

# **GUIDELINE FOR PLANNING AND DESIGN OF THE GTA WEST CORRIDOR THROUGH THE GREENBELT**

**GTA West Corridor Environmental Assessment Study**

**Prepared For:  
ONTARIO MINISTRY OF TRANSPORTATION**

*Final Draft: August 2013*

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## **GLOSSARY**

Alignment -	The vertical and horizontal position of a road.
CSD -	Community Sensitive Design
CVP -	Community Value Plan
EA -	Environmental Assessment
EA Act -	Ontario Environmental Assessment Act, or OEAA
Evaluation -	The outcome of a process that appraises the advantages and disadvantages of alternatives.
GTA -	Greater Toronto Area
GTAG -	Greenbelt Transportation Advisory Group
Individual EA -	An environmental assessment for an undertaking to which Assessment the EA Act applies and which requires formal review and approval under the Act.
Interchange -	The intersection between two roadways at different levels with connecting ramps for traffic turning between them.
Mitigation -	Taking actions that either remove or alleviate to some degree the negative impacts associated with the implementation of alternatives.
MTO -	Ontario Ministry of Transportation
PIC -	Public Information Centre
Preliminary Design -	That part of the planning and design process during which various alternative solutions are examined and evaluated, including consideration of environmental effects and mitigation. The recommended design is then developed in sufficient engineering detail to ensure its feasibility.
Stakeholder -	Individuals or organizations with an interest in the Greenbelt, including neighbours and individuals, environmental groups or clubs, naturalist organizations, agricultural organizations, sports or recreational groups, organizations from the local community, municipal heritage committees, ratepayers associations, businesses, etc.
SWM -	Stormwater Management
TDS -	Transportation Development Strategy
Transitway -	A separate transit facility directly associated with a provincial highway.

## **1.0 INTRODUCTION**

### **1.1 PURPOSE OF THE GUIDELINE**

The Greenbelt is a broad band of protected land which supports agriculture as the predominant land use, protects natural heritage and water resource systems and supports economic and social activities associated with rural communities and agriculture. The *Greenbelt Plan (2005)* sets out policies to achieve the goals and objectives of the Greenbelt Act. The Plan also includes objectives and policies for infrastructure. Existing, expanded or new infrastructure is permitted provided that the infrastructure serves the significant growth and economic development expected in Southern Ontario, by providing for the appropriate connections among Urban Growth Centres and between these centres and Ontario's borders.

The GTA West Transportation Development Strategy, released in November 2012, was developed in consideration of the policy framework of the *Greenbelt Plan*, as well as other relevant policies such as the *Provincial Policy Statement (2005)* and the *Province's Growth Plan for the Greater Golden Horseshoe (2006)*. The GTA West Strategy recommends a series of multi-modal improvements to the transportation network, and also includes a new highway/transitway corridor from Highway 400 in York Region to Highway 401 in Halton Region, sections of which traverse Greenbelt lands.

The purpose of this Guideline is to propose key planning and design principles, and recommendations for mitigation measures (a toolkit) for placing new or expanded provincial highways/transitways within areas of the Greenbelt, specific to the GTA West study area. This Guideline and its recommendations are to be considered during Route Planning and Preliminary Design of the GTA West EA and subsequent implementation phases, where impacts to Greenbelt areas would be unavoidable.

A Greenbelt Transportation Advisory Group (GTAG) was established to assist the Project Team in developing key principles and mitigation measures that correspond to key components outlined in the *Greenbelt Plan*. The areas selected (and described in detail in Chapter 2.0) are as follows:

- Community Sensitive Design
- Road Ecology and Wildlife
- Agriculture
- Stormwater Management (SWM)
- Geometric Design
- Bridges

The innovative approaches outlined in this Guide are not a complete list, but rather a realistic starting point, a 'palette of ideas' for the Project Team to consider during the planning, design and construction phases of the new transportation facility.

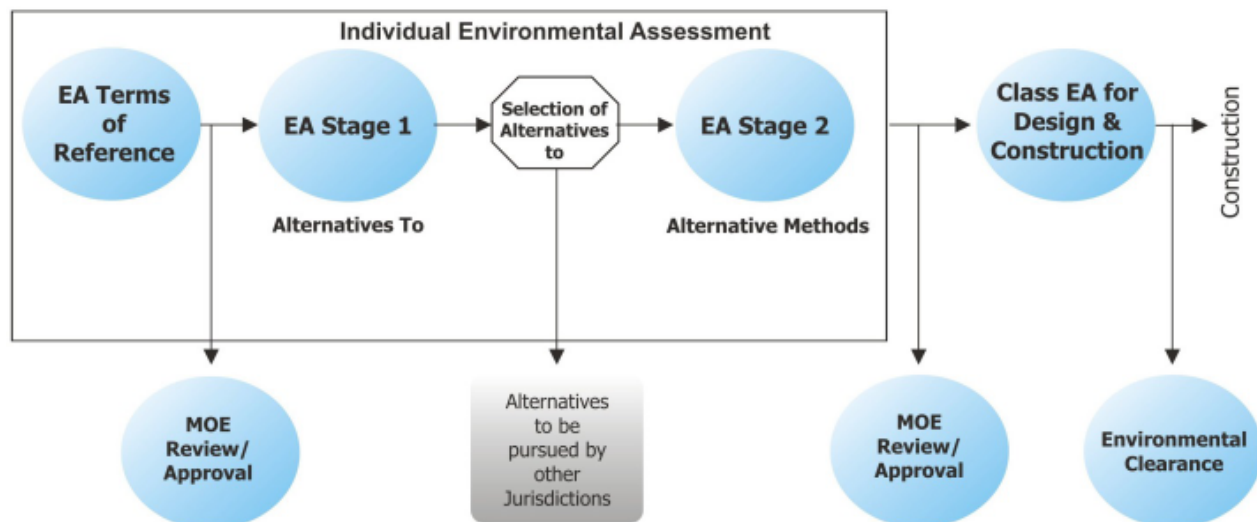
## 1.2 GTA WEST PROJECT OVERVIEW

The Ontario Ministry of Transportation (MTO) is committed to taking a comprehensive and long-term approach in planning for future transportation infrastructure. The GTA West Corridor Planning and Environmental Assessment (EA) Study, initiated in 2006, reflects government policy objectives, including those outlined in the *Growth Plan*, *Greenbelt Plan* and the *Provincial Policy Statement*. The objectives of these policies include a transportation network that links Urban Growth Centres through an integrated system of transportation modes characterized by efficient public transit, a highway system for moving people and goods with improved access to inter-modal facilities, international gateways, airports and transit hubs.

The GTA West EA Study aims to address long-term inter-regional transportation problems and opportunities through the development of an integrated, multi-modal transportation system. Enabling the efficient movement of people and goods, will provide better economic and transportation linkages between Urban Growth Centres in the GTA West preliminary study area.

Planning for major infrastructure projects in Ontario is conducted in accordance with the requirements of the *Ontario Environmental Assessment Act (OEAA)* (R.S.O. 1990) unless otherwise exempted. The GTA West study is following the requirements of the *OEAA* under the Individual Environmental Assessment (Individual EA) process (Section 6.1 (2) of the *OEAA*). The overall EA process for the GTA West Corridor is outlined in **Exhibit 1.1**.

### 1.1 GTA West Corridor Environmental Assessment Process



Stage 1 of the GTA West study (initiated in 2006 according to the process outlined in the Environmental Assessment Terms of Reference), included:

- Identifying specific transportation problems and opportunities within the preliminary study area;
- Developing, assessing and evaluating a range of Area Transportation System Alternatives to address the identified transportation problems and opportunities within the preliminary study area; and
- Recommending a *Transportation Development Strategy (TDS)* based on the Area Transportation System Alternatives carried forward from the evaluation.

The release of the *TDS* in November 2012 concluded Stage 1 of the EA and established the starting point for Stage 2 of the EA – Route Planning and Preliminary Design. The *TDS* includes recommendations for transportation improvements to be required throughout the Preliminary Route Planning Study Area.

The following are the key elements of the *TDS*:

- Support transit initiatives that are consistent with the Metrolinx Regional Transportation Plan and GO 2020;
- Optimize use of existing transportation infrastructure through Transportation Demand Management and Transportation System Management measures, in cooperation with Metrolinx;
- Initiate a region-wide Active Traffic Management Study (using technology to manage traffic);
- Widen selected highways to provide additional capacity, including HOV lanes (buses or 2+ occupancy) and multi-modal uses;
- Initiate a study to investigate longer term inter-regional transit opportunities linking western Urban Growth Centres; and
- New transportation corridor (highway plus transitway) from Highway 400 westerly and then southerly to connect to Highway 401/407ETR at the Halton-Peel boundary (see **Exhibit 1.2**).

The Preliminary Route Planning Study Area for the recommended new transportation corridor is shown in **Exhibit 1.2**. The new transportation corridor is proposed to include:

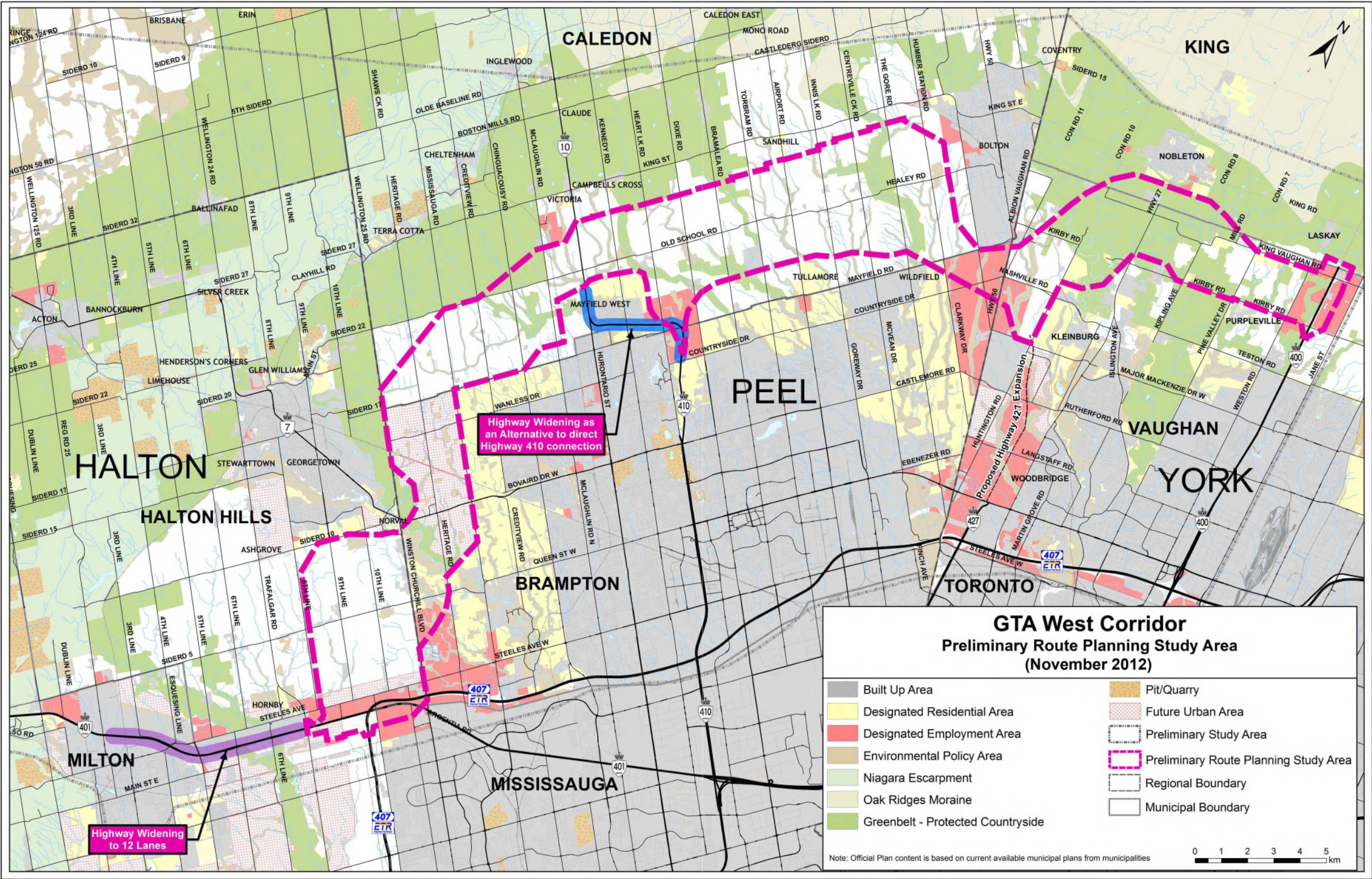
- 6 lanes (three in each direction) between Highway 400 and the Highway 427 Extension;
- 4 lanes (two in each direction) between Highway 427 and the north-south portion of the corridor near the Halton / Peel municipal boundary; and
- 6 lanes as the corridor turns south and connects to the Highway 401 / 407 ETR interchange in the Town of Milton and Town of Halton Hills.

