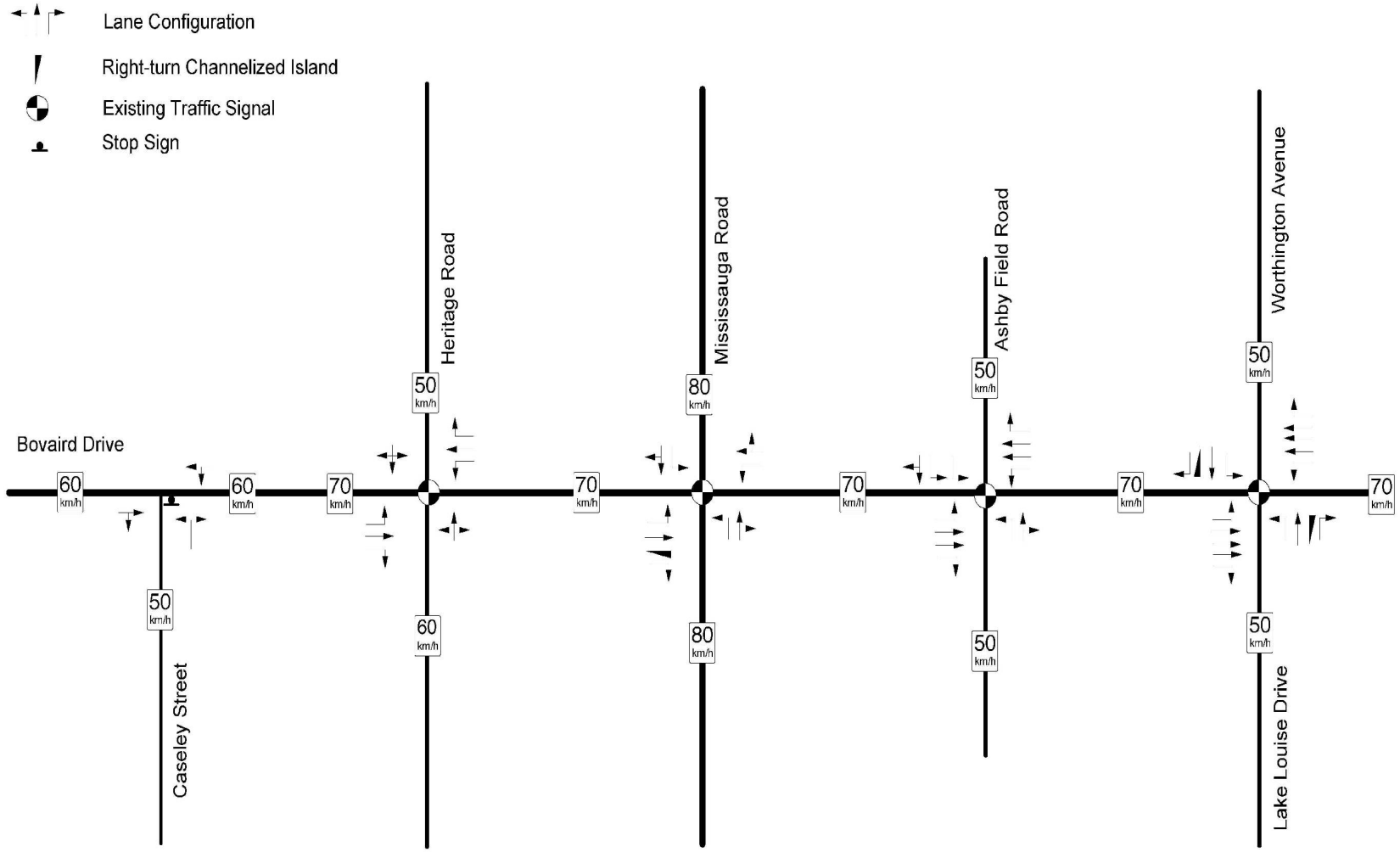
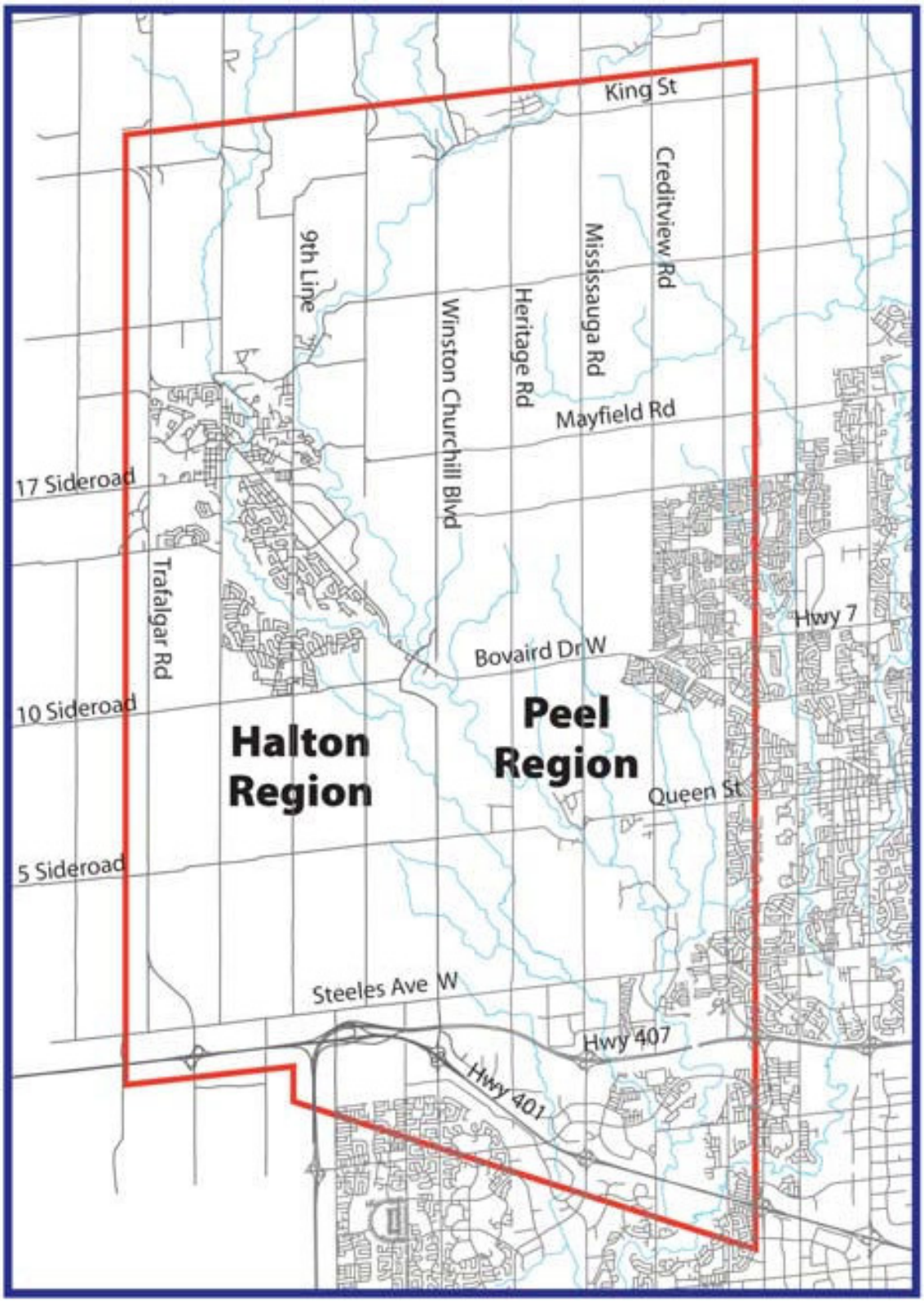


Figure 3.3 - Study Area: Halton-Peel Boundary Area Transportation Study

(Source: Halton-Peel Boundary Area Transportation Study)



3.3.3 Existing Traffic Conditions

Traffic data for this study was provided by the Region of Peel. The data consists of weekday eight-hour turning movement counts at the intersection of Bovaird Drive and Worthington Avenue/Lake Louise Drive on September 29, 2009, and at the intersections of Bovaird Drive with Ashby Field Road, Mississauga Road, Heritage Road, and Caseley Street on December 1, 2009. The results of this data are shown on Figure 3.4. The key traffic characteristics to note are as follows:

- The existing signalized intersections at Worthington Avenue, Ashby Field Road, Mississauga Road, and Heritage Road, all currently operate at satisfactory levels of service.
- The westbound left-turn movement at the intersection of Bovaird Drive and Mississauga Road is over capacity with a 92 second delay in the AM peak hour.
- The existing unsignalized intersection of Bovaird Drive and Caseley Street has no capacity problems and operates at an acceptable level of service during all peak hours.

3.3.4 Future Traffic Conditions

The future traffic conditions have been estimated for a study horizon year of 2021 and 2031 based on forecasts developed by the Region of Peel travel forecasting model, supplemented with estimates of the traffic that is expected to result from planned development within the study area. The projected traffic volumes are shown on Figure 3.5 and 3.6.

Figure 3.7 (HP-BATS Recommended Road Network, 2031) shows the proposed general route of the road network in NW Brampton based on the recommendations from the HPBATS. The NSTC will theoretically cross Bovaird Drive mid-block between Heritage Road and Mississauga Road. It has been assumed that the NSTC will not be in place until the ultimate horizon year of 2031. As well, if future Environmental Assessments conclude that the crossing location be west of Heritage Road, an addendum to the Bovaird Drive Class EA will be undertaken.

The Region of Peel Long Range Transportation Plan (LRTP) was initiated in late 2002 to address transportation challenges anticipated by the Region over the next 20 to 30 years, and developed appropriate policies and road improvement plans. The LRTP identifies the need to widen Bovaird Drive to six lanes by 2031.

The GTA West Corridor Environmental Assessment Study has recently fulfilled the requirements of the MTO planning process in November 2012. For the purposes of this study, it is assumed that the facility will be in place by the 2031 horizon year. A schematic diagram of the results of the GTA West Study is shown in Figure 3.8.

With the addition of the NSTC and future development of commercial areas, truck traffic is expected to increase from 10% to 15% by 2031. Compounding this is the fact that Bovaird Drive is one of the few major east-west arterials for the area. The widening of Bovaird Drive to six lanes will help to accommodate the future increase in truck traffic.

Figure 3.4 - Bovaird Drive: Existing Traffic Volumes

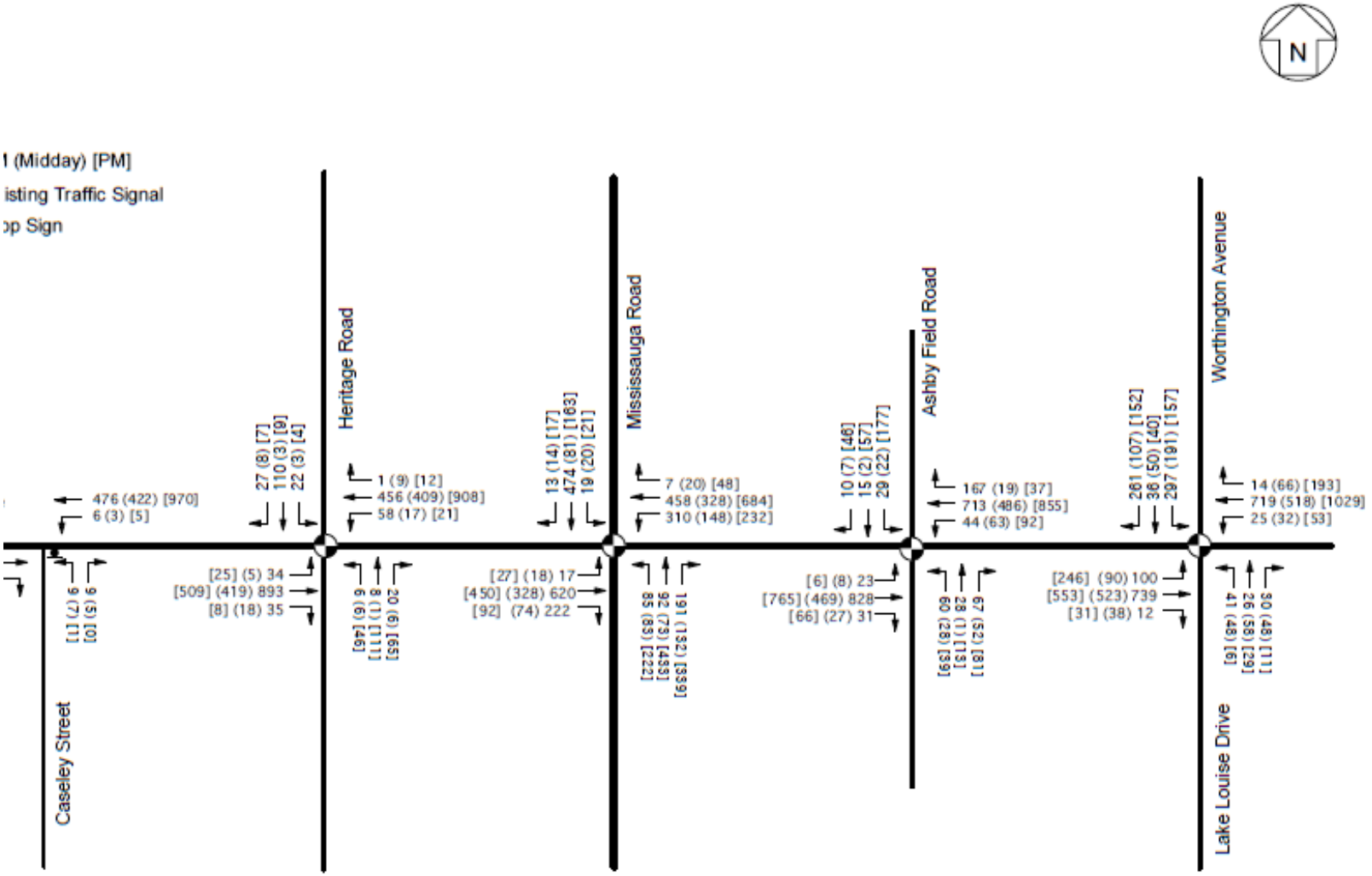


Figure 3.5 - Bovaird Drive: Projected 2021 Traffic Volumes

(Source: Bovaird Drive Environmental Assessment Traffic Study (ENTRA Consultants/Genivar, 2010)

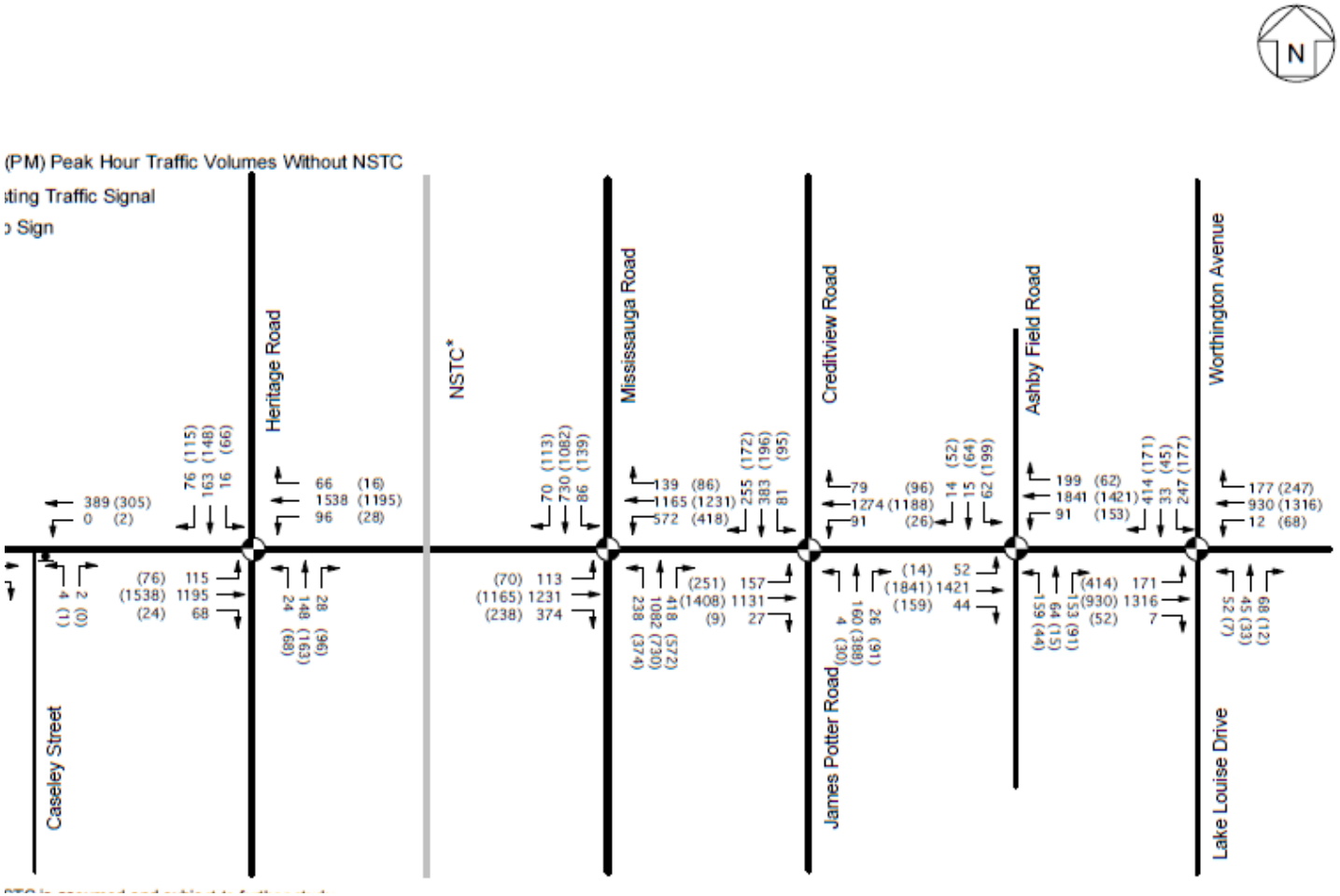


Figure 3.6- Bovaird Drive: Projected 2031 Traffic Volumes
(Source: Bovaird Drive Environmental Assessment Traffic Study (ENTRA Consultants/Genivar, 2010)

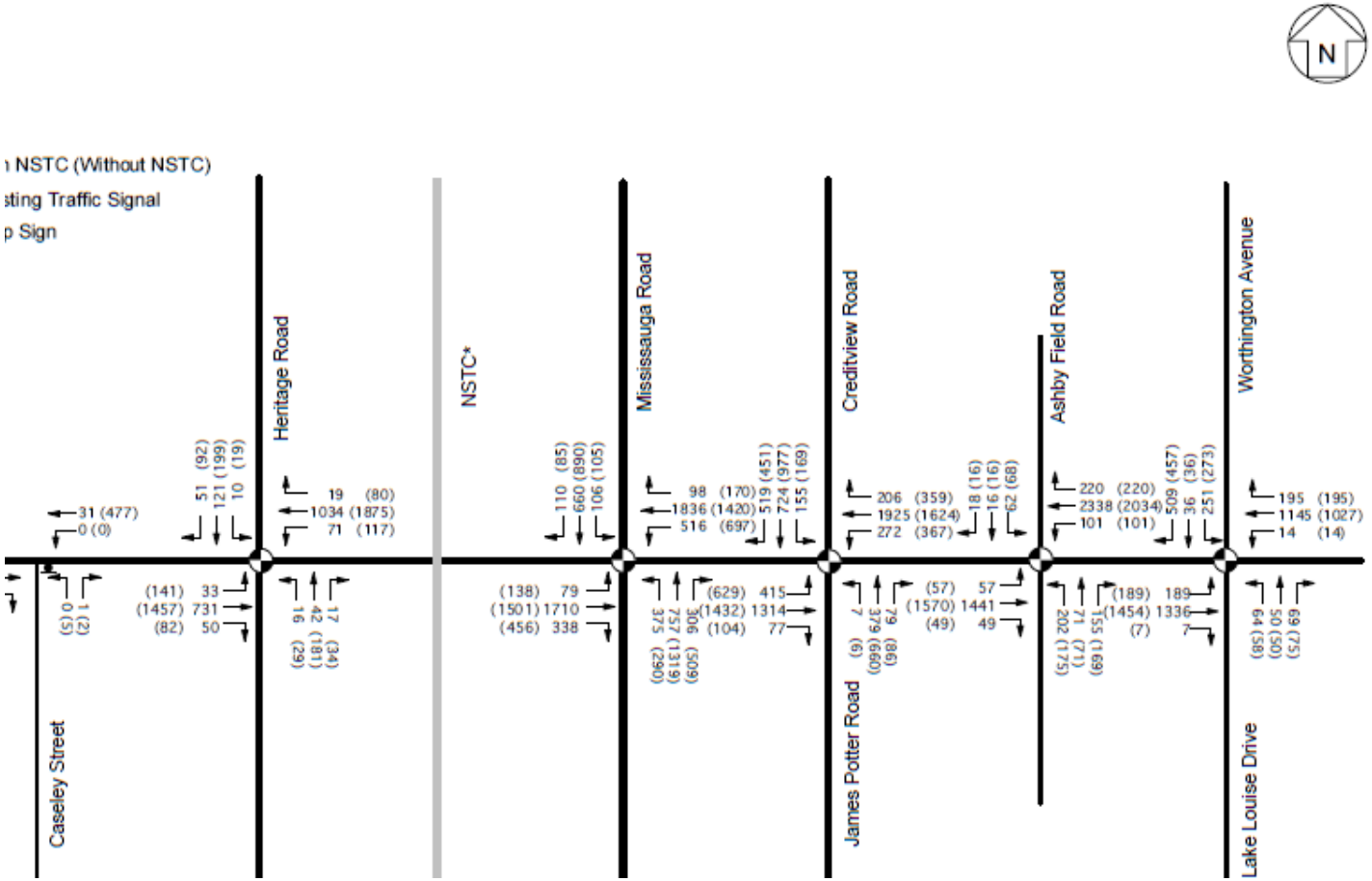
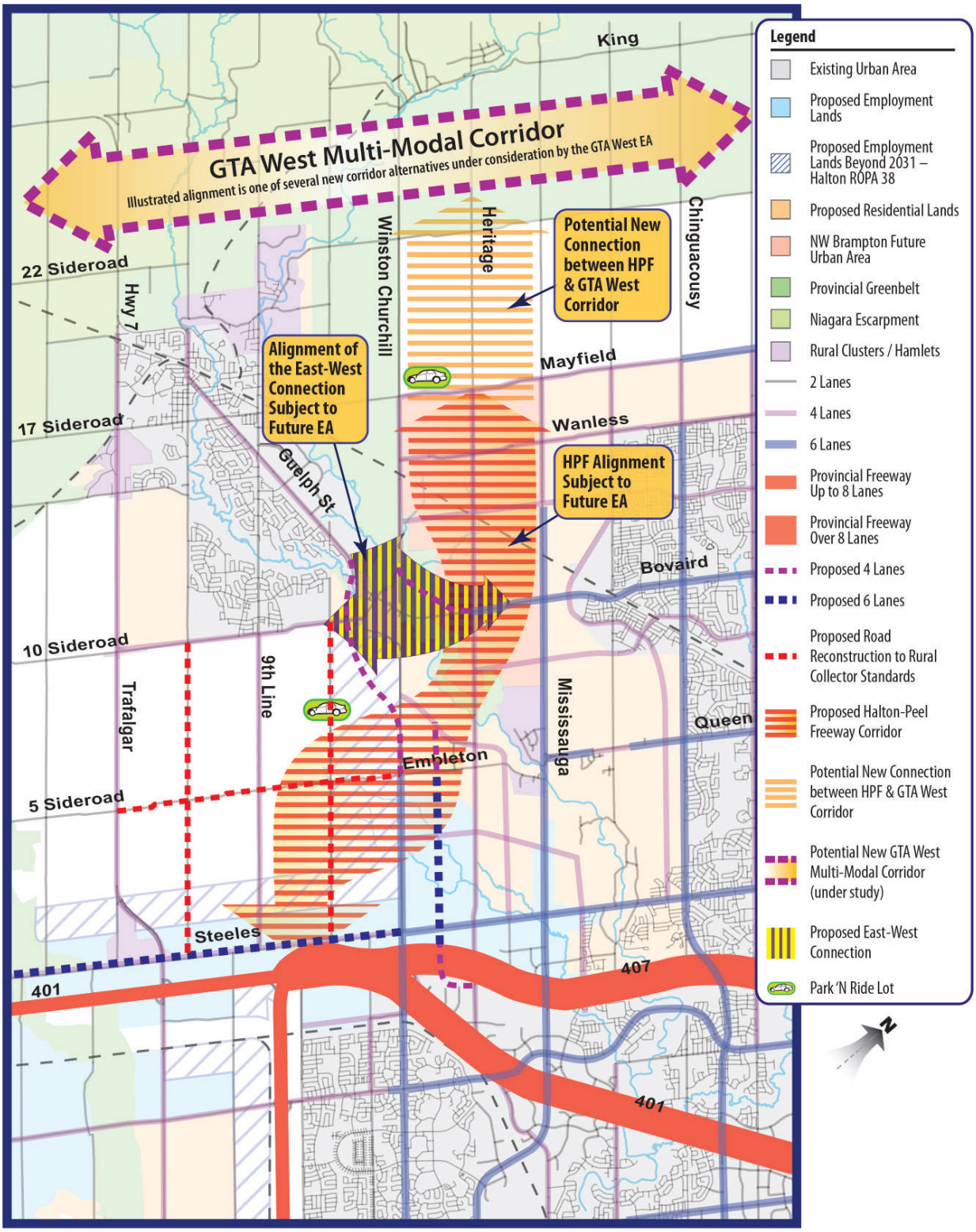
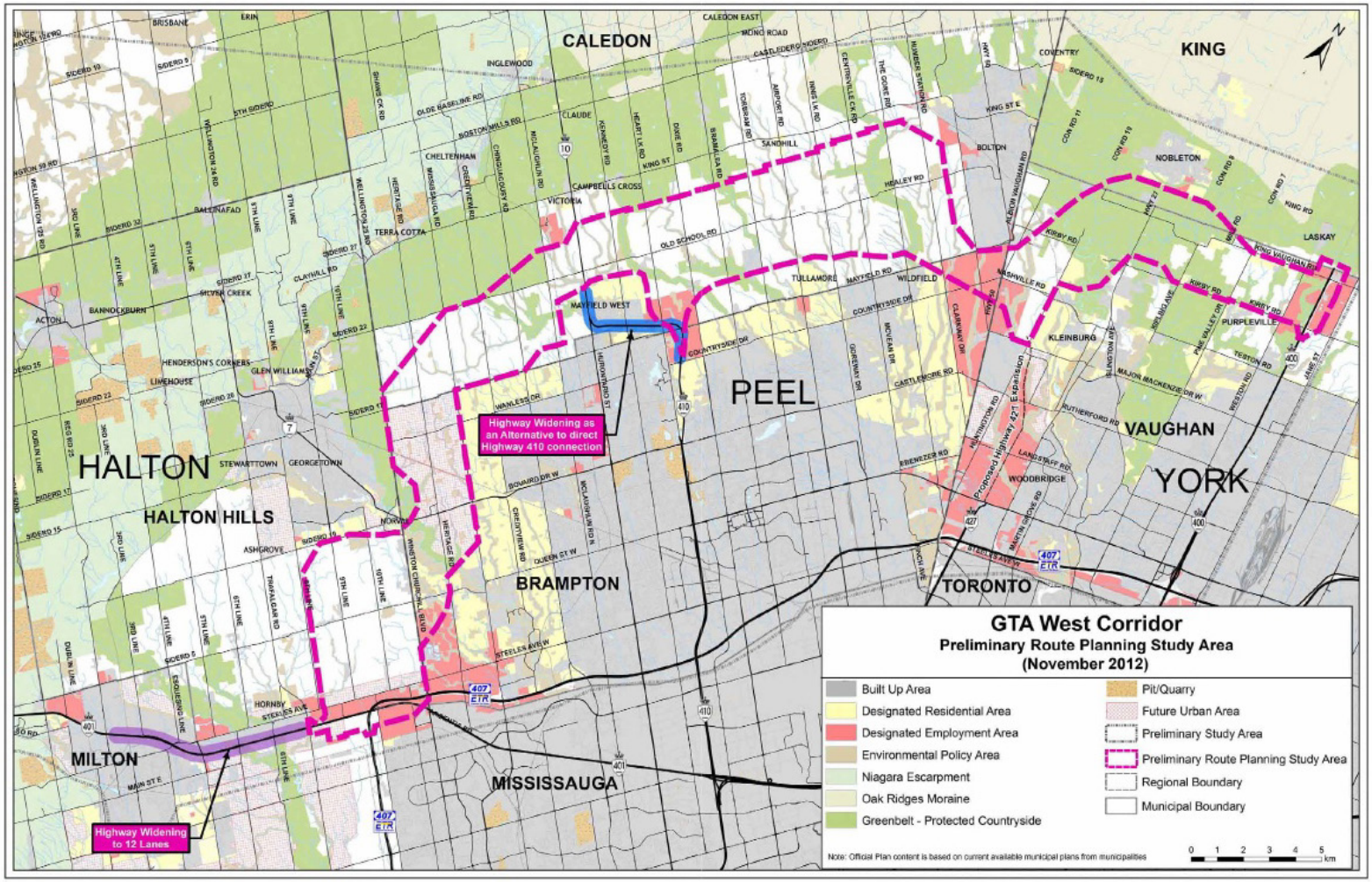


Figure 3.7 - HPBATS Recommended Road Network, 2031
(Source: Halton-Peel Boundary Area Study)



Subject to future Environmental Assessment studies

Figure 3.8 – GTA West Schematic Drawing
(Source: GTA West Final Report – November 2012)



3.3.5 Transit and Active Transportation

Transit

According to the 2009 Brampton Transportation and Transit Master Plan (TTMP), Brampton Transit is expected to expand its services considerably. The proposed expansion includes a Bovaird Drive Bus Rapid Transit (BRT) and a Mississauga Road BRT to the Mount Pleasant GO Station by 2014 and 2017 respectively [ref. Figure 3.9 - Brampton Transit Network (2031 Projection)]. Primary corridors, including Bovaird Drive will incorporate transit priority measures including traffic signal priority, bus bays, and queue jump lanes.

Expansions are also planned for the GO Transit network. This will be facilitated by increases in the amount and frequency of bus and train services, and continued enhancements to the Mount Pleasant GO Station, and will be further enhanced by the establishment of the Mount Pleasant Mobility Hub, a proposed intermodal transportation facility to be located within the new Mount Pleasant community just north of the existing GO Station.

Active Transportation

Active Transportation is a key component of the City of Brampton's Transportation and Transit Master Plan. In addition, the City of Brampton's Pathways Master Plan, developed in 2002 and subsequently updated in 2006, sets out an implementation plan for a city-wide pathway system. Another objective set through the TTMP was to promote bicycle use for purposes other than recreation, such as work, and shopping.

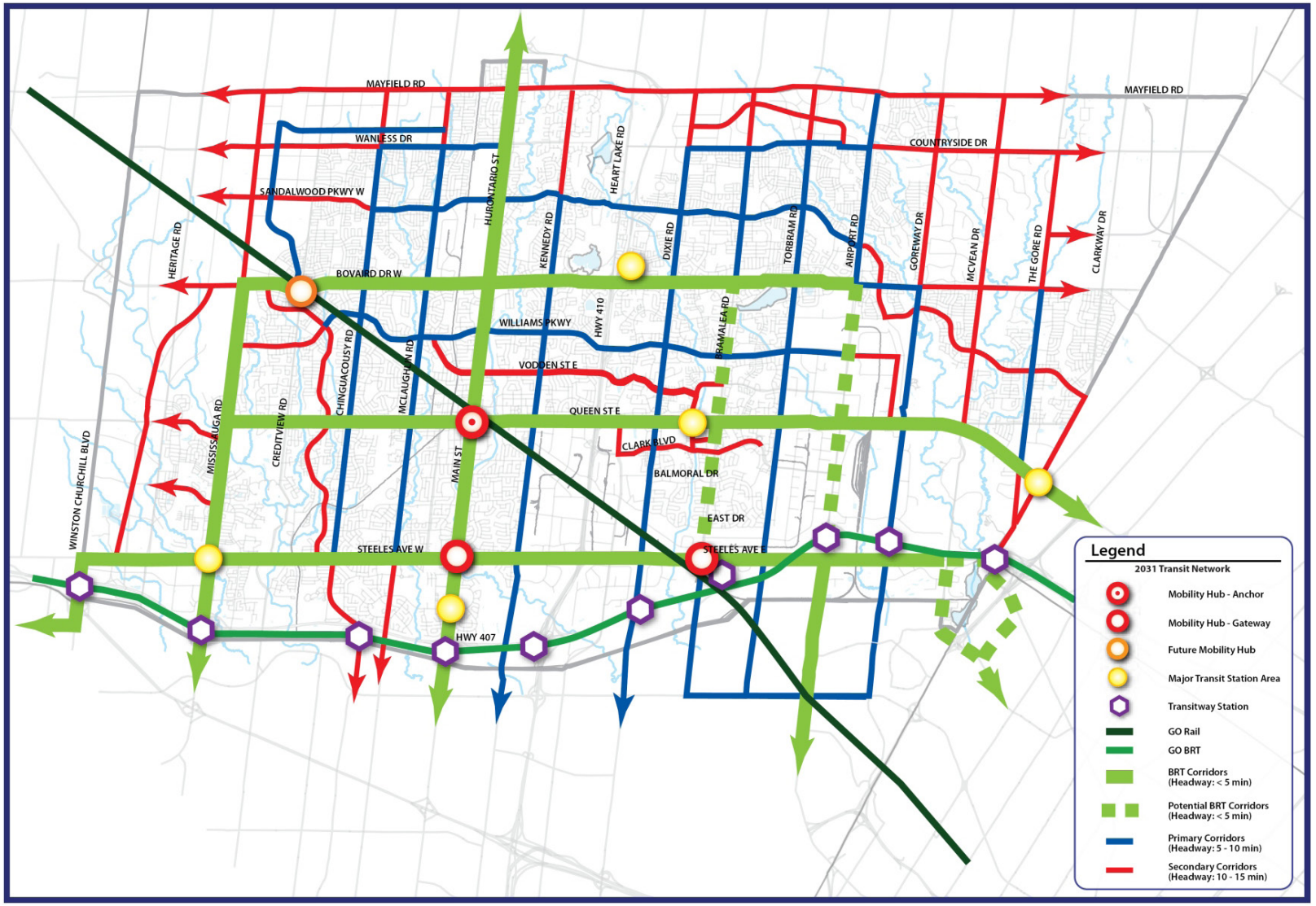
Based on the traffic counts, there are currently few pedestrians utilizing the Bovaird Drive corridor from Worthington Avenue/Lake Louise Drive to Caseley Street. Sidewalks are present at the following locations:

- All four (4) quadrants of the intersection at Bovaird Drive and Worthington Avenue/Lake Louise Drive;
- Southeast side of the Bovaird Drive and Ashby Field Road intersection; and
- South side of Bovaird Drive at Caseley Street.

There are pedestrian signals and crosswalks on Bovaird Drive at all of the intersections within the study area. Cyclists are present but not prominent on Bovaird Drive and there are no dedicated bike lanes on Bovaird Drive.

Figure 3.9 - Brampton Transit Network (2031 Projection)

(Source: Transportation and Transit Master Plan, 2009)



3.3.6 Traffic Safety

A Road Safety Performance Review was prepared by Intus Road Safety Engineering (ref. Appendix 'C' – Road Safety Review). The objective of the study was to identify any safety issues present on Bovaird Drive within the study limits.

The safety assessment followed a systematic process to review physical, traffic, and collision characteristics in order to identify safety problems and issues that may be used by the design team in the Class EA process.

The study area experienced 74 collisions from January 1, 2005 to December 31, 2007, for an average of 24.7 collisions per year. Taking into account the volume and distribution of traffic in the study area the overall safety performance of the intersections and road segments in the study area are acceptable except for the intersection of Bovaird Drive with Mississauga Road.

The following collision trends and patterns were noticeable:

- Higher than expected numbers of collisions are occurring at the study intersections.
- Marked spike in collisions at Bovaird Drive and Mississauga Road intersection in 2007.
- High percentage of angle collision at Bovaird Drive and Mississauga Road that mostly involve westbound vehicles

3.3.7 Pavement Condition

AMEC conducted a geotechnical investigation in October 2009 in order to obtain information on the existing subsurface soil conditions, determine the pavement structure thickness, and assess the pavement condition of Bovaird Drive. (ref. Appendix 'D' - Geotechnical Investigation Report). Existing pavement condition is summarized as follows:

Lake Louise Drive / Worthington Avenue to Mississauga Road
The existing pavement is considered to be in a 'Good Condition', except for mid-lane cracking in the westbound lanes across the CNR structure of 'severe' severity and a few joint cracks of 'slight' severity.

Mississauga Road to Heritage Road
The existing pavement is considered to be in a 'Fair Condition' with intermediate to extensive ravelling and aggregate loss, wheel track rutting, and various cracks of 'slight' to 'severe' severity.

Heritage Road to Peel-Halton Boundary
The existing pavement is considered to be in a 'Fair Condition' with intermediate to frequent ravelling and aggregate, ripping and shoving and cracking of 'slight' to 'moderate' severity.

3.3.8 Structures

A total of fifteen (15) structures along the Bovaird Drive corridor were reviewed by AMEC, including elliptical, box, corrugated steel pipe (CSP), open footing culverts, and the Canadian National Railway bridge. The results of the inspection are presented in the Structural Inspection Report (ref. Appendix 'E' - Structural Inspection Report).

The report recommends the replacement of four small CSPs and the rehabilitation of the westbound lanes structure of the CN bridge on Bovaird Drive. Alternatively, replacement of the westbound structure will be considered. The other structures were found to be in fair condition except for minor end deterioration and erosion. A summary of the findings is outlined in Table 3.1, below.