HOV lanes may also be incorporated and, as standard MTO practice for all new 400-series highways, the proposed new corridor will include a provision for a transitway (an additional 60 m, making the right-of-way a total of 170 m).

The specifics of the proposed new transportation corridor will be explored in further detail during Route Planning and Preliminary Design.



1.2 Preliminary Route Planning Study Area (November 2012)

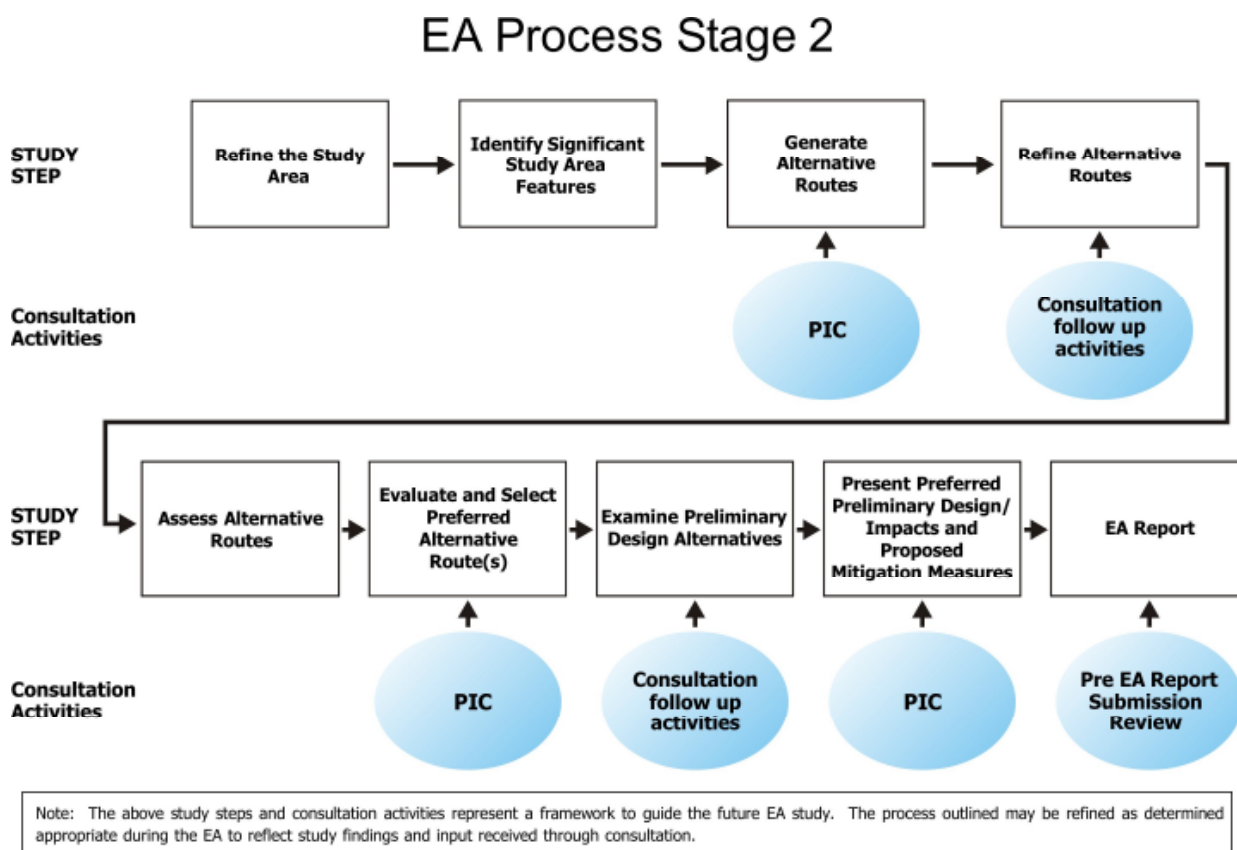




The Preliminary Route Planning Study Area is intended to be large enough to provide for several route alternatives as part of the process of selecting a preferred alignment. The proposed new facility (highway/transitway) will also include interchanges to connecting freeways and major arterials, sideroad connections /realignments, placement of transit / rail, and other related facilities such as stormwater management ponds, etc.

The preferred alignment, right-of-way requirements and individual property requirements for the new transportation corridor will be determined during Route Planning and Preliminary Design (see **Exhibit 1.3**). Extensive consultation opportunities will be included as part of the route selection process and beyond. This includes Public Information Centres (PICs), a Project Website and numerous other consultation activities that provide stakeholders and the public with opportunities to provide input on route and interchange location alternatives as well as the evaluation process.

### 1.3 Stage 2 Environmental Assessment Process



### **1.3 SCOPE OF APPLICABILITY**

This Guideline is intended to assist the Project Team in Stage 2 of the GTA West EA (Route Planning and Preliminary Design) and subsequent implementation phases. The principles and mitigation measures are intended to be applied to the proposed new GTA West transportation corridor for those areas where the new route passes through Greenbelt lands.

### **1.4 GREENBELT POLICY CONTEXT**

The *Greenbelt Plan (2005)* sets out policies to achieve the goals and objectives of the Greenbelt Act. The *Plan* permits existing, expanded or new infrastructure that serves the significant growth and economic development expected in Southern Ontario, by providing for the appropriate connections among urban growth centres and between these centres and Ontario's borders. The Greenbelt Plan Area (Schedule 1 from the *Greenbelt Plan*) is shown in **Exhibit 1.4**.

The Preliminary Route Planning Study Area for the new GTA West Corridor includes lands within the Greenbelt. A significant portion of the Greenbelt lands within the study area are associated with the Humber River Valley (which runs north to south), but there are also other Greenbelt features that may be impacted by the new transportation corridor.

The *Greenbelt Plan* was established in 2005, in response to a number of pressures, with the focus primarily on:

- Urban sprawl;
- Traffic congestion;
- Loss and fragmentation of agricultural lands; and
- Loss and fragmentation of important ecological features.

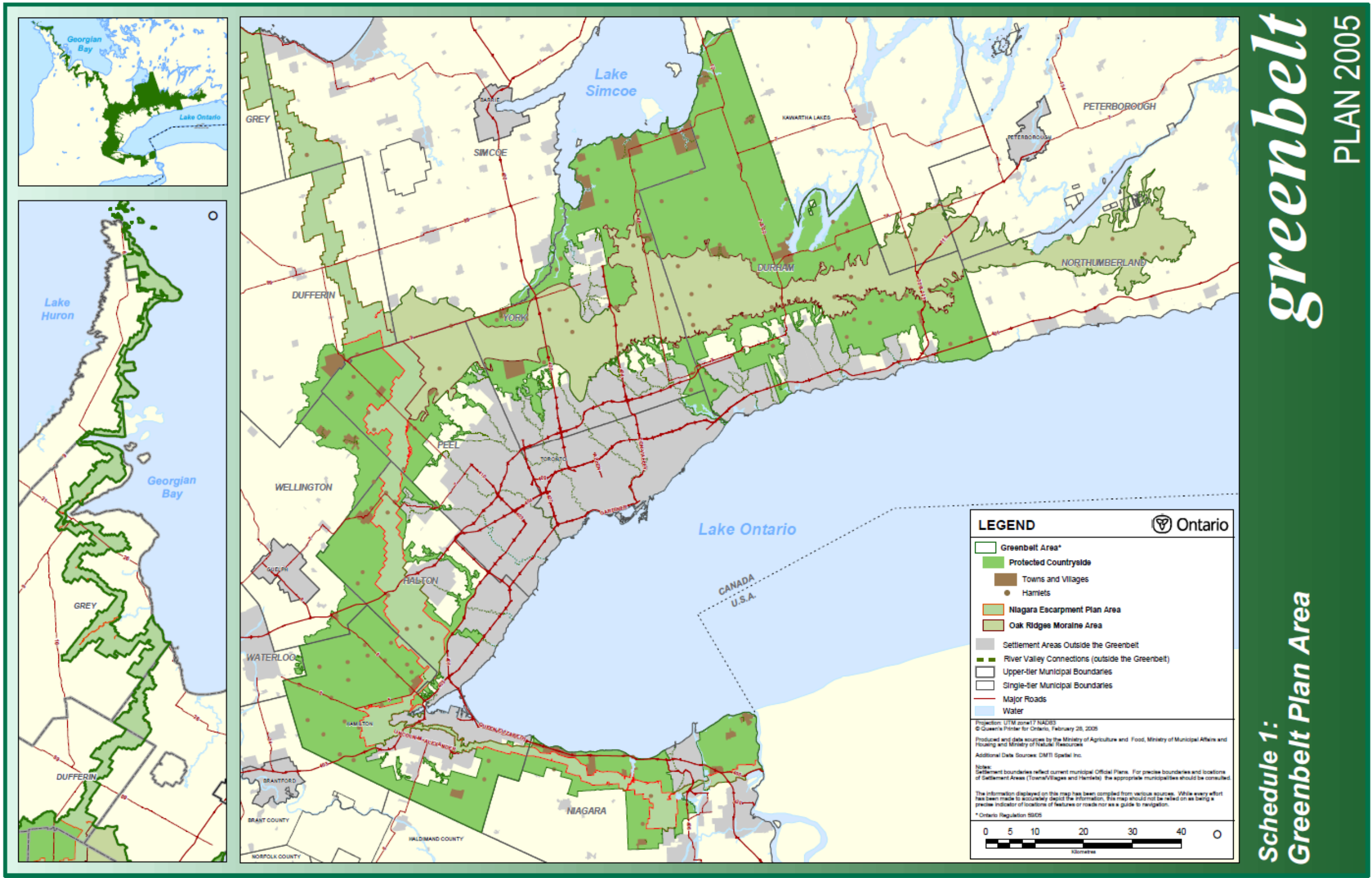
The *Plan* includes policies to protect against the loss and fragmentation of agricultural lands; provide permanent protection to natural heritage and water resource systems; and provide for a range of economic and social activities associated with rural communities.

As part of the Objectives and Goals, the *Greenbelt Plan* sets out specific policies to address how transportation infrastructure should be planned, designed and constructed and the justification that proponents must provide in proposing improvements to existing and/or new transportation facilities throughout the Greenbelt planning area. The goal of the infrastructure policies in the *Plan* are to support infrastructure initiatives that are consistent with the aim of the *Greenbelt Plan* and *Growth Plan*, while seeking to minimize impacts on the environment.

Overall, the *Greenbelt Plan* and *Act* note the need for balance. The importance of key infrastructure needed to support growth is recognized, but its needs are to be balanced with the need to support the goals of the Greenbelt and minimize impacts. The GTA West

Preliminary Route Planning Study Area includes a large portion of Greenbelt Planning Area, primarily extending through the Region of York with smaller portions in the Regions of Peel and Halton.

1.4 Greenbelt Plan Area (Schedule 1 from the Greenbelt Plan)



The following two policies identified in the *Greenbelt Act* and *Plan*, respectively, highlight support for transportation infrastructure that is environmentally sensitive while at the same time, achieving social and economic goals. They are:

Section 5(j): ensure that the development of transportation and infrastructure proceeds in an environmentally sensitive manner; and

Policy 1.2.2.5(a): support for infrastructure which achieves the social and economic aims of the Greenbelt and the proposed Growth Plan while seeking to minimize environmental impacts.

Two broad categories of existing, expanded or new infrastructure are permitted in Policy 4.2.1.1:

- a) It supports agriculture, recreation and tourism, rural settlement areas, resource use or the rural economic activity that exists and is permitted within the Greenbelt; or
- b) It serves the significant growth and economic development in southern Ontario beyond the Greenbelt by providing for the appropriate *infrastructure* connections among urban growth centres and between these centres and Ontario's borders.

In recognition of policies of the *Growth Plan*, a new GTA West corridor would serve the need for significant economic development in southern Ontario, providing connections among growth centres and beyond.

Policy 4.2.1.2 of the *Greenbelt Plan* notes that permitted infrastructure is subject to five key location, design and construction criteria which are as follows:

### 1.5 Five Key Greenbelt Infrastructure Criteria

1	<i>Policy 4.2.1.2(a)</i> Planning, design and construction practices shall minimize, wherever possible, the amount of the Greenbelt, and particularly the Natural Heritage System, traversed and/or occupied by such <i>infrastructure</i> ;
2	<i>Policy 4.2.1.2(b)</i> Planning, design and construction practices shall minimize, wherever possible, the <i>negative impacts</i> and disturbance of the existing landscape, including, but not limited to, impacts caused by light intrusion, noise and road salt;
3	<i>Policy 4.2.1.2(c)</i> Where practicable, existing capacity and coordination with different <i>infrastructure</i> services is optimized so that the rural and existing character of the Protected Countryside and the overall urban structure for southern Ontario established by the Greenbelt and any provincial growth management initiatives are supported and reinforced;
4	<i>Policy 4.2.1.2(d)</i> New or expanding <i>infrastructure</i> shall avoid <i>key natural heritage features</i> or <i>key hydrologic features</i> unless need has been demonstrated and it has been

	established that there is no reasonable alternative; and
<b>5</b>	<i>Policy 4.2.1.2(e)</i> Where <i>infrastructure</i> does cross the Natural Heritage System or intrude into or result in the loss of a <i>key natural heritage feature</i> or <i>key hydrologic feature</i> , including related <i>land-form features</i> , planning, design and construction practices shall minimize <i>negative impacts</i> and disturbance on the features or their related functions, and where reasonable, maintain or improve <i>connectivity</i> .

Greenbelts and related legislation are being used in many jurisdictions around the world. A jurisdictional review of similar Greenbelt-related legislation from around the world was compiled to compare distinctive natural features and review how each jurisdiction manages new infrastructure corridors in these areas. Each of the six jurisdictions reviewed addresses transportation and infrastructure within their Greenbelts in differing ways based on local planning principles and objectives. None of the jurisdictions prohibit the creation of new infrastructure projects in the greenbelt areas, although some have restrictions on how they are planned and constructed. For example, Melbourne's Green Wedges were designed to protect agriculture and open spaces and also to protect land to be used for future infrastructure, while Frankfurt's Greenbelt allows for new infrastructure if it is environmentally sound, adapts to the natural scenery and is carefully integrated into the public transportation and roads system and compensation is made.

Each of the Greenbelts reviewed was used as a tool to protect agriculture and open space for future generations from encroaching developments. All of these jurisdictions understand the need to protect their agricultural lands and natural heritage while balancing the needs for infrastructure for the local and inter-regional population.

## **1.5 OVERVIEW OF THE GREENBELT TRANSPORTATION ADVISORY GROUP**

### **1.5.1 Structure and Member Organizations**

Collaboration and consultation with Greenbelt stakeholder groups was regarded as critical for developing a new approach to planning transportation infrastructure in Greenbelt lands within the GTA West EA Study.

The GTA West Project Team sought input from Greenbelt experts and stakeholders in developing principles, guidelines and innovative solutions that support the vision, goals and infrastructure policies of the *Greenbelt Act* and *Plan*. The Greenbelt Transportation Advisory Group (GTAG) was established with the objective to assist in developing principles and guidelines that will be considered in Stage 2 of the EA, Route Planning and Preliminary Design.

Participation required a commitment to pro-actively contribute to ideas and discussion around mitigation, planning and design considerations for new transportation infrastructure in the Greenbelt and not about the need for, or where the alignment would be placed. It was

also made clear that participation by GTAG members would not be construed as endorsement of the highway recommendation that is included in the *Transportation Development Strategy*.

The following stakeholder groups confirmed their interest in participating on the GTAG:

- The Greenbelt Council
- Ontario Road Ecology Group (OREG)
- Burlington Green
- Oakville Green
- Coalition on the Niagara Escarpment (CONE)
- Christian Farmers Federation of Ontario
- Concerned Residents Against Superhighway in Halton Hills (CRASHH)
- Conservation Halton
- Credit Valley Conservation Authority
- Escarpment Biosphere Conservancy
- Friends of the Greenbelt Foundation
- Greenbelt Alliance
- GTA Agricultural Action Committee
- Ministry of Natural Resources
- Preservation of Agricultural Land Society (PALS)
- Protect Our Water and Environmental Resources (POWER)
- Ontario Professional Planners Institute (OPPI)
- Rural Ontario Municipal Association (ROMA)
- Ontario Farmland Trust
- Ontario Nature
- Ontario Road Builders Association (ORBA)
- Region of Halton
- Region of Peel
- Region of York
- Toronto and Region Conservation Authority

### **1.5.2 Process Overview**

Since being formed in December 2012, the GTAG met three times at facilitated workshops/meetings attended by members of the GTA West Project Team and MTO. This Guideline was the result of the work accomplished in these sessions. For details regarding the purpose, discussions, and outcomes refer to **Sections 1.5.3 to 1.5.5**.

Prior to the initiation of the GTAG, the Study Team undertook a jurisdictional review of similar Greenbelt-related legislation around the world and discussed the current research on minimizing impacts of new transportation infrastructure in sensitive (natural heritage and agriculture) areas, as well as the “state of the art” approaches to planning, design and mitigation from other jurisdictions.

An initial meeting with stakeholder groups representing a cross-section of interests across the Greenbelt was held to explain the GTAG initiative. Representatives were invited to participate in the GTAG, with an introductory meeting held on April 2, 2012.



The Project Team also engaged and kept the Greenbelt Council aware of the GTAG's progress. On March 25, 2013 the GTA West Project Team and MTO presented an update on the work of the GTAG at the request of the Greenbelt Council.

### **1.5.3 Workshop #1 – February 5, 2013**

Following the release of the GTA West Transportation Development Strategy in November 2012, the GTAG was re-convened and members were invited to attend a start-up meeting that was held in February 2013. The purpose of the workshop was to review the focus and process, and to begin generating a 'palette of ideas' or toolkit for consideration in the planning of a new GTA West transportation corridor within the Greenbelt.

An overview presentation of the GTA West study was provided, as well as a presentation from the Ministry of Municipal Affairs and Housing on the Greenbelt Plan and its policies. The group discussed some of the challenges to placing new transportation infrastructure in the Greenbelt, and how MTO might best consult with Greenbelt stakeholders as the EA proceeds to Route Planning and Preliminary Design.

Project Team specialists associated with six key topic areas presented information / dialogued with participants about possible innovations on topic areas including:

- Community Sensitive Design
- Road Ecology and Wildlife
- Agriculture
- Stormwater Management (SWM)
- Geometric Design
- Bridges

### **1.5.4 Workshop #2 – April 3, 2013**

The purpose of Workshop #2 was to apply the "Ideas Palette" developed during Workshop #1 to three representative areas in the GTA West Preliminary Route Planning Study Area. The focus was not to identify a recommended alignment in each area, but rather gain an appreciation of the various EA trade-offs involved in assessing alignment locations.

A presentation on the "Ideas Palette" and high level principles and guidelines was followed by the workshop portion of the meeting. Each of the three groups provided 'hands-on' input on the representative scenarios using acetate highway curves, markers, etc. to draw and label the constraints associated with possible alignment while discussing the circumstances and challenges associated with each.

The concept of Natural Capital was briefly discussed. It includes assigning an economic value to an existing natural feature / environment, similar to the way that goods and services are measured. The group shared their ideas on how this concept could possibly be applied in Stage 2 of the GTA West EA. Refer to **Section 3.0** for more details.

## **1.6 Presentation at Workshop #2**



### **1.5.5 Workshop #3 – June 21, 2013**

The purpose of Workshop #3 was to receive comment and feedback on the draft GTAG Guideline, which was provided in advance of the workshop.

An overview presentation of the draft Greenbelt Guideline's structure and context was provided. Following the presentation, attendees were engaged in plenary exercises in order to garner input on the draft Greenbelt Guideline.

A rotating section discussion exercise was then held. Attendees were split into three tables. Each table hosted two project team members, every 40 minutes, who reviewed the sub-sections of Section 2.0 in detail. The team members documented the detailed input from each table on large print-outs of the sections.

The following sections were discussed in tandem:

- Sections 2.1 and 2.3 (Community Sensitive Design, Agriculture)
- Sections 2.2 and 2.4 (Road Ecology and Wildlife, Stormwater Management)
- Sections 2.5 and 2.6 (Geometric Design, Bridges)

Following the rotating section discussions, there was an open discussion about Ecosystem Services. Section 3.0 of the draft Greenbelt Guideline was reviewed, including the proposed approach for incorporation into Stage 2 of the EA. Next steps were then reviewed.

At the conclusion of the meeting, the participation and invaluable input from GTAG members over the course of the study was acknowledged. Each member played an important role in helping to shape how the project moves forward. Tokens of appreciation

were distributed and members were encouraged to continue to be involved in Stage 2 of the EA.

#### **1.5.6 GTAG Consultation for Stage 2**

The Greenbelt Transportation Advisory Group (GTAG) has provided invaluable input into the development of this Guideline and on identifying potential GTA West study issues. The Project Team has appreciated their time and commitment. MTO is committed to continue to engage the GTAG as part of Stage 2 of the EA, and will be contacting the members to discuss participation opportunities once Stage 2 is initiated.

## 2.0 STAGE 2 – ROUTE PLANNING AND PRELIMINARY DESIGN

The *Greenbelt Plan* sets out policies for how transportation infrastructure may be planned, designed and constructed. Stage 1 of the GTA West Corridor EA addresses the need and justification for proposed improvements to existing facilities or new facilities through the Greenbelt planning area. Stage 2 of the EA (Route Planning and Preliminary Design) will address how transportation infrastructure will be constructed in the Greenbelt, which will be governed by the strict policies of the *Plan*.

Route Planning and Preliminary Design for the GTA West EA will involve the generation, analysis, evaluation and selection of route alternatives that will traverse the Greenbelt within the preliminary study area. During the analysis and evaluation of route alternatives a broad range of natural, socio-economic and cultural factors are considered along with transportation and technical considerations. This is sometimes referred to as the “triple-bottom line” approach considering the environment, community and economy. Recognizing the important provincial policies and objectives of the *Greenbelt Plan*, a focussed approach is required to respond to the policies and objectives of the plan where route alternatives traverse *Greenbelt Plan* areas.

Six topic areas, to be considered during the Route Planning and Preliminary Design stage, have been developed which respond to the five key Greenbelt Infrastructure criteria noted in **Exhibit 1.7**. In all cases, the topic areas identified respond to multiple Greenbelt infrastructure criteria as there are overlapping design and mitigation measures that are identified in **Section 2.0** that address multiple criteria. These six topic areas are intended to enhance or provide special emphasis for consideration of route alternatives within the Greenbelt and are not intended to replace the ‘triple-bottom line’ route evaluation process. Mitigation measures which address a combination of topic areas are preferred.

### 1.7 Key Greenbelt Infrastructure Criteria and Topic Area Linkage

Greenbelt Plan Infrastructure Criteria		Topic Area
1	<i>Policy 4.2.1.2(a)</i> Planning, design and construction practices shall minimize, wherever possible, the amount of the Greenbelt, and particularly the Natural Heritage System, traversed and/or occupied by such <i>infrastructure</i> ;	<ul style="list-style-type: none"> <li>• Road Ecology and Wildlife</li> <li>• Agriculture</li> <li>• Geometric Design</li> <li>• Bridges</li> </ul>
2	<i>Policy 4.2.1.2(b)</i> Planning, design and construction practices shall minimize, wherever possible, the <i>negative impacts</i> and disturbance of the existing landscape, including, but not limited to, impacts caused by light intrusion, noise and road salt;	<ul style="list-style-type: none"> <li>• Community Sensitive Design</li> <li>• Road Ecology and Wildlife</li> <li>• Stormwater Management</li> <li>• Geometric Design</li> <li>• Bridges</li> </ul>
3	<i>Policy 4.2.1.2(c)</i> Where practicable, existing capacity and coordination with different <i>infrastructure</i> services is optimized so that the rural and existing character of the Protected Countryside and the overall urban structure for southern Ontario established by the Greenbelt and any provincial growth management initiatives are supported and reinforced;	<ul style="list-style-type: none"> <li>• Agriculture</li> <li>• Bridges</li> </ul>
4	<i>Policy 4.2.1.2(d)</i> New or expanding <i>infrastructure</i> shall avoid <i>key natural heritage features</i> or <i>key hydrologic features</i> unless need has been demonstrated and it has been established that there is no reasonable alternative; and	<ul style="list-style-type: none"> <li>• Road Ecology and Wildlife</li> <li>• Agriculture</li> <li>• Geometric Design</li> <li>• Bridges</li> </ul>
5	<i>Policy 4.2.1.2(e)</i> Where <i>infrastructure</i> does cross the Natural Heritage System or intrude into or result in the loss of a <i>key natural heritage feature</i> or <i>key hydrologic feature</i> , including related <i>land-form features</i> , planning, design and construction practices shall minimize <i>negative impacts</i> and disturbance on the features or their related functions, and where reasonable, maintain or improve <i>connectivity</i> .	<ul style="list-style-type: none"> <li>• Road Ecology and Wildlife</li> <li>• Community Sensitive Design</li> <li>• Agriculture</li> <li>• Stormwater Management</li> <li>• Geometric Design</li> <li>• Bridges</li> </ul>

## **2.1 COMMUNITY SENSITIVE DESIGN**

### **2.1.1 Introduction and Applicability**

Community Sensitive Design (CSD) is an essential component in the evaluation, planning, design, construction and operation of transportation infrastructure within the Greenbelt. Although the *Greenbelt Plan* clearly articulates goals, policies and strategies for all aspects of the built form and natural heritage which comprises the Greenbelt, it is paramount that these be considered in a comprehensive and balanced approach. CSD engages the proponent, community and stakeholders in the process of planning, designing and operations, through a series of workshops and information meetings in search of a balanced approach. Alternative design solutions to highlight community based elements are developed and build community consensus through refining a selected design option.

CSD considerations address *Greenbelt Plan infrastructure criteria 2 and 5* (see **Exhibit 1.7**) as CSD can assist in minimizing the negative impacts to the landscape including impacts by light, noise and salt and maintaining or improving connectivity where crossing the Natural Heritage System.