Table 3.1 Summary of Structural Report

Culvert	Structure Location	Span/ Type	Observation	Recommendation
A	Bovaird Drive, 1.1 km west of Heritage Road	1.2 m Box	Outlet end is fair. Inlet is unknown.	More detailed structural investigation recommended. Recommended reconstruction of inlet end.
B	Bovaird Drive, 450 m west of Heritage Road	0.91 m Open Footing	Sagging and cracking	More detailed structural investigation recommended.
C	Bovaird Drive, 20 m west of Heritage Road	1.2 m Open Footing	Good condition Banks eroding.	Existing concrete structure adequate. Remove CSP section and repair erosion.
C2	Heritage Road, 50 m south of Bovaird Drive	0.9 m CSP	Corrosion throughout. Damage to ends.	Replace CSP
CN EB	Bovaird Drive, CN Overhead (east bound lane structure)	30 m Bridge	Good condition	Existing structure adequate.
CN WB	Bovaird Drive, CN Overhead (west bound lane structure)	30 m Bridge	Fair condition	Rehabilitation or replacement required.
D	Bovaird Drive, 440 m east of Heritage Road	1.2 m Open Footing	Good condition Banks eroding.	Existing structure adequate with repair of erosion.
E	Bovaird Drive, 320 m west of Mississauga Road	0.9 m Open Footing	Good condition with minor defects	Existing structure adequate with minor repair.
F	Bovaird Drive, 20 m east of Mississauga Road (Bridge 1071879)	5.53 m Box Open Footing	Good condition	Existing structure adequate.
F2	Mississauga Road, 20 m north of Bovaird Drive	0.63 m CSP	Good condition	Existing structure adequate.

Table 3.1 Summary of Structural Report

Culvert	Structure Location	Span/ Type	Observation	Recommendation
F3	Mississauga Road, 400 m south of Bovaird Drive	0.50 m CSP	Ends in poor condition	Replace CSP.
F4	Mississauga Road, 80 m south of Bovaird Drive	0.65 m CSP	Ends in poor condition	Replace CSP.
G	Bovaird Drive, 280 m west of Ashby Field Road	0.9 m Box	Good with minor defects	Existing section adequate with minor repair.
H	Bovaird Drive, 115 m east of Ashby Field Road	0.9 m Box 1.05m CSP	Good condition with damage to CSP	Concrete section adequate. Consider CSP removal/replacement.
I	Bovaird Drive, 20 m west of Lake Louise Drive	2.25 m Ellipse	Good condition	Existing structure adequate.

Replacement of CSP pipe is subject to review by detailed design. The material selected for replacement should be verified by Region of Peel Roads Operations and Maintenance Staff.

Crossing ‘A’, ‘C’ and ‘F’ have been identified by the Credit Valley Conservation authority to fall within their regulated limits. Any modification to these crossings will require approval from CVC during detailed design.

3.4 Natural Environment

3.4.1 Terrestrial Resources

A terrestrial resources review was completed by Dougan and Associates in March of 2010 (ref. Appendix 'F' - Preliminary Constraint Assessment for Terrestrial Resources and Environmental Impact Study for Terrestrial Resources). The natural features within the study are described in Figure 3.10 (Terrestrial Constraints). The assessment is based on available background data, mapping data and a reconnaissance visit to the study area for vegetation and wildlife. There are also 3 natural heritage area studies which provided guidance for this review:

- Credit Valley Subwatershed Study and [Huttonville Creek (7), Springbrook Creek (8a), Churchville Tributary (8b)] (TSH et al. 2004);
- North West Brampton Phase 2 Urban Expansion Area Environmental Open Space (EOS) Study (2005); and
- North West Brampton Landscape Scale (LSA): In support of the Mount Pleasant Secondary Plan Subwatershed Study (City of Brampton, August 2007 Draft).

The assessment found that the potential constraint areas include Greenbelt Protected Countryside, Core Area Valleylands and Woodlots, Linkage Corridors, and Species at Risk. The

most likely features to be impacted by development are the valleylands of the Credit River and its tributaries.

The impacts on the terrestrial resources for the Bovaird Drive alignment were estimated by overlaying the limits of disturbance for each alternative onto the Ecological Land Classification (ELC) polygons and onto the Tree Survey drawing (ref. Appendix 'F' - Preliminary Constraint Assessment for Terrestrial Resources and Environmental Impact Study for Terrestrial Resources).

Study Area Context

According to Credit Valley Conservation Authority's Ecological Land Classification data, the majority of the land bound by the study corridor has been impacted by human activity, which includes agricultural fields and commercial lots. Despite the dominance of these uses, there are a number of natural features present including cultural meadow, cultural woodland, deciduous forest, marsh, and streams. The non-cultural natural features are concentrated at the western third of the study corridor, and are primarily associated with tributaries of the Credit River.

Policy and Land Designation

Several levels of policy are relevant to terrestrial resources present at and within the vicinity of the Bovaird Drive corridor, based on provincial, regional, municipal, and conservation authority legislation, policies and regulations.

There are two high-level policy areas within the Bovaird Drive Study corridor: the western section of the study corridor that is protected under the province's Greenbelt Act (2005), and the reaches of Huttonville Creek that support Redside Dace which is protected under the provincial Endangered Species Act (2007) and federal Species at Risk Act (2005). Figure 3.10 (Terrestrial Constraints) identifies the general limits of the Greenbelt. Redside Dace is discussed in more detail in the Fisheries section.

Other areas representing regional and municipal-level policy constraints are the core Greenland features which are part of the Greenlands System for the Region of Peel and the City of Brampton. Terrestrial resources that fall under provincial policy include those within the boundary of the Greenbelt Protected Countryside, or areas identified as significant wetland and or wildlife habitat. Bovaird Drive west of Heritage Road falls within the boundaries of the Greenbelt Protected Countryside.

Natural features within the study corridor are recognized in the Region of Peel and City of Brampton Official Plan Greenlands System, including core valleylands and core forest. The core valleylands are those associated with the Credit River and its tributaries (ref. Figure 3.10 Terrestrial Constraints). Four valley systems are located within the study corridor; the Credit River Valley, located at the western edge of the study corridor, is a major valley system and floodplain. The other identified tributary valleys are located approximately 1 km east of the Town

of Norval (tributary 2A), approximately 0.25 km south of Bovaird Drive and 0.6 km west of Heritage Road (tributary 2B), and south of Bovaird Drive just east of Mississauga Road (Huttonville Creek). Two core forest patches were identified in background mapping at the northern edge of the study corridor (ref. Figure 3.10 Terrestrial Constraints). Huttonville Valley Environmentally Sensitive Area (ESA No. 16) is also within the vicinity of the study corridor, and is contiguous with the Huttonville Creek core valleyland.

Most of the terrestrial resources under the jurisdiction of Credit Valley Conservation Authority (CVC) are covered by provincial, regional, and municipal legislation. The implementation guidelines and necessary setbacks are provided in the CVC Watershed Planning and Regulation Policies (2010). CVC regulation of development (O. Reg. 160/06) applies to all proposed developments that will interfere with wetlands and alterations to shorelines and watercourses. Permission to develop may be granted where “the control of flooding, erosion, dynamic beaches, pollution or the conservation of land will not be affected by the development” (O. Reg. 160/06, s. 3 [1]).

Potential Constraint Areas

Greenbelt Protected Countryside

According to the general infrastructure policies (4.2.1) of the Greenbelt Plan (2005), expansion of existing infrastructure is permitted in the Greenbelt Protected Countryside. However, infrastructure projects should:

i. Minimize the area traversed and/or occupied by the resulting infrastructure,

ii. Minimize the negative impacts and disturbances of the existing landscape,

iii. Avoid key natural heritage features (unless need has been demonstrated and there is no reasonable alternative), and

iv. Where the resulting infrastructure has inevitable impacts on the Natural Heritage System, steps should be taken to minimized the impacts on the features and their ecological functions.

These constraints apply to the natural heritage features located within the boundary of the Greenbelt Protected Countryside at the western section of the Bovaird Drive study corridor.

Core Area Valleylands and Woodlots

The Credit River Valley and Huttonville Valley ESA are the most significant natural features within the vicinity of the Bovaird Drive study corridor. The majority of terrestrial resources associated with these features lie outside of the study corridor boundary. The Credit River Valley intersects a small portion of the west side of the study corridor, and runs in an east direction southeast of Bovaird Drive. The northern tip of the Huttonville Valley ESA is located approximately 1.4 kilometres south of Bovaird Drive, just east of Mississauga Road. Huttonville

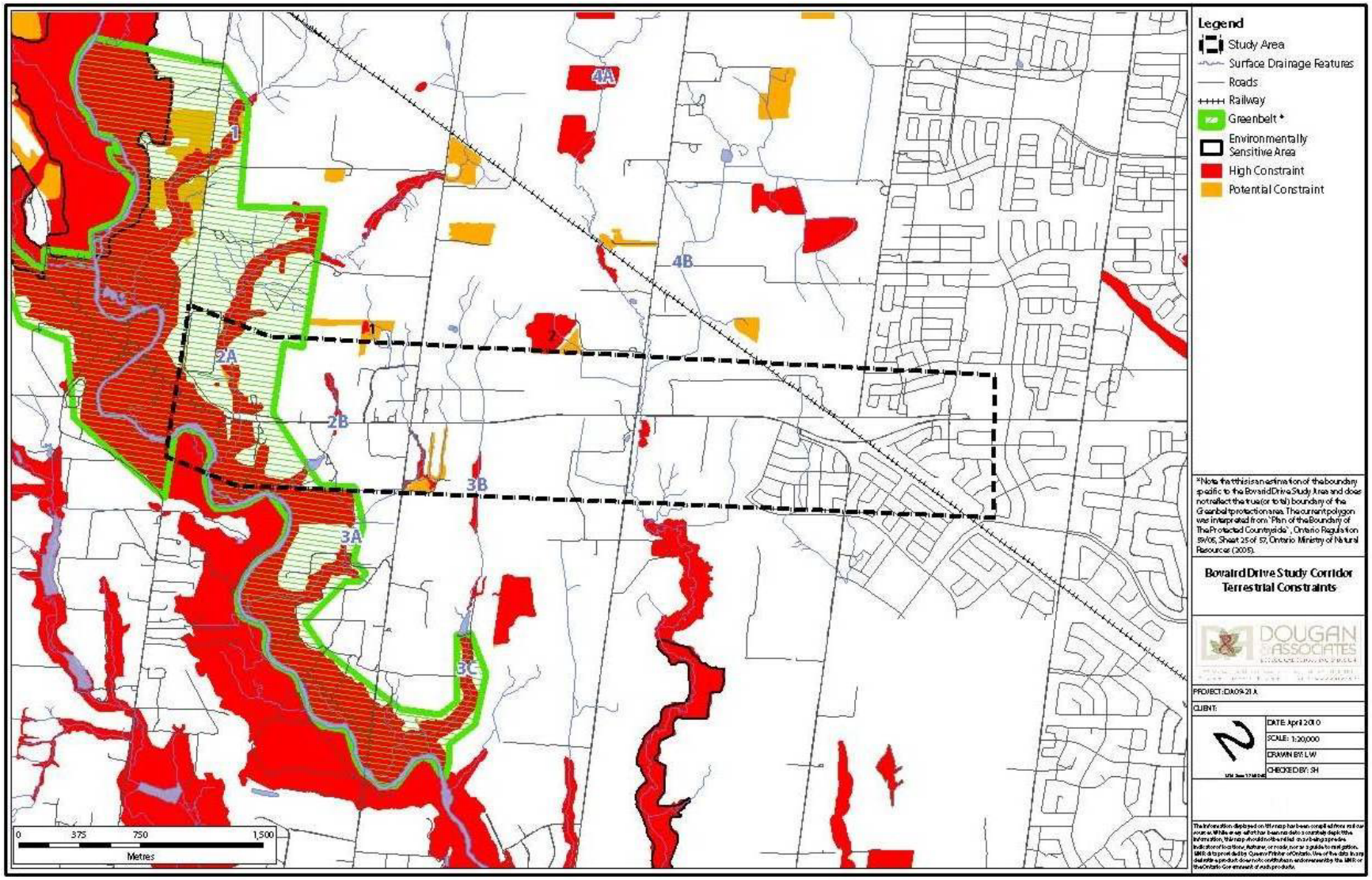
Creek, however, crosses Bovaird Drive at Mississauga Road and the associated vegetated riparian and upland areas are therefore contiguous with the Huttonville Valley ESA. The Credit Valley subwatershed study has identified this habitat as being of high constraint as it is part of the primary valley of Huttonville Creek).The associated tributary valleys of the Credit River are considered significant features with respect to their linkage functions, riparian habitat and associated upland features.

Although development and site alterations to Core Areas are prohibited under the Regional Official Plan (Section 2.3.3.5), exceptions can be made for essential infrastructure if there are no alternative locations outside of the respective Core Area. Furthermore, the impacts must be minimized, and efforts should be made to mitigate these impacts through restoration or enhancement.

These constraints apply to the core area valleylands that are tributaries of the Credit River, and the two core area woodlots that are located north of Bovaird Drive and West of Heritage Road as identified in the Regional and Municipal Official Plans.

Figure 3.10 - Terrestrial Constraints

(Source: Dougan & Associates)



3.4.2 Fish and Fish Habitat

A fish and fish habitat assessment of streams in the Bovaird Drive study area has been completed by C. Portt and Associates. (ref. Appendix 'G' – Fish and Fish Habitat Assessment). A field investigation was conducted on March 30, 2010. Seven (7) tributary watersheds, which all flow into the Credit River, were identified within the study limits. Several of these tributaries are unnamed.

The drainage features in the study area range from short reaches between piped sections to natural streams containing the endangered Redside Dace. Habitat, fish community, and overall sensitivity vary depending on the tributary. A summary of flow status, channel form, fish communities and habitat and fish community sensitivity for each drainage feature is provided in Table 3.2 (Summary of Fisheries Habitat) below.

Table 3.2 Summary of Fisheries Habitat

Water-course	Flow Status at Bovaird Drive	Channel Form at Bovaird Drive	Fish Community at Bovaird Drive	Fish Community Downstream	Habitat Sensitivity	Fish Community Sensitivity	Overall Sensitivity
2a	Permanent	Natural	Warmwater and migratory salmonids	Coolwater	High	Medium to high	High
2b	Intermittent/ ephemeral	None upstream; straight, constructed downstream	None or seasonal warmwater	Unknown	Low	Low	Low
3a	Permanent	Natural upstream; naturalized but constructed along heritage road	Unknown	Unknown	Medium to high	Medium to high	Medium
3b	Intermittent	Straight, constructed upstream; across cultivated field downstream	None	Coldwater	Low	Low	Low
Huttonville Creek	Permanent	Natural	Endangered Redside Dace	Coldwater	High	High	High

Table 3.2 Summary of Fisheries Habitat

Water-course	Flow Status at Bovaird Drive	Channel Form at Bovaird Drive	Fish Community at Bovaird Drive	Fish Community Downstream	Habitat Sensitivity	Fish Community Sensitivity	Overall Sensitivity
Spring-brook Creek	Ephemeral	Straight, constructed	None	Coldwater	Low	Low	Low
Fletcher's Creek	Permanent or intermittent	Constructed	None	Warmwater baitfish?	Low	Low	Low

3.4.3 Stormwater

Background for Drainage Assessment

Bovaird Drive is located within the Credit River Tributaries, Huttonville Creek and Springbrook Creek subwatersheds. Each of these subwatersheds flows into the Credit River south of Bovaird Drive. Each has been studied in various reports, with the main reports used as background information listed below:

Credit River Tributaries

- North West Brampton Phase 2 Urban Expansion Area Environmental Open Space Study, 2005, Dougan and Associates et al.

Huttonville Creek

- Credit Valley Subwatershed Study [Huttonville Creek (7), Springbrook Creek (8a), Churchville Tributary (8b)], 2004, TSH et al.
- North West Brampton Phase 2 Urban Expansion Area Environmental Open Space Study, 2005, Dougan and Associates et al.
- Draft Phase 1 Subwatershed Characterization and Integration, North West Brampton Urban Development Area. Huttonville and Fletcher's Creeks, Mount Pleasant Plan Area, December 2007, Philips Engineering Ltd. (now AMEC) et al.
- "Working Paper", Phase 2: Subwatershed Impact Assessment Testing Of Second Generation (2g) Land Use Plan, Mount Pleasant Community, North West Brampton, March 2010
- Bluegrass Helport Stormwater Management Pond H1 Design Report, Bluegrass Helport Property CVSP Sub-Area 1, February 2011, Schaeffers Consulting Engineers

Springbrook Creek

- Stormwater Management Pond Design Brief Mattamy Area 44 Lands (North of Highway 7), Extended Detention/ Quantity Pond, City of Brampton, October 1999, Cosburn Patterson Mather Limited.
- Credit Valley Subwatershed Study [Huttonville Creek (7), Springbrook Creek (8a), Churchville Tributary (8b)], 2004, TSH et al.
- Mount Pleasant Village Block Plan No. 44-1 Stormwater Management Design Brief, April 2010, Urbantech Consulting.

Mapping

The following mapping data was available to conduct the stormwater assessment for Bovaird Drive.

- City of Brampton topographic mapping, 2005
- City of Brampton watercourse mapping, 2005

Existing Drainage

Credit River Tributaries (2a, 2b, 3a, 3b)

Bovaird Drive runs perpendicular to the Credit River Tributaries and has four watercourse crossings. The Credit River Tributaries are considered to be relatively flat with the exception of the valley feature crossing Bovaird Drive at the west limit of the study area. The existing land use is predominantly agricultural with some residential and institutional land use (ref. Section 3.2).

A Drainage Area Plan has been prepared to establish drainage areas to each of the four crossings (ref. Drawing 2: Drainage Area Plan; in rear pocket). The westerly crossing on watercourse 2A, has a drainage area of 475 ha, while the other 3 crossings west to east have drainage areas of 17.75 ha, 32 ha, and 86.42 ha.

To assess the existing hydrological conditions a SWMHYMO model has been created. The dominant soil condition within the area is the Halton ‘fractured till’. The hydrologic soil group for the Credit River Tributaries has been determined to be ‘BC’ with CN values ranging from 50 to 75.

The City of Brampton’s IDF relationship has been used with the 12 hour SCS storm distribution. Peak flows at each of the crossings have been provided in Table 3.3 [Simulated Design Flows for Existing Land Use Conditions (m^3/s)].

Table 3.3 Simulated Design Flows for Existing Land Use Conditions

Location/node	Frequency (years)					
	2	5	10	25	50	100
Culvert 'A'	2.94	6.63	10.85	14.65	18.55	22.82
Culvert 'B'	0.31	0.61	0.94	1.22	1.50	1.82
Culvert 'C'	0.70	1.30	1.93	2.46	2.99	3.58
Culvert 'D'	0.93	1.82	2.79	3.65	4.51	5.48

Although the existing land use is mainly agricultural, the City of Brampton is proposing to develop these lands. The Heritage Heights Secondary Plan will be developed through input received from various studies including the subwatershed study that has recently commenced. It is anticipated that peak flows at each of the watercourse crossings at Bovaird Drive would be maintained by stormwater management facilities to be located north of Bovaird Drive.

Huttonville Creek

Huttonville Creek crosses Bovaird Drive immediately east of Mississauga Road. The drainage area to Bovaird Drive is approximately 913 ha. As with the Credit River Tributaries, the drainage area is flat and is currently mostly agricultural land use. Development is planned as part of the Mount Pleasant Secondary Plan and has recently commenced. Huttonville Creek has been extensively assessed as part of the on-going subwatershed study.

The subwatershed study has assessed peak flows at Bovaird Drive using a continuous HSP-F hydrologic model and frequency flows. Peak flows have been assessed for the existing land use, and various stormwater management scenarios as outlined within Table 3.4.

For the purposes of modelling the culvert, CVC has directed the study team to use a value of 98 m^3/s from the GAWSER model for the creek.

Table 3.4 Huttonville Creek: Frequency Flows

Location	Scenario	Frequency (years)								
		1.05	1.25	2	5	10	20	50	100	Regional
Huttonville (H3)	Existing Land Use	1.88	2.80	4.28	6.67	8.49	10.40	13.10	15.40	61.90
	Future Land Use No SWM	5.96	8.88	13.50	20.70	26.00	31.60	39.30	45.50	86.2

Table 3.4 Huttonville Creek: Frequency Flows										
Location	Scenario	Frequency (years)								
		1.05	1.25	2	5	10	20	50	100	Regional
	Future Land Use Conventional Stormwater Management	1.46	2.36	3.88	6.38	8.30	10.30	13.20	15.50	85.50
	Future Land Use Conventional SWM	1.35	2.04	3.39	6.57	7.59	9.7	12.90	15.70	84.3

Future development west of Creditview Road/James Potter Road is planned with the Bluegrass Helport Property on the south side of Bovaird Drive. Currently a stormwater management pond, Pond H1, is planned to have a contributing drainage area of 37.31 ha, which includes a portion of the Bovaird Drive corridor from the western limit of the Spingbrook Creek subwatershed to Creditview Road/James Potter Road.

Springbrook Creek

The existing drainage area from north of Bovaird Drive to Springbrook Creek consists primarily of commercial and residential development.

East of Creditview Road/James Potter Road approximately 38 ha of the Mount Pleasant Village will drain under the CNR tracks via an 1800 mm diameter storm sewer which will then discharge to the existing 2.4 m x 1.5 m box culvert, which drains to the existing Creditview Stormwater Management Facility S1. The stormwater management facility will provide stormwater quantity and quality controls for the drainage from the Mount Pleasant Village. Although not shown on the drainage plans for the Mount Pleasant Village, a section of Bovaird Drive also drains to the major and minor system within the Credit Valley development area. The peak flow for the box culvert at Bovaird Drive occurs for the 100 year storm and would be approximately 9.5 m^3/s.

The developed area of Springbrook Creek located east of Creditview Road/James Potter Road drains to the existing Stormwater Management Facility No. 2 as described in the 1999 Stormwater Management Brief for Mattamy Area 44. The stormwater management facility discharges to a 2.25m horizontal ellipse storm sewer under Bovaird Drive. The peak flow through the storm sewer is approximately 4.9 m^3/s during the Regional Storm Hurricane Hazel.

Future Drainage Issues and Constraints

A primary concern for the proposed widening of Bovaird Drive is the impact on the surrounding environment. Unmitigated, the widening could result in an increase in flood and erosion impacts, due to increased runoff from paved surfaces. The conveyance and treatment of the additional runoff is examined in the drainage assessment to follow in this report.

Sections of Bovaird Drive are within the regulated area (floodplain, fill limit, top of valley and wetlands) of Huttonville Creek and the Credit River tributaries. Specifically culvert crossing 'A', 'C' and 'F' are within the regulated area. Any proposed works would require permits from Credit Valley Conservation. Confirmation of the regulated area limits should be determined during detailed design.

3.4.4 Hydrogeological Investigation

A hydrogeological assessment was completed to determine the hydrogeological conditions along the Bovaird Drive alignment, and to determine any potential impacts of the road on groundwater resources during and after construction (Appendix 'H' - Hydrogeologic Investigation).

The hydrogeological assessment component of the study involved the following:

- Review of borehole logs and grain size analyses from 3 geotechnical boreholes;
- Groundwater elevation monitoring at three monitoring wells located along Bovaird Drive within the study area;
- In-situ hydraulic conductivity testing of three monitoring wells along Bovaird Drive within the study area;
- Assessment of Ontario Ministry of Environment (MOE) water well records within the study area;
- Identification of significant groundwater recharge and discharge areas;
- Characterization of the study area hydrogeology based on field data;
- An evaluation of the potential impact of the proposed redevelopment on local groundwater resources, streams and private wells; and
- Recommendations of mitigation measures as needed to protect existing groundwater flow patterns and stream flows.

Hydrogeological Background Information

The study area is located within the South Slope and Peel Plain physiographic regions. The topography within the study area slopes gradually down from a high elevation of approximately 250 m above sea level (asl) in the northeast to an elevation of approximately 235 m asl at the top of the Credit River Valley, in the southwest. The ground elevation then decreases more steeply down to an approximate elevation of 190 m asl at the Credit River located just beyond the southwest limit of the study area.

The soils within the area consist predominantly of red to brown clay and silt which overlies relatively flat-lying shale bedrock. Three small areas of glaciolacustrine sand were also

identified within the study area and there is some modern alluvium in the valleys of the Credit River, Huttonville Creek and parts of two small tributaries in the western part of the study area.

The direction of groundwater flow as inferred from MOE water well data for shallow wells is south-westerly, modified to some extent by discharge into Huttonville Creek and the Credit River within the study area and Fletcher's Creek, east of the study area. The other tributaries, except the most westerly on in the study area, are considered to be ephemeral and do not influence groundwater flow directions throughout most of the year.

Water Well Survey

Water well records available from the Credit Valley Conservation Authority and the City of Brampton databases were reviewed and assessed electronically by Aquaresource Inc. to plot well locations and prepare stratigraphic cross-sections.

Logs of boreholes drilled along Bovaird Drive within the study area indicated varying thicknesses of clay (rarely sandy) fill beneath surface, especially adjacent to surface water courses, except under the road where aggregate fill was encountered. The fill materials encountered consist of sand and gravel fill and silty clay fill. Approximately forty-nine wells completed in overburden and bedrock within the study area may be used for domestic purposes. No information on the condition or current use of these wells is available.

The quality of the groundwater from wells completed in overburden and shallow bedrock (<5 m below bedrock surface), although very hard, meets the Ontario Drinking Water Quality Standards (ODWQS). The quality of groundwater in deep bedrock, in addition to being very hard, may be highly mineralized and concentrations of a number of parameters (some health related) exceed the ODWQS.

3.5 Socio-Economic Environment

3.5.1 Utilities

At present, there are various utilities present within the Bovaird Drive right-of-way. Existing utilities are summarized as follows:

TransCanada Pipelines – TCPL has a 36-inch diameter pipeline approximately 0.6-1.2 m in depth crossing Bovaird Drive within an easement west of Mississauga Road.

Enbridge (local) – Enbridge has a 4 inch diameter service line along the north side of Bovaird Drive, from 350 m west of Heritage Road to Mississauga Road. The service line continues along the north side, increasing in diameter to 6 inches just east of Mississauga Road, and crosses to the south side 125 m west of Ashby Field Road. The line continues along the east side of Ashby Field Road to service the development south of Bovaird Drive.

Enbridge Pipelines (transmission) – Enbridge has a 24 inch diameter transmission line which crosses Bovaird Drive within an easement west of Mississauga Road (same easement as TransCanada Line). The pipe is protected by a 30 inch diameter steel casing as it crosses the road. This pipe is also regulated by the National Energy Board, and a crossing permit is required for construction of Bovaird Drive.

Hydro One – No Hydro One plant reported in the study area

Rogers Cable – No Rogers Cable plant reported in the study area.

Bell Canada – Bell has buried lines and conduit throughout the study area. In general, the lines are located:

- Along the centre line of Bovaird Drive between Lake Louise Drive and Evanwood Crescent (cul-de-sac with no access to Bovaird)
- On the west side of Ashby Field Road along the radius of Bovaird Drive
- Along the west side of Mississauga Road
- On the south side of Bovaird Drive between Heritage Road and Mississauga Road
- Along the north and south side of Bovaird Drive from 1.45 km west of Heritage Road to Heritage Road

Brampton Hydro – Heavy overhead hydro lines exist along the north side of Bovaird Drive from Mississauga Road to Lake Louise Drive. West of Mississauga Road the overhead hydro shifts to the south side. The overhead hydro continues along Bovaird Drive to Heritage Road, where the overhead line shifts back to the north side.

3.5.2 Archaeological

AMEC completed a Stage 1 Archaeological Assessment Area in December 2009, in support of the Class EA Study being undertaken. The archaeological assessment was completed to assess potential impacts of corridor improvements for the study area (ref. Appendix 'J' - Stage 1 Archaeological Assessment).

A field review of the study corridor was conducted by AMEC in November 2009 to confirm the assessment of archaeological site potential and to determine the degree to which development and landscape alteration may have affected that potential. The Stage 1 Background Study revealed that sixty-two previously-recorded archaeological sites are located within approximately 2 km of the study area, as registered with the Ontario Ministry of Culture. Four previously-recorded sites were recorded within the study area. These include archaic and early woodland artifact findspots, an undescribed Early Woodland site and another site of unknown character.

A preliminary examination of historical documents and land titles, as verified during the field visit, suggests that the earliest Euro-Canadian structures within the study area have been replaced, although remains of these may exist archaeologically. The Curry saw mill and log house, which may be the earliest Euro-Canadian structures in the study area, were once located in the Credit River valley near the village of Norval.

In summary, much of the property within the study area has the potential to contain significant pre-contact aboriginal and historic Euro-Canadian archaeological sites. Lands with the highest potential include the grounds of heritage buildings near the major transportation routes, and the banks of rivers, ravines, and creeks.

Based on the results of the Stage 1 Archaeological Assessment of the study area, further archaeological investigation is recommended. A Stage 2 Property Assessment targeting the high and moderate potential lands within the study area will be completed. This includes a pedestrian survey of recently ploughed and weathered agricultural fields and a test pit survey of the ground of potential heritage properties and the forested banks of creeks, rivers and ravines.

3.5.3 Built Heritage and Cultural Landscape

A Built Heritage Property (BHP) and Cultural Heritage Landscape (CHL) evaluation was carried out concurrently with the Stage 1 Archaeological Assessment by AMEC. A total of 10 built heritage properties and six cultural heritage landscapes were identified during the study (ref. Appendix 'J' – Built Heritage and Cultural Heritage Landscape Assessment).

An evaluation of BHP and CHL is a systematic qualitative process carried out to assess the potential heritage value of a given property based on its physical and design characteristics, historical use and associations, and context, both social and environmental.

The study area covers a corridor of 350 to 450 m on either side of Bovaird Drive in the City of Brampton, between Lake Louise Drive/Worthington Avenue in the northeast to Old Pine Crescent in the southwest. The study area narrows to the southeast where it enters the Credit River Valley at the village of Norval.

Approach and Methodology

The assessment was conducted on November 6, and November 20, 2009 and included a windshield survey and walk-though of the road allowance lands within the study area and photographic documentation. All visual assessment was conducted from the roadways. The road allowances accessed include Bovaird Drive, Lake Louise Drive/Worthington Avenue intersection, Mississauga Road, Heritage Road in Brampton and Caseley Drive in the village of Norval.

Findings

Built Heritage Landscapes

A total of ten buildings that may qualify as built heritage properties were identified during this study. Of these, the City of Brampton has listed five as potentially worth designating under the *Ontario Heritage Act.* The built heritage properties represent a late nineteenth century rural/village/hamlet occupation of the region. The ten properties are listed in Table 3.5: Built Heritage Properties.

Table 3.5 Built Heritage Properties

Record	Address	Description	Approximate Age	Brampton Heritage List Rating	Magnitude of Project Effects	Recommendations
BHP1	10055 Creditview Road	Mount Pleasant Brick House	1870 to 1885	B - Significant	Negligible	Avoidance; No further investigation
BHP2	10060 Creditview Road	Mount Pleasant Church	1904	A - Most Significant	Negligible	Avoidance; No further investigation
BHP3	1985 Bovaird Drive W	McCandless Plank House	1860s	-	Moderate	No further Investigation
BHP4	10020 Mississauga Road	Apple Factory Brick House	1880s	-	Moderate	No further Investigation
BHP5	2472 Bovaird Drive W	Greensward House	1875 to 1885	B - Significant	High	Further evaluation; Identify discrepancy with Brampton Heritage Listing name
BHP6	2634 Bovaird Drive W	Ross House	1910s	-	Moderate	No further investigation
BHP7	2591 Bovaird Drive W	Robert Currie Farm	1865 to 1875	A - Most Significant	High	Further evaluation
BHP8	2702 Bovaird Drive W	Pettigrew House	1865 to 1875	-	Moderate	No further Investigation
BHP9	2838 Bovaird Drive W	Laird House	1880s	A - Significant	Moderate	Avoidance; No further Investigation; identify discrepancy with Brampton Heritage Listing name
BHP10	1 Caseley Drive	Maxted-Caseley House	1860s	-	High	Further evaluation

Cultural Heritage Landscapes

A total of six cultural heritage landscapes or remnants of heritage landscapes were identified in the study area. These include five organically evolved landscapes (CHL Records 1 to 4), four of which are representative of recurring landscape motifs within the region. One of these is a named place (CHL Record 5). The sixth landscape is associative, a natural area that has significant cultural and historic value.

Table 3.6 (Cultural Heritage Properties) provides a summary of the six cultural heritage properties identified during the preliminary assessment.

Table 3.6 Cultural Heritage Properties

Record Number	Address/Description	City of Brampton Heritage Listing	Magnitude of Project Effects	Recommendations
CHL1	Mount Pleasant Crossroads	Not listed	Negligible	avoidance; no further investigation
CHL2	Heritage Road	Not listed	Moderate	no further investigation
CHL3	Greensward Orchard	Not listed	High	further evaluation
CHL4	Robert Currie Farm	A - most Significant	High	further evaluation
CHL5	Laird's Hill	Not listed	Moderate	no further investigation
CHL6	Credit River Flats	Not listed	Moderate	avoidance; no further investigation

4.0 DEVELOPMENT AND EVALUATION OF ALTERNATIVE PLANNING SOLUTIONS

4.1 Problem/Opportunity Definition

Based on a review of existing and future conditions, as well as preliminary consultation with stakeholders, it has been determined that improvements are needed along the Bovaird Drive corridor in order to:

- Accommodate existing and future traffic growth resulting from development and population increases;
- Accommodate pedestrian and cyclist movements through the corridor;
- Accommodate future transportation network improvements such as the North-South Transportation Corridor (NSTC), GTA West, and the Norval By-Pass;
- Accommodate transit system expansion along the corridor, and;
- Address drainage deficiencies identified by this study and opportunities for Stormwater Management.

Existing and Future Traffic Demand

Bovaird Drive is currently operating at a moderate level of service, with congestion at intersections during the peak hours. Improvements to the corridor are required to address existing traffic congestion. With anticipated growth in the area, Bovaird Drive will not be able to support future traffic volumes if no improvements are made to the corridor, and significant levels of congestion will occur.

North-South Transportation Corridor

The Halton-Peel Boundary Area Transportation Study (HP-BATS) recommends that a north-south transportation corridor (NSTC) be constructed, from the 407 ETR/401 to Mayfield Road, with provision for connection to the proposed GTA West Corridor. Improvements to Bovaird Drive must accommodate traffic demand to and from the NSTC.

The location for the NSTC is unknown at this time. In order to allow the Class EA to proceed, the location of the NSTC is assumed to cross Bovaird Drive east of Heritage Road. However, if future Environmental Assessments conclude that the crossing location be west of Heritage Road, an addendum to the Bovaird Drive Class EA will be undertaken.

Accommodation of Transit System Expansions

Both Brampton Transit and GO Transit propose increases in the frequency of their transit services along Bovaird Drive and certain intersecting arterials such as Mississauga Road. Plans are currently underway for a Bus Rapid Transit (BRT) along Bovaird Drive as part of the

Brampton ZUM system. The cross-section of the future roadway must be wide enough to accommodate transit priority and queue jump lanes, and bus stops, in addition to the core lanes.

Drainage Deficiencies and Stormwater Management

Both stormwater quantity and quality management must be assessed for the road widening. The potential provision of stormwater management within existing facilities will have to be established. Where existing facilities have not been designed to accommodate the proposed Bovaird Drive works, other alternatives such as stormwater management facilities within the Region's lands and/or integrated with proposed private development facilities should be assessed. Alternatives such as oil/grit chambers, enhanced grass swales and others will be considered.

Drainage deficiencies have to be assessed as part of the hydraulic assessment of both the major and minor systems. This would include the watercourse crossings, overland drainage paths within the proposed right-of-way and storm sewer systems.

Accommodation of pedestrians and cyclists

The City of Brampton's Transportation and Transit Master Plan affirms walking and cycling as key elements of the City's integrated, intermodal transportation system. Existing and future residential development in the area will generate both cyclist and pedestrian traffic along the Bovaird Drive corridor. There are currently no bicycle lanes on Bovaird Drive within the study area and only intermittent pedestrian infrastructure. Brampton's Transportation and Transit Master Plan also identifies a need to better accommodate pedestrians and/or cyclists.

4.1.1 Future Traffic Conditions

By the 2021 horizon year development, traffic along Bovaird Drive is expected to increase substantially (ref. Figure 4.1 Bovaird Drive: 2021 Proposed Lane Configuration). Therefore, many road and network improvements would be necessary. Based on the 2031 HPBATS transportation model data provided by the Region, the Municipal Class Environmental Assessment Study for Mississauga Road, and the 2009 Brampton Transportation and Transit Master Plan north of Bovaird Drive to Mayfield Road, the base road improvements required for the 2021 horizon year are as follows:

- Bovaird Drive is expected to widen to a six-lane cross-section (three lanes in each direction) from Worthington Avenue to west of Mississauga Road.
- Bovaird Drive is expected to widen to a four-lane cross-section (two lanes in each direction) from west of Mississauga Road to west of Heritage Road.
- Mississauga Road is expected to widen to a four-lane cross section, however depending on the traffic volumes, Mississauga Road may need a six-lane cross section in 2021.

- Heritage Road is expected to widen to a four-lane cross-section both north and south of Bovaird Drive.
- Additional roadways to by-pass Norval from Bovaird Drive such as the Georgetown-Norval By-pass, which would provide an alternative to commuter truck traffic passing through the communities in Georgetown and Norval and support development in Georgetown and Brampton. The Georgetown-Norval By-pass is currently being examined for routing options, however still in the preliminary stages. The additional roadways to by-pass Norval are expected to be in place for the 2021 horizon year.

By the 2031 horizon year, development along Bovaird Drive is expected to increase substantially. (ref. Figure 4.2 Bovaird Drive: 2031 Proposed Lane Configuration). Therefore many road and network improvements would be necessary. Based on the aforementioned study reports, the base road improvements required for the 2031 horizon year projections are as follows:

- Bovaird Drive is expected to be a six-lane cross-section (three lanes in each direction) from Worthington Avenue to NSTC
- Bovaird Drive is expected to widen to a four-lane cross-section (two lanes in each direction) from west of NSTC to west of Heritage Road
- Mississauga Road is expected to widen to a six-lane cross section to Sandalwood Parkway, and four-lane cross section north of Sandalwood Parkway
- Heritage Road is expected to widen to a four-lane cross-section both north and south of Bovaird Drive
- The location for the NSTC is unknown at this time. In order to allow the Class EA to proceed, the location of the NSTC is assumed to cross Bovaird Drive east of Heritage Road. However, if future Environmental Assessments conclude that the crossing location be west of Heritage Road, an addendum to the Bovaird Drive Class EA will be undertaked.

Figure 4.1 - Bovaird Drive: Proposed 2021 Lane Configuration

(Source: Bovaird Drive Class Environmental Assessment Traffic Study (ENTRA Consultants/Genivar, 2010)

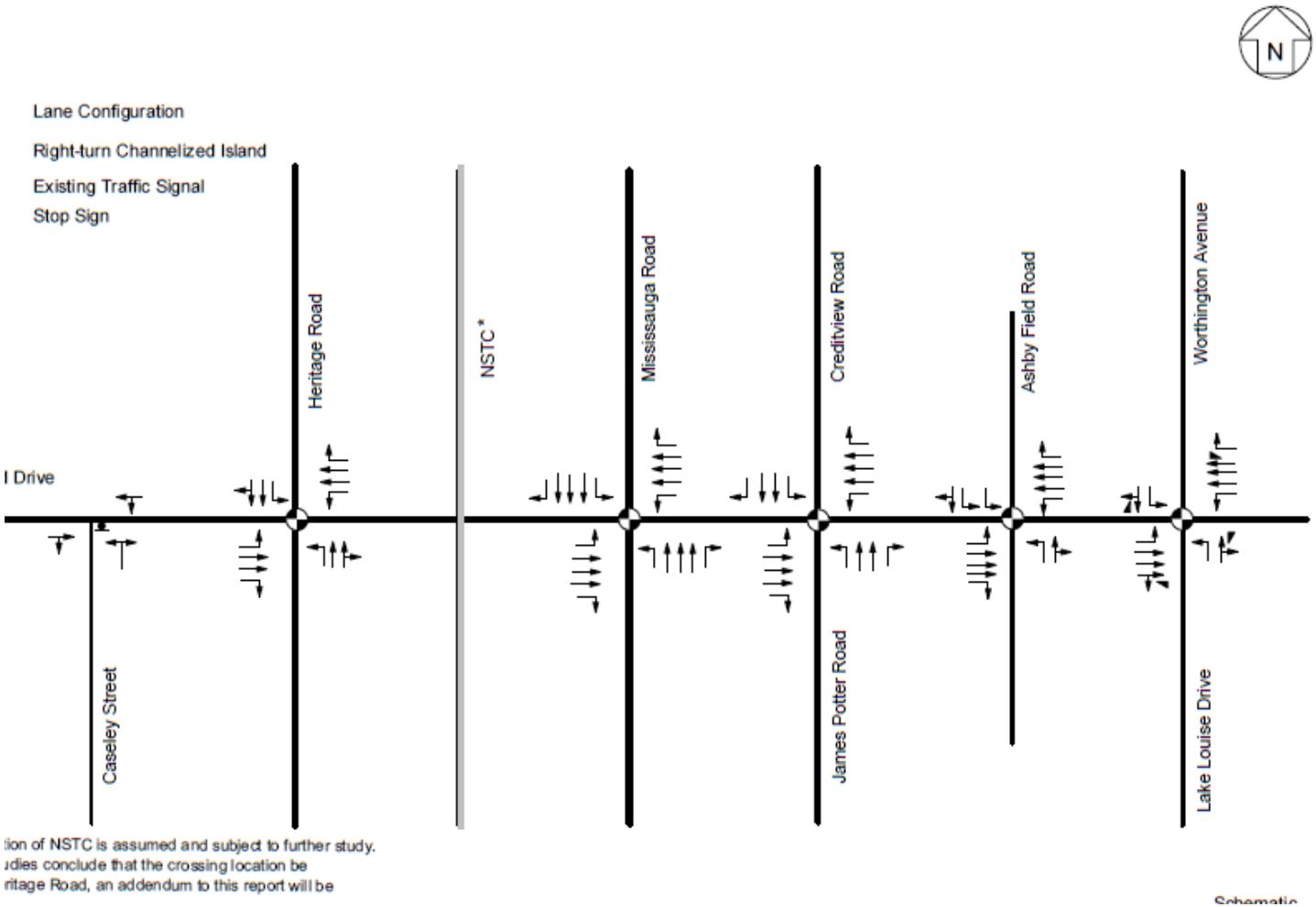
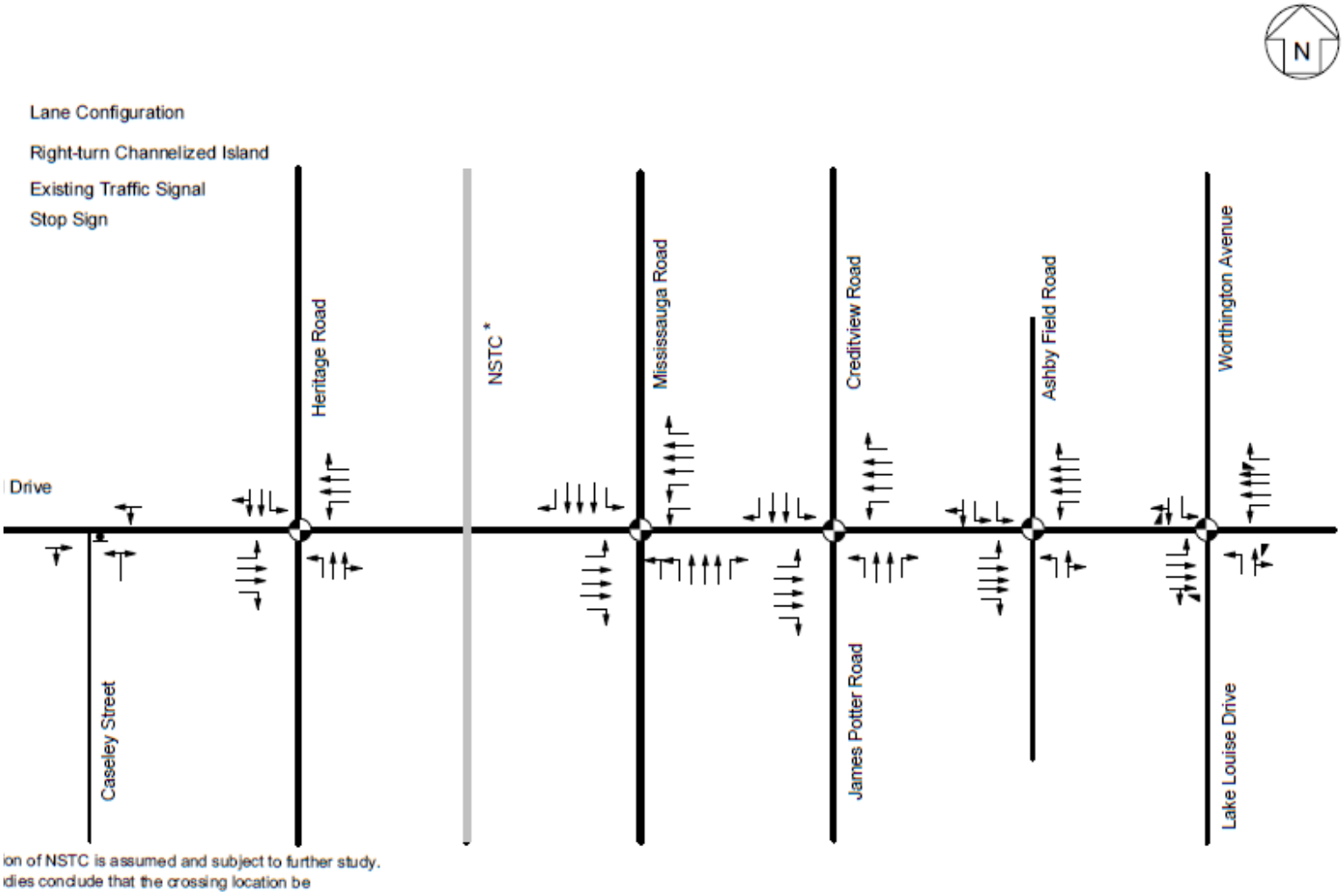


Figure 4.2 - Bovaird Drive: 2031 Proposed Lane Configuration
(Source: Bovaird Drive Class Environmental Assessment Traffic Study (ENTRA Consultants/Genivar, 2010)



4.2 Identification of Planning Alternatives

The following planning alternatives have been identified for consideration in addressing the problems and opportunities discussed above:

Alternative 1: **Do Nothing:** Maintain Bovaird Drive in its present configuration west of Mississauga Road. Proceed with previously approved improvements east of Mississauga Road.

Alternative 2: **Improve other Roads:** Improve adjacent parallel arterial roadways to accommodate the projected future traffic demand for Bovaird Drive.

Alternative 3: **Transit Service Improvements**: Improve existing public transit service within the City of Brampton, and connect to the major activity areas of the Greater Toronto Area (GTA), to encourage a shift in modal choice from automobile to public transit modes.

Alternative 4: **Travel Demand Management (TDM):** TDM measures are aimed at shifting travel behaviour to reduce peak hour vehicular traffic demand. Such measures may include increasing the number of car-pool parking facilities, creating high occupancy vehicle (HOV) lanes, introduction of flexible work hours by major employers and using active modes of transportation such as walking and cycling.

Alternative 5: **Widen Bovaird Drive with Intersection Improvements:** Addition of through traffic lanes (6 lanes from Lake Louise Drive to the NSTC and 4 lanes from the North-South Transportation Corridor (NSTC) to the western study limits) including intersection improvements to increase traffic capacity of the corridor.

Alternative 6: **Combination:** Combine alternatives 3-5 as mentioned above to increase the overall effectiveness of individual alternatives and reduce environmental impacts.

4.3 Assessment of Planning Alternatives

In assessing planning alternatives, a range of environmental issues has been addressed and potential avoidance or mitigation of negative effects has been considered. As a key part of assessing planning alternatives, this study has identified evaluation criteria that reflect the concerns of various stakeholders, as communicated through preliminary consultation, as well as the concerns of the Regional Municipality of Peel. Table 4.1 (Description of Evaluation Criteria) provides a description of the evaluation criteria used.

Table 4.1 Description of Evaluation Criteria

Component	Evaluation Criteria	Description
Natural Environment	Wetlands and Vegetation	Proximity, size, characteristics and sensitivity of significant natural areas, terrestrial ecosystems and wetlands. Potential impact of loss of natural areas, terrestrial ecosystems or wetland area, function or habitat.
	Wildlife Habitat	Presence of identified or documented wildlife habitat areas. Potential adverse effects on existing wildlife due to disturbance or loss of habitat.
	Groundwater/ Surface Water/Drainage	Potential adverse effect to groundwater resources and private water wells. Potential adverse affect on surface water quality, erosion or flood potential.
	Fisheries and Water Quality	Potential impacts to fish community and habitat as a result of the proposed alternatives and potential impacts to water quality as a result of the proposed alternatives. Potential adverse effect on surface water quality, erosion and flood potential.
Social, Cultural & Economic Environnent	Land Use	Presence, number and characteristics of residences, community facilities, public parks, institutions or businesses within or adjacent to the study corridor.
	Noise	Number and characteristics of noise sensitive receivers (generally residences adjacent to the study corridor). Potential effects of traffic related noise on residences, adjacent to the study corridor.
	Archaeology and Cultural Heritage Resources	Presence and characteristics of registered archaeological resources and designated built heritage resources under the *Heritage Act.* Potential adverse impacts on archaeological resources and built heritage resources within or adjacent to the study corridor.
	Agricultural	Presence and characteristics (agricultural capability of soil) of agricultural lands within the study corridor. Potential adverse impact of loss of agricultural lands within the study corridor.
	Access Considerations	Potential adverse effects include limited access during construction and changes to residential or commercial entrances.
	Utilities	Potential adverse effects on existing utilities. Opportunity to accommodate future utilities.
	Construction Disruptions	Potential adverse effects include noise, dust and disruption to existing traffic.
Transportation	Safety	Safety related factors include roadway geometrics, roadside hazards, intersection design, and signalization.
	Travel Delay/ Traffic	Potential to address existing and future capacity and

Table 4.1 Description of Evaluation Criteria		
Component	**Evaluation Criteria**	**Description**
	Capacity	operational needs. Potential for adverse effects including traffic delays during construction.
	Transit	Potential to address transit needs for future planned transit initiatives.
	Active Modes of Transportation	Potential to address requirements for active modes of transportation like walking and cycling
Costs	Capital Cost	Capital costs of the proposed improvements.
Transportation Plans & Policies	Compatibility with Regional and City Transportation Plans and Policies	Compatibility with Regional and Municipal Official Plans and policies, the Region's Long Range Transportation Plan, the City of Brampton's Transportation and Transit Master Plan and the Halton Peel Boundary Area Transportation Study (HPBATS).

4.4 Evaluation of Alternatives

The preliminary recommended planning alternative developed in consultation with agencies is Alternative 6 (A combination of alternatives 3-5). This combination of Transit service improvements, Travel Demand Management, and widening Bovaird Drive with intersection improvements, will address the stated problems on the Bovaird Drive corridor while minimizing environmental impacts. Table 4.2 (Evaluation of Planning Alternatives) shows the evaluation considerations for each alternative relative to the criteria being considered.

This combination of Transit Service Improvements, Travel Demand Management, and widening Bovaird Drive with intersection improvements, will address the stated problems on the Bovaird Drive corridor while minimizing environmental impacts.

Table 4.2 Evaluation of Planning Alternatives

Alternative #	Evaluation Criteria					Recommendation
	Natural Environment	**Social, Cultural & Economic Environment**	**Transportation**	**Cost**	**Compatibility with Plans and Policies**	
1	Minor adverse effects. Increase in traffic congestion could impact air quality. Opportunities for enhancement of existing natural features would not be realized.	If the projected increase in travel demand is not addressed it could lead to travel delays/ increased travel times. Increased traffic congestion could result in driver frustration, and lost business opportunities due to delay and congestion	Does not address the travel demand for the 2031 planning horizon. Traffic safety will decrease with increased traffic demand and congestion No potential to incorporate transit services or pedestrian/cyclist facilities.	No associated capital costs in addition to those already approved. Maintenance costs will continue and may be higher with older infrastructure.	Not consistent with the transportation infrastructure needs established through the LRTP and HPBATS.	Not Recommended
2	No adverse effects on the Natural Environment along the Bovaird Drive corridor. However, opportunities for enhancement of existing natural features would not be realized.	The effects on the social and cultural environment due to improvements on parallel roadways are unknown. It could affect local businesses due to traffic using alternate routes. Opportunities to facilitate transit and active modes of transportation would not be realized.	Even with the improvements to parallel arterial roadways assumed in the traffic model, capacity deficiencies will exist along Bovaird Drive. This alternative will not address travel demand for the 2031 planning horizon. This alternative does not support transit or active modes of transportation.	Significant capital costs for parallel roadways, dependent on the recommended design. None for Bovaird Drive corridor.	Is consistent with the transportation infrastructure needs established through the LRTP and HPBATS but does not meet all of the objectives of the plans.	Recommended through other initiatives by the City and the Region but does not address issues directly for Bovaird Drive

Table 4.2 Evaluation of Planning Alternatives

Alternative #	Evaluation Criteria					Recommendation
	Natural Environment	**Social, Cultural & Economic Environment**	**Transportation**	**Cost**	**Compatibility with Plans and Policies**	
3	Minimal adverse effects on the Natural Environment. Adverse effects would be associated with additional footprint required for bus stops, queue jump lanes, or other transit related infrastructure. 	Minor adverse effects to Socio-Economic factors including potential property impacts for transit facilities. 	Will not address the travel demand for the 2031 horizon on its own; only in conjunction with other enhancements. Supports transit initiatives but does not accommodate active modes of transportation. 	Minor capital cost for improvements. 	Consistent with the transit infrastructure needs established through the Brampton TTMP but does not meet all the objectives of the LRTP, HPBATS and TTMP. 	Carried forward for further consideration
4	Varying degree of adverse effects on the Natural Environment (i.e. car pool lots and HOV lanes could have some adverse effect while flexible work hours would not). 	Will require changes in employer policy and lifestyle habits and a shift in transportation modes. 	Will not address the travel demand for the 2031 planning horizon on its own; only in conjunction with other improvements. Supports active modes of transportation including walking and cycling. 	Varying capital costs associated depending on which TDM is implemented (i.e. car pool lots and HOV lanes have high capital costs). 	Is consistent with the active transportation plans and polices but does not meet all of the objectives of the LRTP, HPBATS and TTMP. 	Carried forward for further consideration

Table 4.2 Evaluation of Planning Alternatives

Alternative #	Evaluation Criteria					Recommendation
	Natural Environment	**Social, Cultural & Economic Environment**	**Transportation**	**Cost**	**Compatibility with Plans and Policies**	
5	Adverse effects associated with roadway widening could be avoided to the extent possible or mitigation measures employed. This alternative will provide opportunities to enhance some of the natural features. 	Adverse effects associated with roadway widening could be avoided to the extent possible or mitigation measures employed. This alternative will provide increased business opportunities. 	Will address the travel demand for the 2031 planning horizon through major capacity improvements. On its own this alternative does not support transit and active transportation modes. 	High capacity cost for construction. 	Consistent with infrastructure needs established through the LRTP and HPBATS and meets the major objectives of traffic capacity identified by the plans. Does not address Transit and Active Transportation needs. 	Carried forward for further consideration
6	Adverse effects associated with roadway widening could be avoided to the extent possible or mitigation measures employed. This alternative will provide opportunities to enhance some natural features and marginally reduces impacts compared to implementation of	Adverse effects associated with roadway widening could be avoided to the extent possible or mitigation measures employed. This alternative will provide increased business opportunities and marginally reduce impacts compared to implementation of Alternative 5 without implementation of	Will address the travel demand for the 2031 planning horizon through major capacity improvements. This alternative supports both transit initiatives and active modes of transportation.	High capital cost for construction.	Consistent with the transportation infrastructure needs established through the Brampton TTMP, Region's LRTP and HPBATS.	Recommended

Table 4.2 Evaluation of Planning Alternatives

Alternative #	Evaluation Criteria					Recommendation
	Natural Environment	Social, Cultural & Economic Environment	Transportation	Cost	Compatibility with Plans and Policies	
	Alternative 5 without implementation of Alternatives 3 and 4. 	Alternatives 3 and 4. 				

 **Positive**  **Neutral-Positive**  **Neutral**  **Negative-Neutral**  **Negative**

4.5 Meetings

Agency meetings were held in April 2010 and 2011 with representatives from the City of Brampton, Ministry of Natural Resources, Canadian National Railway, GO Transit and the Credit Valley Conservation (ref. Appendix 'O' - Meeting Minutes). The purpose of the meetings was to present preliminary information on the study to date, including the need and justification for improvements and an assessment of planning alternatives. The meetings also provided an avenue for feedback on the background studies and preliminary design alternatives, and allowed agencies to voice any concerns with the project or the Class EA process. Details of the specific concerns and opportunities discussed in the meetings are recorded in the Meeting Minutes.

4.6 Summary of Phase 2 Public/Agency Consultation

The first Public Information Centre (PIC) was held on Tuesday, May 18, 2010 at the Peel Regional Police Association. Notification of the PIC was sent to stakeholders including local residents, agencies and municipal staff, by mail and notices were placed in the Brampton Guardian and the Georgetown Independent on May 5 and 14, 2010. A copy of the PIC notice and all the comments received are provided in the appendix. (ref. Appendix 'P' - Public Information Centre Number 1). Table 4.3 (Summary of Phase 2 Public / Agency Consultation) is a summary of the comments received through public and agency consultation from PIC 1.

Table 4.3 Summary of Phase 2 Public/Agency Consultation

Comment / Question Received from Stakeholders	Response / Commitments
Why is the Region of Peel considering transportation corridor improvements on Bovaird Drive?	Through traffic is expected to grow gradually over time and increased traffic will result from the approved development and the expansion of the community along the road.
Safety concerns regarding potential for excess speeds, turning movements, pedestrian and entrance/existing issues.	Horizontal measures such as provision for pedestrian crossing at signalized intersections and an urban-cross section with a median at intersections and sidewalks have been included in this study, which will improve safety throughout the study area.
Funds would be better allocated to various other local roadways.	The Region of Peel is responsible for maintenance and upkeep of Regional Roads only. Maintenance and improvements to local roads is the responsibility of the City of Brampton.
How will this project affect the water table?	Groundwater and source water protection is an important consideration in the development of the lands. The study team included a hydrogeologist, ensuring that the study conformed with all applicable legislation, including: the Ontario Water Resources Act, the Water Opportunities Act and Water Conservation Act.

4.7 Preferred Planning Solution

Based on input provided by stakeholders, technical agencies, and public participants, as well as an assessment by the study team, the preferred planning alternative developed is Alternative 6: A combination of alternatives 3 to 5:

3. Transit service improvements;
4. Travel Demand Management; and
5. Widen Bovaird Drive with intersection improvements to increase capacity.

Various design options for Alternative 6 have been prepared and assessed by the study team. The results of the assessment are presented in the following sections.

5.0 ALTERNATIVE DESIGN CONCEPTS AND ASSESSMENT

5.1 Cross Section Alternatives

Cross section alternatives were developed based on Region of Peel Streetscaping Guidelines (2007), preliminary minimum requirements for Right-of-Way developed by the BILT team (2011), and consultation with Region of Peel staff.

A full urban section has been proposed for the corridor east of the assumed location of the North-South Transportation Corridor (NSTC). Urbanization is required in order to meet the objective outlined in Section 4.1 of accommodating pedestrian and cyclist movements through the corridor. A rural cross-section will be maintained west of the NSTC.

Due to varying timelines for development of the Bovaird Drive Corridor, interim drainage ditches will be provided along both sides of the corridor, in order to maintain existing drainage patterns for the surrounding lands. Once the lands are developed, these ditches will be replaced by internal drainage systems for each development. *Permission to Enter* will be required in some areas to accommodate the space required for the interim works.

5.2 Alignment Alternatives

Several alignment alternatives were considered for the widening of Bovaird Drive, as follows:

i. Widen to the North

ii. Widen from the Centerline

iii. Widen to the South

iv. A hybrid approach

After considering all issues in relation to each other, Alternative 4 was chosen (ref. Table 5.1 - Evaluation of Bovaird Drive Alignment Alternatives). This alternative minimizes the impact to the greatest number of properties.

Table 5.1 Evaluation of Bovaird Drive Alignment Alternatives

Category	Criteria	Criteria Indicators	Alternative 1 Widen to the North	Alternative 2 Widen from the Centreline	Alternative 3 Widen to the South	Alternative 4 A hybrid approach
Engineering	Constructability	Ability to minimize construction constraints & complexity				
		Ability to facilitate phasing requirements				
	Transportation	Ability to maximize road capacity				
	Overall Safety	Ability to improve vehicular safety along corridor				
	Stormwater Management	Ability to address water quantity and quality in ROW.				
	Utility Conflicts	Ability to minimize effects on utilities within ROW				
Natural Environment	Terrestrial Features	Adverse effects on terrestrial species and habitats				
		Potential to enhance local terrestrial communities.				
	Aquatic Features	Adverse effects on Huttonville Creek				
		Potential to minimize impact to aquatic features				
	Drainage	Ability to minimize infringement into floodplain				
Socio-Economic Environment	Property Requirements	Amount of property required (hectares)				
	Accessibility to Properties	Ability to maintain/maximize access				
		Ability to accommodate future development.				
	Business Operations	Ability to minimize adverse effects on businesses				
		Ability to enhance business attractiveness				
	Active Transportation	Ability to maximize sidewalks and a multi-use trail				
		Ability to meet pedestrian requirements				
	Noise	Ability to minimize noise after construction.				
Cultural Environment	Archaeological Resources	Potential for disruption of archaeological resources.				
	Built Heritage &Cultural Landscapes	Potential disruption of heritage/cultural landscapes				
Cost	Capital and Operating Costs	Cost of construction and operating costs				

5.3 Mississauga Road

The intersection of Bovaird Drive with Mississauga Road has a number of constraints. In particular, widening of this intersection is limited by Huttonville Creek to the east, and the existing development to the west. A series of alternatives were explored to address the constraints:

- Do Nothing Option: Maintain Existing Culvert with Existing Road Width
- Option 1: Widen Mississauga Road West, Extend Existing 1.65m x 5.53m x 60.0m Huttonville Culvert 16.0m north and 8.0m south
- Option 2: Widen Mississauga Road West, Replace Existing Huttonville Culvert on Existing Alignment with 1.65m x 10.5m x 83.0m Culvert
- Option 2b: Widen Mississauga Road West, Construct New Culvert East of Existing, Realign Huttonville Creek
- Option 3: Shift Mississauga Road West, Maintain Existing Huttonville Culvert on Existing Alignment
- Option 4: Widen Mississauga Road West, Replace Existing Culvert with Bridge to Span Meander Belt
- Option 5: Widen Mississauga Road West without Right-Turn Channelization, Maintain Existing Huttonville Culvert on Existing Alignment and Construct a 4.2m x 1.8 m Supplementary Open Box Culvert

These alternatives were explored further by assessing each criterion individually, and then compared to each other. The results of this assessment are shown in Table 5.2. Note that Option 2b is not included in the additional analysis, as it was deemed unacceptable by the project team due to high environmental constraints.

This assessment was presented to the key stakeholders, CVC, and MNR for approval. Meetings took place on April 14 2010, October 26 2011, and January 19 2012 to address the concerns of these parties. After their concerns were addressed, the CVC and MNR agreed to a variation of Option 2, which requires a minimum 3.66m x 14.6m x 83.0m open-footing precast concrete arch culvert to replace the existing crossing. This alternative allows for a balance to be achieved with all criteria and stakeholder interests, while fulfilling the needs of the CVC and the MNR.

Table 5.2 Design Alternatives for Bovaird Drive/Mississauga Road Intersection and Huttonville Creek Crossing

Component	Area of Study	Criteria	Alternatives					
			Do Nothing Option: Maintain Existing Culvert with Existing Road Width	**Option 1: Widen Mississauga Road West Extend Existing 1.65m x 5.53m x 60.0m Huttonville Culvert 16.0m north and 8.0m south (total 24.0m)**	**Option 2: Widen Mississauga Road West Replace Existing Huttonville Culvert on Existing Alignment with 1.65m x 14.6m x 83.0 m Culvert**	**Option 3: Shift Mississauga Road West Maintain Existing Huttonville Culvert on Existing Alignment**	**Option 4: Widen Mississauga Road West Replace Existing Culvert with Bridge to Span Meander Belt**	**Option 5: Widen Mississauga Road West without Right-Turn Channelization Maintain Existing Huttonville Culvert on Existing Alignment and Construct a 4.2 by 1.8m Supplementary Open Box Culvert**
NATURAL ENVIRONMENT	Wetlands and Vegetation	Proximity, size, characteristics and sensitivity of significant natural areas, terrestrial ecosystems and wetlands. Potential impact of loss of natural areas, terrestrial ecosystems or wetland area.	No significant terrestrial impacts of widening on northwest and southwest of intersection; only anthropogenic features are present. No significant terrestrial impacts of right-of-way adjustments and culvert replacement on the immediate northeast and southeast sides of the intersection; disturbed roadside conditions and cultural meadow (CUM) currently exist in this area.	No significant terrestrial impacts of widening on northwest and southwest of intersection; only anthropogenic features are present. No significant terrestrial impacts of right-of-way adjustments and culvert extensions on the immediate northeast and southeast sides of the intersection; disturbed roadside conditions and cultural meadow (CUM) currently exist in this area.	No significant terrestrial impacts of widening on northwest and southwest of intersection; only anthropogenic features are present. No significant terrestrial impacts of right-of-way adjustments and culvert replacement on the immediate northeast and southeast sides of the intersection; disturbed roadside conditions and cultural meadow (CUM) currently exist in this area.	No significant terrestrial impacts of widening on northwest and southwest of intersection; only anthropogenic features are present. No significant impact to the existing terrestrial features on the northeast and southeast of intersection as right-of-way and creek will be maintained on existing alignments.	No significant terrestrial impacts of proposed design on northwest and southwest of intersection; only anthropogenic features are present. No significant long-term terrestrial impacts of right-of-way adjustments and culvert replacement on the immediate northeast and southeast sides of the intersection; disturbed roadside conditions and cultural meadow (CUM) currently exist in this area.	No significant terrestrial impacts of widening on northwest and southwest of intersection; only anthropogenic features are present. No significant impact to the existing terrestrial features on the northeast and southeast of intersection as right-of-way and creek will be maintained on existing alignments.
	Wildlife Habitat	Presence of identified or documented wildlife habitat areas. Potential adverse effects on existing wildlife due to disturbance or loss of habitat.	No significant impact to wildlife as available habitat and connectivity will remain the same.	No significant impacts to wildlife of widening on northwest and southwest of intersection; only anthropogenic features are present. No significant wildlife habitat impacts of right-of-way adjustments and culvert extension on the immediate northeast and southeast sides of the intersection; disturbed roadside conditions and cultural meadow (CUM) currently exist in affected area. Extension and bending of culvert may restrict movement of some wildlife along channel, negatively impacting linkage functions compared to existing	No significant impacts to wildlife of widening on northwest and southwest of intersection; only anthropogenic features are present. No significant wildlife habitat impacts of right-of-way adjustments and culvert extension on the immediate northeast and southeast sides of the intersection; disturbed roadside conditions and cultural meadow (CUM) currently exist in affected area. Widening the culvert may provide opportunity to enhance design to facilitate wildlife movement, improving the linkage potential compared to	No significant impacts to wildlife of widening on northwest and southwest of intersection; only anthropogenic features are present. No significant impacts to wildlife habitat as right-of-way and creek will be maintained on existing alignment.	Replacing the existing culvert with the proposed span provides opportunities to enhance design to facilitate wildlife movement, improving the linkage potential compared to existing conditions. Improvements may, however, only be realized by large animals, as the current structure is of sufficient size to facilitate movement of smaller animals. However, the proximity of the span to a major intersection may constrain its use by wildlife due to noise levels.	No significant impacts to wildlife of widening on northwest and southwest of intersection; only anthropogenic features are present. No significant impacts to wildlife habitat as right-of-way and creek will be maintained on existing alignment.

Table 5.2 Design Alternatives for Bovaird Drive/Mississauga Road Intersection and Huttonville Creek Crossing

Component	Area of Study	Criteria	Alternatives					
			Do Nothing Option: Maintain Existing Culvert with Existing Road Width	**Option 1: Widen Mississauga Road West Extend Existing 1.65m x 5.53m x 60.0m Huttonville Culvert 16.0m north and 8.0m south (total 24.0m)**	**Option 2: Widen Mississauga Road West Replace Existing Huttonville Culvert on Existing Alignment with 1.65m x 14.6m x 83.0 m Culvert**	**Option 3: Shift Mississauga Road West Maintain Existing Huttonville Culvert on Existing Alignment**	**Option 4: Widen Mississauga Road West Replace Existing Culvert with Bridge to Span Meander Belt**	**Option 5: Widen Mississauga Road West without Right-Turn Channelization Maintain Existing Huttonville Culvert on Existing Alignment and Construct a 4.2 by 1.8m Supplementary Open Box Culvert**
NATURAL ENVIRONMENT				conditions.	existing conditions.			
	Groundwater	Potential adverse effect to groundwater resources and private water wells. Potential interference with groundwater discharge or recharge.	No potential for change to groundwater discharge volume within adjacent reach.	Low potential for change to groundwater discharge volume within adjacent reach.	Low potential for change to groundwater discharge volume within adjacent reach.	Low potential for change to groundwater discharge volume within adjacent reach.	Low potential for change to groundwater discharge volume within adjacent reach.	Low potential for change to groundwater discharge volume within adjacent reach.
	Surface Water	Potential adverse affect on surface water quality, erosion or flood potential.	Existing culvert crossing would continue to convey all storm events, apart from the Regional storm, for which minimal overtopping occurs. Although Bovaird Drive would remain unchanged, the alignment of Mississauga Road would reduce flood storage and potentially impact flood elevations, but to a lesser extent than Option 1 and 2.	Existing culvert crossing would require extension, which may negatively impact culvert hydraulics. Existing culvert conveys all storm events, apart from the Regional Storm, for which minimal overtopping occurs. The alignment of Mississauga Road would reduce flood storage and potentially impact flood elevations. Widening of Bovaird would also have an impact on existing flood storage (riparian).	Proposed culvert widening would reduce existing flood elevations upstream of Bovaird Drive and would eliminate Regional Storm overtopping. The alignment of Mississauga Road would reduce flood storage and potentially impact flood elevations. Widening of Bovaird would also have an impact on existing flood storage (riparian), although flood storage with the culvert in place would benefit with the proposed culvert widening.	Existing culvert crossing would continue to convey all storm events, apart from the Regional storm, for which minimal overtopping occurs. The alignment of Mississauga Road would reduce flood storage and potentially impact flood elevations, but to a lesser extent than Option 1 and 2.	Proposed culvert widening would significantly reduce existing flood elevations upstream of Bovaird Drive and would eliminate Regional Storm overtopping. The alignment of Mississauga Road would reduce flood storage and potentially impact flood elevations, but would have less impact than Options 1 to 3 due to the proposed bridge span for the Bovaird Road crossing. Widening of Bovaird would also have an impact on existing flood storage (riparian), although flood storage with the culvert in place would benefit with the proposed bridge span.	Existing culvert crossing would continue to convey all storm events, apart from the Regional storm, for which a supplementary culvert would eliminate the Regional Storm overtopping the centreline of the Road. The supplemental culvert would be established east of the existing culvert. Supplemental culvert would be set in the overbank area with invert at the existing 2 year flood elevation to not impact the 2 year hydraulics. The alignment of Mississauga Road would reduce flood storage and potentially impact flood elevations, but to a

Table 5.2 Design Alternatives for Bovaird Drive/Mississauga Road Intersection and Huttonville Creek Crossing

Component	Area of Study	Criteria	Alternatives					
			Do Nothing Option: Maintain Existing Culvert with Existing Road Width	**Option 1: Widen Mississauga Road West Extend Existing 1.65m x 5.53m x 60.0m Huttonville Culvert 16.0m north and 8.0m south (total 24.0m)**	**Option 2: Widen Mississauga Road West Replace Existing Huttonville Culvert on Existing Alignment with 1.65m x 14.6m x 83.0 m Culvert**	**Option 3: Shift Mississauga Road West Maintain Existing Huttonville Culvert on Existing Alignment**	**Option 4: Widen Mississauga Road West Replace Existing Culvert with Bridge to Span Meander Belt**	**Option 5: Widen Mississauga Road West without Right-Turn Channelization Maintain Existing Huttonville Culvert on Existing Alignment and Construct a 4.2 by 1.8m Supplementary Open Box Culvert**
								marginally less extent than Option 1 and 2.
NATURAL ENVIRONMENT	Fluvial Geomorphology	Impacts to stream morphology and opportunity for improvement to stream morphology.	Existing channel processes would continue. No opportunity for improvement of existing culvert crossing which is currently causing pooling and erosion upstream and pooling downstream of the crossing.	No opportunity for improvement of existing culvert crossing which is currently causing pooling and erosion upstream and pooling downstream of the crossing. Extension of impacted culverted length of Huttonville Creek by approx. 24m (16m north and 8m south) – total length 83m. Encroachment of Mississauga Road eastwards into the meander belt (fill directly to banktop upstream of crossing as part of interim project).	Opportunity for reduction of the impact of the culvert on channel processes by replacing it with a wider structure. Extension of impacted culverted length of Huttonville Creek by approx. 24m (16m north and 8m south) – total length 83m. Encroachment of Mississauga Road into the meander belt (fill directly to banktop upstream of crossing as part of interim project).	Reduction of further encroachment of Mississauga Road into the meander belt of the creek. No improvement of existing culvert crossing which is currently causing pooling and erosion upstream and pooling downstream of the crossing.	Opportunity for reduction of potential impacts of the crossing on the left bank. Overall benefit limited due to encroachment of Mississauga Road into the meander belt (fill directly to banktop upstream of crossing as part of interim project).	No opportunity for improvement of existing culvert crossing which is currently causing pooling and erosion upstream and pooling downstream of the crossing. Greater disturbance of creek continuity during higher flows due to division between culverts. Potential for erosion downstream due to perched nature of supplemental culvert, causing discontinuity in bed profile.
	Fisheries	Potential impacts to fish community and habitat in Huttonville Creek as a result of the proposed alternatives.	No change in length of creek enclosed in culvert. No disturbance of existing channel. No flow bypass requirement. Riparian buffers may or may not be affected, depending upon configuration of Mississauga Road.	Increase in length of creek enclosed in culvert. Disturbance of existing channel for extensions and tie-in reaches. Flow bypass may be required during construction. Riparian buffer reduced or eliminated north of Bovaird and reduced south of Bovaird.	Increase in length of creek enclosed in culvert. Disturbance of channel contained in existing culvert and existing channel extensions and tie-in reaches. Flow bypass may be required during construction. Riparian buffer reduced or eliminated north of Bovaird and reduced south of Bovaird.	No increase in length of creek enclosed in culvert. No disturbance of existing channel, or possible minimal disturbance at upstream end to stabilize banks. No flow bypass channel required during construction. Little impact on width of existing riparian buffers.	Increase in length of creek under bridge. Disturbance of channel contained in existing culvert. Possible disturbance of additional channel length spanned by bridge and tie-in reaches during construction. Flow bypass channel may be required during construction. Riparian buffer reduced or eliminated north of Bovaird and	No increase in length of creek enclosed in culvert. No disturbance of existing channel, or possible minimal disturbance at upstream end to stabilize banks. No flow bypass channel required during construction. Disturbance in east riparian buffers during construction but no permanent loss for width.