Section 1.2.2 of the *Greenbelt Plan* includes five important goals to enhance urban and rural areas and overall quality of life, all of which form the backbone of CSD. The CSD process will consider and integrate the goals and opportunities of:

- Agricultural Protection
- Environmental Protection
- Culture, Recreation and Tourism
- Settlement Areas
- Infrastructure and Natural Resources

Furthermore, the *Greenbelt Plan* states that “*the location and construction of infrastructure and expansions, extensions, operations and maintenance of infrastructure in the Protected Countryside, are subject to...*” five key infrastructure criteria, which were previously outlined in **Exhibit 1.7**.

The *Greenbelt Plan*’s policies, strategies and goals clearly articulate a vision of acceptable alteration within the Greenbelt lands. As on other MTO 400 series EA Studies, an *enhanced public involvement program* can be implemented with one of the key activities being the development of a *Community Value Plan (CVP)*.

For Stage 2 of the GTA West EA, Route Planning and Preliminary Design, the GTAG recommended the development of a Community Value Plan for the Greenbelt i.e., a *Greenbelt Community Value Plan* that would focus on the geographic areas delineated by the Greenbelt Plan, rather than the entire length of transportation corridor. The approach to, and content under consideration is similar to a typical CVP other than the fact that special emphasis would be placed upon the Greenbelt’s unique and valuable attributes, such as agriculture, natural heritage and the hydrological integrity of watersheds.

### **2.1.2 Key Planning and Design Principles**

Planning recommendations and design solutions should respond to, and not precede the Community Value Plan (CVP). The CVP approach is a collaborative and interdisciplinary one. The goal of the process is to consider the scenic, aesthetic, historic, cultural and environmental settings of the study area and determine how best to fit the transportation corridor into these settings while maintaining the mobility and safety of users. The following key principles apply to the collaborative consultation process and to the solutions it will engender.

#### ***Principles for developing a Community Value Plan (Process)***

1. Communication with all stakeholders that is open, honest, early, and continuous.
2. A multidisciplinary team is established early, with disciplines based on the needs of the specific project, and with the inclusion of the public.
3. A full range of stakeholders and transportation officials are involved in the scoping phase. The purposes of the project are clearly defined, and consensus on the scope is forged before proceeding.
4. The highway development process is tailored to meet the circumstances. This process should examine multiple alternatives that will result in a consensus of approach methods.
5. A commitment to the process from top agency officials and local leaders is secured.
6. The public involvement process, which includes informal meetings, is tailored to the project.
7. The landscape, the community, and valued resources are understood before engineering design is started.
8. A full range of tools for communication about project alternatives is used (e.g., visualization).
9. Tracks and honours commitments through the life cycle of the project.

#### ***Principles for Designing a Community Value Plan***

The Project:

1. Satisfies the purpose and needs as agreed to by a full range of stakeholders. This agreement is forged in the earliest phase of the project and amended as warranted as the project develops.
2. Is a safe facility for both the user and the community.
3. Is in harmony with the community, and it preserves environmental, scenic, aesthetic, historic, and natural resource values of the area as identified by the stakeholders.
4. Meets or exceeds the expectations of both designers and stakeholders and achieves a level of excellence in people's minds, i.e. enhances the driving experience.
5. Involves efficient and effective use of the resources (time, budget, community) of all involved parties.

6. Designed and built with minimal disruption to the community.
7. Seen as having added lasting value to the community.
8. Respect for all stakeholders.

### **2.1.3 Toolbox of Mitigation Measures**

A ‘toolbox’ of design and mitigation strategies has been developed for each of the six topic areas that was developed based on feedback from the GTAG participants and expert input from the specialists involved in guiding the topic area discussions. The proposed ‘toolbox’ of Community Sensitive Design mitigation and enhancement strategies can be grouped into seven general themes:

- a. Universal Measures
- b. Landscape Screenings
- c. Gateways
- d. Architecture
- e. Local Heritage
- f. Wildlife Crossings
- g. Wetland Restoration

Examples of these mitigation measures are provided below.

- a. **Universal Measures** consist of a variety of mitigation and enhancement strategies that could be used throughout the corridor such as:
  - Use of low maintenance and salt-tolerant native plant species
  - Promoting pre-planting of vegetated areas
  - Naturalizing the appearance and function of stormwater management ponds
  - Using animal friendly fencing
  - Collecting and re-using of soils from construction areas
  - Using slope stabilization plantings
  - Using plant palettes and visual buffer plantings
  - Maintaining access to agricultural fields/operations
  - Erosion and sediment controls
- b. **Landscape Screenings** provide a screening effect for aesthetics, as well as providing sound and visual mitigation. They include:
  - Planting berms
  - Using trees and shrubs to disguise slope and ramp fills
  - Landscaping to buffer adjacent residential areas
  - Plantings to soften the look of sound barrier structures



- Using dense coniferous hedgerows to protect against wind, salt spray and snow drifting
- c. **Gateways Treatments** visually enhance the approach to a community located along the transportation corridor. They can:
  - Be built to reflect community, municipal and regional values
  - Include opportunities for public art
  - Include the use of signs with themed elements
  - Contain ornamental and salt tolerant plantings to compliment signage features
- d. **Architectural Enhancement Strategies** are used on road-related structures to complement the landscape character or local community. They may include:
  - Decorative lighting to reflect heritage or rural character of the area
  - Decorative signage on bridge structures
  - Themed motif or pre-cast liners on bridges
  - Design of noise barrier and acoustical function
- e. **Local Heritage Strategies** recognize the importance of local heritage and cultural resources in a community. This can include the use of:
  - Themed signage and other elements to reflect heritage character
  - Buffering measures to protect heritage elements
- f. **Wildlife Crossing** measures ensure the safe movement of animals across the corridor. They can include the use of:
  - Wildlife funnel-fencing to guide animals to and through the crossings, while restricting access to the roadway
  - Specially designed structures for wildlife passage
  - Plantings that provide food and cover at the crossing locations
- g. **Wetland Restoration Measures** should be considered in strategic areas. They can include:
  - Restoring lands back to wetland habitat
  - Using nodal plantings of native species to simulate natural succession
  - Using salt tolerant species to buffer wetland areas
  - Developing opportunities for educational and recreational use
- h. **Form and function of watercourses and aquatic habitats** should be considered.

Each of the above noted mitigation measures will also help to create the opportunity to attract tourists and showcase the local area.

The evolution of Community Sensitive Design in the Route Planning and Preliminary Design stage for the GTA West Corridor EA Study could follow the MTO Community Value Plan process (that was applied on the 407 East Individual EA Study). Community members living adjacent to or in close proximity to the subject transportation corridor are invited to participate on an on-going basis to share their knowledge of the Study Area and actively participate in the identification of cultural, social, historical and/or environmental values or concerns that define their community. Referred to as “Community Values”, these are developed through a series of workshops designed specifically for the project. For the GTA West project, the “Community” would be related specifically to the Greenbelt, with participants either living in, or having interests in the Greenbelt areas.

## **2.2 ROAD ECOLOGY AND WILDLIFE**

### **2.2.1 Introduction and Applicability**

Consideration of Road Ecology and Wildlife issues addresses *Greenbelt Plan* infrastructure criteria 1, 2, 4 and 5 (see **Exhibit 1.7**) as integrating road ecology and wildlife issues can assist in minimizing the amount of Greenbelt area impacts, minimizing the negative impacts to the landscape including impacts by light, noise and salt, avoiding natural heritage and key hydrological features and maintaining or improving connectivity where crossing the Natural Heritage System.

The essence of criteria 4 and 5 is that infrastructure, such as a highway facility, needs to be carefully positioned on the ecological landscape to minimize negative effects and maintain/promote connectivity. This objective reflects a Road Ecology perspective.

Road Ecology is a relatively new term that looks at the influence of roads on the environmental landscape from the following perspectives:

- Interaction of organisms and the environment with road systems in the landscape and vehicles;
- Assessment of road effects (habitat, mortality, barrier/filter); and
- Roadway design and environmental management.

Road Ecology looks at roads from a different perspective – not just blacktop, fill, and crossing structures, but rather as a linear system for the transport of goods and services that need to be better integrated into landscape ecosystems from a functional perspective.

Roadway effects have been discussed in detail in the scientific literature and can be summarized as habitat loss, changes in habitat quality, wildlife mortality, and reduced connectivity for organisms across the landscape.

To address Greenbelt policies concerning infrastructure, the application of Road Ecology principles and assessment is best done early – during the Route Planning and Preliminary Design stage.

### **2.2.2 Key Planning and Design Principles**

To reduce road effects and to better integrate the new GTA West corridor into the landscape ecosystem, the following route planning priorities should be followed, in descending order of priority:

#### **1. Avoidance**

- Avoidance of functionally important habitat areas and connecting areas is the first and highest priority, because once adversely fragmented, mitigation of impacts can be very difficult, if not impossible.

#### **2. Minimize habitat fragmentation**

- Fragmentation can act to reduce the size and function of a habitat area, increase its isolation, and reduce connectivity functions within the habitat patch for resources such as water, seed dispersal, aquatic species, and terrestrial wildlife. If avoidance is not feasible, intrusion into natural heritage features should be minimized and focussed on edges, because central fragmentation will essentially eliminate existing functions.

#### **3. Consider the road effect zone (or, secondary effects)**

- Road effects go beyond just the physical footprint within the right-of-way (ROW). Secondary effects can occur from contaminants (oil, metals, other vehicle materials), untreated road runoff (chemicals, dissolved road salts), microclimate changes (increased drying, temperature in newly exposed forest edges), introduction of (new roadway) or increase in traffic noise.
- The extent of these secondary effects can extend from tens to hundreds of meters depending on terrain, drainage, and habitat conditions. These effects are assumed to occur in grassland, wetland and forest environments, to varying degrees, and are influenced by traffic volumes, although the mechanism of effects, terrain influences, and species tolerances are still poorly understood.
- The envelope of effects, extending beyond the roadway ROW, should be considered when assessing roadway placement on the landscape.

#### **4. Employ innovative design and mitigation measures to reduce the impacts of the selected route**

- Route Planning for the GTA West corridor will be conducted in Stage 2 of the Environmental Assessment. From a Road Ecology perspective it would be preferred to select an alignment location that maximizes the protection of key/important ecological functions (aquatic and terrestrial) while also considering the other evaluation factors.

- The final step in this process is to maximize ‘Value Added’ to the selected route by developing and incorporating a toolbox of design and mitigation measures to help reduce/soften effects from the roadway footprint on the ecological landscape. These are reviewed further in **Section 2.2.3**.

### **2.2.3 Toolbox of Mitigation Measures**

The proposed ‘toolbox’ of Road Ecology and Wildlife design and mitigation measures which could be considered in the Route Planning and Preliminary Design stage of the GTA West Corridor EA includes the following:

- a. Dedicated wildlife crossing structures
- b. Wildlife habitat design elements for structures
- c. Median barrier openings
- d. Wildlife exclusion/funnel fencing
- e. Wildlife escape measures
- f. Wildlife signs/detection systems
- g. Highway landscaping and fields of view
- h. Habitat creation
- i. Monitoring

Each of the proposed mitigation measures are described in further detail below. In Ontario, Road Ecology design mitigation measures are already being implemented by MTO on several highway projects, notably Highway 69, as well as Highway 11, Highway 17 (Sault Ste. Marie), and the future extension of Highway 407 East.

#### **a. Dedicated wildlife crossing structures**

There are two main types of wildlife crossing structures:

1. Large overpasses that span the highway and allow wildlife to cross **over the highway**.
  - This type of structure provides ambient light, temperature and moisture conditions, favouring species that require and/or do not favour enclosed conditions (as with underpasses). Overpasses can be naturalized with vegetation, trees, shrubs and even ponds, creating a “mini ecosystem” for a broad range of target species (see Wildlife habitat design elements);
2. Underpasses, ranging from small to very large structures (including viaducts), which target wildlife species that pass **through/under the structure with the roadway located above**.

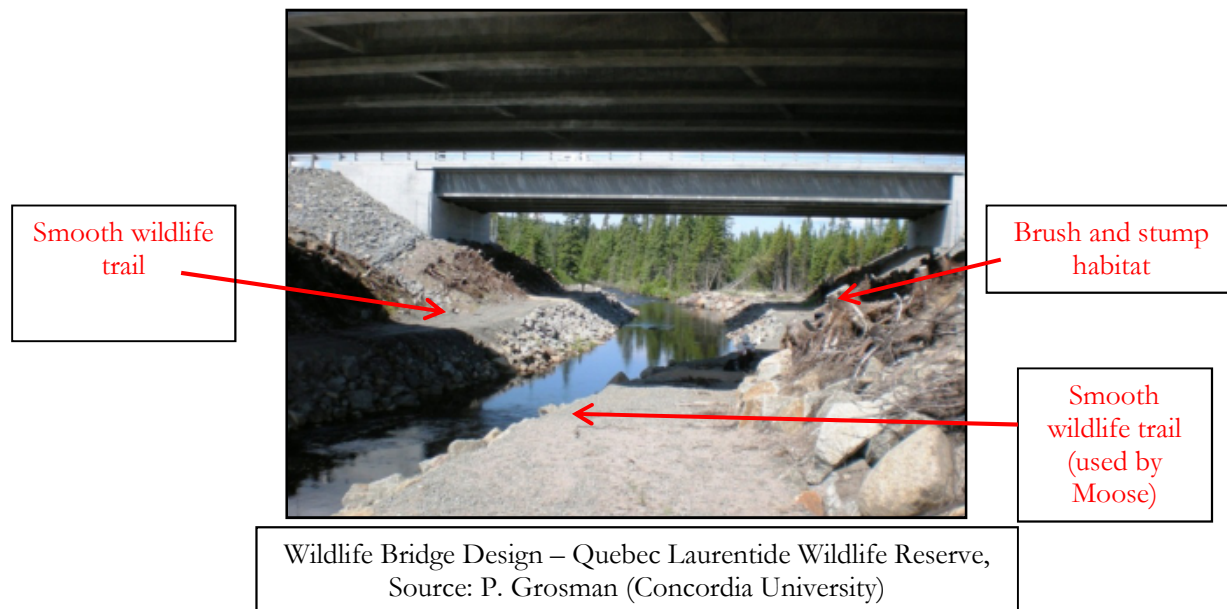
- Depending on size and length, these can represent a more enclosed environment favoured by some wildlife species and less so (or avoided) by others. Natural and, ideally, native substrates are typically provided, and other habitat elements can be added to facilitate wildlife passage.

Research/background information will be used to determine the best type of crossing for an area.

#### **b. Wildlife habitat design elements for structures**

Wildlife structures can be enhanced by providing various habitat elements on top of, within, or underneath the structure to facilitate wildlife use. These can include ponds and vegetation on top of overpasses, pipes, boulders, woody debris in culverts, and providing trails and other cover elements under bridges.

#### **1.8 Sample Wildlife Bridge Design**



#### **c. Median Barriers**

Median barriers can be installed to meet traffic safety needs while attempting to allow for wildlife habitat connectivity. Modified concrete median barriers may help to mitigate some of the wildlife crossing conflicts. Median barriers with small opening slots on the bottom are being used for drainage purposes in Ontario. This would allow passage by small animals. Similar but larger openings for the purposes of wildlife crossing have been tested for crashworthy and is being used in Texas. In

addition, overlapping median concrete barriers with gaps may permit animals otherwise trapped to cross the highway.

**d. Wildlife Exclusion/Funnel Fencing**

Wildlife funnel walls/fencing increase the effectiveness of wildlife structures, help to reduce wildlife mortality, and can also reduce vehicle accidents and human injury (or death). Funnel walls can consist of a variety of materials – stone, concrete, wood, composites, and wire mesh fencing. Overall, they should be durable, low maintenance, cost-effective, and effective at preventing target species from climbing and overtopping the wall.

**e. Wildlife Escape Measures**

Wildlife escape measures are also recommended within fencing near wildlife structures, to enable animals trapped on the roadway to access the habitat side safely. Designs are available for smaller wildlife as well as larger ungulates and carnivores.

**f. Wildlife Signs/Detection Systems**

Sometimes, provision of wildlife structures and funnel fencing is not feasible because of challenges with road profiles, not enough height to accommodate structures, constraints to providing fencing (such as existing land uses/buildings), or other variables. However, if a significant ungulate collision risk is evident, expected, or documented, some form of mitigation may be warranted. One option is a wildlife detection system with sensors placed along the ROW that detect wildlife movement across the sensor beam and trigger a flashing wildlife warning light/sign to warn motorists of an impending collision risk.

**g. Highway Landscaping and Fields of View**

Highway landscaping can be an important component of Community Sensitive Design (CSD), entailing the use of compatible native species that are aesthetically pleasing, non-invasive, add/maintain local vegetation diversity (native species whenever feasible), ensure motorist safety, and are compatible with local site conditions. Implementation of a highway vegetation plan should also ensure that the planting design does not provide a barrier screen between wildlife approaching the road and motorists.

**h. Habitat Creation**

Habitat creation, in recognition of some unavoidable impacts associated with highway footprints, is a design measure that MTO has been implementing for example, in the

Rt. Hon. Herb Gray Parkway undertaking, and in the planned final extension of Highway 407 East to Highway 115. Implementation requires considerable discussion with, and feedback from, resource agencies such as local Conservation Authorities as well as stewardship agencies to identify candidate priority areas for creation/enhancement as well as future maintenance requirements and responsibilities.

### **i. Monitoring**

Monitoring of wildlife structures and associated mitigation measures is important in order to:

- Assess the effectiveness of the structures and measures;
- Enable adaptive management by adjusting/changing designs of future highway stages based on monitoring findings; and
- Add to Road Ecology understanding for future projects.

Key monitoring principles identified in Road Ecology literature are:

- Monitoring should be multi-year (ideally 3-4 years), because wildlife typically require time to acclimatize to fencing and new structures.
- Remote triggered wildlife cameras are considered the best approach for multi-year studies.
- Video camera recording can be useful if there is a need to evaluate animal behaviour when approaching/using fencing and structures.
- Rates of use are important to document. Monitoring strength is increased if structure use is evaluated in terms of local wildlife abundance/distribution. These data are often unavailable during a typical EA, but could be collected through MTO/University research partnerships in advance of or as part of the planning work.
- Monitoring information is also enhanced if genetic information is also collected to determine number and sex of individuals using structures (which measures genetic exchange and effectiveness of structure in providing connectivity).

## **2.3 AGRICULTURE**

### **2.3.1 Introduction and Applicability**

Consideration of agricultural issues addresses *Greenbelt Plan* infrastructure criteria 1, 3, 4 and 5 (see **Exhibit 1.7**) as integrating agricultural issues can assist in minimizing the amount of Greenbelt area impacts, optimizing with different infrastructure services, avoiding natural

heritage and key hydrological features and maintaining or improving connectivity where crossing the Natural Heritage System.

The *Greenbelt Plan* supports agriculture and agricultural uses by allowing the expansion of existing use, providing that it will not have a negative impact on the natural or hydrologic features. The *Greenbelt Plan* does not allow for the creation of new non-agricultural uses of agricultural lands in the Greenbelt Area.

Section 3.1 of the *Greenbelt Plan* provides the specific policies for the Agricultural System in the Protected Countryside. The Agricultural System is comprised of specialty crop areas, prime agricultural areas and rural areas. The specialty crop areas are defined as the Niagara Peninsula Tender Fruit and Grape Area, and the Holland Marsh (which is not applicable to the GTA West study area). Prime agricultural areas are defined as those lands designated as such within municipal Official Plans. Rural areas are defined as “those lands outside of settlement areas which are not prime agricultural areas and which are generally designated as rural or open space within municipal official plans.”

*Greenbelt Plan* policies for prime agricultural areas indicate that these areas shall not be re-designated in municipal Official Plans for non-agricultural uses except for refinements to the area (subject to the criteria identified in the municipal implementation policies in Section 5.3 of the *Greenbelt Plan*), or settlement area expansions subject to the settlement area policies of Section 3.4 of the *Greenbelt Plan*. Other uses may be permitted subject to the general policies of Sections 4.2 to 4.6 of the *Greenbelt Plan*.

With respect to the construction, operation and maintenance of any infrastructure in an agricultural area there are a number of key potential impacts and concerns. Three key potential impacts that were identified within the *Greenbelt Plan* are: light intrusion, noise, and road salt.

- Light intrusion
  - Light intrusion would be considered to be the addition of any new light sources into the protected countryside. New light sources may include vehicle headlights, road and intersection lighting.
- Noise
  - Noise impacts are related to the excess noises produced during the construction, operation and maintenance of any new infrastructure.
- Road salt
  - Road salt impacts occur during the colder months when the use of de-icing salt is applied to the road surface. Road salt impacts include salt spray (mist migrating from the infrastructure onto agricultural lands and crops) and the accumulation of road salts in surficial drains and sedimentation ponds.



Previous infrastructure studies and discussions with potentially affected landowners identified additional impacts and concerns, including (but not limited to):

- Loss of agricultural land
  - Direct loss of land for agricultural production is a major impact to agriculture. Loss of land to an agricultural operation may be significant enough to affect the viability of the operation.
- Loss of agricultural buildings
  - Loss of agricultural buildings could result in the loss of an agricultural business (depending on the type of farm operation and the use of the particular building).
- Property/field fragmentation
  - Property fragmentation impacts are related to the severing/fragmentation of a farm property by the proposed infrastructure. Fragmentation of a property may create: a land locked parcel; a parcel too small to farm; or a parcel that has a shape that makes it difficult to farm.
- Property/field access
  - Property/field access impacts are related to fragmentation and infrastructure design. A fragmented field may be difficult to access due to: land locking; sight lines to vehicular traffic on side roads; or by the creation of raised ramps and overpasses which may limit farm/field access.
- Surface/groundwater /drainage disruption
  - Impacts relate to the potential disruption of surface water sources (streams, creeks, ponds), groundwater sources (drilled/dug wells, artesian springs), and tile drainage that are used for agricultural production.
- Local traffic disruption (during construction and road closure events)
  - Impacts relate to the potential closure (temporary or permanent) of side roads which would limit access to farms/fields or potential suppliers/markets. Additional traffic impacts are related to the potential narrowing of roads during construction resulting in inadequate lane widths for the transportation of wide farm machinery. Similar concerns were raised about moving farm machinery from one location to another on side roads that bridge new infrastructure. Concerns relate to the line of sight to the other side of the bridge and the potential narrow width on any new structures, making it difficult to transport wide agricultural equipment.
- Fragmentation of the agricultural community
  - A potential concern due to the creation of infrastructure that severs the farm community.
- Relocation of farm operations
  - Due to the loss of adequate space to continue to farm after the construction of the infrastructure is a potential impact to agriculture.

- Loss of access to rental properties due to Side/Concession Road closures at highway crossings.
  - Similar to the potential to fragment the agricultural community, the loss of access to agricultural rental properties due to Side/Concession Road closures at highway crossings is a potential impact.
- Traffic (farm vehicle interaction with traffic on roads and bridges).

These potential concerns and impacts play a role in the planning and design of infrastructure such that any impacts are minimized to the extent possible for agriculture when agricultural factors/parameters are considered in conjunction with potential impacts to other environmental factors.

### **2.3.2 Key Planning and Design Principles**

It is recognized that the design, construction, operation and maintenance of infrastructure will result in the loss of land and create impacts to agriculture. It is that recognition of impacts to agriculture that has resulted in the creation of the policies within the *Greenbelt Plan* and respective Official Plans to minimize impacts and provide (where reasonable) mitigative measures in the agricultural areas.

The following route planning priorities should be followed:

- Minimize impacts to agriculture. Class 1 to 3 lands should be given high recognition.
- As per standard practice, input from agricultural groups and individual farmers will be sought out and incorporated into the decision making process. Mitigation to property fragmentation and field access will be important considerations.

### **2.3.3 Toolbox of Mitigation Measures**

The proposed 'toolbox' of Agricultural design and mitigation measures which could be considered in the Route Planning and Preliminary Design stage of the GTA West Corridor EA includes the following:

- Use of light shielding, shorter light poles and adaptive lighting to minimize light intrusion in agricultural and natural areas.
- Planting (and maintaining) of berms, barriers or vegetation to minimize impacts from noise.
- Planting (and maintaining) of berms, barriers or vegetation to minimize impacts from road salt.
- Salt management plans to reduce the amount of salt required for de-icing through the use of different application systems (such as liquid de-icers, broad casting, and selective broad casting).

- Design linear highway facilities to traverse along mid-concession roads, lot lines (where reasonably possible), or adjacent to other existing linear features (hydro corridors) to minimize loss of, or fragmentation of, agricultural lands.
- Highways are created with specific design standards. In some areas, these standards could be reduced to allow for the tightening of road curves to avoid specific features.
- Construct new agricultural buildings/facilities to mitigate the loss of agricultural buildings. This mitigative measure is site specific and would depend on the nature of the agricultural operation and the net result of the impacts to the operation.
- Construct or replace appropriate access points for property/field access impacts. In the case of land locked parcels, opportunities may allow for the sale and/or purchase of these properties by adjacent landowners for their use.
- Avoid surface water features where possible; relocating the feature (with enhancement to the relocated feature), where appropriate, and providing sediment ponds to prevent direct access of road water to the surface water feature.
- Provide new wells or other water access (such as a water tank and trucked water) for potential disruptions to groundwater.
- Restore any impacts to tile drainage systems.
- Provide a traffic plan that identifies closures and open routes to minimize impacts to local traffic.
- Maintain local roads to allow for the movement of oversized agricultural equipment which may require the use of additional signage and/or flagging.
- Maintain cross road access over/under highway infrastructure to mitigate the potential for the fragmentation of the agricultural community and loss of access to rental properties.
- Consider relocating farm operations as a result of the removal of agricultural land subject to individual property owner requirements.
- Consider potential traffic concerns related to line of sight and farm vehicle interactions on bridge ramps and bridge structures.
- Cross the Greenbelt at the narrowest point.