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			Do Nothing Option: Maintain Existing Culvert with Existing Road Width	**Option 1: Widen Mississauga Road West Extend Existing 1.65m x 5.53m x 60.0m Huttonville Culvert 16.0m north and 8.0m south (total 24.0m)**	**Option 2: Widen Mississauga Road West Replace Existing Huttonville Culvert on Existing Alignment with 1.65m x 14.6m x 83.0 m Culvert**	**Option 3: Shift Mississauga Road West Maintain Existing Huttonville Culvert on Existing Alignment**	**Option 4: Widen Mississauga Road West Replace Existing Culvert with Bridge to Span Meander Belt**	**Option 5: Widen Mississauga Road West without Right-Turn Channelization Maintain Existing Huttonville Culvert on Existing Alignment and Construct a 4.2 by 1.8m Supplementary Open Box Culvert**
NATURAL ENVIRONMENT							reduced south of Bovaird.	Riparian buffers may be affected by works on Mississauga Road.
SOCIAL, CULTURAL & ECONOMIC ENVIRONNENT	Land Use	Potential impact to residences, community facilities, public parks, institutions or businesses.	Reduced opportunity for growth of the surrounding community. No impact to the existing property.	Encroachment into parking facility for the "Great Apple Factory" resulting in loss of parking. Encroachment into Petro Canada Gas Bar site. Layout for the Petro Canada Gas Station will need to be reconfigured. Relocation/removal of the residence on 10020 Mississauga Road will be required.	Encroachment into parking facility for the "Great Apple Factory" resulting in loss of parking. Encroachment into Petro Canada Gas Bar site. Layout for the Petro Canada Gas Station will need to be reconfigured. Relocation/removal of the residence on 10020 Mississauga Road will be required.	The parking lot for the "Great Apple Factory" will be reduced by a greater extent than Option 1 and 2. Continued operation of the site is not viable without expansion on adjacent lands. The proposed realignment directly conflicts with the Petro Canada Gas Bar, The gas pumps, canopy and building will need to be relocated. Underground tanks will likely need to be relocated. Continued operation of the site is not viable without expansion on adjacent lands. Relocation/removal of the residence on 10020 Mississauga Road will be required.	Encroachment into parking facility for the "Great Apple Factory" resulting in loss of parking. Encroachment into Petro Canada Gas Bar site. Layout for the Petro Canada Gas Station will need to be reconfigured. Relocation/removal of the residence on 10020 Mississauga Road will be required.	Encroachment into parking facility for the "Great Apple Factory" resulting in loss of parking. Encroachment into Petro Canada Gas Bar site. Layout for the Petro Canada Gas Station will need to be reconfigured. Relocation/removal of the residence on 10020 Mississauga Road will be required.
	Noise	Number and characteristics of noise sensitive receivers (generally residences adjacent to the study corridor). Potential effects of traffic related noise on residences, adjacent to the study corridor.	With increase in traffic volumes and no expansion of existing facilities, congestion will increase. This will further increase the noise levels through this area.	Widening to the west reduces buffer to residences on west side of Mississauga Road, resulting in increased traffic noise levels at the outdoor living area.	Widening to the west reduces buffer to residences on west side of Mississauga Road, resulting in increased traffic noise levels at the outdoor living area.	Shifting Mississauga Road to the west reduces the buffer to residences on the west side more than Options 1, 2, 4, and 5. This results in increased traffic noise levels at the outdoor living area.	Widening to the west reduces buffer to residences on west side of Mississauga Road, resulting in increased traffic noise levels at the outdoor living area.	Widening to the west reduces buffer to residences on west side of Mississauga Road, resulting in increased traffic noise levels at the outdoor living area.

Table 5.2 Design Alternatives for Bovaird Drive/Mississauga Road Intersection and Huttonville Creek Crossing

Component	Area of Study	Criteria	Alternatives					
			Do Nothing Option: **Maintain Existing Culvert with Existing Road Width**	**Option 1:** **Widen Mississauga Road West** **Extend Existing 1.65m x 5.53m x 60.0m Huttonville Culvert 16.0m north and 8.0m south (total 24.0m)**	**Option 2:** **Widen Mississauga Road West** **Replace Existing Huttonville Culvert on Existing Alignment with 1.65m x 14.6m x 83.0 m Culvert**	**Option 3:** **Shift Mississauga Road West** **Maintain Existing Huttonville Culvert on Existing Alignment**	**Option 4:** **Widen Mississauga Road West** **Replace Existing Culvert with Bridge to Span Meander Belt**	**Option 5:** **Widen Mississauga Road West without Right-Turn Channelization** **Maintain Existing Huttonville Culvert on Existing Alignment and Construct a 4.2 by 1.8m Supplementary Open Box Culvert**
SOCIAL, CULTURAL & ECONOMIC ENVIRONMENT	Archaeology and Cultural Heritage Resources	Presence and characteristics of registered archaeological resources and designated built heritage resources under the *Heritage Act.* Potential adverse impacts on archaeological resources and built heritage resources within or adjacent to the study corridor.	No impact to archaeology and cultural heritage resources.	The residence located at 10020 Mississauga Road would need to be removed or relocated to allow for a widening to the west. This residence is on the City of Brampton's Heritage Listing, (December 2012).	The residence located at 10020 Mississauga Road would need to be removed or relocated to allow for a widening to the west. This residence is on the City of Brampton's Heritage Listing, (December 2012).	The residence located at 10020 Mississauga Road would need to be removed or relocated to allow for a widening to the west. This residence is on the City of Brampton's Heritage Listing, (December 2012).	The residence located at 10020 Mississauga Road would need to be removed or relocated to allow for a widening to the west. This residence is on the City of Brampton's Heritage Listing, (December 2012).	The residence located at 10020 Mississauga Road would need to be removed or relocated to allow for a widening to the west. This residence is on the City of Brampton's Heritage Listing, (December 2012).
	Access Considerations	Potential adverse effects including limited access during construction and changes to residential or commercial entrances.	No impact to existing entrances.	Access to Petro Canada Gas Station would either require raising of the profile of Mississauga Road or significant adjustment to site layout.	Access to Petro Canada Gas Station would either require raising of the profile of Mississauga Road or significant adjustment to site layout.	Access to Petro Canada Gas Station may require raising of the profile of Mississauga Road in addition to significant adjustment to site layout.	Access to Petro Canada Gas Station would either require raising of the profile of Mississauga Road or significant adjustment to site layout.	Access to Petro Canada Gas Station would either require raising of the profile of Mississauga Road or significant adjustment to site layout.
	Utilities	Potential adverse effects on existing utilities. Opportunity to accommodate future utilities.	No impact on existing utilities, however, opportunity missed to expand facilities for potential development in the community.	Relocation of utilities as necessary for widening.	Relocation of utilities as necessary for widening.	Relocation of utilities as necessary for widening.	Relocation of utilities as necessary for widening.	Relocation of utilities as necessary for widening.
TRANSPORTATION	Construction Disruptions	Potential adverse effects including noise, dust and disruption to existing traffic.	No impact to community from construction.	Disruptions to traffic patterns and dust would occur but can be mitigated during construction.	Disruptions to traffic patterns and dust would occur but can be mitigated during construction.	Disruptions to traffic patterns and dust would occur but can be mitigated during construction.	Disruptions to traffic patterns and dust would occur but can be mitigated during construction.	Disruptions to traffic patterns and dust would occur but can be mitigated during construction.

Table 5.2 Design Alternatives for Bovaird Drive/Mississauga Road Intersection and Huttonville Creek Crossing

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			Do Nothing Option: Maintain Existing Culvert with Existing Road Width	**Option 1: Widen Mississauga Road West Extend Existing 1.65m x 5.53m x 60.0m Huttonville Culvert 16.0m north and 8.0m south (total 24.0m)**	**Option 2: Widen Mississauga Road West Replace Existing Huttonville Culvert on Existing Alignment with 1.65m x 14.6m x 83.0 m Culvert**	**Option 3: Shift Mississauga Road West Maintain Existing Huttonville Culvert on Existing Alignment**	**Option 4: Widen Mississauga Road West Replace Existing Culvert with Bridge to Span Meander Belt**	**Option 5: Widen Mississauga Road West without Right-Turn Channelization Maintain Existing Huttonville Culvert on Existing Alignment and Construct a 4.2 by 1.8m Supplementary Open Box Culvert**
TRANSPORTATION	Safety	Safety related factors including roadway geometrics, roadside hazards, intersection design, and signalization.	Increase in traffic volumes with no expansion of the corridor will increase the potential for collisions.	Tangent alignment on Mississauga Road is preferred.	Tangent alignment on Mississauga Road is preferred.	Reverse curve alignment exceeds minimum standards but tangent alignment on Mississauga Road is preferred.	Tangent alignment on Mississauga Road is preferred.	Tangent alignment on Mississauga Road is preferred.
	Travel Delay/ Traffic Capacity	Potential to address existing and future capacity and operational needs. Potential for adverse effects including traffic delays during construction.	Future capacity issues will not be addressed, causing an increase in congestion and traffic delays.	Existing and future capacity issues will be addressed with the proposed widening.	Existing and future capacity issues will be addressed with the proposed widening.	Existing and future capacity issues will be addressed with the proposed widening.	Existing and future capacity issues will be addressed with the proposed widening.	Existing and future capacity issues will be addressed with the proposed widening, however, marginal reduction in level of service with elimination of westbound right turn channelization.
	Transit	Potential to address transit needs for future planned transit initiatives.	No potential to address future transit needs.	Future transit needs will be addressed with the proposed widening.	Future transit needs will be addressed with the proposed widening.	Future transit needs will be addressed with the proposed widening.	Future transit needs will be addressed with the proposed widening.	Future transit needs will be addressed with the proposed widening.
	Active Modes of Transportation	Potential to address requirements for active modes of transportation such as walking and cycling	No potential to address requirements for active modes of transportation.	The need for facilities to allow for pedestrian and cycling requirements will be addressed.	The need for facilities to allow for pedestrian and cycling requirements will be addressed.	The need for facilities to allow for pedestrian and cycling requirements will be addressed.	The need for facilities to allow for pedestrian and cycling requirements will be addressed.	The need for facilities to allow for pedestrian and cycling requirements will be addressed.
	Incremental Capital Cost	Incremental cost of the proposed improvements.	No incremental cost for this option.	**TOTAL COST = $3.28 M**	**TOTAL COST = $4.95 M**	**TOTAL COST = $22.2 M**	**TOTAL COST = $10.8 M**	**TOTAL COST = $ 3.5 M**
	Compatibility with Regional and City	Compatibility with Regional and Municipal Official	Not compatible with Region's Official Plans, Long Range Transportation Plan,	The proposed widening meets the Region's Official Plans, Long Range Transportation	The proposed widening meets the Region's Official Plans, Long Range Transportation	The proposed widening meets the Region's Official Plans, Long Range Transportation	The proposed widening meets the Region's Official Plans, Long Range Transportation	The proposed widening meets the Region's Official Plans, Long Range Transportation

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TRANSPORTATION	Transportation Plans and Policies	Plans and policies, the Region's Long Range Transportation Plan, the City of Brampton's Transportation and Transit Master Plan and the Halton Peel Boundary Area Transportation Study (HPBATS).	Transportation and Transit Master Plan, or HPBATS.	Plan, Transportation and Transit Master Plan, and HPBATS.	Plan, Transportation and Transit Master Plan, and HPBATS.	Plan, Transportation and Transit Master Plan, and HPBATS.	Plan, Transportation and Transit Master Plan, and HPBATS.	Plan, Transportation and Transit Master Plan, and HPBATS.

5.4 Future Creditview Road/James Potter Road

Land development has progressed on the southeast corner of the intersection of Bovaird Drive with the future Creditview Road/James Potter Road. In order to reduce the impact of roadway widening on the development, a number of alternatives were explored:

- Option 1: Maintain existing alignment, construct ultimate roadway with standard boulevard, and redesign internal development road (Frenchpark Circle) to accommodate design.
- Option 2: Shift alignment north 5.0m, construct ultimate roadway with standard boulevard width.
- Option 3: Maintain existing alignment, construct ultimate roadway with bus bay on southwest corner.
- Option 4: Shift alignment north 2.0m, construct ultimate roadway with reduced boulevard.

Option 4 was chosen as it minimizes the impact on the development, while balancing the social, economical, and environmental needs of the surrounding area.

5.5 CN Structure

The traffic study completed for the Class EA has indicated a need for three lanes of traffic in both the eastbound and westbound directions. In addition, a sidewalk is required along the north side of Bovaird Drive.

The roadway is designated as an Undivided Arterial Urban Road (UAU) with a posted speed of 70 km/h and a design speed of 90 km/h. The minimum stopping sight distance is 170 m.

Metrolinx has indicated that as their commuter service will be extended to Kitchener and possibly beyond, in the near future, they need to protect for a fourth track under the structure. Metrolinx also wishes to protect for electrification on this corridor. Electrification will require an increase in vertical clearance from 7.01m to 7.4m. This clearance was provided on the EBL structure and should also be provided for on the WBL structure.

The Region of Peel has indicated that the EBL structure was built to accommodate widening for the proposed WBL configuration. Ideally construction is best suited if the new structure is isolated from other structures. This will minimize the impact on the existing EBL structure, which would require removal of the north barrier wall and deck to tie-in the new structure under the previous assumption. Further analysis should be undertaken during detailed design.

Options

Two (2) options were considered to potentially satisfy the requirements for the grade separation. The options include:

- Option 1: Rehabilitation of the existing westbound bridge to provide for three (3) lanes of traffic, with a separate pedestrian structure adjacent to the existing structure, and provide for a fourth track;
- Option 2: Reconstruction of the WBL structure with three (3) lanes and a sidewalk, providing for a fourth track and for clearance for electrification.

The two options considered are shown on the attached drawings (ref Figure 5.1 Structure Option 1 and 5.2 Structure Option 2).

The existing westbound CNR Overhead provides the following lane and shoulder widths:

- 2 lanes @ 3.75 m
- 2 shoulders @ 2.915 m
- No sidewalks

The existing structure could accommodate the additional westbound lane by reducing the right shoulder. The resulting lanes and shoulder widths would be as follows:

- 3 lanes @ 3.65 m
- 2 shoulders @ 1.19 m
- No sidewalks

However, this reduction in shoulder width to 1.19m will restrict the stopping sight distance over the concrete barrier for a westbound vehicle in the inside lane. The resultant maximum available stopping site distance from the midpoint of the westbound right lane is 115m. For a 90 km/h design speed, the minimum required stopping sight distance is 160m.

The 115 m site distance provided with 3 lanes on the existing structure would meet the requirements of a design speed of 70km/h. Typically, the posted speed is 20 km/h below the design speed, which in this case would mean a posted speed of 50 km/h. Given that the recently rebuilt structure for the eastbound lanes has a posted speed of 70 km/h, it would be unrealistic to assume that a reduced posted speed on the westbound structure would be adhered to by motorists, or be enforceable. In light of the above, it is recommended that the westbound structure be replaced so the appropriate sight distance can be accommodated. Also given that the lack of pedestrian facilities needs to be addressed and the clearance can be increased to accommodate the potential electrification of the railway corridor, replacing the structure should be considered as the preferred alternative.

Figure 5.1 Structure Alternative Option 1

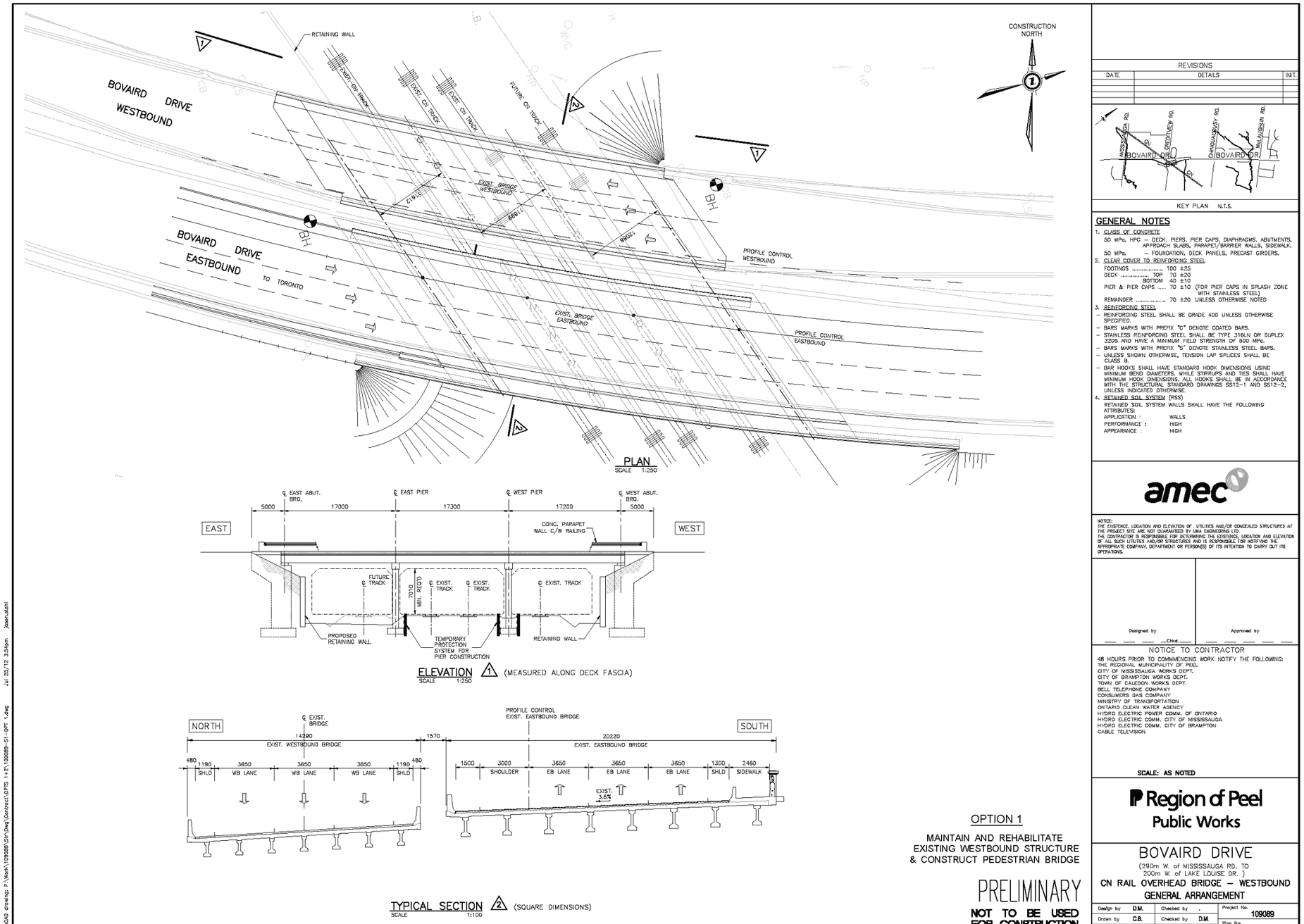
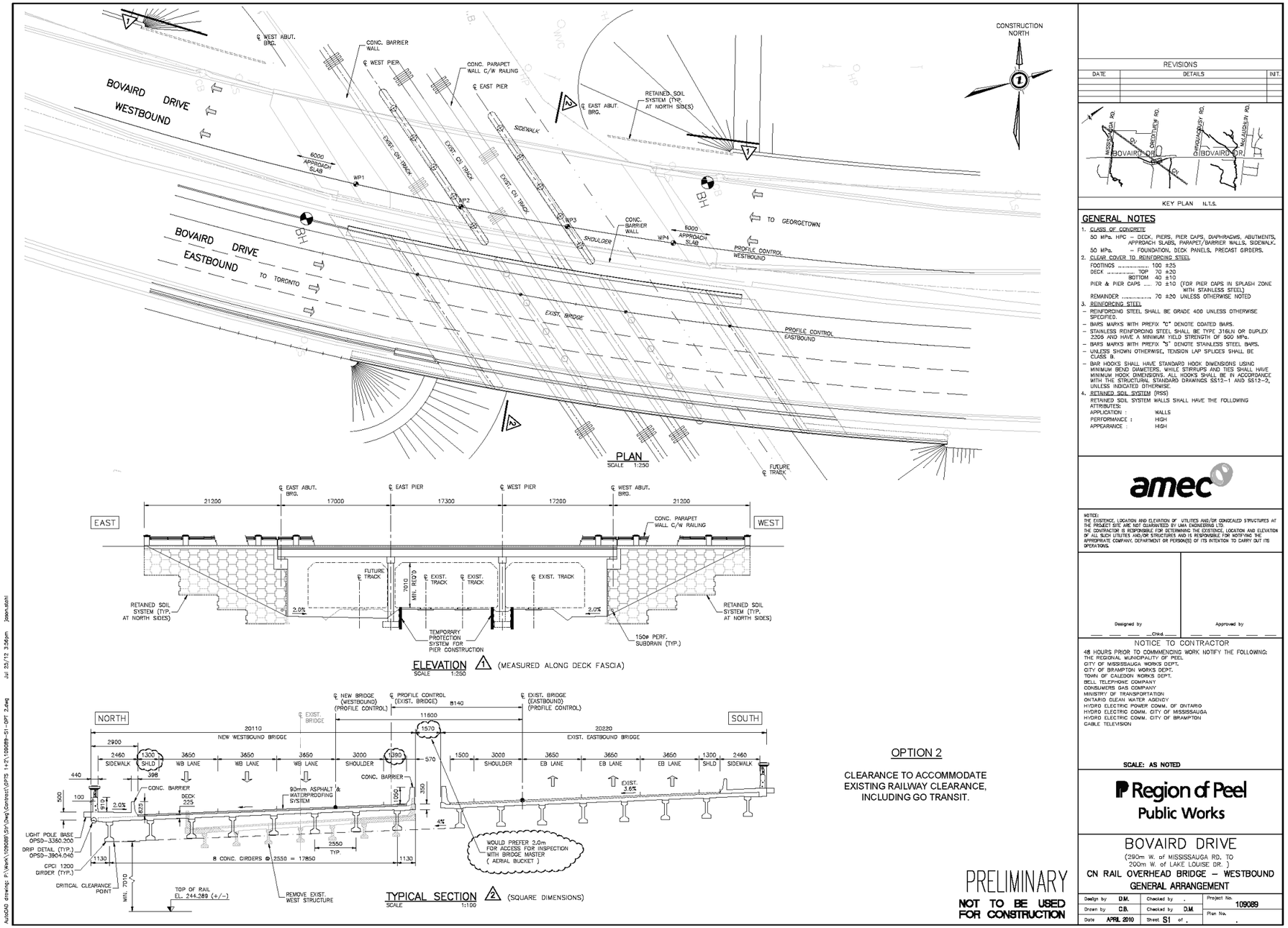


Figure 5.2 Structure Alternative Option 2



Option 2 satisfies all of the requirements, namely:

- Three (3) lanes of westbound traffic;
- Adequate sight lines for a 90 kph design speed;
- 3.0m multi-use path;
- Provisions for a fourth track;
- Vertical clearances for the electrification;
- Two metre clearance between the structures, providing room for inspection and proper adequate air flow between the structures, reducing moisture build up which can cause premature concrete deterioration.

5.6 Stormwater Management Opportunities

5.6.1 General

Stormwater Management practices (SWMPs) for the management of roadway runoff generally fall into two categories; those that address water quantity and those that manage quality of surface runoff. Water quantity management issues relate to properly sizing watercourse crossings of the roadway, as well as the conveyance of roadway runoff along the roadway corridor for minor and major storm events. In addition, water quantity management strategies can include the need for facilities to address downstream flood and erosion potential from the expansion of the roadway right-of-way.

In terms of water quality, the SWMPs relate to the treatment of new pavement and where possible, the treatment of existing pavement; however, current legislation solely relates to the former. Typically, the treatment level is related to the standards defined in the watershed or subwatershed planning study, which are dependent on the quality and sensitivity of the receiving stream system (i.e. Type 1, Type 2, etc.). For the Credit River Tributaries, Huttonville Creek and Springbrook Creek systems, the standard is Type 1 as required by CVC.

Various Best Management Practices or Stormwater Management practices are available to address both the quantity and quality of runoff from roadways. Due to the linear nature of roadway corridors, however, the full spectrum of stormwater management practices is typically not appropriate.

5.6.2 Alternative Stormwater Management Practices

Quantity Management

- ***Watercourse Crossings***

For watercourse crossings of roadway corridors, typical management opportunities include:

i. Controlling or reducing upstream flows to the capacity of existing crossings.

ii. Increasing the capacity of the existing crossing to the appropriate runoff standard.

iii. Developing optimized diversions between subcatchments to facilitate and/or reduce hydraulic crossings.

The decision process to control upstream flows or increase roadway infrastructure largely relates to environmental impacts, economics, timing and future required gradients. Given that the roadway is planned for reconstruction, the need or warrant for upgrading hydraulic capacity of culverts needs to be co-ordinated with the structural assessment of the respective culverts.

- ***Flood and Erosion Control***

Flood and erosion impacts due to increased runoff from expanded paved surfaces can be mitigated by on-site storage techniques and/or off-site mitigation measures, such as flood proofing, regulation or stream stabilization.

Quality Management

There are numerous stormwater management practices, which can be used to treat contaminated stormwater runoff from roadway surfaces. These include the following:

i. Wet ponds/wetlands/hybrids (generally linear facilities)

ii. Enhanced grass swales

iii. Oil and grit separators

iv. Off-site stormwater management facilities

v. Cash-in-lieu of on-site treatment

The respective characteristics, advantages and disadvantages of the foregoing have been well documented in previous municipal and provincial literature and hence this information has not been repeated within this document. Some brief advantages and disadvantages, though, are discussed in the following.

5.6.3 General Assessment

The advantages and disadvantages of the various Best Management Practices associated with both quantity and quality control measures are as follows:

Quantity Control

Controlling runoff in stormwater management facilities upstream of crossings requires land and future management/maintenance by municipal forces. The advantages relate to maintaining existing sizing of drainage infrastructure or smaller infrastructure across the roadway, as well as downstream. Disadvantages include the cost of land, infrastructure and maintenance. Increasing the size of drainage infrastructure, while somewhat more costly to the roadway authority, reduces the need for future maintenance and eliminates the need for the dedication of stand-alone land for surface controls. Inter-subcatchment diversions can be effective on a minor scale in optimizing and/or reducing the number of crossings and are typically followed to address both major and minor runoff conditions.

For flood and erosion control, on-site measures to reduce peak flow impacts can be highly constraining due to the general lack of properly configured land. Roadway corridors, due to their inherent linear nature, can only effectively manage relatively small volumes of increased runoff (peak flows), in the absence of stand-alone land acquisition. Combination of measures to mitigate impacts through some on-site storage, along with off-site upgrades as necessary, is often the 'best' approach, where impacts exceed allowable minimums.

Quality Control

- ***Wetponds, Wetlands, Hybrids***

These systems generally require the dedication of land that most often is not available in linear corridors for roadway projects. Most often when applied to roadway runoff, these SWMP's are located adjacent to creek crossings. For Bovaird Drive, this particular opportunity is considered extremely limited. Typically these systems provide an excellent level of treatment and as end-of-pipe systems, the management and performance is more visible, hence less prone to failure.

- ***Enhanced Grassed Swales***

Grassed swales designed with a trapezoidal geometry and flat longitudinal profiles with largely un-maintained turf can provide excellent filtration and treatment for storm runoff from roadways. It is generally conceded that treatment levels are at a minimum, Normal (formerly Level 2) treatment, and combined with other practices can provide Enhanced treatment. Their application in linear corridors is also particularly appropriate and can be further enhanced through the introduction of check dams to provide additional on-line storage. The application in

urbanized roadway cross-sections (i.e. curb and gutter) often requires alternative grading and roadway configurations which can compromise the function of the roadway itself, and are therefore typically not preferred. Notwithstanding, gutter outlets along outside lanes have functioned effectively in the past where the right-of-way can accommodate the design.

- ***Oil and Grit Separators***

These systems tend to serve limited drainage areas and provide levels of treatment (less than Enhanced, formerly Level 1). They are typically encouraged as part of a "treatment train" approach. Disadvantages include the need for frequent maintenance, as well as relatively high capital costs and the ability to serve small drainage areas.

- ***Off-Site Stormwater Management Facilities***

While facilities can often not be constructed within roadway right-of-way lands, roadway runoff can be directed towards subdivisions, which would have their runoff managed by future stormwater management facilities. The Mount Pleasant and Bluegrass Helport developments would include stormwater management facilities in the subdivisions adjacent to Bovaird Drive. In addition there is a possibility that the Heritage Heights development may have facilities on the north side of Bovaird Drive, however the currently proposed rural roadway cross section would limit the potential for runoff from the right-of-way to be conveyed to these facilities.

- ***Cash-in-Lieu of On-Site Treatment***

Often, due to the sensitivity of downstream systems (i.e. low habitat potential) and the difficulty of providing affordable and effective stormwater management on-site, roadway authorities have proposed the contribution of cash-in-lieu of on-site stormwater management, to be directed towards other environmental enhancement projects. These can either be identified in subwatershed planning studies or addressed on a site-specific basis. The priority of application usually relates first to improving watershed conditions in the directly affected watershed. This approach is supported by both Provincial and Municipal policy.

5.6.4 Assessment of Drainage Design Alternatives

The reconstruction and widening of Bovaird Drive within the study limits would increase the amount of impervious coverage within the roadway corridor. This would increase the total runoff and mass loading of pollutants, including the concentrations of contaminants within the runoff, thereby affecting the quality of runoff. The main receiving waters of the Bovaird Drive corridor have been designated as Type 1 habitat as defined by the Ontario Ministry of Natural Resources, and therefore "Enhanced" treatment of the stormwater runoff is required for the future conditions.

5.6.5 General Storm Water Quality Management

In terms of quality control, all crossings/outlets in the study area exhibit comparable or similar conditions, and for this reason the drainage design alternatives have been assessed together in the following discussion.

Given the limited availability of land along Bovaird Drive, the opportunity for standalone stormwater quality controls would be constrained. A cash-in-lieu option could be pursued for the impacted segments of Bovaird Drive; however, this option would be less favourable, due to the sensitivity of the receiving watercourse since some form of treatment would be warranted in these settings. The use of oil/grit separators is also considered impractical given the generally low level of treatment provided, and the high capital and maintenance costs.

Based on the current information, the Region of Peel could implement enhanced grass swales for the western road section of Bovaird Drive that would maintain rural cross-sections. Using the 25 mm 4 hour Chicago distribution storm event, appropriate enhanced grass swales would be designed to maintain flow velocities below 0.5 m/s with an average 1.0% longitudinal slope or less and a resulting flow depth of less than 0.3 m, in order to maximize the detention and contact treatment that would be provided. Runoff would be conveyed for a minimum of 60 m in the enhanced swale before the outlet is considered fully treated to Normal levels, less than 60 m is considered partially treated. Enhanced quality control would not be directly achieved for the additional paved area, however the enhanced swales would also treat the currently untreated existing pavement, resulting in the net removal of a mass of suspended solids greater than that required for the additional pavement.

5.7 Public Consultation

5.7.1 Meetings

Agency meetings were held in January 2012 with representatives from the Ministry of Natural Resources and Credit Valley Conservation (ref. Appendix 'O' - Meeting Minutes). The purpose of the meetings was to present information on the Huttonville Creek Crossing and to provide an opportunity for agencies to voice any concerns with the project or the Class EA process. Details of the specific concerns and opportunities discussed in the meeting are recorded in the Meeting Minutes.

5.7.2 Summary of Phase 3 Public/Agency Consultation

The second Public Information Centre (PIC) was held on Tuesday, May 3, 2012 at the Peel Regional Police Association. Notification of the PIC was sent to stakeholders including local residents, agencies and municipal staff, by mail and notices were placed in the Brampton Guardian and the Georgetown Independent on April 18 and 25, 2012. A copy of the PIC notice and all the comments received is provided in Appendix 'Q' - Public Information Centre

Number 2. Table 5.3 is a Summary of Phase 3 Public/Agency comments received through consultation to date.

PIC No. 2 provided the general public an opportunity to ask questions of the Project Team, review the preferred design alternative, and discuss issues related to the project, including traffic and environmental considerations. Letters to stakeholders and agencies, a copy of the presentation, and copies of all comments received and written responses regarding PIC No. 2 are contained in Appendix 'Q' - Public Information Centre Number 2.

Table 5.3 Summary of Phase 3 Public/Agency Consultation

Comment / Question Received from Stakeholders	Response / Commitments
What are the benefits (improvements) resulting from installation of a 14.6m versus 10.5m culvert where Huttonville Creek passes under Bovaird Drive?	A detailed assessment of the Huttonville Creek crossing was presented to key stakeholders, CVC, and MNR for approval. Benefits to wildlife habitat, terrestrial/wetland ecosystems and fisheries and fish habitat. Stormwater quantity management will also benefit.
How does the location and role of the future North-South Transportation Corridor (NSTC) factor into the Bovaird Drive Class EA.	In order to facilitate discussion in the traffic study, the crossing of the NSTC with Bovaird Drive was assumed to occur between Heritage Road and Mississauga Road. This allowed for the Class EA traffic study to proceed based on the best available information at the time. The NSTC will be subject to an EA Study or studies outside the of secondary planning process for Heritage Heights
The Class EA did not address the location of the access points to existing and future private property and/or developments.	For development, access points cannot be shown until the municipal application process has been completed and associated access approved by the Region of Peel. Access and geometric details will be determined during the Traffic Impact Study stage. At existing private access points, the road platform, grading, and drainage will closely match existing conditions.