## **2.4 STORMWATER MANAGEMENT**

### **2.4.1 Introduction and Applicability**

Stormwater management design addresses *Greenbelt Plan* infrastructure criteria 2 and 5 (see **Exhibit 1.7**) as stormwater management can assist in minimizing the amount of Greenbelt area impacts, minimizing the negative impacts to the landscape including impacts by light, noise and salt, avoiding natural heritage and key hydrological features, and maintaining or improving connectivity where crossing the Natural Heritage System.

The *Water Resource System* within the Greenbelt, including its significance and context within the *Natural Heritage System* is generally described in Section 3.2.1 of the *Greenbelt Plan*. Water resource systems and their required protection are highly integrated into most if not all aspects of the *Greenbelt Plan*.

Accordingly, in areas of the Greenbelt potentially affected by projects such as the GTA West Transportation Corridor, an approach to *Stormwater Management* (SWM) is required to ensure impacts on the Greenbelt and downstream watercourses are adequately mitigated. SWM includes the control of precipitation/run-off from storm events, but is generally recognized as an expanded term whereby an effective set of SWM plan objectives are defined as follows in Section 4.2.3 of the *Greenbelt Plan*:

3. *The objectives of a stormwater management plan are to avoid, minimize and/or mitigate stormwater volume, contaminant loads and impacts to receiving water courses in order to:*
  - a. *Maintain groundwater quality and flow and stream baseflow;*
  - b. *Protect water quality;*
  - c. *Minimize the disruption of pre-existing (natural) drainage patterns wherever possible;*
  - d. *Prevent increases in stream channel erosion;*
  - e. *Prevent any increase in flood risk; and*
  - f. *Protect aquatic species and their habitat.*

The effectiveness of a SWM strategy for areas of works that must encroach into the Greenbelt will be seen and judged in terms of how Greenbelt environmental and water resource values are being addressed and preserved.

#### Highway impact issues/concerns

The physical presence of a highway as well as its ongoing operation can directly affect the existing hydrologic functioning of an area and its water balance. Examples of removed or altered natural water environment functions can include infiltration and ex-filtration regimes, sediment regimes, and micro flow path changes. The extreme complexity of various interactions within the water environment makes accurate replication of more sensitive systems very difficult. The first principle of Stormwater management planning in the

Greenbelt, avoidance of the Greenbelt, is meant to recognize the difficulty of adequate replication of detailed function.

Impacts of highway projects can otherwise generally be grouped according to two main descriptors which are water quantity and water quality. These main areas are also quite integrated, as are the life cycle considerations of a highway project. Water quality and quantity issues are different at different periods of a highway's life cycle, with the main divider being before and after construction. Seasonal considerations are also important such as winter maintenance. Ensuring long term commitment to ongoing maintenance should also be considered, or the highway has potential to decrease its environmental performance.

#### Role in highway planning and design

With appropriate understanding of the various existing water environment issues and their interactions, the predicted effects of various routes and designs can be assessed with required mitigating measures put in place. However, the level of baseline study required to ensure the design of highway project can minimize impacts becomes more extensive as complexity issues are better understood. Within the Greenbelt, policies indicate expectations are very high with respect to the level of knowledge of site specific water environment potential impacts. Expectations are similarly high regarding reliability of the predicted effects of potential SWM measures.

As one of the many aspects of planning, the quick identification of potentially high impact SWM issues is essential in order that the overall route selection and design processes are well guided. In some cases SWM issues will drive the routing of the highway as perhaps one of the most important issues being considered. In others, the application of known and successful mitigation approaches will allow route selection to proceed with more degrees of freedom.

### **2.4.2 Key Planning and Design Principles**

Within the Greenbelt there is an added recognition of the balanced interplay between all the potential impacts upon the water environment. The *Water Resource System Policies* and related *Key Natural Heritage Features and Key Hydrologic Features Policies* in the *Greenbelt Plan* (Sections 3.2.3 and 3.2.4) outline the protection principles and methods.

One of the key planning principles for projects in the Greenbelt is the recognition of the need to consider watershed scale planning.

Another key SWM and highway planning principle, firmly rooted in appropriate understanding of various complex water environment interactions, is taken from Section 3.2.3 of the *Greenbelt Plan* with underline/bold added for emphasis as follows:

*All planning authorities shall provide for a comprehensive, integrated and long-term approach for the protection, **improvement or restoration** of the quality and quantity of water.*

Recognition in the planning process needs to be made that within the Greenbelt there may be areas that could benefit from improvements and restorations associated with a project. As a general principle, true restoration can be a powerful motivator to allow change.

As a general principle, the most effective mitigation measure is avoidance or reduction of specific potential problems and issues through thoughtful routing and placement. For example, valleys should be spanned completely when possible to avoid interactions in sensitive flood plain areas, with a crossing at ninety degrees (if possible). In terms of SWM issues, some guiding principles are available to allow quick focus on evaluating and pricing required infrastructure and land costs associated with various routing choices.

Data for potential impacts within Greenbelt areas can be obtained from existing government agencies as well as some non-governmental organizations (NGOs). Another general principle is pre-consultation with appropriate agencies, as well as their general involvement in the process for ongoing comment. The knowledge gained from this consultation will allow a quick and effective read of potential problems, provide useful avoidance strategies and ensure issues of increased importance are brought to the forefront.

A third general principle for planning and design is a general adoption of a Low Impact Development (LID) approach, where feasible, to address SWM. A highway project can be a big challenge for implementing an LID approach to infrastructure design due to its inherent intense development, salt use, high imperviousness, high pollutant loadings, and spills potential. However, if these risks are properly accounted for and managed within a good design approach, an LID approach can be integrated into the SWM plan. The long linear nature of roadways for instance lends itself well to some types of quality treatment.

Lastly, the implementation of currently non-standard and technologically advanced approaches to solving various SWM challenges should be considered. These will need to be matched to adaptive management approaches within their long term monitoring plans, with contingency plans put in place. Implementation of non-standard approaches to SWM measures within the Greenbelt may be considered given an expectation to monitoring, maintenance and adjustment as required.

### **2.4.3 Toolbox of Mitigation Measures**

Standard mitigating measures for SWM are well known, including their predicted effectiveness in mitigating pollutants and attenuating flows. These should be compared in the context of project requirements and when found insufficient, additional less standard measures could be investigated and potentially implemented. Low Impact Development (LID) approaches and specific mitigation measures may be considered as a part of the options available.

The proposed 'toolbox' of SWM design and mitigation measures which could be considered in the Route Planning and Preliminary Design stage of the GTA West Corridor EA is outlined in **Exhibit 1.9**. Both standard and additional SWM measures are contained in

**Exhibit 1.9** and also included, where appropriate, are broad considerations of increased cost for implementing alternative items as well as required maintenance.

1.9 SWM Toolbox Measures

SWM Focus Area:	Standard SWM Examples	Additional Alternatives and Options
Water Quantity Issues		
Peak Flow control	Surface ponds.	Underground vaults (results in greatly increased costs, however land costs are saved). Reduction in runoff through LID approaches, although harder to rely upon for infrequent storm events.
Flooding impacts	Ensure flood plain levels and storages are preserved through 1D (HEC-RAS) modelling.	Consider 2D modelling approaches in complex areas to best determine configuration (generally results in extra modelling and survey costs).
Erosivity of flows	Extended detention and volume control, event modelling and extrapolation to long term.	Detailed geomorphic driven erosion threshold analysis, including continuous hydrologic analysis to match long term erosivity. Erosivity analysis can be linked to water budget with SWM design affected to address both in an integrated fashion.
Water Balance & Base Flows	General ‘spreadsheet’ approach to guide SWM plan.	Long term continuous modelling to ensure proposed hydrologic regime will respond close to existing conditions. Adjustment of SWM plan as required. Links to erosivity ( <i>see above</i> ).
Groundwater Interaction	Identify areas of high infiltration and also groundwater ex-filtration.	Specialized design of infiltration facilities specific to roadway risks and targeting infiltrative soils. Conveyance of ex-filtration base flows through design.
Water Quality Issues		
Erosion and Sediment control during construction	Temporary siltation ponds, siltation fence, rock check dams.	Flocculation agents in ponds, highly time-managed cut and fill area restoration. Active management and attention to ensure effectiveness.
Controlling suspended sediments – ongoing roadway operation	Surface quality ponds, wet ponds, wetlands and hybrids. Usually part of quantity control ponds. An enhanced level of control is required.	High end filtration devices and approaches (higher costs and more ongoing maintenance). Bioswales and other LID type approaches.
Nutrients and Metals	Reduction through sedimentation at quality ponds and vegetated swales.	Filtration for pollutants adhered to fine sediment. Media adsorption for removal of dissolved pollutants.
Hydrocarbons	Some capture in SWM facilities, especially bottom draw. Oil grit separators where ponds not feasible.	Oil grit separators integrated into SWM plan, especially at high potential spill areas in front of SWM ponds and infiltration facilities.
Chlorides (salt)	Targeted use-reduction management, reductions through dissolved brine application.	Reduction in use strategies, automatic applications at high use areas such as bridges. Active detention of high concentrated runoff for later release to maximize dilution. Development of salt management strategies for maintenance operations within the Greenbelt.
Temperature	Bottom draw SWM facilities having permanent water features.	Integrated measures such as floating islands on SWM facilities, dry facilities combined with removal of sediments through other methods. Buried storage could also be considered.



## **2.5 GEOMETRIC DESIGN**

### **2.5.1 Introduction and Applicability**

#### *Geometric Design Defined*

Geometric Design is a component of highway engineering that involves the selection of the visible components of a road. These visible components include horizontal alignment, vertical profile, cross-section (e.g., lane width, shoulder width, etc.), and other elements such as interchanges. Also included in the overall highway design process are illumination, drainage features, and ancillary facilities such as maintenance yards.

Geometric Design considerations address *Greenbelt Plan* infrastructure criteria 1, 2, 4 and 5 (see **Exhibit 1.7**) as Geometric Design can assist in minimizing the amount of Greenbelt area impacts, minimizing the negative impacts to the landscape including impacts by light, noise and salt, avoiding natural heritage and key hydrological features and maintaining or improving connectivity where crossing the Natural Heritage System.

#### *Highway Impact Issues/Concerns*

The construction of any new road or the widening of an existing road will have impacts to the surrounding environments. Impacts can be negative, such as the removal of wildlife habitat, or positive, such as improving the transportation network to support economic growth.

The most significant impacts of a new highway are the direct or ‘footprint’ impacts, as a result of the physical construction of the highway. Within the right-of-way of a highway, the existing terrain is supplanted by the roadway itself, including pavement, fill materials and the cutting of the existing ground. Vegetation and other features may be removed to provide ‘clear zones’ adjacent to the roadway in order to reduce the chance of errant vehicles colliding with the objects, and also to improve visibility for drivers negotiating curves or intersections. Requirements for the highway right-of-way typically require the acquisition of patented land, and may result in the displacement of residences, businesses or development.

Interchanges are key elements of a full-controlled access highway that provide connections to adjacent communities. These typically require an enlarged footprint to accommodate a safe and efficient design of on- and off-ramps.

Ancillary facilities such as commercial vehicle inspection facilities or patrol yards may be required to support new or improved highways; these facilities have additional footprint impacts and, in the case of patrol yards, implications of on-site salt storage also need to be considered.

A potential significant impact of highway construction to the natural environment is the fragmentation of continuous features such as wetlands, watercourses, agricultural operations,

communities, etc. These impacts could be mitigated by providing connections above or below the highway.

Construction activities for new or improved highways will also have impacts including construction noise and dust. Additional footprint impacts due to construction staging activities may also occur, however, these types of construction activities are temporary.

#### *Role in Highway Planning and Design*

In planning a new highway, the first principle is avoidance of significant features during generation of alternative alignments. Then, for those alternatives that would have resulted in environmental impacts, mitigation is developed to minimize or eliminate the impacts.

The challenge of Geometric Design within the planning process is to provide the best balance between competing objectives. For example, the safest design for a highway may be a divided highway with long, flat curves, wide medians and gentle side-slopes; however, such a design has a correspondingly large footprint and may have little flexibility in avoiding significant features, which may result in significant impacts to the natural, socio-economic and cultural environments as described above. Conversely, a highway that employs tight curves, has a narrow or no median, narrow shoulders and steep side-slopes may minimize footprint impacts; however, such a design may have negative implications on safety and traffic operations. The challenge is to provide the best ‘trade-off’ balance that considers all environments.

### **2.5.2 Key Planning and Design Principles**

In general, a well-designed highway will strike an acceptable balance between level-of-service, cost, environmental impact, and safety. What is considered ‘acceptable’ is subjective, and depends on local values, legislation, and policies. In particular, opinions on local values may differ, and design efforts must be considered as part of the larger planning process, which includes consultation with the public, agencies, and other stakeholders.