6.0 DESCRIPTION OF PREFERRED DESIGN

6.1 Major Features of the Recommended Plan

6.1.1 Design Criteria

The proposed design criteria for the reconstruction of Bovaird Drive is shown in Table 6.1 – 6.9:

Table 6.1 Design Criteria for Bovaird Drive from Caseley Street to Heritage Road

	Present Conditions	Design Standards	Actual Proposed
Highway Classification	RAU	UAU	UAU
Number Of Lanes	3	3	3
Posted Speed (kph)	60	60	60
Design Speed (kph)	80	80	80
Minimum Stopping Sight Distance (m)	150	140	150
Minimum 'K' Factor	CREST – 40 SAG – 25	CREST – 36 SAG – 12	CREST – 40 SAG – 12
Grades Maximum	5%	6%	5%
Superelevation Maximum	4%	4-6%	4%
Minimum Radius (m)	740	250	740
Lane Width - through (m)	3.75	3.75	3.75
Shoulder Width (m)	0 – 3.0	3.0	3.0m (with 1.0m partially paved shoulder)
Median Width (m)	N/A	N/A	N/A
R.O.W. Width (m)	37 - 110	45	45 - 110

Table 6.2 Design Criteria for Bovaird Drive from Heritage Road to Proposed NSTC

	Present Conditions	Design Standards	Actual Proposed
Highway Classification	RAU	UAU	UAU
Number Of Lanes	2	4	4
Posted Speed (kph)	70	70	70
Design Speed (kph)	90	90	90
Minimum Stopping Sight Distance (m)	200+	170	200+
Minimum 'K' Factor	CREST – 80 SAG – 26	CREST – 53 SAG – 20	CREST – 80 SAG – 26
Grades Maximum	0.9%	6%	0.9%
Superelevation Maximum	4%	4-6%	4%
Minimum Radius (m)	1200	340	1200
Lane Width - through (m)	3.75	3.75	3.65 (through lane) 3.75 (curb face lane)
Shoulder Width (m)	2.0 – 3.5	N/A	N/A
Median Width (m)	N/A	2.5 – 6.0	2.0 - 5.5
R.O.W. Width (m)	37	45	45

Table 6.3 Design Criteria for Bovaird Drive from Proposed NSTC to Mississauga Road			
	Present Conditions	**Design Standards**	**Actual Proposed**
Highway Classification	RAU	UAU	UAU
Number Of Lanes	2	6	6
Posted Speed (kph)	70	70	70
Design Speed (kph)	90	90	90
Minimum Stopping Sight Distance (m)	200+	170	200+
Minimum 'K' Factor	CREST – 80 SAG – 120	CREST – 53 SAG – 20	CREST – 80 SAG – 20
Grades Maximum	2%	6%	2%
Superelevation Maximum	3%	4-6%	4%
Minimum Radius (m)	1000	340	1000
Lane Width - through (m)	3.75	3.75	3.65 (through lane) 3.75 (curb face lane)
Shoulder Width (m)	3.0	N/A	N/A
Median Width (m)	N/A	2.5 – 6.0	2.0 - 5.5
R.O.W. Width (m)	37 - 50	45	45 - 50

Table 6.4 Design Criteria for Bovaird Drive from Mississauga Road to Ashby Field Road *			
	Present Conditions	**Design Standards**	**Actual Proposed**
Highway Classification	RAU	UAU	UAU
Number Of Lanes	3 (mid-block) 4 (intersection @ Ashby Field Road) 2 (intersection @ Mississauga Road)	6	6
Posted Speed (kph)	70	70	70
Design Speed (kph)	90	90	90
Minimum Stopping Sight Distance (m)	260	170	260
Minimum 'K' Factor	CREST – 64 SAG – 25	CREST – 53 SAG – 20	CREST – 64 SAG – 25
Grades Maximum	2.3%	6%	2.3%
Superelevation Maximum	4%	4-6%	4%
Minimum Radius (m)	620	340	620
Lane Width - through (m)	3.75	3.75	3.65 (through lane) 3.75 (curb face lane)
Shoulder Width (m)	2.5 – 9.0*	N/A	N/A
Median Width (m)	N/A	2.5 – 6.0	2.0 - 5.5
R.O.W. Width (m)	37 - 65	45	45 – 65

* Extra granular is in place for potential widening

Table 6.5 Design Criteria for Bovaird Drive from Ashby Field Road to Lake Louise Drive/Worthington Avenue			
	Present Conditions	**Design Standards**	**Actual Proposed**
Highway Classification	UAU	UAU	UAU
Number Of Lanes	5	6	6
Posted Speed (kph)	70	70	70
Design Speed (kph)	90	90	90
Minimum Stopping Sight Distance (m)	170	170	170
Minimum 'K' Factor	CREST – 53 SAG – 44	CREST – 53 SAG – 20	CREST – 53 SAG – 44
Grades Maximum	4.5%	6%	4.5%
Superelevation Maximum	6%	4-6%	4%
Minimum Radius (m)	600	340	600
Lane Width - through (m)	3.50 (Existing Westbound) 3.65 (Existing Eastbound)	3.75	3.75 (Westbound) 3.65 (Existing Eastbound)
Shoulder Width (m)	N/A	N/A	N/A
Median Width (m)	2.0 (intersection) 6.0 (mid-block) 2.5 (bridge)	2.5	6.0 (mid-block) (2.0 bridge)
R.O.W. Width (m)	50 - 75	45	50 – 75

Table 6.6 Design Criteria for Heritage Road at Bovaird Drive			
	Present Conditions	**Design Standards**	**Actual Proposed**
Highway Classification	RAU	UAU	UAU
Number Of Lanes	2	4	4
Posted Speed (kph)	50	50	50
Design Speed (kph)	70	70	70
Minimum Stopping Sight Distance (m)	40	110	110
Minimum 'K' Factor	CREST – 3 SAG – 5	CREST – 16 SAG – 10	CREST – 16 SAG – 10
Grades Maximum	6.7%	6%	6%
Superelevation Maximum	N/A	6%	N/A
Minimum Radius (m)	N/A	190	N/A
Lane Width - through (m)	3.5	3.75	3.65 (through lane) 3.75 (curb face lane)
Shoulder Width (m)	0	N/A	N/A
Median Width (m)	N/A	N/A	N/A
R.O.W. Width (m)	20	37	37

Table 6.7 Design Criteria for Mississauga Road at Bovaird Drive			
	Present Conditions	**Design Standards**	**Actual Proposed**
Highway Classification	RAU	UAU	UAU
Number Of Lanes	4	6	6
Posted Speed (kph)	80	80	80
Design Speed (kph)	100	100	100
Minimum Stopping Sight Distance (m)	N/A	N/A	N/A
Minimum 'K' Factor	CREST – 70 SAG – N/A	CREST – 70 SAG – 45	CREST – 70 SAG – N/A
Grades Maximum	2%	6%	2%
Superelevation Maximum	N/A	6%	N/A
Minimum Radius (m)	N/A	420	N/A
Lane Width - through (m)	3.5	3.75	3.65 (through lane) 3.75 (curb face lane)
Shoulder Width (m)	1.5	N/A	N/A
Median Width (m)	N/A	2.5	2.5
R.O.W. Width (m)	38	45	45

Table 6.8 Design Criteria for Proposed Creditview Road/James Potter Road at Bovaird Drive *			
	Present Conditions	**Design Standards**	**Actual Proposed**
Highway Classification	N/A	UAU	UAD
Number Of Lanes	N/A	2	6
Posted Speed (kph)	N/A	50	50
Design Speed (kph)	N/A	70	70
Minimum Stopping Sight Distance (m)	N/A	110	110
Minimum 'K' Factor	N/A	CREST – 16 SAG – 10	CREST – 25 SAG – 12
Grades Maximum	N/A	6%	5%
Superelevation Maximum	N/A	6%	2% reverse crown
Minimum Radius (m)	N/A	190	320
Lane Width - through (m)	N/A	3.75	3.5 (Travel Lane) 3.75 (Transit Lane)
Shoulder Width (m)	N/A	N/A	N/A
Median Width (m)	N/A	2.5	2.0
R.O.W. Width (m)	N/A	26	36

* Source: Creditview Road Realignment Class Environmental Assessment, From Bovaird Drive to Approximately 1,500m North of Bovaird Drive

Table 6.9 Design Criteria for Ashby Field Road at Bovaird Drive			
	Present Conditions	**Design Standards**	**Actual Proposed**
Highway Classification	UAU	UAU	UAU
Number Of Lanes	2	2	2
Posted Speed (kph)	50	50	50
Design Speed (kph)	70	70	70
Minimum Stopping Sight Distance (m)	110	110	110
Minimum 'K' Factor	CREST – 4 SAG – N/A	CREST – 16 SAG – 10	CREST – 23 SAG – 12
Grades Maximum	3.5%	6%	3.5%
Superelevation Maximum	N/A	6%	N/A
Minimum Radius (m)	N/A	190	N/A
Lane Width - through (m)	3.75	3.75	3.75
Shoulder Width (m)	N/A	N/A	N/A
Median Width (m)	1.5	2.5	1.5
R.O.W. Width (m)	26	26	26

6.1.2 Horizontal Alignment

The proposed alignment is a hybrid of alternatives as evaluated previously. For Bovaird Drive, the alignment follows the existing centerline, and varies at the intersection of Bovaird Drive and Creditview Road/James Potter Road due to constraints regarding current development progress. The alignment of Mississauga Road at Bovaird Drive also deviates from existing due to the high level constraint associated with Huttonville Creek. The proposed alignment is shown in detail on the preliminary design drawings (ref. Sheets 1-18: Plan and Profile).

6.1.3 Vertical Alignment

The vertical alignment for Bovaird Drive was developed, and will be refined in detail design, based on the following criteria:

- Meet the design criteria for vertical alignment specified above;
- Match existing centerline as closely as possible;
- Match existing boulevards, commercial properties, entrances and sideroads as closely as possible, and
- Minimize property purchase requirements.

The existing crest vertical curve crossing Bovaird Drive along Heritage Road is sub-standard, providing stopping sight distance 40 m, as opposed to the required 110 m for a 70 kph design. The preferred profile provides for a crest vertical curve of K=16, which provides approximate

sight volume. The existing roadway will be cut by approximately 1.0 km to accommodate this design.

6.1.4 Typical Cross Section

The typical cross sections proposed are illustrated in Figure 6.1 – 6.4. Key elements of the proposed cross-section of Bovaird Drive include the following:

- Concrete curb and gutter;
- Six (6) – 3.65 m lanes (3.75 m adjacent to curb) through lanes east of the NSTC;
- Four (4) – 3.65 m lanes (3.75 m adjacent to curb) through lanes west of NSTC;
- 5.50 m raised median island midblock, tapering to 2.0 m at intersections;
- 3.0 m multi-use path – north side of Bovaird Drive;
- 1.5 m sidewalk – south side of Bovaird Drive;
- 1.0 m splash strip;
- 3.50 m left and right turn lanes as required at all intersections, and
- Illumination on both sides

The cross-sections were developed based on BILT standards, and approved by Region of Peel staff.

Figure 6.1 Typical Cross Section – West of Heritage and at Heritage Road

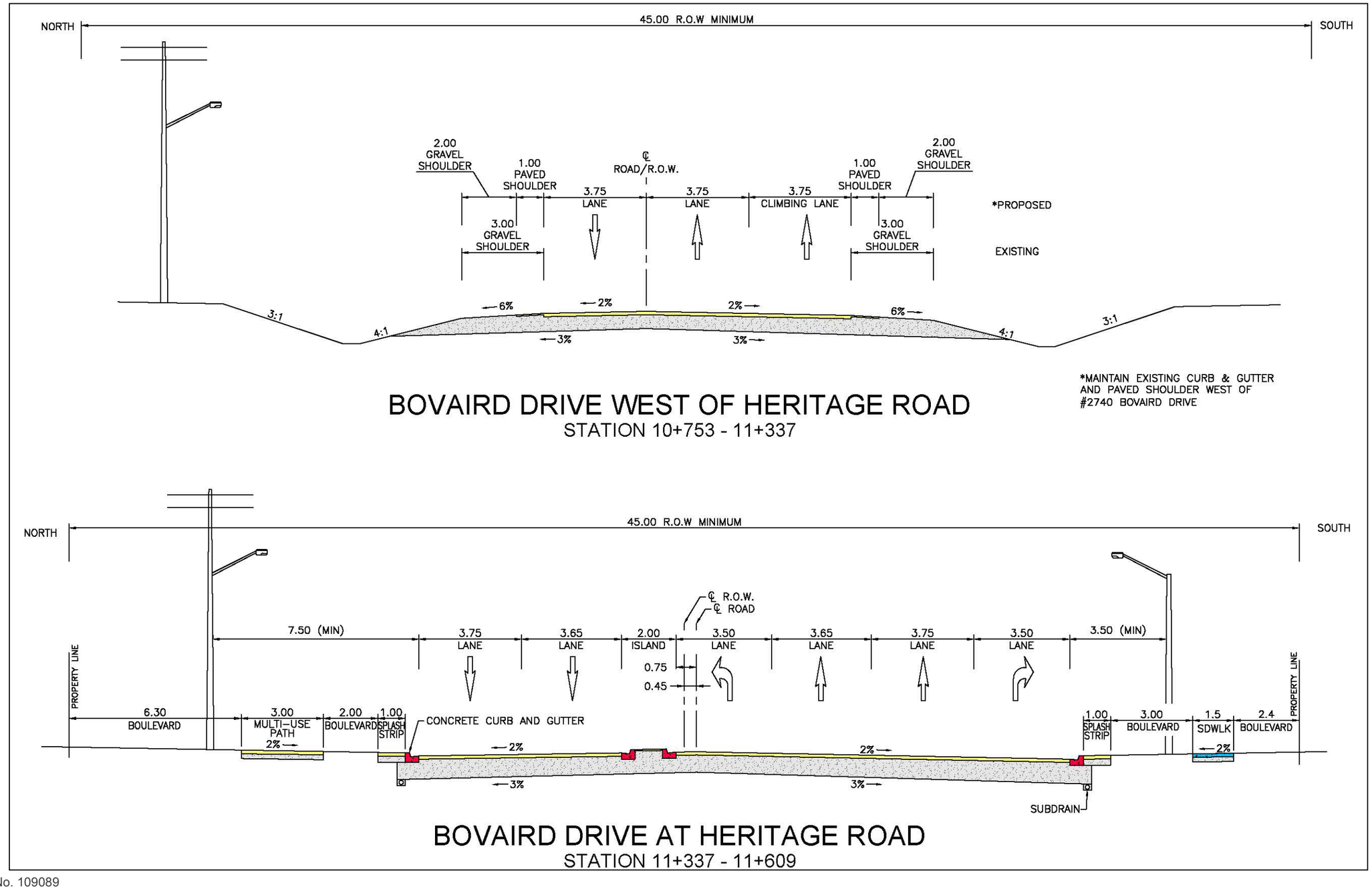
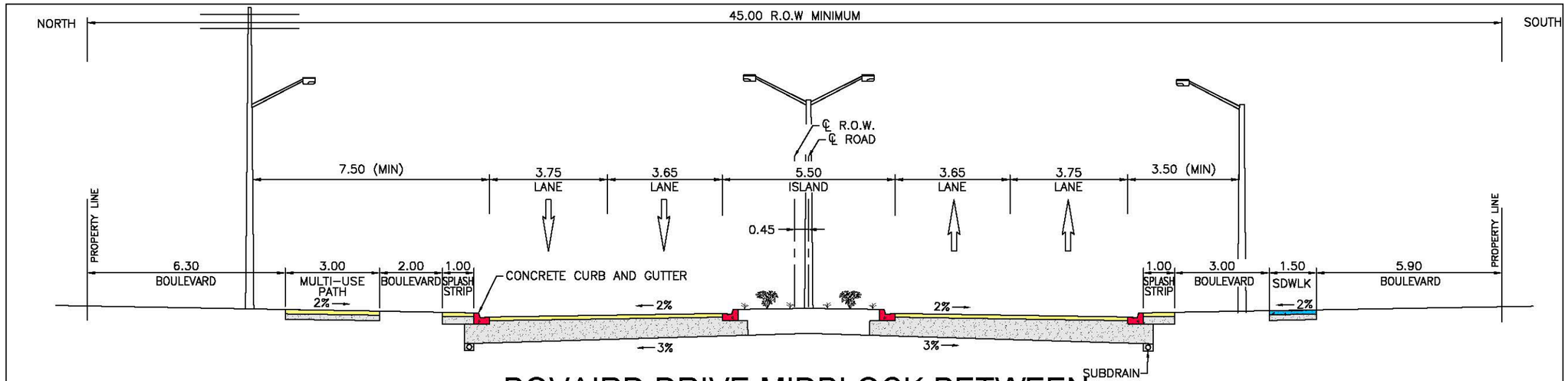
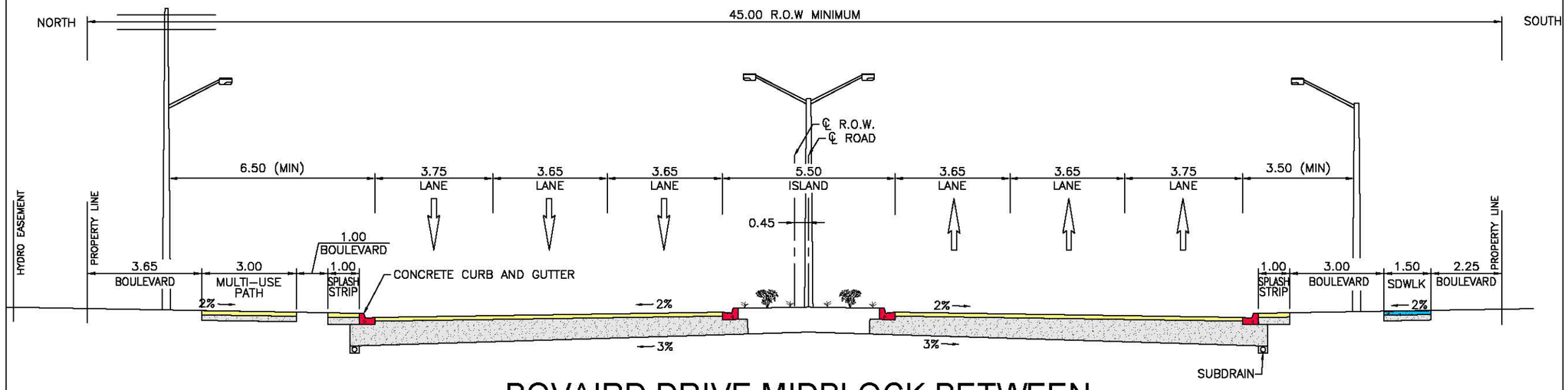


Figure 6.2 Typical Cross Section – Midblock between Heritage and NSTC, NSTC and Mississauga, Mississauga and Creditview Road/James Potter Road



BOVAIRD DRIVE MIDBLOCK BETWEEN
HERITAGE ROAD AND NSTC
STATION 11+609 - 12+141



BOVAIRD DRIVE MIDBLOCK BETWEEN
NSTC AND MISSISSAUGA ROAD, MISSISSAUGA ROAD AND JAMES POTTER ROAD
STATION 12+141 - 12+637
13+088 - 13+198

Figure 6.3 Typical Cross Section – Bovaird at James Potter, Mississauga, Ashby Field Road

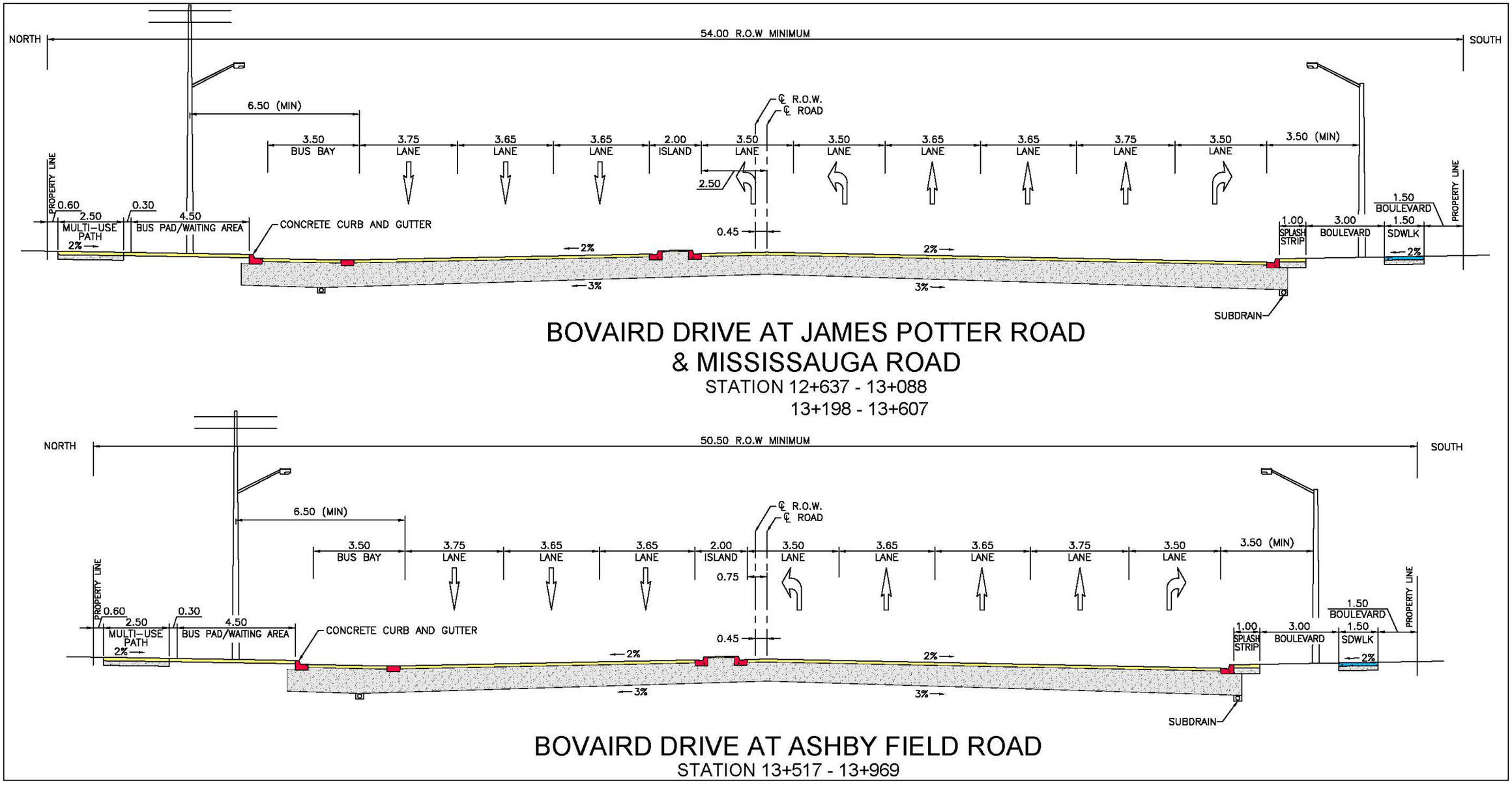
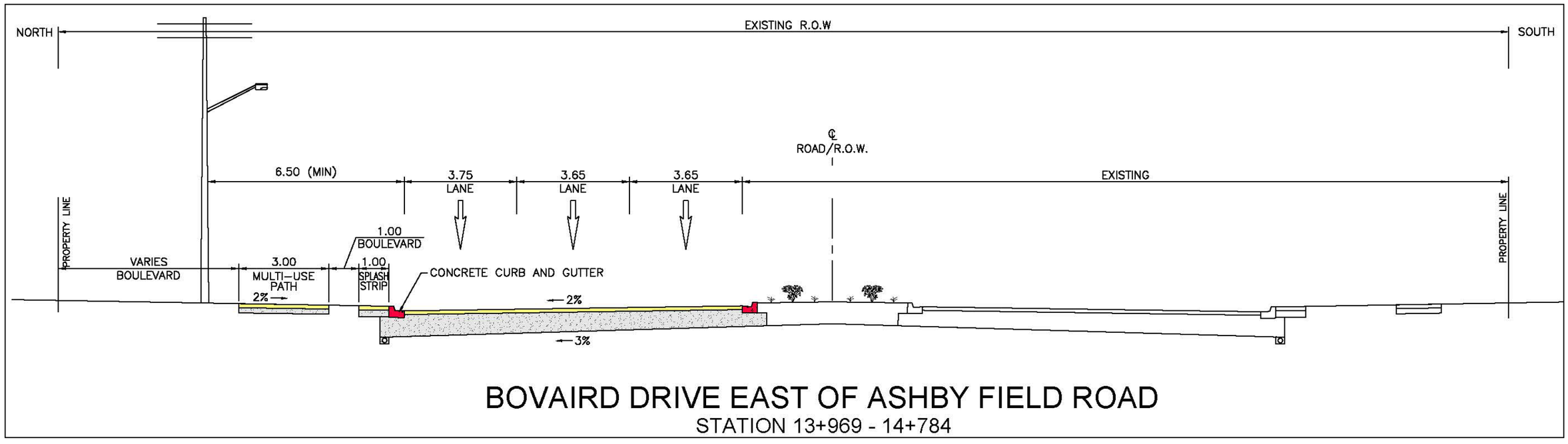


Figure 6.4 Typical Cross Section – East of Ashby Field Road



6.1.5 Intersections and Side Roads

Intersection designs have been developed to provide an acceptable level of service at each intersection. Turning lane lengths are based on the Ontario Geometric Design Standards Manual for a 90 km/h design, and consist of a taper and storage lane component. Storage lengths were calculated based on 95th percentile queue lengths (ref. Appendix 'B' - Traffic Study). Required turning lanes and corresponding storage lengths are shown on the preliminary design drawings (ref. Sheets 1-18 – Plan and Profile).

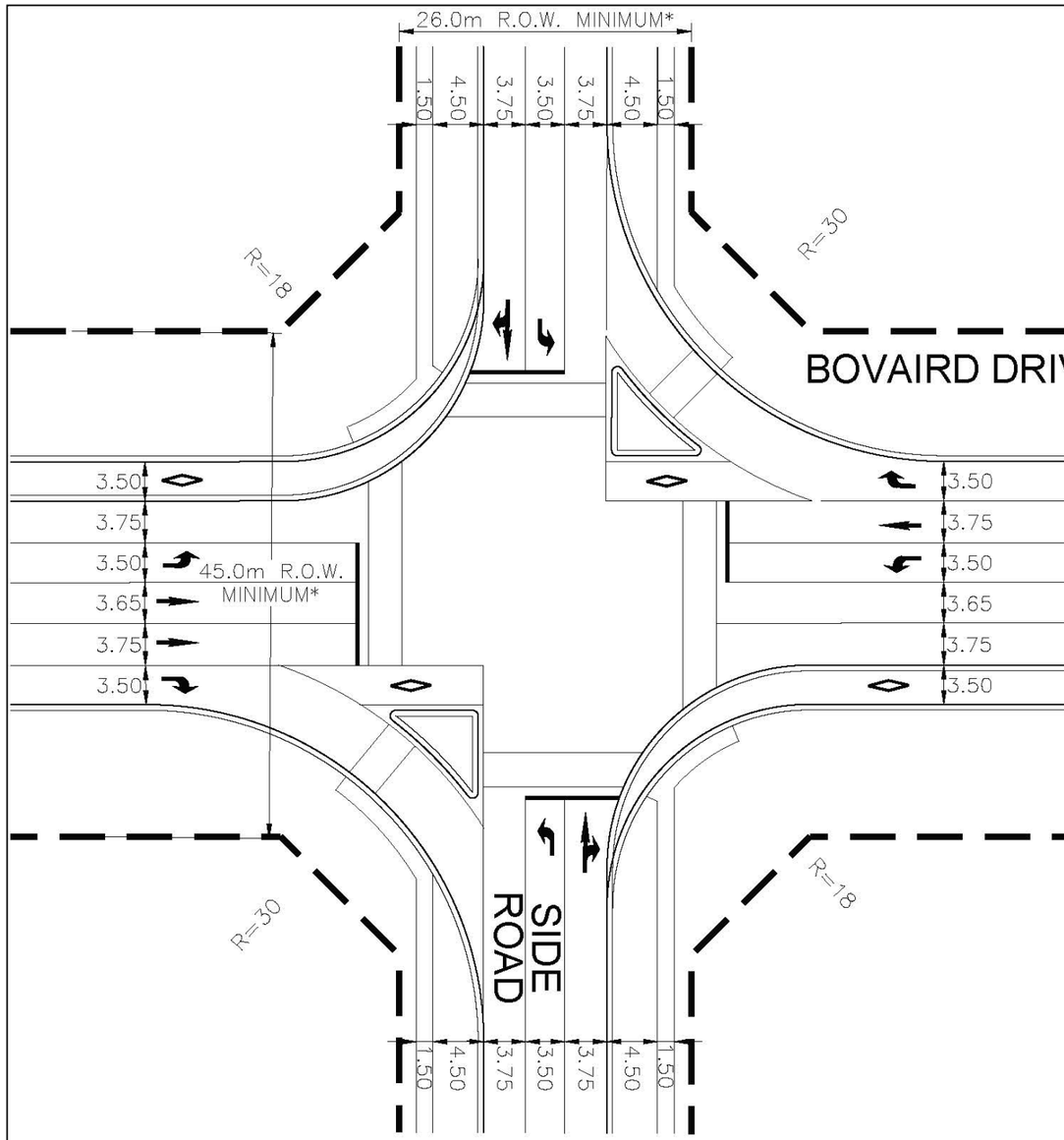
The land surrounding the Bovaird Drive corridor has been identified for development. It should be noted that potential locations of full movement intersections have been included in the preferred alternative for Bovaird Drive. The locations shown are based on the Region of Peel Controlled Access By-Law, which requires a minimum intersection spacing of 300-400m. The typical details for these intersections are shown on Figures 6.5 to 6.7.

North-South Transportation Corridor

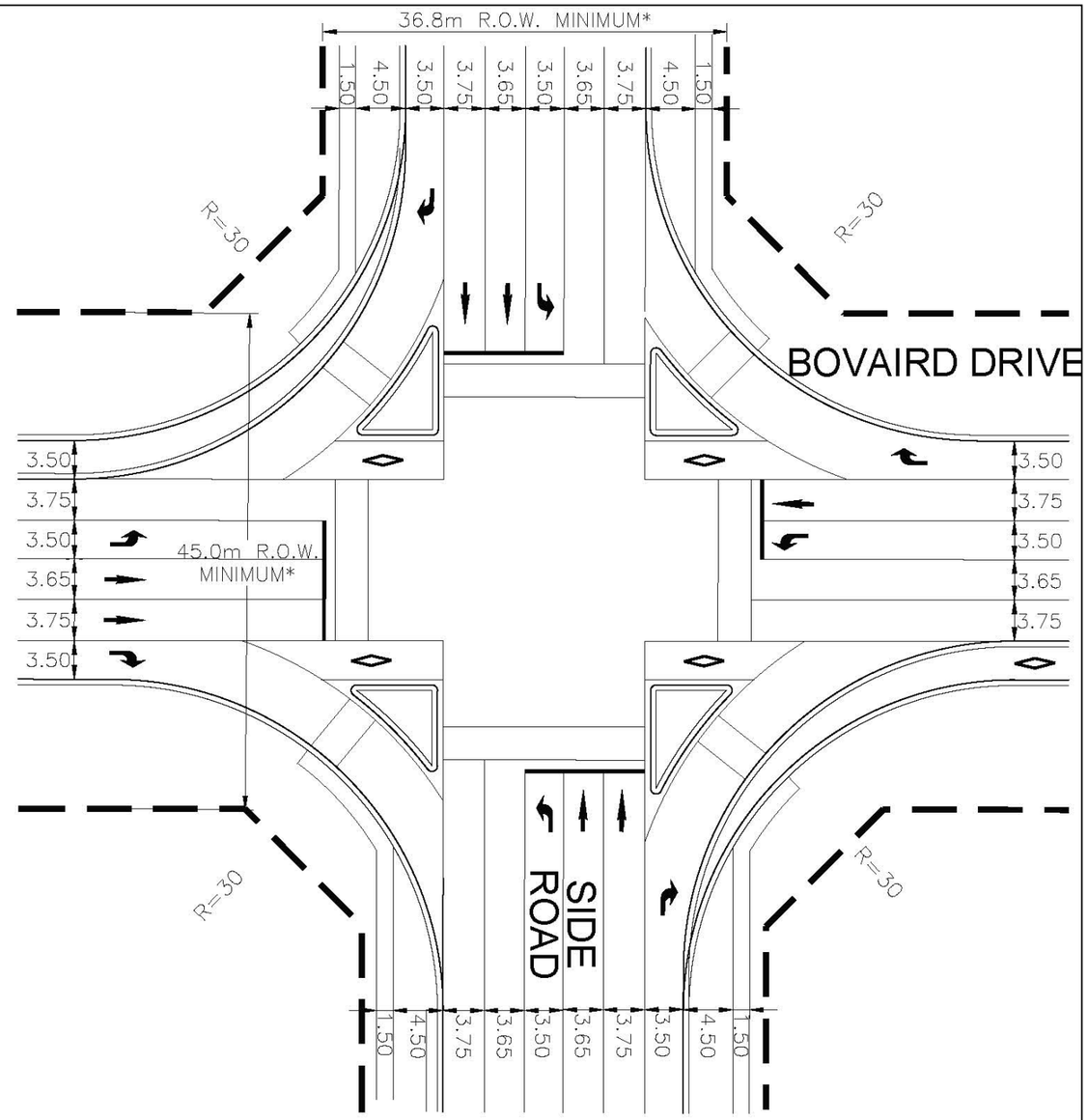
As part of this study, the Halton-Peel Boundary Area Transportation Study (HP-BATS) was reviewed by project staff to better understand the major transportation plans for the community. In particular, the recommendation for the NSTC was studied. HP-BATS identified a wide potential corridor extending from Mississauga Road to west of Heritage Road for the location of the NSTC.

The traffic study states a need for 6 lanes (3 eastbound and 3 westbound) east of the NSTC, and 4 lanes (2 eastbound and 2 westbound) west of the NSTC. In order to communicate the recommended lane configuration in the preferred alternative, the NSTC was assumed to cross Bovaird Drive mid-block between Heritage Road and Mississauga Road. *Modification of the lane configuration shown on the preferred alternative will be required once the location of the NSTC is confirmed.*

Figure 6.5 Potential Access Point Detail West of Heritage Road



2 THROUGH LANES ON SIDE ROAD



4 THROUGH LANES ON SIDE ROAD

Figure 6.6 – Potential Access Point Detail between Heritage Road and NSTC

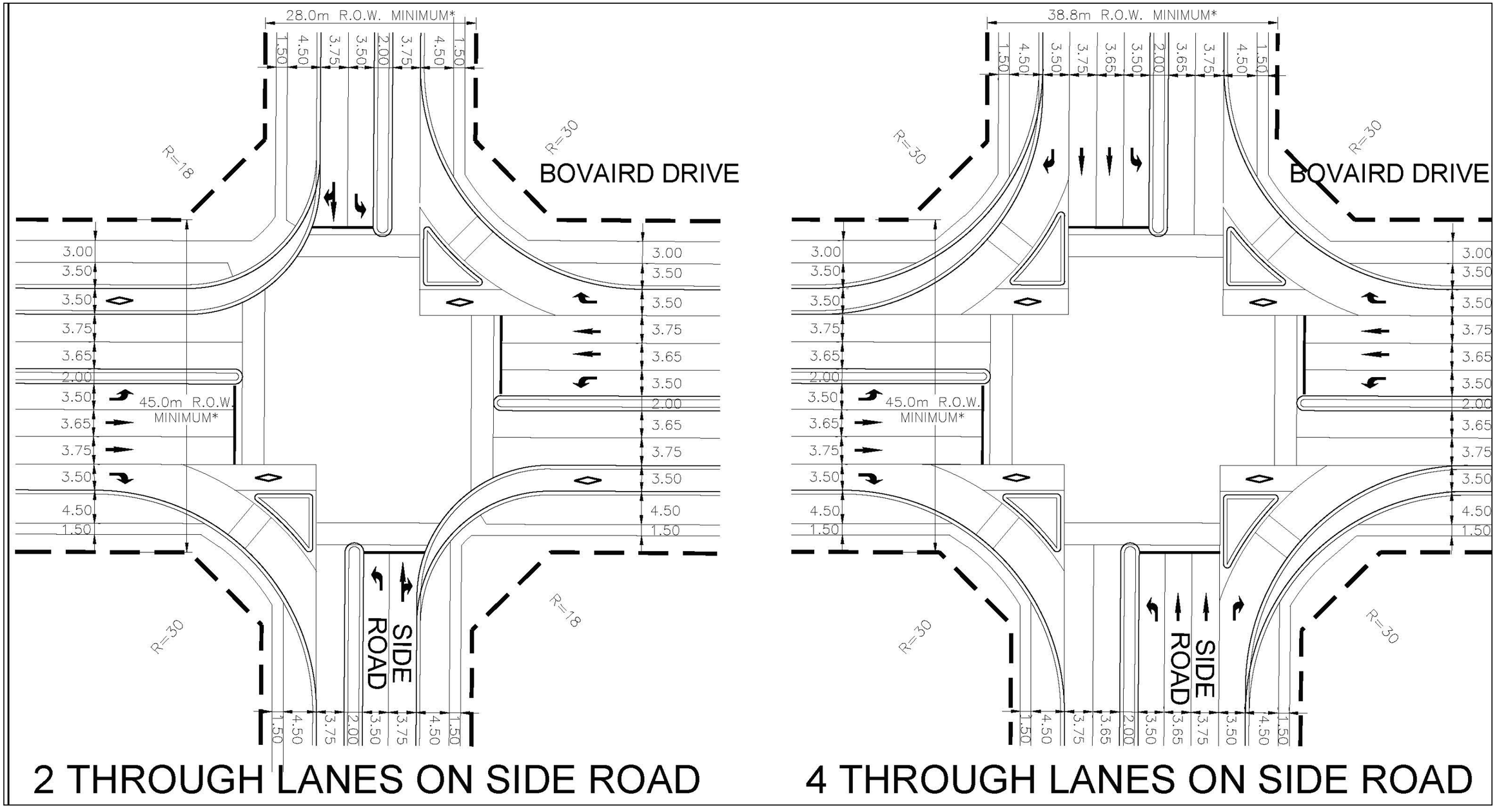
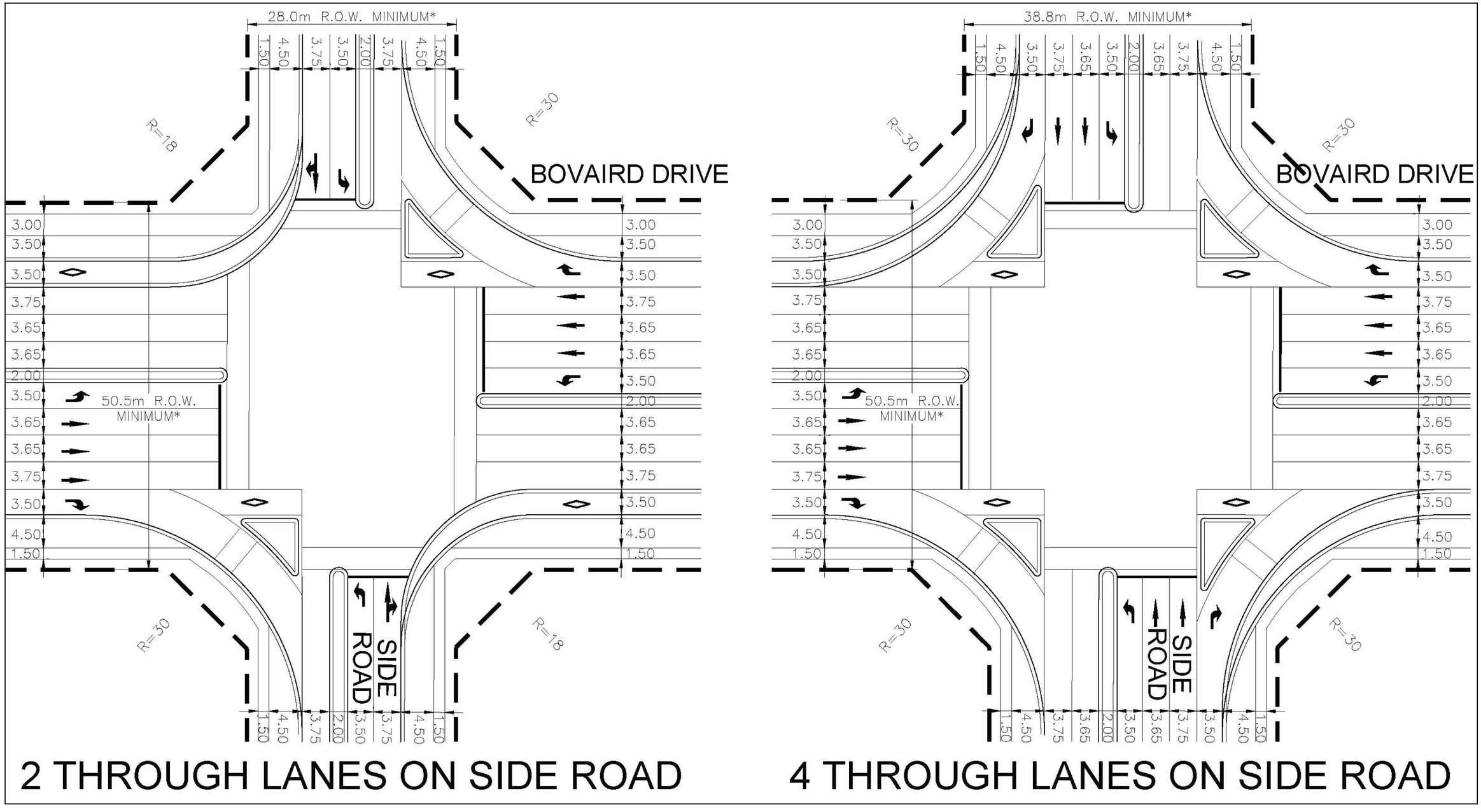


Figure 6.7 Potential Access Point Detail between NSTC and eastern limit



Mississauga Road

The intersection of Mississauga Road and Bovaird Drive has been scheduled for interim improvements involving urbanization and widening to four (4) through lanes. Additionally, Mississauga Road north of Bovaird Drive has been studied previously within the MEA Class EA guidelines for interim improvements to four (4) lanes. This study is only applicable for the ultimate widening to six (6) through lanes.

The interim design includes a number of key elements, which are shown on the preferred alternative for the Bovaird Drive Class EA. A bio-engineered slope is proposed along the east side of Mississauga Road, between Huttonville Creek and the roadway. This bio-engineered slope must be maintained under ultimate conditions, to avoid further disturbance of the Huttonville Creek Floodplain. Widening for ultimate conditions must only take place westward. The bio-engineered slope should also be extended northward when Mississauga Road is widened to the ultimate width.

Additionally it has been identified that a 1200mm diameter culvert crossing Mississauga Road approximately 180m north of Bovaird Drive, and the associated drainage feature, is considered as 'contributing habitat to Redside Dace'. This crossing falls within the study limits of the Bovaird Drive Class EA project.

This crossing is contained within the limits of the interim 4-lane widening of Mississauga Road, currently progressing through detailed design. As stated above, the interim design is considered to be fixing the east limit of the Mississauga Road corridor, and widening for the ultimate 6-lane design would only take place westerly. Consequently, the Bovaird Drive Class EA has assumed that the extension or replacement of this culvert will be addressed by the interim project and, if required, further extended as part of the ultimate 6-lane design. Any details regarding possible further extension of the culvert westerly following the interim widening project will be deferred to detailed design of the ultimate widening.

The proposed storm sewer for the interim project is shown on the preferred alternative. *Coordination with Region of Peel staff and the interim design team should take place to determine if the storm sewer should be sized for ultimate conditions, or retrofitted when the ultimate roadway is built*.

Future Creditview Road/James Potter Road

Development has been progressing rapidly as development moves west from Brampton. Coordination of this intersection design with the final development plans will be necessary during detailed design.

As of completion of this report, the north leg of Creditview Road/James Potter Road has reached the 90% detailed design phase. Coordination should take place during the detailed design phase.

6.1.6 Vehicle Turning Movements

Turning movement wheel tracking was reviewed at all intersections using opposing WB-20 design vehicles. For intersections where dual lefts occur, a WB-19 and WB-20 turning simultaneously with an opposing WB-20 was simulated. The median locations were then positioned to accommodate the simulated movements.

6.1.7 Private Entrances

In general, existing private entrances will be reconstructed based on the following criteria:

- Asphalt aprons between the curb and sidewalks;
- Match original driveway material at the property line;
- Driveway grades in accordance with municipal standards, and
- Permission to enter required for re-grading of driveways

In addition, gaps in the raised median will be provided to allow for full vehicular movements. Drop curbs at driveway locations should also be considered during the detailed design phase.

Entrances to the Calldron Gas Bar and #2036 Bovaird Drive have been noted to require full movement access onto Bovaird Drive. However, accommodating this requirement will negatively impact the safety and traffic capacity of the intersection of Bovaird Drive with Mississauga Road. Further discussions between the property owners and the Region of Peel should be undertaken during detailed design.

Calldron Gas Bars Ltd East Entrance

The two existing east accesses from Mississauga Road to Calldron Gas Bars Ltd (Petro Canada), which is located on the southwest corner of Bovaird Drive and Mississauga Road, have been reviewed in detail. At present, the gas bar elevation is approximately 1-2 m above the existing centerline of Mississauga Road.

Changes in road elevation and cross section elements will be addressed in the interim 4-lane design of Mississauga Road. The detailed design team for the ultimate configuration must review assumptions made by the interim widening and ensure they are carried forward during the ultimate widening.

6.1.8 Pavement Design

A preliminary pavement investigation was completed by AMEC Environment & Infrastructure (ref. Appendix 'D' - Geotechnical Investigation Report). The pavement design recommendations contained in this report were used for preliminary design and estimating purposes.

The pavement design recommendations are split between resurfacing the existing platform, and widening to accommodate the ultimate width of the roadway. The result of each analysis is summarized below:

Widening

SECTION 1: LAKE LOUISE DRIVE / WORTHINGTON AVENUE TO MISSISSAUGA ROAD			
HOT MIX ASPHALT			
TYPE	THICKNESS (mm)	PERFORMANCE GRADE ASPHALT CEMENT	TRAFFIC CATEGORY
SP 12.5 FC2	40	64-28	D
SP 19.0 mm	50	64-28	D
SP 19.0 mm	50	58-28	D
SP 19.0 mm	50	58-28	D
TOTAL HMA	190		
GRANULAR 'A'	150		
GRANULAR 'B' TYPE I	600		

SECTION 2: MISSISSAUGA ROAD TO HERITAGE ROAD			
HOT MIX ASPHALT			
TYPE	THICKNESS (mm)	PERFORMANCE GRADE ASPHALT CEMENT	TRAFFIC CATEGORY
SP 12.5 FC2	40	64-28	D
SP 19.0 mm	50	64-28	D
SP 19.0 mm	50	58-28	D
SP 19.0 mm	60	58-28	D
TOTAL HMA	200		
GRANULAR 'A'	150		
GRANULAR 'B' TYPE I	600		

SECTION 3: HERITAGE ROAD TO CASELEY DRIVE			
HOT MIX ASPHALT			
TYPE	**THICKNESS (mm)**	**PERFORMANCE GRADE ASPHALT CEMENT**	**TRAFFIC CATEGORY**
SP 12.5 FC2	40	64-28	D
SP 19.0 mm	50	64-28	D
SP 19.0 mm	50	58-28	D
TOTAL HMA	155		
GRANULAR 'A'	150		
GRANULAR 'B' TYPE I	500		

Resurfacing

Target GBE for New Construction	Method of Rehabilitation	Curb and Gutter
Section #1 Lake Louise Drive/Worthington Avenue to Ashby Field Road (Urban)		
HMA = 190 mm Granular A = 150 mm Granular B = 600 mm **Target GBE = 930 mm**	Mill and Overlay Mill 90 mm, complete base repair in rutted/distorted areas, and resurface with 90 mm HMA. **GBE after re-surfacing = 996 mm**	Yes
Section #2 Mississauga Road to Heritage Road (Rural)		
HMA = 200 mm Granular 'A' = 150 mm Granular 'B' = 600 mm **Target GBE = 950 mm**	Pulverization, Remixing, and Resurfacing In-place pulverize the bituminous concrete to a depth of 150mm into an equivalent depth of granular base material, grade, compact, and resurface with 170 mm of HMA. **GBE after re-surfacing = 959 mm**	No
Section #3 Heritage Road to Caseley Drive (Rural)		
HMA = 155 mm Granular 'A' = 150 mm Granular 'B' = 500 mm **Target GBE = 793 mm**	Partial Depth Reconstruction In-place pulverize the bituminous concrete to a depth of 150 mm into an equivalent depth of granular base material, grade, compact, and resurface with 155 mm of HMA **GBE after re-surfacing = 985 mm**	No

A detailed geotechnical study and pavement design report will be completed during the detail design phase.

6.1.9 Storm Drainage

The ultimate drainage condition was investigated by the project team, and is summarized below. A fold-out plan highlighting the crossing points is provided (ref. Future Drainage Plan, Drawing 3, in back pocket). The conclusions reached below are based on the best available information at the time of writing this report. The detailed design team is required to confirm all conclusions made below and document the updated assessment in a stormwater management report.

West Study Limit (Sta. 10+386) to West of Heritage Road (Sta. 11+205), Drainage Outlets 'A' and 'B'

- ***Quality Management***

The future modification to this segment of Bovaird Drive are limited and would increase the impervious area from approximately 0.742 ha to 0.782 ha for Outlet A and 0.48 ha to 0.64 ha for Outlet B. In general, the current road section will be maintained. The existing roadway runoff currently receives no formal treatment, thus 0.04 ha (Outlet A) and 0.16 ha (Outlet B) additional pavement would require Enhanced formal treatment under proposed conditions.

As discussed previously, for rural road cross-sections the Region of Peel would be able to implement enhanced grass swales. Table 6.10 indicates the formal treatment proposed for this segment.

Table 6.10 Drainage Outlets 'A' and 'B' Storm Water Quality Treatment

Outlet	Catchment	Swale Location	Impervious Area		New Pavement (m^2)	Proposed Quality Control				
			Existing (m^2)	Future (m^2)		Basic (m^2)	Normal (m^2)	Untreated (m^2)	Equivalent 100% Removal (m^2)	Equivalent Enhanced (m^2)
A	2	Northeast	5700	6100	400	0	0	6100	0	0
	1	Northwest	450	450	0	0	0	450	0	0
	35	Southeast	1200	1200	0	0	0	1200	0	0
	36	Southwest	70	70	0	0	0	70	0	0
B	4	Northeast	1100	2000	900	588	1412	0	1341	1676
	3	Northwest	700	1400	700	500	900	0	930	1163
	33	Southeast	1600	1600	0	464	1136	0	1074	1342
	34	Southwest	1400	1400	0	500	900	0	930	1163
			12220	**14220**	**2000**	**2052**	**4348**	**7820**	**4275**	**5343**

As noted, the rural road cross section will be maintained. As is evident, by virtue of treating a considerable portion of existing pavement by formal enhanced grass swales, the Enhanced treatment warrants for the new proposed pavement are considered satisfied. At the detailed design stage, the proponent should investigate and apply Low-Impact-Development practices where possible.

- ***Quantity Management***

Peak Flows

The increase in peak flows resulting from the additional 0.04 ha and 0.16 ha of pavement for Outlets A and B respectively has been considered insignificant as the total drainage area to the crossings along this 0.82 km segment of Bovaird Drive is 494.91 ha (i.e. < 0.03 % of the road drainage area). The 100 year peak flow at Culverts A and B would increase by 0.3 m^3/s at each location with the percent difference in the 100 year peak flows of 0.1 % and 1.4 % respectively. Based on the insignificant increase in peak flows, stormwater quantity management has not been proposed for Drainage Outlets A and B.

Table 6.11 Peak Flow Comparison (cms) – (Drainage Outlets A and B)

Drainage Outlet	Ex Drainage Area (ha)	Fut Drainage Area (ha)	100 Year			Regional		
			Existing	Future	Difference	Existing	Future	Difference
A	474.24	474.24	23.42	23.45	0.03	43.25	43.25	0.00
B	17.67	17.67	2.10	2.13	0.03	2.09	2.09	0.00

Hydraulic Crossings

Two culverts, Outlets A and B are located within this section of roadway. Outlet A is a 1.2 m by 2.43 m box culvert. The upstream side of the culvert is 13.39 m below the centreline of the road. The Regional Storm and 100 year peak flows to the culvert are 43.25 m^3/s and 23.45 m^3/s respectively. The culvert assessment completed using HEC-RAS results in the 100 year peak flows not being conveyed within the culvert and overtopping the driveway by 0.21 m. The Regional Storm also overtops the culvert by 0.66 m ± and spills down the side of the roadway. The weir flow would be approximately 17.82 m^3/s. An approximate culvert replacement size has been determined based on fluvial morphology, animal passage, and hydraulics. As such, a 12m by 2m open-footing box structure would be considered adequate to address these deficiencies. However, the Heritage Heights Subwatershed Study is ongoing and would assess hydraulic structures, including Culvert A, and will likely require revision to the assumed culvert size of 12 m x 2 m. The development of this area has been slated for 2023. Due to the upcoming revisions of the area drainage patterns for the Heritage Heights Subwatershed Study, the long timeframes for development at this location, that the deficiencies identified are pre-existing and that no improvements are proposed at this location, a final decision on replacing the crossing is deferred to a separate project.

The culvert at Outlet B is a 0.91 m by 0.70 m box culvert. The culvert is 3.73 m below the centre line of road at the upstream side. The Regional Storm and 100 year peak flows are 2.09 and 2.13 m^3/s respectively. The culvert provides 1.52 m of freeboard to the centre line of road for the Regional Storm and therefore provides adequate flow capacity. The culvert does not require

extending and would therefore remain as is. The culvert is not recommended for structural replacement in the next 20 years.

West of Heritage Road (Sta. 11+205) to West of Mississauga Road (Sta. 12+400): Drainage Outlets (C, D and E)

- ***Quality Management***

The future development of this segment of Bovaird Drive would increase the impervious area by 1.703 ha. The existing roadway runoff currently receives no formal treatment. The additional pavement would require Enhanced formal treatment. Outlets C, D, and E would have increased impervious areas of 0.545 ha, 0.784 ha and 0.374 ha respectively.

This section of roadway is proposed to be urbanized with curbs, without ditches within the ultimate right-of-way (although ditches may be provided for interim conditions). Several options have been assessed for stormwater quality including, stormwater management facilities providing quality treatment for the proposed Regional right-of-way, stormwater management combined with future development lands and oil/grit chambers at outlets.

Stormwater Management Facilities

Stormwater management facilities have been sized for each outlet to provide Enhanced water quality control. Each facility apart from Outlet E would be split between the west and east sides of the watercourse, therefore the permanent pool and extended detention volumes would be split based on contributing west and east areas. Typically, end-of-pipe facilities require drainage areas 5 ha or greater to be practical. Providing stormwater quality management facilities for each outlet is considered impractical. Land requirements for stormwater management facilities would require the purchase of lands outside of the Regional right-of-way, with each facility requiring approximately 0.5 ha.

Table 6.12 Stormwater Water Quality Management Facility Sizing (Drainage Outlets C, D and E)

Outlet	Total Drainage Area (ha)	Right-of-way Drainage Area	Impervious Area Increase (ha)	Increase in Impervious %	Permanent Pool m^3	Extended Detention m^3
C	31.39	2.18	0.57	25	134	84
D	86.48	2.80	1.54	55	282	112
E	50.81	1.04	0.50	48	138	42
Totals	168.68	6.02	2.61	43.4	554	238

*SS = Suspended Solids

Oil/ grit chambers provide water quality treatment for areas that are approximately 2 ha. For Outlets C, D and E, 5 chambers would be required as per Table 6.13. Although Table 6.13

presents TSS removal greater than 80% equivalent to Enhanced water quality removal, approval agencies typically only accept Normal water quality treatment from oil/grit chambers. In addition to potential water quality treatment concerns, oil/grit chambers are considered to have high capital and operation and maintenance costs. Total capital costs for 5 oil/grit chambers could be $150,000 to $250,000.

Table 6.13 Oil Grit Chamber Sizing (Drainage Outlets C, D and E)

Drainage Outlet	Right-of-way Drainage Area	Increase in Impervious %	StormceptorTM Model (Or Equivalent)	TSS Removal (%)
C West	1.12	21	STC750	82
C East	1.06	30	STC750	85
D West	0.90	36	STC750	81
D East	1.90	35	STC2000	80
E	1.04	48	STC2000	83

The third potential local alternative is combining the required stormwater quality needs for the Bovaird Drive improvements with the stormwater quality needs of the proposed Heritage Heights development in future stormwater management facilities. This approach does provide the Enhanced level of water quality control required and does not require the purchase of lands. This approach is considered to be the most effective for ultimate Bovaird Drive conditions, with the potential use of oil/grit chambers as a temporary interim solution until the stormwater quality facilities are constructed.

- ***Quantity Management***

Peak Flows and Erosion Control

The increase in peak flows for the 100 year storm event and Regional Storm resulting from the additional 0.57 ha, 1.54 ha and 0.61 ha of pavement for Outlets C, D and E, respectively, has been documented in Table 6.14. and provides the peak flow comparison for existing and future conditions for the 100 year and Regional Storm.

Table 6.14 Peak Flow Comparison (m^3/s) – (Drainage Outlets C, D and E)

Drainage Outlet	Ex Drainage Area (ha)	Fut Drainage Area (ha)	100 Year			Regional		
			Existing	Future	Difference	Existing	Future	Difference
C	31.39	31.39	3.85	3.95	0.10	3.82	3.84	0.02
D	86.48	86.48	6.83	6.96	0.13	8.67	8.69	0.02
E	50.81	50.81	0.95	0.82	-0.13	1.68	2.39	0.71

Stormwater quantity management facilities have been sized for the 100 year storm event to maintain existing peak flows using the 12 hour SCS storm distribution. Due to timing of peak flows there is a marginal reduction in the 100 year future peak flow for Outlet E.

For erosion control in absence of other local criteria, the storage requirements for the 24 hour detention of the 25 mm storm event have been assessed for each drainage outlet and have also been provided in Table 6.15. Drainage Outlets C and D would require stormwater quantity controls on either side of the outlet, which would result in active volume within the stormwater management facilities below 165 m^3, while Drainage Outlet E, would have a 156 m^3 active volume requirement. As the active storage volumes and the respective drainage areas (< 1.90 ha) are considered insignificant, it would be preferable to integrate stormwater management with the pending Heritage Heights development.

Table 6.15 Stormwater Quantity Requirements (Drainage Outlets C,D, E)

Drainage Outlet	25 mm		25 Year		100 Year		
	Unitary Storage Volume (m^3/imp ha)	Unitary Discharge (m^3/imp ha)	Unitary Storage Volume (m^3/imp ha)	Unitary Discharge (m^3/s /ha)	Unitary Storage Volume (m^3/imp ha)	Unitary Discharge (m^3/s /ha)	Total Volume (m^3)
C	232.14	0.06	342.86	0.20	428.57	0.26	240
D	178.79	0.06	268.69	0.18	330.30	0.25	327
E	184.00	0.06	252.00	0.19	312.00	0.26	156

Hydraulic Crossings

Three crossings, Outlets C, D and E, are within this section of roadway. Outlet C consists of a culvert under Bovaird Drive (C1) and 35m+/- downstream a culvert under Heritage Road (C2). C1 consists of a 1.2 m by 1.2 m open footing culvert with a 0.50 m diameter CSP extension. The upstream side of the culvert C1 is 3.60 m below the centreline of the road. The Regional Storm and 100 year peak flows to the culvert are 3.84 m^3/s and 3.95 m^3/s respectively. The culvert assessment completed using MTO culvert nomographs results in the 100 year peak flows being conveyed mostly over the road with only 1.1 m^3/s out of 3.95 m^3/s conveyed by the culvert.

Culvert C2 is a 0.90 m diameter CSP, which would convey approximately 1.75 m^3/s before the road would be overtopped. As such, it is considered to be hydraulically deficient.

Outlet C has been identified to be deficient from a geomorphological perspective. To address this deficiency and the overtopping issue identified above, both culverts are proposed to be replaced with 3.66 m span x 1.22 m high open footing con/span precast arch concrete structure. The proposed culverts would convey the Regional and 100 year peak flows with 0.85 m flow depth. The recommended 3.66 m span for both culverts C1 and C2 is considered adequate

from a geomorphological perspective, as the minimum span required to accommodate meander amplitude would be 2.3 m.

Outlet D is a 1.0 by 1.2 m open footing culvert. The culvert is able to convey the 10 year storm event and is overtopped by 0.46 m during the Regional Storm. As the culvert is unable to convey the 25 year storm adequately as per MTO's Highway Drainage Design Standard, dated January 2008, section SD-13 Design Flows and Freeboards, the culvert would require upgrading. In addition to the foregoing it is understood that the Region of Peel prefers to have no flooding on roadways at creek crossings during the Regional Storm.

The centreline of the road at this location would only be 1.57 m (+/-) above the invert of upstream side of the culvert. Based on the height restriction for an upgraded culvert, conveying the Regional Storm peak flow of 8.69 m^3/s without any flooding would not possible. A 6 m span by 1m rise opening would convey all storm events up to the 100 year with a peak flow of 6.96 m^3/s and would result in 0.05 m freeboard during the Regional Storm event. The 6 m by 1 m opening has been considered adequate for meeting all criteria with the exception of the Region's criteria, and therefore should be considered by the Region. The 6 m span is also 6 times the bankfull width determined by Parish Geomorphic and the recommended span to meet stream morphology requirements.

Table 6.16 Design Flow Return Period for Bridges and Culverts – Standard Road Classifications (Source: MTO Highway Drainage Design Standard)

Functional Road Classification	Return Period of Design Flows (Year)1,2,3		Check Flow for Scour
	Total Span less than or equal to 6.0 m	Total Span greater than 6.0 m	
Freeway, Urban Arterial	50	100	130% of 100 year
Rural Arterial, Collector Road	25	50	115% of 100 year
Local Road	10	25	100% of 100 year

Note: The listed design flow applies to roads under the jurisdiction of the Ministry of Transportation.
The Fish Passage Design Flow for culverts is defined in standard WC-12 Fish Passage Requirements Through Culverts. Sometimes referred to as Normal Design Flow

The culvert at Outlet E is a 0.96 m by 0.90 m open footing culvert. The culvert is 2.82 m below the centre line of road at the upstream side. The future Regional Storm and 100 year peak flows are 0.82 and 2.39 m^3/s respectively. The culvert would provide 0.92 m of freeboard to the centreline of road during the Regional Storm and therefore provides adequate flow capacity and does not need to replaced or supplemented.

Huttonville Creek (Outlet F, includes E1 and E2) Stations 12+400 to 13+452

- ***Quality Management***

The future development of this segment of Bovaird Drive is located within the limits of the completed Huttonville and Fletcher's Creeks Subwatershed Study. The proposed road section east of Mississauga Road would increase the impervious area from approximately 2.166 ha to 4.674 ha. The existing roadway runoff currently receives no formal treatment, thus 2.508 ha of additional pavement would require formal treatment under proposed conditions. The Huttonville Creek and Fletcher's Creek Subwatershed Study, in support of the proposed Mount Pleasant lands, recommends that no water quality impact occur from proposed development and this would include the proposed Bovaird Drive widening. It has been proposed in the subwatershed study that a minimum of an Enhanced level of water quality treatment be provided within Mount Pleasant lands and the residual contaminant loading be treated using stormwater quality retrofits within the City of Brampton. A Stormwater Quality Retrofit Study that had commenced in April 2012 will establish the retrofit sites required to reduce the Mount Pleasant contaminant loadings to zero impact. Based on the foregoing, the Bovaird Drive improvements require a minimum Enhanced level of water quality treatment and the remaining loadings will be treated in stormwater quality retrofits somewhere within the City limits as yet to be determined by the City of Brampton. Discussions between the City of Brampton and the Region of Peel will be required during the retrofit study to address the difference between the enhanced level of water quality treatment and zero impacts.

Outlets E1 and E2

The small section of Bovaird Drive west of Mississauga Road draining to Huttonville Creek consists of Outlets E2 and E1. E2 is currently the 0.71 ha area drained by the north ditch and outlets to the upstream side of the Huttonville Creek crossing of Bovaird Drive. E1 is currently the 0.58 ha area on the south side of Bovaird Drive which discharges to Huttonville Creek south of Bovaird Drive. It is proposed that E2 and E1 will be combined into one area using a storm sewer system that will discharge to Huttonville Creek on the south side of Bovaird Drive. The combined 1.29 ha drainage area of E2 and E1 has an existing impervious coverage of 43% which will increase to 78.3% or 1.01 ha.

The combined 1.29 drainage area of E2 and E1 would have an increase in impervious coverage of 35% or 0.61 ha. This area drains to Huttonville Creek from west of Mississauga Road and contains the Apple Factory store and Petro Canada gas station. For stormwater quality there are limited options as existing development is located on either side of the right-of-way. Three stormwater quality management options have been assessed:

- Stormwater quality management facility treating Bovaird Drive only;
- Stormwater quality management facility located outside of the right-of-way; and
- Oil/grit chamber treatment train.

The requirements for an Enhanced level wet pond are provided within Table 6.17. Clearly, the drainage areas are small, which results in wet pond volumes that are not practical. Unless the water quality requirements could be allocated to another stormwater management facility, such as for the east side of Mississauga Road or a future facility west of Mississauga Road, this alternative is not considered viable.

Table 6.17 Stormwater Quality Management Facility Sizing Outlets E1 and E2

Outlet	Total Drainage Area (ha)[1]	Right-of-way Drainage Area	Impervious Area Increase (ha)	Increase in Impervious %	Permanent Pool m3	Extended Detention m3
E1	NA	0.58	0.26	45	73	23
E2	NA	0.71	0.35	49	96	28
Totals	NA	1.29	0.61	47	169	51

1. Part of Huttonville Creek

Based on the small (1.29 ha) roadway drainage area contributing to the storm sewer outlet, a stormwater management facility is not feasible. An oil/grit chamber equivalent to STC750 or equivalent would provide an Enhanced level of water quality treatment. As an oil/grit chamber is considered to only provide a Normal level of water quality control by approval agencies, a treatment train approach would be required. Vegetative filter strips could be used to provide further stormwater quality treatment. The location of the filter strips would have to be within the creek block based on the storm sewer outlet grades, with details determined at the detail design stage.

The stormwater quality for Mississauga Road south of the West Huttonville Creek crossing and north of Bovaird Drive, could either be treated within an oil/grit chamber just south of the creek, or could be integrated into a future stormwater management facility that would be constructed as part of Heritage Heights. As part of the on-going Mississauga Class EA, the Region of Peel is considering two (2) separate oil/ grit separators, one south of Bovaird Drive and one north of Bovaird Drive, both discharging to the Huttonville Creek. Should oil/grit separators be the water quality measure used in final design of the Mississauga Road and Bovaird Drive intersection, the oil grit separators recommended for Drainage Outlets E1 and E2 should be integrated with the proposed oil/grit separators for Mississauga Road. To improve upon the water quality treatment provided by oil/grit separators, filter strips could be constructed at the outlets of each separator unit.

It is assumed that due to constraints of existing development that there would be limited room for a stormwater management facility south of the West Huttonville Creek, suggesting an oil/grit chamber as the preferred solution.

Outlet F

This section of roadway is proposed to be urbanized with curb and gutter, without ditches within the permanent right-of-way. Several options have been assessed for stormwater quality including a stormwater management facility providing quality treatment for the proposed Regional right-of-way, stormwater management combined with future development lands and oil/grit chambers.

The section of roadway draining to Outlet F would be approximately 2.69 Ha with an increase in impervious area of 0.95 ha or 35.3 %.

The requirements for an Enhanced level wet pond for the increase in impervious coverage are provided within Table 6.18. The drainage area of 2.69 Ha is below the minimum threshold of 5 Ha specified for a stand-alone SWM facility, which results in wet pond volumes that are not practical. However, there is a possibility that 1.28 Ha of the 2.69 Ha contributing drainage area could be diverted to the Bluegrass Helport lands planned stormwater management facility, Pond H1. Discussions have commenced to drain a 1.28 Ha portion of the contributing drainage area for Outlet F to Pond H1. At the time of writing this report, discussions are ongoing. The 1.28 Ha drainage area would have a 95% impervious ratio, therefore 1.22 ha (+/-) of impervious area would have stormwater quality treatment in Pond 1. The 1.22 Ha would be above the 0.95 Ha area increase in proposed pavement for Outlet F, therefore Pond H1 would provide greater than an Enhanced level of water quality treatment (ref. Table 6.18). The detailed design team should verify if Pond H1 is approved to accept the additional drainage area.

Table 6.18 Stormwater Quality Management Facility Sizing – Outlet F

Outlet	Total Drainage Area (ha)	Right-of-way Drainage Area	Impervious Area Increase (ha)	Increase in Impervious %	Permanent Pool m3	Extended Detention m3
F (Bovaird Drive)	924.70	2.69	0.78	45	336	108
Pond H1	1.28	1.28	1.22[1]	95%	349	140

1 All right-of-way pavement to be considered

As a third option, oil/grit chambers could be considered. The drainage area to Outlet F is 2.69 ha. An oil/grit chamber (STC4000^{TM} or equivalent has been sized for the 2.69 ha drainage area within Table 6.19. As oil/grit chambers are considered to only provide a Normal level of water quality control by approval agencies, a treatment train approach would be required, as such; vegetative filter strips could be used to provide further stormwater quality treatment. The location of the filter strips would have to be within the creek block based on the storm sewer outlet grades, with details determined at the detail design stage.

Table 6.19 Oil/Grit Chamber Sizing Outlet F				
Outlet	**Right-of-way Drainage Area**	**Increase in Impervious %**	**StormceptorTM Model (Or Equivalent)**	**TSS Removal (%)**
F (Bovaird Drive)	2.69	435	STC4000	80

The most effective and economic stormwater quality treatment would result from using the proposed stormwater management facility within the Bluegrass Helport lands, south of the Region's right-of-way. Should Bovaird Drive be constructed ahead the ultimate stormwater management facility, interim water quality controls would have to be implemented such as the oil/grit chamber(s), vegetative filter strip approach or an interim stormwater management facility could be constructed in the Bluegrass Helport lands. To use the proposed stormwater management facility within the Bluegrass Helport lands an agreement between the land owners, City of Brampton and the Region would be required.

- ***Quantity Management***

Peak Flows

Outlets E1 and E2

The increase in peak flows resulting from the additional 0.26 ha and 0.35 ha of pavement for Outlets E1 and E2 would result in a 0.04 m^3/s and 0.05 m^3/s increase in the 100 year storm peak flows. Table 6.20 provides the peak flow comparison for existing and future conditions for the 100 year and Regional Storm based on the Bovaird Drive right-of-way drainage area.

Table 6.20 Peak Flow Comparison (m^3/s) Outlets E1 and E2								
Culvert	**Ex Drainage Area (ha)**	**Fut Drainage Area (ha)**	**100 Year**			**Regional**		
			Existing	**Future**	**Difference**	**Existing**	**Future**	**Difference**
E1	0.58	0.58	0.16	0.20	0.04	0.08	0.08	0.00
E2	0.71	0.71	0.17	0.22	0.05	0.09	0.10	0.00

Stormwater quantity management facilities have been sized for the 100 year storm event to maintain existing peak flows using the Huttonville and Fletchers Creek Subwatershed Study unitary rates for conventional stormwater management. Based on the 100 year storm quantity control volume requirement of 732 m^3 and the lack of land within Region's right-of-way, the volume should be incorporated into the stormwater management requirements for future Heritage Heights development within the West Huttonville Creek drainage area, adjacent to the Mount Pleasant lands.

Table 6.21 Stormwater Quantity Requirements (Drainage Outlets E1 and E2)								
Drainage Outlet	Drainage Area/ Increase In Impervious Area (ha)	Erosion Control		25 Year		100 Year		Total Volume (m^3)
		Unitary Storage Volume (m^3/imp ha)	Unitary Discharge (m^3/imp ha)	Unitary Storage Volume (m^3/imp ha)	Unitary Discharge (m^3/s /ha)	Unitary Storage Volume (m^3/imp ha)	Unitary Discharge (m^3/s /ha)	
E1	0.58/ 0.26	325	0.00052	675	0.0068	1200	0.025	312
E2	0.71/ 0.35	325	0.00052	675	0.0068	1200	0.025	420

Outlet F

Table 6.22 provides the peak flow comparison for existing and future conditions for the 100 year and Regional Storm based on the area for Creditview Road/James Potter Road contributing to Bovaird Drive.

Table 6.22 Peak Flow Comparison (cms)*1								
Culvert	Existing Drainage Area (ha)	Future Drainage Area (ha)	100 Year			Regional		
			Existing	Future	Difference	Existing	Future	Difference
F	2.69	2.69	0.68	0.81	0.13	0.36	0.38	0.02

*1. Based on right-of-way drainage only

Stormwater quantity management facilities have been sized for the 100 year storm event to maintain existing peak flows using the Huttonville and Fletchers Creek Subwatershed Study unitary rates. Based on the 0.78 ha increase in impervious coverage to Outlet F, the 100 year storm quantity control volume requirement would be 780 m^3 based on the Mount Pleasant Subwatershed Study 100 year unitary storage requirement of 1000 m^3/imp.ha (ref. Table 6.23). Due to the lack of land within the Region's right-of-way, the volume should be incorporated into the stormwater management requirements for the future management facility to be located at the north east corner of Huttonville Creek and Bovaird Drive. As discussed in the stormwater quality section for Outlet F, and of the time of this report, the planned stormwater management facility north of Bovaird Drive just east of Mississauga Road, has been proposed just south of the CNR tracks, therefore drainage from Bovaird Drive could not drain to the facility.

A second possibility is the 100 year drainage from 1.28 ha of Bovaird Drive could be captured with additional inlets and conveyed to the planned Bluegrass Helport H1 stormwater management facility within an oversized 100 year storm sewer. The 100 year unitary storage rate would be established based on criteria for the lands on the south side of Bovaird Drive. At the time of writing this report, discussions are ongoing as to the incorporation of the quantity controls into the H1 stormwater management facility.

Table 6.23 Stormwater Quantity Requirements (Drainage Outlet F)								
Drainage Outlet	Drainage Area/ Increase In Impervious Area (ha)	Erosion Control		25 Year		100 Year		Total Volume (m3)
		Unitary Storage Volume (m3/imp ha)	Unitary Discharge (m3/imp ha)	Unitary Storage Volume (m3/imp ha)	Unitary Discharge (m^3/s /ha)	Unitary Storage Volume (m3/imp ha)	Unitary Discharge (m^3/s /ha)	
F	2.69/ 0.78	200	0.00052	550	0.0075	1000	0.025	780

Hydraulic Crossings

Outlet F

The existing Huttonville Creek culvert is a 5.53 m by 1.65 m by 60.0 m open box culvert. The culvert has a flow capacity of 15.4 m^3/s (100 year storm +/-), as the Regional Storm with a peak flow (CVC'S GAWSER hydrologic model) of 98.03 m^3/s overtops the culvert by more than 1 m. The existing culvert has to be replaced based on the ultimate alignment and width of both Mississauga Road and Bovaird Drive. The preferred design is to replace the existing culvert with a 3.66m x 14.6m x 83.0m open-footing precast concrete arch culvert. The culvert sizing has been determined through discussions with CVC and MNR and by the culvert hydraulics. The proposed culvert would have a freeboard of 1.65 m+/- for the Regional Storm.

Outlet E1 and E2

Drainage outlets for E1 and E2 are currently both CSPs with diameters of 0.58 m and 0.71 m respectively. Both culverts would be eliminated and replaced with storm sewer when Bovaird Drive and Mississauga Road are urbanized.

Outlet G (Sta. 13+600 to Sta. 14+250)

- ***Quantity and Quality Management and Hydraulics***

The future development of this segment of Bovaird Drive would increase the impervious area by 0.35 ha. The existing roadway runoff currently receives no formal treatment, thus the additional pavement would require Enhanced formal treatment. This Section of the roadway would drain south to stormwater management Facility 'H' as per the Sub-areas 1 & 3 (Credit Valley Secondary Plan Area Environmental Implementation Report, March 2005). The stormwater management facility has been designed to incorporate this road section and provide stormwater quantity and quality controls before discharging to Huttonville Creek.

The existing 1.0 m by 0.90 m box culvert under Bovaird Drive would be replaced by the storm sewer system which would connect to the storm sewer on the south leg of Creditview Road/James Potter Road.

Outlet G1 and H (Sta. 13+600 to Sta. 14+250)

- ***Quantity and Quality Management and Hydraulics***

The future development of this segment of Bovaird Drive would increase the impervious area by 0.49 ha. Both the existing and the ultimate roadway runoff have been planned to receive stormwater quantity and quality control through the existing Creview Subdivision stormwater management located south of Bovaird Drive.

Outlet G1 is currently serviced by the existing storm sewer system located at the intersection of Bovaird Drive and Ashby Field Road. The existing 0.90 by 0.90 m box culvert serving Outlet H would be replaced by the proposed storm sewer system.

Outlet I (Sta. 14+250 to Sta. 15+100)

- ***Quantity and Quality Management***

The future development of this segment of Bovaird Drive located east of the CNR overpass centreline would increase the impervious area by 0.20 ha. Both the existing and the ultimate roadway runoff have been planned to receive stormwater quantity and quality control through the existing stormwater management pond located south of Bovaird Drive and north of the CNR tracks and adjacent to Dunlop Court as part of the Mattamy South Fletcher's Meadow, 2005 Ozner/ Mattamy Area 44 South Stormwater Management Facility.

Table 6.24 below summarizes the above recommendations in a tabular format. Confirmation of the recommendations with a full stormwater management report specific to the detailed design process is required to confirm the conclusions. Figure 6.8 schematically shows the proposed drainage paths and quality/quantity control measures.