Planners and designers recognize that for any new highway or highway improvement project, each study area will be unique and have a unique set of values, constraints, objectives, and other characteristics; the various parts of a single study area may differ in their characteristics. To that end, designers and planners must employ context sensitive design in order to best address the needs of given area or community. The broad-brush application of a singular design philosophy may not be appropriate in a given locale.

The hallmarks of context sensitive design are consultation with communities, agencies and stakeholders, and flexibility in Geometric Design requirements. This does not imply an ‘anything goes’ approach to design, however, and the basic objectives of a good design must be kept in mind throughout the process.

Objectives include the following:

- **Mobility** – Provision of mobility is the prime benefit of a roadway. This may be quantified by highway capacity, traffic volumes, traffic level-of-service, travel time, and other measures.
- **Environmental Impacts** – A good design will limit impacts to the natural, socio-economic and cultural environments as much as reasonably possible, within the context of the overall objectives of the project.
- **Safety** – While it is not reasonable to expect that any roadway will be “completely safe,” the goal of the designer is to develop a design that is as safe as possible while still addressing other objectives of the project. It is recognized that no roadway is collision-free over the long-term; however, a good highway design is one that has a relatively low collision frequency.
- **Capital Costs** – Lower capital costs are preferred over higher costs; however, it is understood that choices made as part of the context-sensitive design process may not represent the lowest-cost alternative for a given solution. The design challenge is to develop solutions that are effective in mitigating impacts without incurring unreasonably high capital costs.
- **Maintenance Costs** – While capital costs represent the up-front costs associated with construction, maintenance costs are the long-term costs of keeping the highway facility operating safely and efficiently. As with capital costs, a design that is effective in mitigating impacts may not have the lowest maintenance costs of the alternatives considered; however, this may be acceptable provided that the long-term costs are not unreasonably high.
- **Aesthetics** – The visual appeal of a highway is significantly influenced by the choices made as part of Geometric Design. Aesthetics must be considered from both highway users and observers at other locations. Good design aesthetics are typically achieved by the careful coordination of horizontal and vertical curves to best match the existing topography. It is noted that an aesthetically pleasing alignment can improve the driving experience, and even reduce collisions.

### **2.5.3 Toolbox of Mitigation Measures**

With the evolution of context sensitive highway design in recent decades, designers have a wide range of mitigating measures to choose from to address the many different constraints and issues that are encountered as part of the highway planning process. Further, many of the mitigating measures available have been in service elsewhere (e.g., other cities, provinces or countries), and the designer is often able to refer to the operational experience of a given measure in order to evaluate its appropriateness to the situation at hand.

The proposed ‘toolbox’ of Geometric Design mitigation measures which could be considered in the Route Planning and Preliminary Design stage of the GTA West Corridor EA includes the following:

### ***Footprint Reduction and Avoidance of Sensitive Features***

Footprint reduction is typically accomplished by using as narrow a highway cross section as possible. Measures to reduce the cross section can include:

- *Reduced median width* – This may involve using a closed/urban median, in which the two directions of traffic are separated by a hard median barrier. Typically, a median barrier is required where the median is less than 22.5 m wide, in order to prevent cross-median collisions. It is noted that wide, gently sloped medians (which normally do not require barrier protection) are generally considered safer than a barrier-separated median; this is because in an open median, vehicles do not collide with the physical barrier, and there is less chance of a vehicle hitting the median and deflecting back into traffic, which may cause secondary collisions.
- *Steep side-slopes* – Flat side-slopes (e.g., 6:1 slope) are desirable, in that errant vehicles can retain control, and there is reduced risk of a vehicle rollover. Flat slopes, however, typically have large cut or fill footprints, with corresponding footprint impacts. Steeper slopes have a smaller footprint; however, vehicles are more likely to lose control and/or roll over on steeper slopes. Typically, steep side slopes require barrier protection to prevent vehicles from leaving the roadway; however, this has the same implications as median barriers with respect to barrier collisions.
- *Reduced shoulder width* – This strategy reduces the highway footprint and reduces footprint impacts. Care must be taken with the decision to reduce shoulders, as disabled vehicles and emergency vehicles will be more vulnerable when stopped.
- *Retaining walls/structures* – The use of retaining walls can be very effective in reducing cut and fill footprints. Typically, retaining walls are more costly than traditional cuts and fills, both in terms of capital and maintenance costs; however, they are in relatively common use where footprint impacts must be minimized.
- *Curb and gutter* – Curb and gutter may be applied as a roadside drainage feature in order to reduce the cross section requirements associated with open ditches. Construction and maintenance costs are generally higher than for ditches.
- *Vertical alignments* – Appropriate design of the vertical alignment of a highway that results in no excessive cut or fill will also reduce the footprint. Treating the two directions of the highway as separate roadways in terms of vertical alignment can better match the existing terrain and reduce cut and fill requirements.
- *Depressed roadway* – Where feasible, a depressed roadway can limit noise and visual impacts. It is noted that watercourse passage requirements may preclude a depressed roadway in some locations.
- *Causeway* – Causeways, which are normally long, low bridges, can reduce footprint impacts by spanning over sensitive areas and retaining connectivity. Construction and maintenance costs are high for this measure, and special techniques (e.g., top-down construction) may be required to minimize construction impacts.

- *Reduced ancillary facility requirements* – A decision to construct fewer interchanges, inspection facilities, patrol yards, etc., would reduce footprint impacts, as well as capital cost. These decisions must be considered carefully with respect to impacts on mobility, emergency response, and other factors.
- *Interchange types* – Where interchanges are required, the choice of interchange configuration has an effect on the size of the footprint impacts. For example, the ‘Parclo A4’ interchange configuration is desirable in terms of traffic capacity, safety and operations; however, it has a relatively large footprint, and associated impacts. A ‘tight diamond’ interchange, by comparison, has a smaller footprint; however, if high traffic volumes are anticipated, this interchange configuration may not operate as well as higher-capacity alternatives.

Examples of some of the mitigating measures described above are shown in **Exhibit 1.10**.

Avoidance of sensitive features may be accomplished by footprint reduction, as described above. A reduced cross section concept may be appropriate for application to the Greenbelt areas of the current study. The typical cross section for a new freeway includes wide, flat medians and side-slopes, and a 110 m right-of-way. A reduced ‘Greenbelt cross section’ could include a closed median, with steep side slopes and a 70 m right-of-way. It is noted that the right-of-way requirements may be increased or decreased depending on local topographic conditions. The inclusion of a transitway component would result in an increase in the overall right-of-way width, therefore the ‘Greenbelt cross section’ in this case would be larger than 70 m.

In terms of horizontal alignment, it may be appropriate to reduce the minimum curve radius to a lower value than the minimum allowable by current design standards for a 120 km/h design speed. While there are negative implications with respect to sight distance, particularly where continuous lateral barriers are present (such is the case with the narrow cross section), this is not expected to greatly reduce safety performance, and allows designers to better avoid sensitive features by giving greater horizontal alignment flexibility.

Where significant environmental features are encountered, consideration should be given to causeways or long bridges in order to mitigate impacts. Further consideration should be given to construction techniques in order to reduce the impacts of those activities. Consideration should also be given to tunnelling as a means of avoiding impacts to highly sensitive features; it is acknowledged, however, that tunnelling is extremely costly.

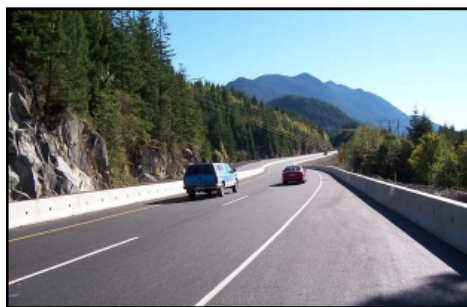
Consideration should also be given to minimizing the number of interchanges constructed as part of any future highway, as well as minimizing the requirements for new ancillary facilities such as inspection stations and patrol yards within the Greenbelt.

Illumination requirements will also be considered; however it is not anticipated that full illumination will be required in Greenbelt areas, owing to the rural character of the adjacent land uses.

Therefore, during Stage 2 of the GTA West Corridor EA (Route Planning and Preliminary Design), the following key items should be considered with regards to Geometric Design:

- Use of a reduced cross-section for application in the Greenbelt areas of the study area.
- Reducing the minimum curve radius, allowing designers to better avoid sensitive features by providing greater horizontal alignment flexibility.
- Where significant environmental features are encountered, consideration should be given to causeways, long bridges or tunneling in order to mitigate impacts.
- Construction techniques that reduce environmental impacts.
- Minimizing the number of interchanges constructed in the Greenbelt, as well as minimizing the requirements for new ancillary facilities such as inspection stations and patrol yards.

#### **1.10 Examples of Geometric Design Mitigation Measures**



Narrow Median/Reduced Cross Section



Retaining Walls



Curb and Gutter



Causeway



Tunnel



‘Tight Diamond’ Interchange

## **2.6 BRIDGES**

### **2.6.1 Introduction and Applicability**

Bridge design addresses *Greenbelt Plan* infrastructure criteria 1 through 5 (see **Exhibit 1.7**) as bridge design can assist in minimizing the amount of Greenbelt area impacts, minimizing the negative impacts to the landscape including impacts by light, noise and salt, optimizing with different infrastructure services, avoiding natural heritage and key hydrological features and maintaining or improving connectivity where crossing the Natural Heritage System.

GTA West corridor routes will likely comprise a number of underpass structures, overpass structures, railway grade separations and river valley crossing structures within the study area. The structures across the Humber River and Credit River are located in a significantly wooded area/conservation area and potentially significant wetlands area respectively. A number of preliminary routes will be developed during the study in consultation with the stakeholders and the public.

The primary factors that impact the environment during and after bridge construction are the location, materials used in bridge construction and traffic using the bridge. The potential benefits of investing additional efforts and resources to construct sustainable bridges could include, but are not limited to, the following:

- Structures that:
  - Accommodate alternate forms of transportation, such as public transportation, bikes and pedestrians; and
  - Utilize less energy and time to construct.
- Bridges that:
  - Minimize impacts to the upstream and downstream natural and developed communities;
  - Consider wildlife movement, groundwater conditions/upwelling and other natural environment features;
  - Balance economic and social needs, against conserving natural resources;
  - Are self-sufficient in meeting their electrical/energy requirements; and
  - Minimize waste by utilizing fewer raw materials on site and utilizing re-cycled material.

### **2.6.2 Key Planning and Design Principles**

Key design and planning principles of sustainable construction include:

- a. Sustainable Sites
- b. Traffic Efficiency
- c. Alternative Transportation
- d. Energy Efficiency
- e. Water Efficiency

- f. Materials and Resources
- g. Innovation in Design

Each of the key design and planning principles are described further below.

**a. Evaluation/Identification of sustainable sites**

- Consideration could be given to evaluating if a proposed bridge links two developed communities and the proposed structure benefits the social and economic value of the two communities connected.
- Minimize impacts to greenfield lands, wetlands, forests, trails and farmlands.
  - Open and long span structures are preferred. Consideration should be given to spanning entire valleys.
  - Span wetlands or use innovative mitigation near wetlands.
  - Avoid placement of fill in valleys.
  - Utilize topographic contours to aid in the assessment of potential routes for valley crossings.
  - Investigate the potential to utilize existing utility corridors in order to reduce impacts to undisturbed core habitat areas.
- Place watercourse crossing structures/piers to minimize hydraulic impacts.
  - Consider crossing rivers where future meandering is unlikely.
  - Consider locating river crossings perpendicular to the river and its bank, and locate it at a narrow section.
- Employ best practices in sedimentation and erosion control.
- Consider flooding and geomorphology.

**b. Traffic Efficiency**

- Provide the flexibility to accommodate changes in load capacity or deck geometry due to unforeseen future conditions. This could be achieved by designing a bridge such that it can accommodate two or more traffic lanes without strengthening or widening the substructure.

**c. Alternate Forms of Transportation**

- Consider accommodating High Occupancy Vehicle (HOV) lanes and transitway to encourage other modes of transportation.
- Develop plans to include both bike lanes and sidewalks on crossing roads.

**d. Energy Efficiency**

- Determine the energy needs of the bridge and explore opportunities to utilize green power such as solar energy for illumination and signage.
- Consider using Accelerated Bridge Construction technology or other techniques to minimize construction activity and energy consumption.



**e. Water Use and Quality**

- Reduce the need for treated water. Consider using a minimum of 50% gray water in production of ready mixed concrete.
- Develop plans to capture the storm water runoff from the bridge. Consider providing mechanical or natural treatment system such as constructed wetlands and grass swales to treat water run-off from the bridge.

**f. Materials and Resources**

During the planning and design phase, consideration should be given to choosing bridge materials which ensure that:

- Regionally available materials are utilized as opposed to being brought in from long distances.
- Consider using high strength or high performance material to reduce the amount of material required. Consider potential re-use of formwork to reduce material required.
- Use of recycled materials in the structure.
- Choose new materials for bridge construction that can be recycled.
- Choose bridge material and specifications that provide an extended service life and minimize future maintenance and repair needs.
- Consider bridge aesthetics, especially in cultural heritage areas.
- Consider combining new crossings with existing utility corridors/other infrastructure to create one “infrastructure ROW”.
- Integrate with wildlife measures.