Table 6.24 Summary of Recommendations

Outlet	Quantity Management	Quality Management	Hydraulic Crossing
A	• Enhanced grass swale	• Increase in peak flows are insignificant	• Overtopping occurs for both Regional and 100 year events • Improvement is deferred to a separate detailed design project
B	• Enhanced grass swale	• Increase in peak flows are insignificant	• 1.52 m of freeboard during the Regional event
C	• Utilization of a stormwater management facility within the Heritage Heights	• Stormwater quality controls are required on either side of the outlet	• Consists of two crossings, one under Bovaird Drive, and a second 35 m to the south

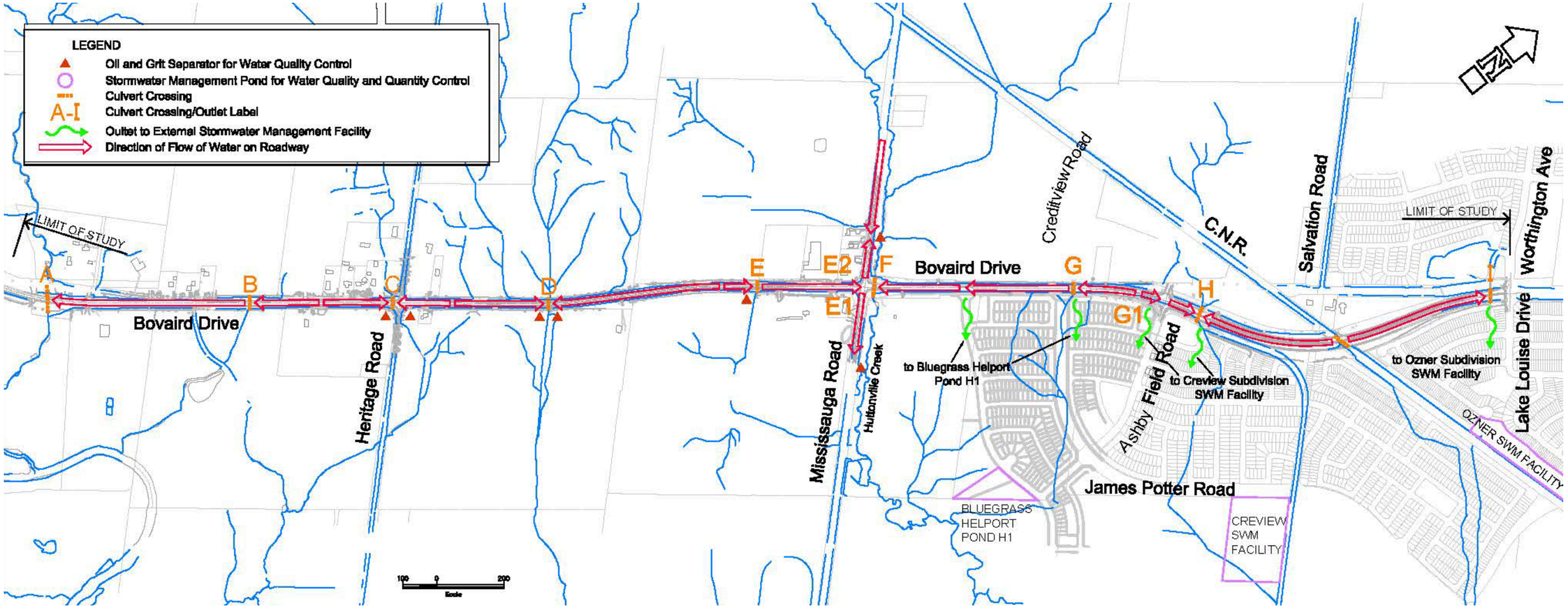
Table 6.24 Summary of Recommendations

Outlet	Quantity Management	Quality Management	Hydraulic Crossing
	development, with oil/grit separators used as a temporary interim solution	• Facilities will be sized for the 100 year storm event to maintain existing peak flows using the 12 hour SCS storm distribution • Active volume within the potential stormwater management facility is below 165 m3	crossing Heritage Road • Both crossings overtop during the Regional event • A 3.66m span x 1.22 m high open footing con/span precast concrete arch culvert is proposed for each crossing
D	• Utilization of a stormwater management facility within the Heritage Heights development, with oil/grit separators used as a temporary interim solution	• Stormwater quality controls are required on either side of the outlet • Facilities will be sized for the 100 year storm event to maintain existing peak flows using the 12 hour SCS storm distribution • Active volume within the potential stormwater management facility is below 165 m3	• The crossing overtops during the Regional event • A 6 m span x 1 m high open footing is proposed to replace the existing crossing
E	• Utilization of a stormwater management facility within the Heritage Heights development, with oil/grit separators used as a temporary interim solution	• Stormwater quality controls are required on either side of the outlet • Facilities will be sized for the 100 year storm event to maintain existing peak flows using the 12 hour SCS storm distribution • Active volume within the potential stormwater management facility is below 156 m3	• 0.92 m of freeboard during the Regional event
F	• Utilization of a stormwater management facility Pond H1 within the Bluegrass Helport development for 1.28 Ha of the drainage area (to be confirmed during detailed design),	• Quantity control should be incorporated into the design of Pond H1	• The existing culvert overtops during the Regional event • A 3.66 m x 14.6 m x 83.0 m is proposed to allow for a balance to be achieved with all criteria and stakeholder interests, while fulfilling the needs of the CVC and the MNR
G	• Utilize drainage path to Pond H1 within the Bluegrass Helport development	• Utilize drainage path to Pond H1 within the Bluegrass Helport development	• The existing 1.0 m x 0.90 m box culvert under Bovaird Drive would be replaced by the proposed storm sewer system
H	• Utilize drainage path to Creview Subdivision Stormwater Management	• Utilize drainage path to Creview Subdivision Stormwater Management	• The existing 0.90m x 0.90m box culvert would be replaced by the proposed storm sewer

Table 6.24 Summary of Recommendations

Outlet	Quantity Management	Quality Management	Hydraulic Crossing
	located south of Bovaird Drive	located south of Bovaird Drive	
I	• Utilize drainage path to Ozner/Mattamy Area 44 South Stormwater Management Facility	• Utilize drainage path to Ozner/Mattamy Area 44 South Stormwater Management Facility	• The existing crossing will be maintained

Figure 6.8 – Schematic Drainage Layout



6.1.10 Utilities

Utility companies were contacted at the commencement of the study and invited to participate. A response was received from Hydro One Brampton, Bell Canada, Enbridge Gas, and TransCanada Pipelines.

Based on preliminary review, relocation or protection of various utilities will be required, as follows:

Hydro One Brampton

- Relocation of overhead hydro line along the north side of Bovaird Drive from 100 m west of Ashby Field Road to 300m west of Heritage Road
- Protection of recently relocated poles on the west side of Mississauga Road
- Relocation of overhead hydro on the east side of Heritage Road

Bell

- Relocation of buried cable and pedestals on the west side of Mississauga Road
- Relocation of buried cable and pedestals on Bovaird Drive just west of Mississauga Road
- Relocation of buried cable and pedestals within proposed grade change limits at the Bovaird Drive and Heritage Road intersection

Enbridge

- Relocation of local distribution line at intersections of Bovaird Drive with Heritage Road and Mississauga Road
- Possible relocation where widening west of Mississauga Road, towards the proposed property line, as access for maintenance will be more difficult if it remains at the current location.

Pipeline Crossings

Existing transmission pipelines exist at the following locations:

- TransCanada Pipeline Stn. 12+166
- Enbridge Gas Stn. 12+160

No direct conflict with the roadway construction will occur with either of the pipeline crossings. However, ground cover over the pipelines could potentially change, subject to the final vertical

alignment, and protection may be required. Storm sewer is proposed to cross over the pipelines at each location. Any potential conflict between the storm sewer and the pipelines can be dealt with by modification of the storm sewer profile. Verification of location in the field, preparation of pipeline crossing drawings, and submission of crossing applications will be required at the detail design stage for all pipeline crossings.

Correspondence from TransCanada Pipelines has been received in regards to the Parkway Pipeline Project. The Parkway Pipeline Project is in the planning stages for twinning of an existing gas transmission pipeline through the City of Brampton and Vaughan. The project will cross Bovaird Drive immediately adjacent to the existing crossing at Sta. 12 + 166 with a 1.0 m diameter high pressure natural gas pipe. The Region of Peel should continue to review the status of the project, and coordinate the elevation of the new crossing with the proposed widening of Bovaird Drive.

6.1.11 Property Requirements

Purchase of property will be required along both sides of Bovaird Drive and the intersecting side roads throughout the project limits. Preliminary property requirements are shown on Sheets 1 – 18 – Plan and Profile Drawings. Property requirements will be confirmed during the detail design phase. Table 6.25 summarizes the property requirements.

Table 6.25 Property Requirements

No.	Type	Location	Area (m2)
1	Future Greenspace	2719 Bovaird Drive	398
2	Rural Residential	2740 Bovaird Drive	153
3	Rural Residential	2716 Bovaird Drive	319
4	Rural Residential	2702 Bovaird Drive	221
5	Future Residential	West of Heritage Road (1575690 Ontario Ltd)	346
6	Institutional	2594 Bovaird Drive	648
7	Agricultural	2591 Bovaird Drive	2323
8	Rural Residential	2578 Bovaird Drive	227
9	Rural Residential	2556 Bovaird Drive	220
10	Rural Residential	2538 Bovaird Drive	220
11	Rural Residential	2534 Bovaird Drive	1286
12	Future Residential	East of Heritage Road (1166802 Ontario Inc.)	6311
13	Future Residential	East of Heritage Road (Amber Forest Land Development Corp.)	4509

Table 6.25 Property Requirements			
No.	**Type**	**Location**	**Area (m2)**
14	Rural Residential	2475 Bovaird Drive	246
15	Rural Residential	East of Heritage Road (Snyder)	204
16	Future Residential	West of Mississauga Road (Osmington)	4344
17	Future Residential	West of Mississauga Road (Calldron Gas Bars Ltd.)	5584
18	Future Institutional	West of Mississauga Road (Trustees of Norval United Church)	386
19	Commercial	2036 Bovaird Drive	837
20	Commercial	10020 Mississauga Road	2208
21	Residential	10042 Mississauga Road	715
22	Residential	10054 Mississauga Road	552
23*	Future Residential	East of Mississauga Road (Mattamy Credit River Ltd.)	9395
24	Future Institutional	East of Mississauga Road (Corp of City of Brampton)	233
25	Future Residential	East of Mississauga Road (Helport Developments)	686
		TOTAL	**42571**

6.1.12 Permits

Agency approvals are required before construction can begin. They are summarized in Table 6.26.

Table 6.26 Required Agency Approvals	
Agency	**Approval Required**
Ministry of the Environment	Approval of Sewage Works (C of A), Permit To Take Water (if required)
TransCanada Pipeline	Pipeline Crossing Agreement
Enbridge	Pipeline Crossing Agreement
Credit Valley Conservation	Permit for Approval for culvert extension/replacement, work in regulated area, and storm outlets
Ministry of Natural Resources	Permit for Approval for Activities that may affect Species or Habitat protected under the Endangered Species Act (17C) Possible Fisheries Act Authorization
Canadian National Railway	Structure Crossing Agreement

6.1.13 Traffic Signals and Illumination

Traffic signals will be replaced at all intersections along Bovaird Drive.

Full illumination will be provided along Bovaird Drive within the limits of construction.

6.1.14 Structural Design

Concrete Culverts

Culvert 'A'
The existing 1.20 m x 2.80 m concrete box culvert has been determined by the drainage study to be insufficient for large storm events. Also, the culvert is considered a barrier to fish passage, and the geomorphological study recommends the span be increased to 12 m to convey the bankfull flow and minimize potential impacts on stream morphology. However, no roadway widening is required at this location and therefore, modification to this culvert is not triggered by this study.

The Heritage Heights Community Secondary Plan, being completed by the City of Brampton, will be investigating the drainage area upstream of this culvert. As a result, potential modifications to, or reconstruction of the culvert to address the identified deficiencies will be deferred to a separate project where the ultimate configuration of this community and its impact on the watercourse can be determined.

Replacement of this culvert is included in the cost estimate to fulfill budget planning needs. The Region has also committed to a detailed inspection and rehabilitation of the inlet portion of the structure to address maintenance and structural concerns. Further commitment to replacement will be deferred according to the procedure noted above.

Culvert 'B'
The existing 0.95 m x 0.68 m concrete box culvert is deficient structurally, and a more detailed inspection is recommended. However, no extension of this culvert is required to accommodate the proposed configuration of Bovaird Drive.

Culvert 'C'
There are two culverts grouped into this crossing, one crossing under Bovaird Drive, and another crossing Heritage Road. The existing 1.30 m x 0.90 m concrete structure under Bovaird Drive is considered adequate structurally. The older 500 mm diameter CSP portion of this crossing should be removed and replaced with a concrete box structure.

The geomorphology study found that the crossing should be a minimum of 2.3 m wide based on the meander amplitudes measured upstream. Given that the majority of the culvert is being replaced and the deficiency identified in the geomorphologic study, it is recommended that

Culvert 'C' be replaced with a 3.66 m span x 1.22 m high open footing con/span precast arch concrete structure.

The continuation of this crossing south of Bovaird Drive under Heritage Road is an existing 900 mm diameter CSP. The crossing is approximately 35 m south of the Bovaird Drive crossing. Given the small distance between the two crossings, it is assumed that the recommendations made for the Bovaird Drive crossing also applies to the Heritage Road crossing. As a result, replacement of this portion of the crossing with a 3.66 m span x 1.22 m high open footing con/span arch concrete structure is recommended.

Additionally, the 35 m length of the drainage feature between the two crossings is defined as a fish habitat with an overall sensitivity rating of medium. This feature is required to be designed as a naturalized channel during detailed design. An approximate alignment has been determined for the purposes of securing the necessary property for this work.

Culvert 'D'

The existing 1.25 m x 0.80 m open-footing concrete culvert has been determined by the drainage study to be insufficient for large storm events. The crossing is required to be replaced by a minimum of 1 m x 6 m open-footing culvert. A permit from Credit Valley Conservation will be required for this culvert.

Culvert 'E'

The existing 0.90 m x 1.10 m open-footing concrete culvert is adequate structurally, and should be extended with a similar configuration to accommodate the wider platform.

Huttonville Creek Crossing (Culvert 'F')

The proposed 3.66 m x 14.6 m x 83.0 m concrete arch culvert was chosen to satisfy CVC and MNR constraints, while addressing the needs for the Region to improve this culvert. Integration of the structure with the bio-engineered slope is required during the detailed design phase.

This structure will be subject to review and approval by MNR under the Endangered Species Act. Conversation with MNR should proceed early in the detailed design phase, to ensure timeframes for construction of this structure are maintained.

Three other smaller crossings of Mississauga Road are included in group 'F'. These crossings will be extended east under the 4 lane interim project. Extension westward will be required for the ultimate 6 lane widening of Mississauga Road.

Culvert 'G'

Major development is proposed adjacent to this culvert. Coordination with the servicing plan for the development should be undertaken during detailed design to confirm required modifications.

Culvert 'H'

The existing 0.94 m x 0.92 m concrete box culvert is adequate structurally, and should be extended with a similar configuration to accommodate the wider platform.

Culvert 'I'

The existing 2.25 m diameter elliptical concrete culvert is adequate structurally. Extension is not required to accommodate the proposed configuration of Bovaird Drive.

Westbound CN Structure

The preferred option for the CNR Structure is construction of a new separate three lane structure (ref. Figure 6.9) as this option is the only option that addresses all objectives while providing adequate sight lines for a 90 kph design speed.

The estimated construction cost of Option 2 is $6.4M.

A 2 m gap is provided between the EB and WB structures. The purpose of the gap is to provide continuous air movement through the gap, minimizing the opportunity of moisture build up and increase the durability of the structure. This gap also provides inspection from a bridge master to inspect the soffit, bearings and piers from the roadway level.

Traffic staging will be required. Traffic will be diverted from the existing WBL structure to the north half of the existing EBL structure. The EBL will be reduced to 2 lanes EB along the south half of the structure, allowing for 2 lanes WB lanes on the EBL structure. Crossovers will need to be constructed across the median on the approaches to the structure to facilitate this temporary traffic arrangement.

Sidewalk traffic will be diverted at the intersections immediately east and west of the structure, namely Lake Louise Boulevard/Worthington Avenue to 1 Ashby Field Road.

The **vertical clearance** under the structure is 7.4m to accommodate the electrification for GO Trains.

Shoring Protection will be designed to retain the Ultimate WBL roadway along the median between the two structures.

Footings will be spread footings similar to the EBL structure constructed in 2007; concrete strength shall be 50 MPa. A temporary protection system will be required for the pier footing construction. The protection system must be designed to accommodate railway loading.

Piers will be similar to the EBL structure, completed with 5 circular pier shafts, and a concrete cap. Concrete strength shall be High Performance Concrete (HPC-50MPa).

Pier Protection will be provided to protect the piers from a train derailment. This protection will be provided in accordance with CN's Standard K1U-10.2m. Concrete strength shall be HPC (50 MPa).

Abutments will be supported on deep foundations, similar to the EBL structure. The abutments will be conventional abutments, with an RRS wing wall with a concrete barrier on the wall. The barrier will be design for a performance level PL-2. Concrete strength shall be HPC (50 MPa).

An **RSS** wall will be required to be constructed in front of the east abutment to allow for the fourth track under this structure.

Bearings will be elastomeric bearings designed to accommodate both vertical and horizontal forces and horizontal deformation caused by thermal and applied forces.

Girders will be CPCI 1200, in accordance with the MTO's standard drawing SS107-2. The girders will have positive moment connections over the piers. Concrete strength shall be 50MPa.

Concrete Deck will consist of precast concrete panels, in accordance with MTO's standard SS109-40, SS109-41 for the lower section and conventional HPC for the overhang sections and the top of the deck. The precast concrete panels will speed up construction and reduce the time required for Railway flagging and overall cost of the project. Reinforcing steel will be either stainless steel, GFRP or a combination of the two for the top mat and non-coated steel for the lower mat.

Drip edge along the edge of the structures shall be in accordance with the MTO's OPSD 3390.100

Sidewalk will be constructed with HPC and GFRP reinforcing.

Light Standard will be supported on Light Standard bases as shown on OPSD-3904.040

Barrier Walls will be adjacent to the EBL structure and between the travelled roadway and the sidewalk will be constructed in accordance with SS110-58 with GFRP reinforcing.

North Barrier will be 300mm wide parapet wall with GFRP reinforcing and utility ducts. Aesthetic details to replicate the details south barrier wall on the EBL Structure will be incorporated on this parapet wall as well. The Parapet Wall will be constructed in accordance with MTO's Structural Drawings SS110-59 and the railing will be in accordance with SS110-21.

Expansion Joints will be required at the abutments as the skew angle is too large to consider integral abutments for this project. The expansion joints will be in accordance with MTO's

standard drawings SS113-10, SS113-11, SS113-12 and SS113-14. This joint provides for a Strip Seal Expansion Joint - Type "A". The joint also directs water off the bridge into a catch basin and down spout.

The asphalt wearing surface and waterproofing system should be with a new wearing surface and waterproofing (90 mm – Total).

Approach Slab The approach will be in accordance with MTO's SS116-1. Concrete shall be HPC.

Asphalt wearing surface and waterproofing system (90 mm – Total) proposed is in accordance with MTO's standards.

Shoring Protection will be designed to retain the Ultimate WBL roadway in the median between the two structures.

6.1.15 Construction Staging and Phasing

The proposed construction of the westbound CN structure will require traffic to be diverted from the existing WBL structure to the north half of the existing EBL structure. The EBL will be reduced to 2 lanes EB, allowing for 2 lanes WB on the EBL structure. Crossovers will need to be constructed across the existing median. Sidewalk traffic will be diverted at the intersections immediately east and west of the structure, namely from Lake Louise Boulevard/Worthington Avenue to Ashby Field Road.

Construction of the Huttonville Creek Culvert will require staging. The culvert will be constructed in two or three stages, with the north or south half of the culvert under construction while traffic is diverted to the other half. The culvert will likely be constructed while maintaining the existing channel and culvert.

The horizontal and vertical profile of Bovaird Drive is largely maintained for the length of the project. Widening can take place while maintaining traffic on the existing platform. Traffic would then shift to the new platform, allowing for rehabilitation of the existing platform, and construction of the raised median.

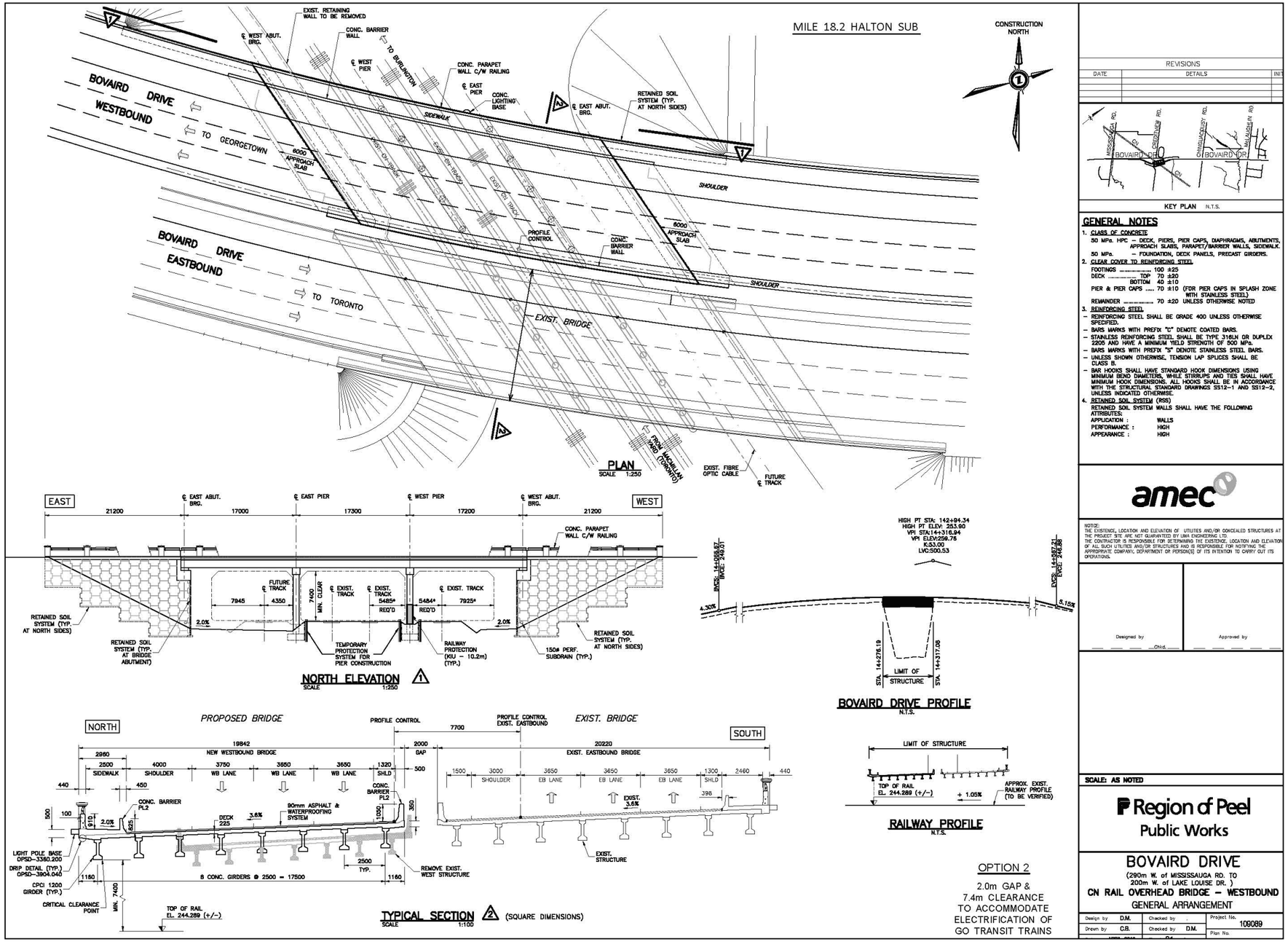
The exception to this occurs at the intersection of Bovaird Drive and Heritage Road, where significant change in the vertical profile is proposed. Locations where alignment/grade change is required will require additional measures such as lane diversions or temporary widening to allow for construction to proceed. Further investigation of staging should be undertaken during detailed design.

Some elements required for the ultimate width construction of Mississauga Road at Bovaird Drive will be provided by the interim 4 lane widening contract at the same location. Components such as retaining walls, bus bays, boulevards, crown location, etc. are proposed to be included under the interim project. The detailed design team for the interim contract will need to account for these elements in their design.

6.1.16 Preliminary Cost Estimate

The preliminary cost estimate for this project, not including utility relocations and land acquisition, is provided in Appendix 'R' - Cost Estimate.

Figure 6.9 – General Arrangement Drawing



6.2 Environmental Issues and Commitments

6.2.1 Land Use

The proposed reconstruction and widening of Bovaird Drive will result in the roadway and associated traffic being brought closer to existing residential and rural land uses. The following impacts to property have been documented within the project limits, and will be reviewed during the detail design process:

- Purchase of property along both sides of Bovaird Drive: Purchase will be completed in accordance with Region policy.
- Driveway reconstruction/grading (both asphalt and gravel): Driveways will be reconstructed to match existing materials.
- Impact to landscape features (fencing, gates and retaining walls): Landscape features will be modified and/or reconstructed as indicated on the preliminary design drawings.
- Impact to or removal of trees and residential landscape planting at various properties along Bovaird Drive: A tree preservation plan and landscape planting plan will be prepared in detail design.
- Modification to the east entrance to the Petro Canada Gas Station owned by Calldron Gas Bars Ltd. Changes in road elevation and cross section elements will be addressed in the interim 4-lane design of Mississauga Road. The detailed design team for the ultimate configuration must review assumptions made by the interim widening and ensure they are carried forward during the ultimate widening.
- Reduction of parking for the Apple Factory on the northwest quadrant of the Bovaird Drive and Mississauga Road intersections, including removal of residential structure associated with this property.
- Coordination with development plans (Mount Pleasant Secondary Block Plan, Proposed school on southeast corner of Bovaird Drive and Mississauga Road, Huttonville North, Heritage Heights, and Osmington)
- Coordination with detailed design for Creditview Road/James Potter Road

6.2.2 Air Quality

An Air Quality Assessment Report has been prepared in support of the Bovaird Drive Class EA (ref. Appendix 'M' - Air Assessment). The findings of the air quality study were as follows:

- The potential effect associated with air emissions is an increase in the airborne concentrations of the key pollutants NOx, PM2.5, PM10, CO, and SO2, in the vicinity of the project, with the potential to impact air quality;

- The incremental (project) effects for PM2.5 and PM10 were predicted to be below the respective ambient air quality criteria, and lower than the existing background concentrations for these parameters;
- The incremental (project) effects for CO were predicted to be well below the respective ambient air quality criteria;
- The highest predicted NOx concentrations (1-hour averaging time) were found to exceed the ambient air quality criteria within the bounds of the intersection and the immediate vicinity, but decrease to below the AAQC within approximately 10 metres or less of the roadside;
- The predicted effects for PM10, and CO were highest for the 2031 scenario without the NSTC, and for PM2.5 the effects were highest when the NSTC and the new Creditview Road/James Potter Road were considered;
- The predicted effects for NOx were highest for the 2011 scenario, as the NOx emissions reductions achieved as older vehicles are removed from service were significant and off-set the increased traffic volumes for 2031. Although the emission factors for the other target pollutants (PM2.5, PM10, CO, SO2) also decreased over time, the reductions were not as significant as for NOx and the increased traffic volumes resulted in higher effects on air quality in 2021 and 2031;
- The cumulative effects of the roadway PM2.5, PM10, CO, and SO2 emissions within the study area and the background concentrations were below the respective ambient air quality criteria for all averaging times under each scenario;
- The cumulative effects of the roadway NOx emissions within the study area and the background concentrations were found to be slightly higher than the respective ambient air quality criteria for the 1-hour averaging times at receptors located on the roadway itself or within close proximity to an intersection.

Based upon these findings, the future traffic volumes along Bovaird Drive are not expected to have a significant negative cumulative effect on local air quality.

6.2.3 Traffic Noise

AMEC completed a Traffic Noise Assessment for the proposed widening of Bovaird Drive (ref. Appendix 'L' – Traffic Noise Study).

Sound levels were predicted to exceed the Region's 60 dBA noise barrier retrofit criteria at (11) of nineteen (19) Noise Sensitive Areas (NSAs), each representing properties that are not reversed frontage (i.e., they face toward the road). For reference, MTO methodology was applied as a means to determine sound levels at the Outdoor Living Areas (OLAs) of NSAs that face the subject roads. Sound levels were calculated at the OLAs with consideration of

intervening building row densities and increased distance from the road. This assessment was completed for the future scenario with influence of the NSTC, which represents worst-case future with-project conditions at most NSAs. At two (2) NSAs (R16 and R19), sound levels at the backyard OLA would continue to exceed 60 dBA by less than 1.5 dBA. However, to reiterate Regional policy, the Region does not evaluate mitigation at properties that are not reversed frontage.

In addition, assessment results indicate that the proposed roadway improvements would result in an increase in sound levels of up to 4 dBA over future ambient conditions. This increase is below the MTO's 5-dBA impact criteria due to increases in projected sound levels. The Region of Peel does have noise impact or mitigation criteria that assess increases in noise over a future do-nothing scenario.

The proposed NSTC is expected to result in traffic noise levels that are less than 1 dBA above a no-NSTC scenario. Along Mississauga Road, sound levels would be less than 2 dBA lower with the NSTC due to traffic diverted away from Mississauga Road.

To summarize, noise barrier mitigation is not warranted at any of the existing or known future NSAs along Bovaird Drive or Mississauga Road. This is because either 1) predicted levels are below the Region's noise barrier retrofit policy, or 2) projected impacts are at properties that are not reversed frontage, and therefore do not meet noise barrier retrofit requirements. Results include future ambient and future with and without NSTC scenarios. Where sound levels were projected to exceed 60 dBA, a conclusion of feasibility is presented, based on whether the corresponding OLA faces the road (i.e., reversed frontage or not).

Future Development

Regardless of the conclusions of this assessment, developers will be required to follow the Regions' General Guidelines for the Preparation of Acoustical Reports in the Region of Peel to evaluate exterior and interior sound levels at these future properties.

Construction Noise

During construction there would be temporary increases in sound levels at locations near active construction areas and along routes to these areas. The sound level increases would be due to construction activities involving heavy equipment and the hauling of construction materials. The increase in noise levels would depend on the type(s) of equipment being used and the amount of time it is in use. Excavation, grading and paving would generate sounds likely audible on surrounding properties. Table B3 shows in the Traffic Noise Study describes the typical range of noise levels for construction equipment that could be used during the construction along Bovaird Drive. Sounds from construction equipment and activities (usually point sources) decrease about 6 dBA for each doubling in distance from the source. Based on these levels, it is likely that NSAs located near the construction areas would be temporarily impacted by construction noise.

Construction Noise Levels and Mitigation

The City of Brampton has not specifically identified noise from construction activity in its noise by-law. Therefore, there are no regulatory requirements that restrict construction activity or timing. However noise from construction activities related to the proposed project could nonetheless disturb nearby residences. The potential for such disturbance could be reduced with the practical and inexpensive techniques described below. The following construction noise mitigation techniques are suggestions for times when construction activities occur close to existing residences or other sensitive lane uses.

- Limit noisy construction activity to daytime hours to minimize the potential for noise impacts during typical hours of rest of sleep.
- Construction noise could be minimized with properly sized and maintained mufflers, engine intake silencers, engine enclosures, and turning off equipment when not in use. Stationary construction equipment should be located away from sensitive receiving properties where possible.
- Where stationary equipment is located near NSAs and the above noise-reducing measures are not feasible, portable noise barriers could be placed around the equipment with the opening directed away from the sensitive receiving property. These measures are especially effective for engines used in pumps, compressors, welding machines, etc., that operate continuously and contribute to high, steady background noise levels. In addition to providing about a 10-dBA reduction in equivalent sound levels, the portable barriers demonstrate to the public the contractor's commitment to minimizing noise impacts during construction.
- Back-up alarms used as safety warning devices often emit some of the most annoying sounds from a construction site. One effective technique for reducing backup alarm noise would be to employ ambient-sensing alarms that test the noise environment and broadcast a sound loud enough to be heard instead of using a pre-set (usually maximum) sound level. Alternatively, the use of broadband backup alarms instead of the typically employed pure tone alarms have been found to be very effective in reducing off-site annoyance due to these required warning devices.
- Noise from material handling can be minimized by requiring operators to lift rather than drag materials wherever feasible.
- Substituting hydraulic or electric models for impact tools such as jack hammers, rock drills and pavement breakers would also reduce construction noise. Electric pumps could be specified if pumps are required to remove water.
- The most important element in reducing construction noise impacts would be to restrict noisy work to daytime hours when people nearby are not trying to relax or sleep. Such a restriction is desirable because background noise would be more likely to mask

construction noise during the day, and because most people are more sensitive to noises when they expect quiet and when they are trying to sleep.

6.2.4 Archaeology

AMEC completed a Stage 1 Archaeological Assessment for this study. (Appendix 'J' - Stage 1 Archaeological Assessment).

A Stage 2 Archaeological Assessment has been initiated, but has yet to be completed. Completion of this additional study will be completed subsequent to completion of this report.

The Archaeological Reports are subject to Ministry of Culture approval, and it is an offence to alter any archaeological site without Ministry of Culture concurrence. No grading or other activities that may result in the destruction or disturbance of an archaeological site are permitted until notice of Ministry of Culture approval has been received.

The following Ministry of Culture conditions also apply:

- Should deeply buried archaeological remains be found during construction activities, the Heritage Operations Unit of the Ontario Ministry of Culture should be notified immediately; and
- In the event that human remains are encountered during construction, the proponent should immediately contact both the Ministry of Culture, and the Registrar or Deputy Registrar of the Cemeteries Regulation Unit of the Ministry of Government Services, Consumer Protection Branch.

6.2.5 Built and Cultural Heritage Resources

AMEC completed a Built Heritage and Cultural Heritage Landscape Assessment for this study. (Appendix 'K' - Built Heritage and Cultural Heritage Landscape Assessment).

Based on the results of the built heritage and cultural heritage landscape assessment of the Study Area, consisting of a corridor along Bovaird Drive between Lake Louise Drive/Worthington Avenue and Old Pine Crescent, in the City of Brampton, the following measures are recommended to mitigate project effects on these heritage resources:

- Avoidance of encroachment on built heritage properties and cultural heritage landscapes where possible;
- Use of heritage plants, heritage themes, and/or sympathetic design in landscaping and noise abatement structures, where possible;
- Conduct full heritage evaluation and impact assessment on Built Heritage Properties BHP1, 2, and 9 and Cultural Heritage Landscapes CHL1 and 6 if the properties cannot be avoided, and;

- Conduct full heritage evaluation and impact assessment, including historical research, mapping, floor plans, photographic documentation, of buildings and their context at 2472 Bovaird Drive West (BHP5 and CHL3), 2591 Bovaird Drive West (BHP7 and CHL4), and 1 Caseley Drive (BHP10). Also, identify and explain discrepancies in naming properties with respect to the City of Brampton Heritage Listing, particularly at 2472 (BHP5) and 2838 Bovaird Drive West (BHP6).

Table 6.27 is a list of all resources identified, with specific recommendations.

Table 6.27 List Of All Resources Identified With Specific Recommendations

Record Number	Address/Description	City of Brampton Heritage Listing	Magnitude of Project Effects	Recommendations
BHP1	10055 Creditview Road; Mount Pleasant Brick House	B - significant	negligible	avoidance; no further investigation
BHP2	10060 Creditview Road; Mount Pleasant United Church	A - most significant	negligible	avoidance; no further investigation
BHP3	1989 Bovaird Drive W; Andrew McCandless Farm/ Plank House	A – most significant	moderate	avoidance; no further investigation
BHP4	10020 Mississauga Road; Apple Factory Brick House	B - significant	moderate	avoidance; no further investigation
BHP5	2472 Bovaird Drive W; Greensward House	B - significant	high	further evaluation;
BHP6	2534 Bovaird Drive W; Ross House	not listed	moderate	further evaluation
BHP7	2591 Bovaird Drive W; Robert Currie Farm	A - most significant	high	further evaluation
BHP8	2702 Bovaird Drive W; Pettigrew House	not listed	moderate	further evaluation
BHP9	2838 Bovaird Drive W; Laird House	B - significant	moderate	avoidance; no further investigation; identify discrepancy with Brampton Heritage Listing name
BHP10	1 Caseley Drive; Maxted-Caseley House	not listed	high	further evaluation

Table 6.27 List Of All Resources Identified With Specific Recommendations				
Record Number	**Address/Description**	**City of Brampton Heritage Listing**	**Magnitude of Project Effects**	**Recommendations**
CHL1	Mount Pleasant Crossroads	not listed	negligible	avoidance; no further investigation
CHL2	Heritage Road	not listed	moderate	avoidance; no further investigation
CHL3	Greensward Orchard	not listed	high	further evaluation
CHL4	Robert Currie Farm	A - most significant	high	further evaluation
CHL5	Laird's Hill	not listed	moderate	avoidance; no further investigation
CHL6	Credit River Flats	not listed	moderate	avoidance; no further investigation

This report has been forwarded to the Ministry of Culture for approval. Once the recommendations are confirmed, the Region of Peel should undertake an additional Cultural Heritage Evaluation (CHER) and Heritage Impact Assessment (HIA).

6.2.6 Fish and Fish Habitat Assessment

As part of this study C. Portt and Associates, sub-consultant to AMEC, completed a fish and fish habitat impact assessment of the preferred alternative (ref. Appendix 'G' - Fish and Fish Habitat Impact Assessment). The results of the assessment are summarized below.

Proposed Works

The characteristics of the existing culverts and the proposed works at each watercourse crossing, as determined by AMEC, are summarized in Table 6.28. At watercourse 2a the proposed works are limited to possible reconstruction of the inlet. At watercourse 2b the existing culvert, if it is replaced, will be replaced with an identical structure. The two culverts for watercourse 3a, one beneath Bovaird Drive and one beneath Heritage Road, will both be replaced with new culverts that are 21 and 22 m longer, respectively. The preferred alternative at the Huttonville Creek is a 14.6 m precast arch structure. No works are proposed as part of this project at the drainage features in the Springbrook Creek and Fletchers Creek watersheds.