**2.6.3 Toolbox of Mitigation Measures**

The proposed ‘toolbox’ of Bridge design and mitigation measures which could be considered in the Route Planning and Preliminary Design stage of the GTA West Corridor EA includes the following:

- a. Encourage alternate modes of transportation
- b. Structures that meet their own electrical needs.
- c. Use of recycled material in bridge construction.
- d. Use of accelerated bridge construction technology to minimize raw material waste and construction duration disruption to traffic.
- e. Use of structural health monitoring technology to monitor health and alert owners to critical conditions.
- f. Minimizing and planning for long-term maintenance to reduce environmental impacts and reduce maintenance cost.
- g. Innovation and signature bridges.

Each of the proposed mitigation measures are described in further detail below.

**a. Encourage alternate modes of transportation**



*(Artistic impression of the Strandherd-Armstrong Bridge, Ottawa – Currently under construction;  
<http://ottawa.ca/en/city-hall/planning-and-development/strandherd-armstrong-bridge-project-overview>)*

The above pictured bridges are typical examples of bridges that:

- Accommodate multi-modal transportation (such as general purpose lanes, dedicated transit lanes, cycling lanes and sidewalks).
- Span a valley with no piers located in the water.
- Aesthetically pleasing signature type bridge

**b. Structures meet their own electrical needs**



*(Blackfriars Bridge a Solar Bridge spanning the River Thames;  
<http://www.guardian.co.uk/environment/picture/2012/jul/05/blackfriars-solar-bridge#> )*

The new Blackfriars station in London, UK, which is being built on a bridge spanning the River Thames, will be the world's largest solar bridge. It is estimated that the solar panels will generate an estimated 900,000kWh of electricity every year,

providing 50% of the station's energy and reducing CO<sub>2</sub> emissions by an estimated 511 tonnes per year.

**c. Use of recycled material in bridge construction**



*(PennDOT District 10-0 Tarrtown Bridge Shredded Tire Project)*

Approximately 557,000 tires were incorporated into the two bridge embankments pictured above.

**d. Use of accelerated bridge construction technology to minimize raw material waste and construction duration disruption to traffic.**



*Rapid Lift – Hwy 417/Island Park Drive Overpass Bridge Replacement*

- e. Use of structural health monitoring technology to monitor health and alert owners to critical conditions**
- f. Minimizing and planning for long-term maintenance to reduce environmental impacts and reduce maintenance cost could be achieved by:**
- Minimizing/eliminating expansion joints

- Selecting long-lasting bearings to minimize need for replacement
- Avoiding painted steel
- Considering incorporating access ways for inspection and maintenance

**g. Innovation and signature bridges**



*(Animal Bridge. Banff National Park, Alberta, Canada)*

### **3.0 CONSIDERATION OF ECOSYSTEM SERVICES**

The innovative concept of Ecological Goods and Services or Ecosystem Services was discussed as part of the GTAG workshops and meetings.

Ecosystem services are the benefits that people, including businesses, derive from ecosystems. Ecosystem services are organized into four types: (i) provisioning services (the products people obtain from ecosystems); (ii) regulating services (benefits people obtain from the regulation of ecosystem processes); (iii) cultural services (nonmaterial benefits people obtain from ecosystems); and (iv) supporting services (the natural processes that maintain the other services).

Environmental interest groups and organizations have been advocating for this innovative concept to be applied to planning, conservation efforts, and management and policy decisions in order to ensure that nature's assets and services are properly valued and accounted for when making decisions.

As the concept and application of Ecosystem Services is relatively new, there are challenges associated with applying its use to MTO projects, like the GTA West Corridor EA, such as:

- Any values attributed to ecological goods and services would be done using a simplified approach interpreted by a person's social values. These values can be subjective and could be hard to justify in a public forum.
- Many ecosystem functions remain intangible; therefore the Ecological Goods and Services approach would not be a true assessment of ecological impacts.
- An Ecosystem Services approach only provides a 'snapshot' of ecological valuation.
- Ecological goods and services are difficult to quantify and there is a broad range of valuation methodologies that could be applied.

In order to better account for ecosystem services during Route Planning and Preliminary Design of the GTA West EA, MTO will consider utilizing the following approach to validate or supplement the analysis and evaluation of route alternatives:

- An "Ecosystem Services" criterion could be added to the evaluation criteria for the route alternatives. This criterion would act as a check to ensure that ecosystem services have been appropriately considered in the overall evaluation.
- Opportunities to engage stakeholders to identify valued ecosystem services within the study area will be considered. This may include both cultural and environmental ecosystem services.

The details of the approach and methodology will be further considered in during Route Planning and Preliminary Design recognizing that there are alternative methodologies that may be employed to supplement the analysis and evaluation and to assist in discerning differences between route alternatives.

## 4.0 SUMMARY OF THE GUIDELINE

**Exhibit 1.11** outlines a summary of the key recommendations of this Guideline, i.e., key planning / design principles and mitigation measures that are recommended for consideration during Route Planning and Preliminary Design (Stage 2) of the GTA West Corridor EA and subsequent implementation phases organized by the six topic areas. To demonstrate the linkages of the recommendations to the *Greenbelt Plan* infrastructure criteria, outlined in Policy 4.2.1.2, each recommendation has been reviewed for how it addresses the *Greenbelt Plan* infrastructure criteria. In many cases the recommendation addresses several criteria as noted in the table below. See **Exhibit 1.7** for a complete list of the five key infrastructure criteria.

### 1.11 Summary of Greenbelt Guideline Recommendations

Recommendation		Greenbelt Policy Linkage
<b>General</b>		
1.	Impacts to Greenbelt Areas should be avoided, wherever possible.	<i>Satisfies Criteria 1 and 4 (Policies 4.2.1.2a, d)</i>
<b>Community Sensitive Design</b>		
2.	Develop a Greenbelt Community Value Plan focussed on the geographic areas in the study area delineated by the Greenbelt Plan.	<i>Satisfies Criteria 2 and 5 (Policies 4.2.1.2b, e)</i>
<b>Road Ecology and Wildlife</b>		
3.	Avoidance of sensitive natural features/areas should be a priority when planning a new roadway facility location.	<i>Satisfies Criteria 1 and 4 (Policies 4.2.1.2a, d)</i>
4.	Minimize habitat fragmentation.	<i>Satisfies Criterion 5 (Policy 4.2.1.2e)</i>
5.	Consider the road effect zone, or secondary effects.	<i>Satisfies Criterion 5 (Policy 4.2.1.2e)</i>
6.	Employ innovative design and mitigation measures to reduce the impacts of the selected route.	<i>Satisfies Criteria 2 and 5 (Policies 4.2.1.2b, e)</i>

<b>Recommendation</b>		<b>Greenbelt Policy Linkage</b>
<b>7.</b>	Implementation of a highway vegetation plan.	<i>Satisfies Criteria 2 and 5 (Policies 4.2.1.2b, e)</i>
<b>Agriculture</b>		
<b>8.</b>	Class 1 to 3 lands should be given high recognition. Input from agricultural groups and individual farmers will be sought out and incorporated into the decision making process. Mitigation to property fragmentation and field access will be important considerations.	<i>Satisfies Criteria 1, 3, 4 and 5 (Policies 4.2.1.2a, c, d, e)</i>
<b>9.</b>	Any new proposed infrastructure should be kept close to potential development to avoid undisturbed areas.	<i>Satisfies Criteria 1 and 4 (Policies 4.2.1.2a, d)</i>
<b>10.</b>	Use lands that are already impacted by infrastructure, such as hydro and pipeline corridors, and combine as much infrastructure (pipelines, hydro, highways, rail) as possible into one corridor to minimize impacts by reducing land required and reducing fragmentation/severances.	<i>Satisfies Criteria 1, 3, 4 and 5 (Policies 4.2.1.2a, c, d, e)</i>
<b>11.</b>	Highways are created with specific design standards. In some areas these standards could be reduced to allow for the tightening of road curves to avoid specific features.	<i>Satisfies Criterion 1 (Policy 4.2.1.2a)</i>
<b>12.</b>	Have a new corridor traverse along mid-concession roads and along back lot lines to reduce property fragmentation and severance.	<i>Satisfies Criterion 1 (Policy 4.2.1.2a)</i>
<b>13.</b>	Cross the Greenbelt at the narrowest point.	<i>Satisfies Criteria 1 and 5 (Policies 4.2.1.2a, e)</i>
<b>Stormwater Management</b>		
<b>14.</b>	The project's construction phase warrants emphasis, especially with respect to siltation control. New approaches may be warranted, especially to control sediment.	<i>Satisfies Criterion 2 (Policy 4.2.1.2b)</i>
<b>15.</b>	Valleys should be spanned completely when possible to avoid interactions in sensitive flood plain areas. Cross at ninety degrees if possible.	<i>Satisfies Criterion 5 (Policy 4.2.1.2e)</i>



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<b>Recommendation</b>		<b>Greenbelt Policy Linkage</b>
<b>16.</b>	Different areas should have different levels of control keyed to sensitivities of receivers.	<i>Satisfies Criterion 2 (Policy 4.2.1.2b)</i>
<b>17.</b>	Development of salt management strategies for maintenance operations within the Greenbelt is important.	<i>Satisfies Criterion 2 (Policy 4.2.1.2b)</i>
<b>18.</b>	Novel and technologically advanced approaches may be appropriate, and design flexibility should be integrated to allow for future and more advanced methods of SWM control.	<i>Satisfies Criterion 2 (Policy 4.2.1.2b)</i>
<b>Geometric Design</b>		
<b>19.</b>	Consider the use of a reduced cross-section for application in the Greenbelt areas of the study area.	<i>Satisfies Criterion 1 (Policy 4.2.1.2a)</i>
<b>20.</b>	Consider reducing the minimum curve radius of 1700 m, allowing designers to better avoid sensitive features by providing greater horizontal alignment flexibility.	<i>Satisfies Criterion 1 (Policy 4.2.1.2a)</i>
<b>21.</b>	Where significant environmental features are encountered, consideration should be given to causeways or long bridges in order to mitigate impacts.	<i>Satisfies Criteria 4 and 5 (Policies 4.2.1.2d, e)</i>
<b>22.</b>	Consider construction techniques that reduce environmental impacts.	<i>Satisfies Criteria 1 and 5 (Policies 4.2.1.2a, e)</i>
<b>23.</b>	Minimize the number of interchanges constructed in the Greenbelt, as well as minimizing the requirements for new ancillary facilities such as inspection stations and patrol yards.	<i>Satisfies Criteria 1 and 2 (Policies 4.2.1.2a, b)</i>
<b>Bridges</b>		
<b>24.</b>	Employ sustainable bridge construction methods.	<i>Satisfies Criteria 1 and 2 (Policies 4.2.1.2a, b)</i>
<b>25.</b>	Open and long span structures are preferred. Consideration should be given to spanning entire valleys. If this is not possible, it would be acceptable to place piers in a valley as long as placing piers in water is avoided.	<i>Satisfies Criteria 1, 4 and 5 (Policies 4.2.1.2a, d, e)</i>



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<b>Recommendation</b>		<b>Greenbelt Policy Linkage</b>
<b>26.</b>	Consider crossing rivers in mature sections where future meandering is unlikely. Consider locating river crossings perpendicular to the river and its bank, and locate it at a narrow section.	<i>Satisfies Criteria 1, 4 and 5 (Policies 4.2.1.2a, d, e)</i>
<b>27.</b>	Span wetlands or use innovative mitigation near wetlands.	<i>Satisfies Criteria 1, 4 and 5 (Policies 4.2.1.2a, d, e)</i>
<b>28.</b>	Avoid placement of fill in valleys.	<i>Satisfies Criteria 1 and 2 (Policies 4.2.1.2a, b)</i>
<b>29.</b>	Utilize topographic contours to aid in the assessment of potential routes for valley crossings.	<i>Satisfies Criteria 1, 4 and 5 (Policies 4.2.1.2a, d, e)</i>
<b>30.</b>	Investigate the potential to utilize existing utility corridors in order to reduce impacts to undisturbed core habitat areas.	<i>Satisfies Criteria 1, 3, 4 and 5 (Policies 4.2.1.2a, c, d, e)</i>
<b>31.</b>	Consider combining new crossings with existing utility corridors/other infrastructure. Create one “infrastructure ROW”.	<i>Satisfies Criteria 1, 3, 4 and 5 (Policies 4.2.1.2a, c, d, e)</i>

The Greenbelt Transportation Advisory Group (GTAG) has provided invaluable input into the development of this Guideline and on identifying potential GTA West study issues. The Project Team has appreciated their time and commitment. MTO is committed to continue to engage the GTAG as part of Stage 2 of the EA, and will be contacting the members to discuss participation opportunities once Stage 2 is initiated. With the aid of this Guideline, Stage 2 of the EA will strive to develop the best possible alignment and design solutions for the future transportation corridor. Specific guidelines for construction and implementation may also come out of consultation during Stage 2 of the EA.