Table 6.28 Characteristics Of Existing And Proposed Culverts Within The Study Area

Watercourse	Culvert	Existing Material and Size	Existing Length (m)	Proposed Material and Size	Proposed Length (m)	Change in Length (m)	Remarks
2a	A	1.2 m concrete box	95	existing to remain	same as existing	0	Reconstruction of inlet may be required
2b	B	0.91 m concrete open footing	35	same as existing	same as existing	0	Structure may need to be reconstructed to mitigate structural deficiencies (subject to detailed design assessment)
3a (Heritage Road)	C2	0.9 m csp	14	0.9 m csp	36	12 m U/S 10 m D/S	Existing culvert to be removed and replaced with longer culvert
3a (Bovaird Drive)	C	1.2 m concrete open footing, csp extension on downstream end	30	1.2 m concrete open footing	51	11 m U/S 10 m D/S	CSP section to be removed and replaced with open footing, plus extensions. Portion of existing watercourse in rights-of-way to be moved to new ditch.
3b	D	1.2 m concrete open footing	23	1.0 m x 6.0 m open footing	45	10 m U/S 12 m D/S	Replacement of existing culvert is required to meet hydraulic requirements
Huttonville	F	5.53 m concrete open footing	60	14.6 m precast open footing arch culvert	83	14 m U/S 9 m D/S	MNR has agreed to this alternative
Springbrook	G	0.9 m x 1.0 m concrete box	33	existing to remain*	same as existing	0	No works proposed as part of this project
Fletcher's	H	0.9x0.9m concrete box, 1.05m CSP extension on south end	47	0.9x0.9 concrete box	55	3 m U/S 5 m D/S	CSP section to be removed and replaced with concrete box extensions

*Existing culvert to remain under interim conditions only. Ultimate (fully developed) conditions will eliminate this crossing

Risk Management Assessment

The proposed works at each watercourse crossing was evaluated using the Fisheries and Oceans Canada Risk Management Framework. This framework assesses the sensitivity of fish and fish habitat based on fish species sensitivity, species' dependence on the habitat, species and habitat rarity and habitat resiliency. The scale of negative effect of the proposed works is assessed based on the extent (size) of the disturbance, the duration of any anticipated negative residual effects, and the intensity of the disturbance, which is the amount of change from the base line condition.

The assessment for each evaluation criteria, is presented for each crossing where works are proposed in Table 6.29. The sensitivity of fish and fish habitat is low, except for watercourse 2a where it is medium and for Huttonville Creek, where it is high due to the presence of the endangered Redside Dace. In all cases the scale of negative effects is low. With the exception of Huttonville Creek, based on this assessment, and provided that best management practices (i.e. for sediment controls, timing restrictions, revegatation guidelines) are followed, the proposed works can be carried out under a letter of advice, or perhaps, in some cases, by following guidance in operational statements. These practices, which are subject to change over time, should be clearly described during detailed design.

A Fisheries Act authorization may be required, and an Endangered Species Act 17C permit will be required, for the Huttonville Creek crossing. The 17C permit, which is issued by the Ministry of Natural Resources, will require that a Redside Dace Overall Benefit proposal be developed prior to its issue.

Table 6.29 Evaluation Of The Proposed Works Based On The Criteria Used In The Fisheries And Oceans Canada Risk Management Assessment

	Sensitivity of Fish and Fish Habitat				Scale of Negative Effect		
Watercourse	**Species Sensitivity**	**Species Dependence on Habitat**	**Species Rarity**	**Habitat Resiliency**	**Extent**	**Duration**	**Intensity**
2a	moderate	moderate	moderate	moderate	low	low	none
2b	none	low	low	low	low	low	low
3a (Heritage Road)	none	low	low	low	low	high	low
3a (Bovaird Drive)	none	low	low	low	low	high	low
3b	none	low	low	low	low	high	low
Huttonville	high	high	high	moderate	low	high	low
Springbrook	no works proposed						
Fletcher's	low	low	low	high	low	high	low

6.2.7 Terrestrial Resources

As part of this study Dougan and Associates (D&A), sub-consultant to AMEC, completed a terrestrial resources assessment of the preferred alternative (ref. Appendix 'F' - Preliminary Constraint Assessment for Terrestrial Resources and Environmental Impact Study for Terrestrial Resources Fish and Fish Habitat Assessment). The results of the assessment are summarized below.

Impacts to natural features within the Bovaird Drive study area are summarized in Table 6.30. The following sections describe in more detail the potential impacts, mitigation, and compensation for the proposed road improvements.

Impacts to Features Identified in the Environmental Overview Study

The preferred design intersects with five potential linkage opportunities that were identified in the Environmental Overview Study (EOS) (D&A et al. 2005). Four of the potential linkages are defined by watercourses and associated riparian vegetation, and therefore cross Bovaird Drive via culverts, the size of which varies based on watercourse size. Specifically for the Huttonville Creek crossing, improvements of this culvert to enhance wildlife passage opportunities should be undertaken. For example, this could involve integrating terrestrial benches above the level of base flow, to facilitate wildlife movement. The fifth potential linkage is bisected by Bovaird Drive 220m east of Heritage Road, where there is currently no culvert connection.

The preferred design will also encroach on a hedgerow that was identified in the EOS study on the southeast corner of the Heritage Road intersection. A number of large diameter trees along the east (and west) side of the intersection will need to be removed to widen Heritage Road at this location.

No other features identified as potentially significant in the EOS study will be impacted directly by the road improvements proposed as part of the preferred design.

Vegetation

Caseley Drive to Heritage Road

Proposed road improvements begin approximately 750m east of Caseley Drive. Encroachment along Bovaird Drive from this point east to Heritage Road will primarily affect agricultural and anthropogenic lands.

The ditch feature running along the north side of Bovaird Drive will be encroached upon; this feature supported a plant community of graminoids and forbs typical of a cultural meadow ecosite. The field directly to the northwest contains an unevaluated wetland feature which was recognized as a potentially significant environmental feature in the EOS (also as part of Tributary 2b). During field visits in 2010, the wetland feature was being farmed, except for a very

small patch of cattail marsh directly north of the edge of proposed grading along Bovaird Drive. Assuming the wetland area has been actively farmed in the past, and will continue to be farmed in the future, road improvements in the adjacent area will have negligible impact on the wetland features and functions. Drainage under Bovaird Drive at this location however, should be maintained to reduce downstream impacts that might occur if surface flows were obstructed. Erosion protection should be provided for the channel and wetland feature. The associated culvert will not be extended, however it may require improvements to mitigate structural deficiencies.

A small section of the cultural woodland on the northwest side of the Heritage Road intersection will be removed. This will include clearing some trees, shrubs, and understory habitat. Alteration of the small watercourse (Tributary 3a) that flows southeast under Bovaird Drive will also be impacted.

The majority of the hedgerow along the west and east sides of Heritage Road (the latter as identified in the EOS), south of Bovaird Drive will be cleared. This will involve the removal of a number of mature trees. The watercourse mentioned above (Tributary 3a) will also be impacted by alterations between the culvert outlet draining the north side of Bovaird Drive, and the culvert inlet flowing east under Heritage Road.

Compensation for tree removal can be achieved through planting the same species in roadside verge areas along the Bovaird Drive corridor that currently have no or low tree density. Although compensation is not required by the City's Tree Bylaw, compensation is often recommended (S. Jorgenson, Senior Environmental Planner, pers. comm., June 19 2011). Compensation approaches that have been used in the past include replacement ratios ranging from 1:1, to 3:1 depending on the stature and maturity of the tree. Furthermore, compensation will help achieve urban tree cover targets for the Region.

Culvert 'C', which crosses Bovaird Drive just west of Heritage Road, will be extended by 21 m (11 m on the upstream side, and 10 m on the downstream side) and widened to a 3.66 m span arch culvert. It is not anticipated that the increase in length will have a negative impact on wildlife movement as the culvert is being widened and constraints likely exist under the current condition (e.g. lack of connectivity to habitat, corrugated steel pipe present on downstream section). The replacement of the crossing will likely improve conditions for smaller wildlife (such as amphibians and small mammals). Terrestrial impacts of extending and replacing the culvert for the watercourse adjacent to the Heritage Road intersection (Tributary 3a), will be negligible as the surrounding community is a mix of cultural woodland, hedgerow and cultural meadow. Channel reconstruction has been recommended, which will result in minor improvements to the existing condition by reducing erosion/sedimentation, and providing more diversity of riparian habitat.

Heritage Road to Mississauga Road

The majority of this alignment will encroach on cultural meadow and ditch features in the roadside verges and existing anthropogenic lands.

The southeast side of the intersection at Bovaird Drive and Heritage Road will involve the removal of mature trees that make up the roadside hedgerow, and a section of the cattail marsh (associated with Tributary 3a) that extends to the southeast between two agricultural fields.

Culvert 'C2', which flows under Heritage Road just south of Bovaird Drive will be removed and replaced with a structure which matches the nearby Bovaird Drive crossing. This represents a significant change to the crossing, however, impacts to wildlife movement are likely to be minimal given that the culvert is being widened and wildlife movement is likely constrained under existing conditions (i.e. 0.91 m diameter corrugated steel pipe).

Expanding the northeast section of the Heritage Road intersection will involve removal of vegetation within and adjacent to the cultural savannah feature. Compensation for community types and species removed can be accommodated through the preparation and implementation of a suitable landscape design in adjacent areas, or elsewhere within the study area.

Approximately 205 m east of the intersection, expansion of the road on the south side of Bovaird Drive will encroach on a hedgerow with a predominantly deciduous tree composition. The interface of impact is relatively short (~20 m) and shallow (~2 m), therefore impacts will be minimal. Staking of the feature during detailed design, and minor adjustments to local grading design, may reduce or prevent disturbance to this feature.

Approximately 440 m east of the intersection, widening of the road right of way on the north and south side of Bovaird Drive will impact a small watercourse (Tributary 3b) and the associated vegetation. A small cattail marsh directly northeast of this feature will also be impacted, albeit indirectly via changes in roadside drainage. Although the ditch on the north side of Bovaird Drive will be filled at this location, there will be no alteration to the drainage received from lands to the north. Additionally, the culvert at this location (Culvert D) will be replaced with a larger structure (6m span, 1 m height, with an open footing); this will provide an improved opportunity over existing conditions (1.2 m width concrete structure) for movement of small wildlife. This location is also within lands that have been proposed as part of the regional Natural Heritage System (NHS); increasing the size of the culvert at this location will support the proposed NHS crossing, offering an improvement to linkage between natural features on the north and south sides of Bovaird Drive. On the south side, the watercourse drains into the Credit River; on the north side, there are two woodland features that will likely be preserved, and other features associated with the East branch of Huttonville Creek (Tributary 4). Therefore, appropriate design of the culvert structure at this location will facilitate movement by various types of wildlife, improving the connectivity of a number of important natural features in the area.

The section directly west of Mississauga Road is primarily anthropogenic and includes a commercial property on the north side of Bovaird Drive, and a driving range and gas station on the south side. Terrestrial impacts of road widening along this section will be negligible.

Mississauga Road to Worthington Drive

Encroachment of road improvements east of Mississauga Road will primarily occur within existing anthropogenic lands, agricultural lands, and roadside drainage ditches. Areas that were identified as high priority included features along Huttonville Creek (Tributary 4), and the hedgerow/swale (associated with Tributary 5) in the vicinity of the intersection of Bovaird Drive and the proposed Creditview Road/James Potter Road extension.

Widening the northeast corner of the Mississauga Road and Bovaird Drive intersection will result in the loss of small section of cattail / reed canary grass marsh and a section of cultural woodland. Widening the southeast corner of the intersection will result in a small loss of cultural meadow. Overall, the reduction in area of these natural features will be negligible. Removal of trees on the northeast section of the intersection can be compensated within the same feature, or elsewhere within the study area. Cultural meadow is a common vegetation type within and beyond the study area; the species present within this community are also very resilient to disturbance and can quickly re-colonized areas that have been cleared.

The location of the proposed Creditview Road/James Potter Road intersection will involve encroachment on a narrow hedgerow/swale (associated with Tributary 5) that runs south to a cultural woodland that is located southwest of the existing intersection of Creditview Road/James Potter Road and Ashby Field Road. Although the cultural woodland feature is currently isolated from other important natural heritage features, in the future it may function as a node for wildlife movement between the Huttonville Creek (Tributary 4) valley, green space / SWM areas south of Creditview Road/James Potter Road. Lands west of the proposed Creditview Road/James Potter Road and south of Bovaird Drive are designated as community park (Schedule SP45[A] in the Credit Valley Secondary Plan area), however the current plan for the Bovaird Drive road improvements identifies this area as being developed as residential lots. Long-term impacts to connectivity resulting from the Bovaird Drive road improvements will be minimal given that reconstruction of the existing infrastructure and removal of the hedgerow/swale will occur as a result of development in the area. The construction of a community park in the lands to the west, adjacent to Huttonville Creek, will provide linkage enhancements by directing localized wildlife movement to the Huttonville Creek corridor; this will ultimately provide a much better opportunity than existing conditions for connectivity to lands to the north of Bovaird Drive.

Wildlife

Birds

In general, it is recommended that impacts to breeding birds be avoided so as not to contravene the Migratory Bird Convention Act (1994). This requires clearing and grubbing outside the nesting period (generally April 15 to July 15), or completion of a nesting survey by a qualified avian ecologist if clearing or grubbing will occur within this period, to identify and temporarily protect active nests until nesting is finished. Areas of proposed disturbances are restricted to habitats immediately adjacent to Bovaird Drive, and will have limited impact on breeding migratory birds directly or indirectly though impacts to their habitat. Based on the small amount of area that will be impacted directly (9.54 ha), and that less than 50% of the affected lands provides potential habitat (i.e. 53% is anthropogenic, the remaining 47% is agricultural, cultural, or natural) impacts to breeding birds will be minimal.

Although direct impacts to breeding birds are unlikely, there is the potential for indirect impacts that may result from construction activities (e.g. noise, increased presence of humans). These impacts can be mitigated by scheduling construction activities that will directly disturb existing habitats during the fall and winter.

Barn Swallow, a “Threatened” species in both Ontario (OMNR 2012) and Canada (COSEWIC 2011), was detected during the breeding bird surveys. Three birds were seen foraging over the open fields south of Bovaird Drive (east of Mississauga Road) on May 30 2010, and five birds were seen in the same general vicinity on June 9 2010. No signs of active breeding were observed, but considering the habitat in the area, and the presence of human-made structures (e.g. barns) that they attach their nests to (Lepage 2007), it is likely that they are breeding locally. However, since the proposed construction activities do not involve removing any such potential structures for nesting, there should be no negative impacts on their breeding activities.

Amphibians

Based on the relative lack of amphibian communities present within the study overall, and none being detected within the affected areas of the proposed road improvements, impacts will be negligible. Only 0.03 ha of wetland is expected to be impacted directly by the proposed road improvements. The majority of this wetland type was cattail dominated shallow marsh, which is unlikely to provide breeding habitat for amphibians. Therefore, we are confident that amphibians will not be impacted by the proposed road improvements along Bovaird Drive.

The treatment of watercourses should include consideration of additional structural elements, such as overflow pools and buffer plantings, to add habitat functionality, which will benefit ecological functions at the system level.

Table 6.30 Summary Of Potential Impacts Of The Proposed Preferred Design To Natural Features Within The Bovaird Drive Study Area

Feature	Location	Characteristics	Sensitivity	Amount of Disturbance	Impact	Mitigation/Compensation
Caseley Drive to Heritage Road						
Ditch and Adjacent Wetland (Polygons 39 & 41)	North and south sections of Bovaird Drive, approximately 450m west of Heritage Road (associated with Tributary 2b).	Ditch features are primarily composed of cultural meadow species. Adjacent wetland features are composed of cattails. Associated with proposed NHS.	Low. Species are relatively insensitive to disturbance, and would easily establish following any disturbances.	Less than 0.2 ha will be disturbed.	Impact will be minimal given the proposed extent of disturbance, and ability of species to reestablish following disturbance.	Replace culverts with those that have designs that facilitate wildlife movement (e.g. terrestrial benches above the typical baseflow level).
Cultural Woodland (Polygon 43)	Northwest corner of Bovaird Drive and Heritage Road intersection.	Woodland is relatively small (0.4 ha), and is composed of American Elm, Black Walnut, Ash, and Manitoba Maple.	Moderate. Some trees are relatively mature and would have to be removed given the proposed road improvements.	Disturbance would be relatively small. Only a section of the feature would be impacted by the proposed road improvements (0.1 ha).	Impact will be moderate, as some mature trees may have to be removed.	Compensate for tree removal with appropriate replacement ratios determined by the City and or Region.
Hedgerow (Polygon 46)	West side of Heritage Road, south of Bovaird Drive.	Hedgerow includes a number of large diameter Ash trees.	Moderate. Some trees would have to be removed given the proposed road improvements.	Disturbance would involve removing trees approximately 150 m south of the intersection.	Impact will be moderate as some mature trees may have to be removed.	Compensate for tree removal with appropriate replacement ratios determined by the City and or Region.
Heritage Road to Mississauga Road						
Hedgerow (Polygon 8)	East side of Heritage Road, south of Bovaird Drive.	Hedgerow includes a number of large diameter Shagbark Hickory and Bur Oak. Section of hedgerow is part of proposed NHS.	Moderate. Some trees would have to be removed given the proposed road improvements	Disturbance would involve removing trees approximately 150 m south of the intersection.	Impact will be moderate as some mature trees may have to be removed.	Compensate for tree removal with appropriate replacement ratios determined by the City and or Region.

Table 6.30 Summary Of Potential Impacts Of The Proposed Preferred Design To Natural Features Within The Bovaird Drive Study Area

Feature	Location	Characteristics	Sensitivity	Amount of Disturbance	Impact	Mitigation/Compensation
Shallow Marsh (Polygon10)	Southeast of Heritage Road and Bovaird Drive intersection (associated with Tributary 3a).	Cattail marsh occurs along watercourse from just south of the intersection, to where it cross back under Heritage Road approximately 310 m to the south. Associated with proposed NHS.	Low. Species present would be relatively insensitive to disturbance and would easily re-establish following disturbance.	Approximately 0.2 ha will be disturbed given the current preferred design. More details to be provided regarding crossing designs.	Impact will be minimal given the proposed extent of disturbance, and ability of species to re-establish following disturbance.	Measures to protect fisheries within the vicinity of this feature will also provide protection for terrestrial resources. Replace culverts with those that have designs that facilitate wildlife movement (e.g. terrestrial benches above the typical baseflow level). Other mitigation measures to be determined based on culvert and crossing designs.
Shallow Marsh (Polygon 12)	North of Bovaird Drive approximately 440m east of the intersection (associated with Tributary 3b).	Cattail dominated marsh.	Low. Species present are relatively insensitive to disturbance.	Approximately 0.005 ha just north of Bovaird Drive will be disturbed.	Impact will be minimal given extent of disturbance based on the preferred design, and ability of species to re-establish following disturbance.	Appropriate placement of silt fencing to reduce unnecessary encroachment on the remainder of the feature, and to reduce sediment inputs.
Mississauga Road to Worthington Drive						
Floodplain areas of Huttonville Creek (Polygons 19 & 20)	North and south of Bovaird Drive, just east of Mississauga Road (associated with Tributary 4).	North of Bovaird Drive is Cultural Woodland. South of Bovaird Drive is Cultural Meadow. Both areas are	Low. Both feature are cultural, and composed of species that would easily re-establish	Disturbance would be associated with removal of existing culvert, and construction of new culvert.	Impact will be minimal given the small area affected, and the ability of species to re-establish following	During construction, appropriate placement of silt fencing will minimize erosion and sedimentation impacts.

Table 6.30 Summary Of Potential Impacts Of The Proposed Preferred Design To Natural Features Within The Bovaird Drive Study Area

Feature	Location	Characteristics	Sensitivity	Amount of Disturbance	Impact	Mitigation/Compensation
		within the floodplain of Huttonville Creek. Associated with proposed NHS.	following any disturbances involved with the construction of road improvements.		disturbance.	Post construction conditions for connectivity will be improved with culvert being wider than the existing structure.
Hedgerow / Swale (Polygon 100)	West of proposed Creditview Road/James Potter Road intersection (associated with Tributary 5).	Drainage feature with sparse woody vegetation cover and in some areas a vegetated swale.	Low. Feature is composed of species that would easily re-establish following any disturbances involved with the construction of road improvements.	Approximately 0.05 ha will be disturbed.	Impact will be minimal given the small area affected, and the ability of species to re-establish following disturbance.	Generally, impacts such as loss of vegetated cover and connectivity could be compensated for if the lands in the vicinity are developed as community park (as outlined in the Secondary Plan for the area).

6.2.8 Groundwater

A Hydrological Assessment was competed by AMEC. The results of this study are summarized below.

- The land use within the study area consists primarily of agricultural (more than 60 %) predominated by intensive agricultural.
- Topographic gradients are low, generally to the southwest, (<0.01) except at the Credit River Valley.
- Major perennial streams in the Study area are the Credit River, Huttonville Creek and the large westernmost tributary to the Credit River in the study area. Lesser, ephemeral streams in the Study area include the Springbrook tributaries, and the unnamed tributaries between Huttonville Creek and the westernmost tributary of the Credit River within the study area.
- The overburden in the area, underlain by Queenston Shale bedrock, consists primarily of clayey silt till (upper) to sandy silt till (lower) (both Halton Till) which is less than 1 m thick at Creditview Road and along the Credit River Valley up to 15 m thick in the central portion of the study area.
- Discontinuous deposits of sand (occasionally with gravel) have been identified, primarily in the vicinity of Mississauga Road and east of it.
- The direction of groundwater flow as inferred from MOE water well data for shallow wells is south-westerly, modified to some extent by discharge into Huttonville Creek and the Credit River within the study area and Fletcher's Creek, east of the study area. The other tributaries, except the most westerly on in the study area, are considered to be ephemeral and do not influence groundwater flow directions throughout most of the year.
- Approximately forty-nine wells completed in overburden and bedrock within the study area may be used for domestic purposes. No information on the condition or current use of these wells is available.
- The hydrogeologic characteristics determined for the overburden and bedrock indicate that both are poor aquifers, generally incapable of supplying sufficient water for domestic uses. Wells that intercept the discontinuous sand or sand and gravel lenses, generally at the bedrock interface may produce sufficient water for domestic use.
- The quality of the groundwater from wells completed in overburden and shallow bedrock (<5 m below bedrock surface), although very hard, meets the ODWQS. The quality of groundwater in deep bedrock, in addition to being very hard, may be very mineralized and concentrations of a number of parameters (some health related) exceed the ODWQS.
- There is minor evidence of impact from road de-icing to the groundwater in overburden and shallow bedrock.

- Several small Provincial Wetlands and an ANSI have been identified within the study area by the Credit Valley Conservation Authority.
- Water budget analysis indicates that the net effect of widening Bovaird Drive from two to four lanes may decrease recharge by less than 3 per cent, an insignificant amount considering the range of error inherent in the assumptions and calculations.
- Impacts to surface water, groundwater or water supply wells from reconstruction of Bovaird Drive and its associated structures (culverts, bridges) is expected to be minimal.

Recommendations

Based on the findings of this assessment, the following recommendations are presented for consideration.

- Locate all groundwater monitors installed and equip with data logging equipment to measure groundwater levels for six to nine months from late winter until late fall.
- Prior to construction, complete a door-to-door water well survey for all water supply wells located within the study area to provide baseline data for comparison with future conditions.
- Review of the potential for impacts of discharge to surface water and impacts to wetlands be revisited when reconstruction options especially as related to bridge reconstruction are developed with more certainty.

6.2.9 Landscaping

An aesthetics/streetscaping plan and associated report (ref. Appendix 'N' - Aesthetics/Streetscaping Study) was completed by McWilliam and Associates, sub-consultant to AMEC, which is summarized below:

The undertaking will have some impacts on existing trees along Bovaird Drive. The impacts will be limited to the section of the corridor west of Mississauga Road, as there will be no impacts on the few trees located along the corridor to the east of Mississauga Road.

It is anticipated that a total of approximately 61 trees will require removal. This total may vary once the detailed design is complete. Most of these trees are semi-mature or mature and include the following species:

- Green Ash (fraxinus pennsylvanica)
- Manitoba Maple (acer negundo)
- Norway Maple (acer platanoides)
- Willow (salix sp.)
- Black Walnut (juglans nigra)

- Elm (ulmus sp.)
- Maidenhair Tree (ginkgo biloba)
- Basswood (tilia Americana)
- Apple (malus sp.)
- Austrian Pine (pinus nigra)
- White Spruce (picea abies)

It is noted that none of the trees inventoried along this section of the Bovaird Drive corridor are identified as significant specimen trees or rare species.

There are a number of trees located along this section of Bovaird Drive that should remain undisturbed by construction activities associated with the road widening. These trees include:

- Remnant woodlot areas and scattered mature trees
- Landscaped boulevard strips located in front of some of the institutional/commercial developments
- Scattered individual specimen trees

Although the proposed undertaking will require the removal of a number of existing trees, the reconstruction of this portion Bovaird Drive will provide an opportunity to improve the overall aesthetics of this major thoroughfare, with a comprehensive streetscaping/tree planting plan.

The following chart summarizes the streetscape opportunities as noted in this report.

Table 6.31 Streetscape Opportunities

Opportunity	Streetscape Treatment
Peel/Halton Boundary to Heritage Road	
Boulevard Trees	To be planted on 15m centres
Stream Channel Restoration	Riparian plantings at Credit River tributary crossing
Heritage Road to Mississauga Road	
Boulevard Trees	To be planted on 15m centres
Median Landscape Strip	Trees/shrubs/grasses/perennials in raised planters (to be confirmed in detailed design), and patterned/coloured concrete hard surface treatment
Mississauga Road to Ashby Field Road	
Boulevard Trees	To be planted on 15m centres
Median Landscape Strip	Trees/shrubs/grasses/perennials in raised planters (to be confirmed in detailed design), and patterned/coloured concrete hard surface treatment
Primary Gateway	Landscaped ‘gateway’ feature at Mississauga Road / Bovaird Drive intersection

Gateway	Landscaped 'gateway' feature at James Potter Road / Bovaird Drive intersection
Ashby Field Road to Lake Louise Drive / Worthington Avenue	
Boulevard Trees	To be planted on 15m centres
Slope Plantings	Planting trees/shrubs on CN rail overpass embankments

Recommendations

The following recommendations relate to the streetscape improvements that are to be implemented along this portion of the Bovaird Drive corridor:

Vegetation Assessment:

A Vegetation Assessment will be required, prepared by a certified ISA arborist. All existing vegetation removed as part of this project should be inventoried and replaced. These recommendations are to be used only as a preliminary guideline as tree conditions will change over time.

Mitigation During Construction

- Construction activities are to avoid damaging existing, healthy, trees located close to the ROW wherever possible. This is to be accomplished by installing suitable tree protection fencing, extending to the 'dripline' of trees designated for protection.
- This tree protection zone is to remain undisturbed by excavation, storage of materials and equipment, and other construction related activities. The fencing is to remain in place through the duration of construction activities.
- Existing trees scheduled for removal are to be inspected to determine if transplanting is a feasible option.
- Existing landscape buffers from adjacent subdivisions are not to be effected if at all possible

Street Tree Planting and Planting/Streetscape Design

Preliminary landscaping planting plans have been prepared for this study (ref. Appendix 'N' – Aesthetics / Streetscaping Study). Tree planting/streetscape plans are to be prepared for the corridor by a registered landscape architect, as part of the detailed design of the roadway. These plans are to address:

- Compensation for vegetation requiring removal on or near private property
- Planting of new street trees to improve the aesthetics of the streetscape, to be planted on 15m centres and similar spacing from hydro poles/light standards
- Restoration of disturbed boulevard landscaped areas
- Existing landscape buffers from adjacent subdivisions impacted by construction activities are to be replaced.

- All tree and shrub plantings within the corridor are to be salt-tolerant, non-invasive, low maintenance, disease/pest resistant and drought tolerant.
- The planting of new trees along the corridor is to be coordinated with existing and proposed utility corridors, and light standards
- Proposed boulevard trees are to be planted within the Region's right-of-way. Compensation planting on private property, if required, will be coordinated with the land owner. Construction impacts at stream crossing areas are to be mitigated with the planting of riparian vegetation. This vegetation should be native, non-invasive, riparian vegetation, as approved by CVC.
- Trees to be planted near overhead utilities to be selected to conform to mature height limitations (Hydro approved species)
- New street trees to be installed as per Peel Region 'Regional Streetscape Policy'
- Gateway' treatments are to be prepared for the Bovaird Drive/Mississauga Road and Bovaird Drive/James Potter Road intersections
- Coloured pattern concrete treatments 75m in length are to be installed at all intersections, to include 'kill-strips', island medians and pedestrian connections.

6.3 Monitoring

During construction, the Region of Peel will review the implementation of mitigation measures and key design features, to confirm that they are consistent with the contract and with commitments made. All Region of Peel construction projects are subject to daily on-site inspection.

7.0 SUMMARY OF ENVIRONMENTAL EFFECTS, PROPOSED MITIGATION, COMMITMENTS TO FURTHER WORK

Table 7.0 Summary of Environmental Effects, Proposed Mitigation, Commitments to Further Work

ID	DETAILS	EXPRESSED BY	ID	DETAILS
1	Air Quality	Region of Peel City of Brampton	1.1	The contractor will be required to limit and control dust during construction
2	Surface Water Quality	Ministry of the Environment CVC Region	2.1	Mitigation measures for erosion and sedimentation from construction operations will be included in the contract and implemented. An erosion and sedimentation plan will be submitted to the CVC during detail design. Work will be controlled to prevent the entry of any deleterious materials to watercourses and located downstream of the study area. Refuelling of all vehicles and equipment will be conducted away from the watercourse to prevent any material from entering the watercourse. Any material (excavated soil, sediment, and backfill material) that is removed during construction will be placed above the high water mark and contained in a manner to ensure sediment will not enter the watercourse.
			2.2	All spills that could potentially cause damage to the environment will be reported to the Spills Action Centre of the Ministry of the Environment. A detailed protocol will be developed during detailed design to be implemented during construction if an incidence should occur.
			2.3	All recommendations made under the stormwater management sections of this report are required to be confirmed during detailed design with a detailed stormwater management report.
			2.4	Within any rural cross section areas, Low-Impact-Development practices are to be investigated and implemented if feasible.
3	Fisheries/Watercourse	CVC MNR DFO	3.1	A Fisheries Act authorization may be required, and an Endangered Species Act 17C permit will be required, for the Huttonville Creek crossing. The 17C permit, which is issued by the Ministry of Natural Resources, will require that a Redside Dace Overall Benefit proposal be developed prior to its issue.

Table 7.0 Summary of Environmental Effects, Proposed Mitigation, Commitments to Further Work

ID	DETAILS	EXPRESSED BY	ID	DETAILS
			3.2	The drainage area associated with culvert crossing at 10+425 (Culvert A) has been identified by MNR and CVC as a barrier to fish passage. Recently, the Heritage Heights Community Secondary Plan study has commenced by the City of Brampton. As a result, potential modifications to or reconstruction of the culvert to address fish passage concerns will be deferred until the ultimate configuration of this community and its impact on the watercourse can be addressed.
			3.3	The small drainage feature between the two crossings identified for Culvert 'C' is required to be designed as a naturalized channel feature during detailed design.
4	Groundwater – Quality and Quantity		4.1	A hydrogeological study was completed as a component of this study. The proposed road reconstruction has little potential to affect water levels in local private wells.
			4.2	Locate all groundwater monitors installed and equip with data logging equipment to measure groundwater levels for six to nine months from late winter until late fall.
			4.3	Prior to construction, complete a door-to-door water well survey for all water supply wells located within the study area to provide baseline data for comparison with future conditions.
5	Property Impacts	Residents City of Brampton Region of Peel	5.1	All impacts to private property will be mitigated where appropriate as documented within this report.
6	Landscaping and Vegetation		6.1	Removal of vegetation and disturbance of soils will be minimized.
			6.2	A Landscape Planting Plan and Tree Preservation Plan will be prepared during detail design.
			6.3	All tree and shrub plantings within the corridor are to be salt-tolerant, non-invasive, low maintenance, disease/pest resistant and drought tolerant.
			6.4	The planting of new trees along the corridor is to be coordinated with existing and proposed utility corridors, and light standards

Table 7.0 Summary of Environmental Effects, Proposed Mitigation, Commitments to Further Work				
ID	**DETAILS**	**EXPRESSED BY**	**ID**	**DETAILS**
			6.5	Proposed boulevard trees are to be planted within the Region's right-of-way. Compensation planting on private property, if required, will be coordinated with the land owner.
			6.6	Construction impacts at stream crossing areas are to be mitigated with the planting of riparian vegetation. This vegetation should be native, non-invasive, riparian vegetation, as approved by CVC.
			6.7	Trees to be planted near overhead utilities to be selected to conform to mature height limitations (Hydro approved species)
			6.8	New street trees to be installed as per Peel Region 'Regional Streetscape Policy'
			6.9	Gateway' treatments are to be prepared for the Bovaird Drive/Mississauga Road and Bovaird Drive/James Potter Road intersections
			6.10	Coloured pattern concrete treatments 75m in length are to be installed at all intersections, to include 'kill-strips', island medians and pedestrian connections.
7	Traffic and Access	Residents City of Brampton Region of Peel	7.1	A construction staging plan will be prepared at the detail design stage.
			7.2	Access to existing residential and business entrances will be maintained during construction.
			7.3	All entrances will be reconstructed with similar material as existing conditions.
8	Pedestrians/Cyclists	Residents	8.1	A multi-use path (north side) and sidewalks (south side) will be constructed along Bovaird Drive.
9	Utilities	Utility Companies	9.1	Conflicts with utilities will be reviewed during the detail design phase. Relocation or protection of utilities will be required.
10	Noise	Region of Peel Residents	10.1	No traffic noise mitigation measures are required along Bovaird Drive.
			10.2	Construction noise control measures to be implemented. General noise control measures to be referred to, or placed into the contract documents.

Table 7.0 Summary of Environmental Effects, Proposed Mitigation, Commitments to Further Work

ID	DETAILS	EXPRESSED BY	ID	DETAILS
11	Property Requirements	Region of Peel	11.1	Property purchase requirements to be minimized where possible. Compensation for property purchase in accordance with the Region of Peel policy.
12	Archaeology	Ministry of Culture, Citizenship and Recreation	12.1	A Stage 1 Archaeological Assessment was completed for this project and a Stage 2 Archaeological Assessment has been initiated. The Stage 2 Archaeological Assessment will be completed subsequent to this study.
			12.2	Any impacts to the identified Built Heritage or Cultural Heritage Resources will be mitigated where possible. The Ministry of Culture has been circulated on the reports and will confirm the results. The Region of Peel should undertake an additional Cultural Heritage Evaluation (CHER) and Heritage Impact Assessment (HIA) subsequent to this study.
			12.3	If any archaeological artifacts are located during construction, work in the area will cease and the Ministry of Culture will be contacted. The Ministry of Culture and the Registrar of the Cemeteries Regulation Unit will be contacted in the event that human remains are encountered during construction.
13	Wildlife	CVC	13.1	Removal of trees is limited to outside the nesting period of April 15 to July 15, or completion of a nesting survey by a qualified avian ecologist will be required, to identify and temporarily protect active nests.
			13.2	Locally rare/uncommon species were identified. Opportunities to relocate or to avoid are required.
			13.3	Barn Swallows were observed in the area. Protection of habitat is required.
14	Wetlands	CVC	14.1	Compensation for loss of wetlands is required.

GLOSSARY OF TERMS AND ABBREVIATIONS

CLASS EA.....Class Environmental Assessment
CNR.....Canadian National Railway
CSP .....Corrugated Steel Pipe
EA.....Environmental Assessment
EA ACT .....Ontario Environmental Assessment Act
ESR .....Environmental Study Report
HPBATS.....Halton-Peel Boundary Area Transportation Study
LRTP .....Long Range Transportation Plan
NEB Act .....National Energy Board Act
OP .....Official Plan
ROP.....Regional Official Plan
ROPA .....Regional Official Plan Amendment
ROW.....Right-of-Way

Agency: Government agencies, ministries or public authorities or bodies whose mandates require them to have jurisdiction over matters affected or potentially affected by projects planned under this Class EA. This includes municipalities other than the proponent.

Class Environmental Assessment: A planning process approved under the *EA Act* for a class or group of undertakings. Projects included in the Class EA may be implemented without further approval under the *EA Act* provided the approved Class EA planning process is followed.

Environment: As defined in the *Environmental Assessment Act*, means:

a) air, land or water;
b) plant and animal life, including human life
c) the social, economic and cultural conditions that influence the life of humans, or a community;
d) any building, structure, machine or other device or thing made by humans;
e) any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from human activities; or
f) any part or combination of the foregoing and the interrelationships between any two or more of them, in or of Ontario.

Environmental Study Report: The documentation for a specific project planned in accordance with the procedures for Schedule C projects, setting out the planning and decision making process, including consultation practices, which has been followed to arrive at the preferred

solution. The ESR also sets out the mitigating measures proposed to avoid or minimize environmental impacts.

Public: The general public, individual members of the public who may be affected by or have an interest in a project and special interest groups.

ADDITIONAL REFERENCES

1. City of Brampton Official Plan (City of Brampton, *2006*)
2. Creditview Road and Sandalwood Parkway Transportation Master Plan, (City of Brampton, *2009*)
3. Halton-Peel Boundary Area Transportation Study (HPBATS), *2009*
4. Long Range Transportation Plan Final Report, (Region of Peel, *2005*)
5. Pathways Master Plan (City of Brampton *2006*)
6. Region of Peel Official Plan, Office Consolidation, (Peel Region, *2008*)
7. ROPA 22, Draft Transportation Technical Report, (Region of Peel, *2009*)
8. Transportation and Transit Master Plan Sustainable Update, (City of Brampton, 2009)
9. Strategic Plan GO 2020 (GO Transit, *2008*)

APPENDICES

Appendix 'A' - Notice of Study Commencement
Appendix 'B' - Traffic Study
Appendix 'C' - In-service Road Safety Review
Appendix 'D' - Geotechnical Investigation Report
Appendix 'E' - Structural Inspection Report
Appendix 'F' - DRAFT Preliminary Constraint Assessment for Terrestrial Resources and Environmental Impact Study for Terrestrial Resources
Appendix 'G' - Fish and Fish Habitat Assessment
Appendix 'H' - Hydrogeologic Investigation
Appendix 'I' - Stream Crossing Geomorphological Assessment
Appendix 'J' - Stage 1 Archaeological Assessment
Appendix 'K' - Built Heritage and Cultural Heritage Landscape Assessment
Appendix 'L' - Traffic Noise Study
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APPENDIX A

Notice of Study Commencement

APPENDIX B

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Preliminary Constraint Assessment for Terrestrial Resources and Environmental Impact Study for Terrestrial Resources

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